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OLA, S.I., W.A. OLAYEMI, G.A. WILLIAMS, O.M. OSINEYE, K.O. KAREEM-IBRAHIM, A.N. MAFIMIDIWO, B.J. ADEBAYO, A.R. ASAFA and S.M. YASHIM.

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KEYNOTE ADDRESS DELIVERED BY HIS EXCELLENCY PROF. PLACID C. NJOKU AT THE OPENING CEREMONY OF THE 29TH ANNUAL CONFERENCE OF ANIMAL SCIENCE ASSOCIATION OF NIGERIA ON 10TH SEPTEMBER, 2024.

PROTOCOL

It is an honor to address this Distinguished body on this important occasion - the celebration of the 29th Anniversary of our noble professional association, Animal Science Association of Nigeria (ASAN). Formed IN 1995, the first Annual Conference of ASAN was held right here in Lagos, the ***Centre of Excellence,*** at this same venue, Airport Hotel. This 2024 ASAN Conference again in Lagos State is particularly eventful as it succeeds two earlier returns to Lagos in 1997 and 1998, and coincides with the creation of a full Ministry of Livestock Development by His Excellency, Bola Ahmed Tinubu GCFR, the President and Commander-in-Chief of the Federal Republic of Nigeria. This delightful news was soon followed by a pronouncement of the birth of the Department of Livestock Services within the Ministry of Agriculture in Lagos state by His Excellency, Mr. Babajide Olusola Sanwoolu, the Executive Governor of Lagos State Soon, we believe that this new Department will be upgraded to a full Ministry of Livestock Development in the state.

Ladies and Gentlemen, it is gratifying to mention the very significant contributions of ASAN in the realization of these new developments in the governance structure of Agriculture in Nigeria. Firstly, and fundamentally, it is important to underscore that ASAN initiated and achieved the passage by the National Assembly, and assent by the President, of the Nigerian Institute of the Animal Science Law No. 26 of 2007, which resulted in the establishment of the Nigerian Institute of Animal Science (NIAS) as a chartered regulatory institution for all matters related to Animal Husbandry. It is further gratifying that the Institute worked assiduously to mainstream the Animal Science profession in the nation and by 2014 achieved the establishment of the Federal Department of Animal Husbandry Services (FDAHS) which gave due respect to Animal Scientists in the Federal Ministry of Agriculture, and nationwide. Following from that, many States created Departments of Animal Husbandry Services which verily expanded the operations and impact of Animal Scientists across these States.

Following the unambiguous impressive impact of the new FDAHS and recognizing that further enablement of the sector would solve emerging and intractable challenges in Animal Agriculture sector, the Federal Government of Nigeria took the critical decision to establish a brand new Federal Ministry of Livestock Development, to soothe the sector and galvanise it for substantially more significant contributions to Nigeria's food and nutrition security, to massively grow opportunities for employment , to enhance the wealth of operators, and to promote/enhance the wellbeing and livelihood of Nigerians. Truly, these developments are not frivolous, or window dressing, but rather underscore the recognition of the important and vital roles that Animal Science and Animal Scientists play in national development. We must therefore all congratulate ASAN for being the "Hen that laid the Golden Egg!"

Ladies and Gentlemen, the theme of this Conference: ***Animal Agriculture: Panacea for Food and Nutrition Security*** is indeed topical, as it defines the right direction for the Animal Agriculture sector. Whether one considers the theme as a statement or as a question, one is left with a huge challenge waiting to be solved. But without a doubt, it is a challenge whose solution will define great potentials, and can bring massive opportunities for those who are willing and able to exploit the terrain.

The Nigerian Agricultural Fundamentals

Nigeria has a total land area of 923,767km^2 with about 413,938 km^2 of cultivated land with very minimal irrigation coverage. So, Nigeria's Agriculture is basically rain-fed. There are nine agro-ecological zones stretching from the southern banks of the Bight of Biafra on the Atlantic Ocean through the derived savannah and the savannah zones in the Middle-belt region to the Sahel region of northern Nigeria. The southern region with rainfall levels of up to 4000mm has perennial forest trees and home to monogastric animals and trypano-tolerant small ruminants (Muturu and West African Dwarf sheep and goats); while the northern

Sahel region, with rainfall levels of 400mm and below, has annuals as the main vegetation. The Sahel region is very prone to drought and is home to estimates of 95% cattle, 70% sheep and 75% goat population. In the derived savannah and savannah belts between the two extremes, rainfall levels are moderate and the soil can support the cultivation of most crops and is laden with a preponderance of rich vegetative grasses, making it a strategic recourse for the large herds of pastoralist cattle and sheep from the Sahel region in times of drought or during the dry season. Invariably, Nigeria has great potentials to produce food crops, livestock, fish and forestry for food and for export. Indeed, Nigeria is globally the highest producer of Cassava (Manihot spp.), Yam (Dioscorea spp.) and fourth in Cocoa. In 2016, Agriculture contributed 23 percent of the national GDP, produced a dominant non-oil sector growth of 4.1 percent, and accounted for 75 percent of non-oil export.

The Animal Agriculture Sub-Sector

Distinct from Crop Agriculture, Animal Agriculture connotes the sub-sector of Agriculture which involves the farming of livestock. Available 2022 estimates of Livestock in Nigeria are given in Table 1 and indicate that Nigeria has very large numbers in its hold (Table 1). While these numbers seem ambitious, it is understood that they were derived from constituent states of Nigeria. However, it shows the enormity of the size of the Nigerian stock. Other statistics give the average weights per species (Table 2). This huge stock size represents an important source of food with high nutritional value critical for food, nutrition, and nutrient security These include proteins (with essential amino acids), vitamins (B12) , minerals (including Iron, calcium, zinc), fibre and many by-products – many of which are industrial raw materials. Animal Agriculture, has the capacity to *pervade the society – feed it; employ its people; lift it out of poverty; grow individual, corporate and state wealth; enhance the environment, and breathe life into it* (Njoku, 2018).

The huge stock size also has an enormous economic value and great wealth, as estimates of the monetary value of Nigerian Livestock is over N33 trillion (FDAHS, 2024). While Nigerian Livestock farmers were originally keeping livestock as a traditional activity, a source of household food, and savings. Today, livestock farming is big commercial activity, which provides massive employment, and current estimates show that over 28million farmers are engaged in extensive, semi-intensive, and intensive livestock farming in various livestock value chains.

Table 1: ESTIMATED LIVESTOCK POPULATION (2022).

S/No.	SPECIES	POPULATION
1	Cattle	58 million
2	Sheep	60 million
3	Goats	124 million
4	Poultry	563 million
5	Pigs	16 million
6	Horses	11 million
7	Donkeys	368,658
8	Camels	5370

(Source: FDAHS, 2024)

Animal Science, encompassing the study and practice of nutrition, genetic/breeding, animal housing and welfare of domestic, game and companion animals, is crucial to a sustainable agricultural system, productivity, and food security. Our profession involves innovation in the aforementioned areas to drive

livestock business in the path of greater efficiency and profitability. The contributions of livestock value chains, and by direct extension that of animal science, to the GDP of Nigeria is profound. The value chains around the production of meat, milk, eggs, pork, hides and skin, and manure have enormous potentials but are grossly undervalued. For instance, over 98 percent of Nigerian households keep poultry and at least 5 million of them weave their livelihood around the commercial poultry industry. If this is extended to cattle (33%), sheep (46%), goat (86%), pig (7.3%), horse, donkey, dog, camel, and 1.3% for rabbit and other less known farmed domesticated animal species, it will become glaring that the sector is huge and affects the lives and fortunes of a major proportion of Nigerians. Consequently, the creation of a separate Ministry for livestock in every state and at the Federal level is indeed a national necessity.

The livestock industry, as an important component of general agriculture, is a key contributor to national development. Livestock products are responsible for one-sixth of the human food energy and also more than one-third of the protein requirement on a global basis (Bradford, 1999). Animal production trends are indeed influenced by strong demand-driven factors, such as human population growth, urbanization, income growth and changing customer services, which are of two categories, The first category encompasses the modern demand driven and capital-intensive non-ruminant - pigs and poultry – sector, which is over 46% extensively, 33% semi-intensively, and 21% intensively managed; while the second category is the traditional resource-driven and labour-intensive ruminant – cattle, sheep and goats – sector, which is 86% extensively (pastoralism), 27% semi-intensively (agro-pastoralism), and only 1% intensively (ranch) managed (Devendra, 2017; PLRIC, 2024). The livestock sector makes diverse contributions to rural livelihoods as most Nigerians keep one specie of livestock or another. Many indeed keep both livestock and also do crop farming in integrated farming systems, with each sub-sector complementing the other.

A review of the management system for livestock shows that the extensively managed local species are comparatively of low-weight because of highly limited availability of feed and water; and they as well have basic poor genotypic and phenotypic characteristics. In extensive management system, such as open-grazing, ruminant animals are uneconomically and insecurely trekked long distances in search of food and water and/or to market. Similarly, the non-ruminants scavenge for food and water while also being exposed to predation and disease.

Livestock in Food and Nutrition Security

Food and Agriculture Organisation (FAO) concept of food security is configured on the principle that food is available, is accessible, is affordable, is sufficient, and is safe to meet the active health needs of a target group. In a food secure society, all peoples are expected to have adequate resources to fully meet their needs for a variety of nutritious food types from available stock at all times. Similarly, nutrition security refers to all peoples having financial and physical access to balanced and good quality food at all times for vigorous healthy living. Livestock products are excellent complements to crop-based products in providing balanced food for society. So, it is inconceivable to consider food or nutrition security without a livestock complement.

From the above, it is understandable that a primary contribution of Livestock is in providing protein and micro-nutrient rich foods. Meat, milk, eggs and fish are excellent sources of protein containing all the essential amino acids, a characteristic that is absent in protein of plant sources. Also, present in animals, are nutrients and micronutrients which include calcium, zinc, iron and vitamin B12. These essential amino acids and nutrients play very critical roles in the physiology of the growth, development, and maintenance of human tissues. Consequently, the deficiency of any will manifest in specific diseases.

Livestock also produces manure which is an important organic fertilizer for crops. Through this, livestock can turn over soil nutrients, enhance soil fertility and agricultural sustainability, as well as promote resilience and stability in food production systems. Furthermore, Livestock farming can bring into productive use savannah range lands for the production of forage for ruminant animal feeding – one of the critical factors limiting ruminant animal production in Nigeria.

Livestock is very important in many cultural and social events. Apart from their use in recreation and entertainment, they are used in key cultural programs such as marriages, naming and burial ceremonies.

Livestock keeping is also quite popular among women and rural households as livestock are regarded as investments or savings and source of milk/food. This practice promotes livestock sustenance and food security while enhancing household nutrition and income.

For most livestock owners, livestock farming is a profit-making commercial business; and in fact a financial reserve – the small livestock (poultry, pigs, sheep and goats) as short-term reserves, while the large ruminants are more of long-term reserves. At all levels of ownership, keeping livestock is a guaranteed source of income through sales of livestock and products. Livestock management prompts several value chains which engender massive economic opportunities and employment.

Challenges of the Livestock Sub-sector in Nigeria

AS shown earlier, Nigeria has a large number of Livestock, indeed the highest in Africa. The primary objective of the sub-sector is to provide products such as protein, vitamins and minerals as food components for the growth and good health of the human body; as well as byproducts (e.g. skin, horns, feathers) which can be used as raw materials for relevant industries. For food and nutrition security, Nigeria must produce enough livestock to provide the national requirement in meat, milk, eggs, fibre, and micronutrients on a sustaining basis. Despite the large number of animals, Nigeria is yet unable to attain livestock products self-sufficiency. This is because Nigerian livestock has several challenges which include:

- Seed stock
  - Poor breed characteristics - poor genotypic and phenotypic characteristics of Nigerian local livestock
  - Low birth weight, low growth rate, low mature weight **(Table 2)**, low milk yield, low egg production;
  - Genetic improvement efforts very limited; artificial insemination (AI) and intensive selection are limited;
  - Limited sources for good quality chicks and turkey poults;
- Management (Extensive Vs Intensive)
  - Mainly Extensive, except for intensive poultry production;
  - High predation (through banditry, rustling, killing, kidnapping) in extensively managed livestock system;
  - Very limited opportunities for forage production or farmer-offtaker partnership
  - exposure to weather and the elements
- Diseases and Pests
  - Varied and some endemic;
  - Drugs and vaccines expensive and generally of uncertain quality;
  - Poor surveillance, Trans-boundary Animal Diseases (TADS) and
  - Migratory pests (Quelea birds, etc)
- Feed
  - Compounded feed expensive; often of poor quality;
  - Psyche of free feed for ruminant animals driving normadism/ hesitance to buy animal feed by elitist cattle owners. So, concept of landless ownership of Cattle supported for extensive BUT not supported for intensive management systems
  - limited grazing land for ruminant animals; lack of technical competence to make hay and silage, so compelled to trek animals long distances in search of water and forage;
  - Forage production seasonal, weather-dependent;
  - Encroachment of grazing reserves, and grazing routes
  - Many animal feeds inputs have alternative human or industrial uses and costs dependent on alternative uses;

- animals usually underfed
- Lack of private sector involvement in forage production

Table 2: Livestock Data: Average Mature Weight (Kg)

S/No.	Livestock Species	Nigerian Average Weight (Kg)	Global Average Weight (Kg)
1	Cattle	250	600 – 1200
2	Sheep	35	45 – 100
3	Goat	30	45 -140
4	Pig	60	100 -300
5	Chicken (Broiler)	1.5	2.0
6	Guinea Fowl	1.0	1 – 1.6
7	Duck	2.0	3.5
8	Turkey (Exotic)	5.0	7.0 – 15.0
9	Camel	460	400 – 600
9	Donkey	150	180 – 450
10	Rabbit	2.0	2.0
11	Horse (Local)	--	--
12	Horse (EXOTIC)	--	400 – 600

(FADHS,2024;PersonalCommunication,)

- Processing technology and Meat Handling
  - Dearth of standard abattoirs for livestock
  - Unsanitary processing habits;
  - Technology very rudimentary;
  - Poor meat handling and unsanitary meat sales outlets;
  - Very few milk processing plants;
  - Dairy products principally imported as dry milk and reconstituted
  - High wastage in occasional regional egg “glut”
  - Dumping of frozen poultry meat and fish into the country
- Credit
  - Nigeria Agriculture Bank not capitalized, poorly monitored
  - Anchor borrowing opportunity new for Livestock value chains
  - Poor public sector investment
  - Confused and hard to access;
  - Largely collateral-dependent, very high interest rates
- Extension
  - Literally under-resourced, comatose in many states;
  - multi-disciplinary; Community Animal husbandry officers as extension support, non-existent in many states
  - Under-staffed

- low morale
- Marketing structure
  - Undeveloped;
  - Long trekking and Trucking of animals common with attendant effect on meat quality;
  - Open and unsanitary meat sales' outlets
- Cross-Cutting Issues (applicable in most cases)
- Inconsistent and/or lack of important livestock policies (eg Dairy Policy, Breed Improvement Policy, Livestock Insurance Policy, Livestock Development Policy)
- Dearth of reliable planning statistics (Last Livestock Census – 1991)
- Ownership of Cattle (especially) belongs to rich elites who control/confuse policies but the poor herders risk all to manage them.
- Poor public and private sector research funding; poor research result uptake, poor institutional support structure;
- Seasonal rainfall, low irrigated land area
- Low grazing land area per farmer, value of rural land (non-collateralizable)
- Poor rural infrastructure
- Significant effects of climate change (increase in temp, limited rainfall and drought, poor forage in Sahel region, over-grazing, deforestation, raging desertification)
- Conflicts and threats to animal production (herdsmen–crop farmer conflicts, Resistance to new policies, Rustling,)
- Unidentified livestock, impossible traceability, prone to rustling

Livestock Value Chains

In order to fully explore and exploit the opportunities in the livestock sub-sector, it is important to adopt a value chain approach. The value chain recognizes that in the production of a commodity such as eggs, meat, milk, honey, hides and skin, there are essential steps that must be taken to ensure that the product is efficiently produced and brought to the consumer. So, the value chain describes the process a commodity passes through *"from farm to fork".* The concept allows the full appreciation of the different activities inherent in the production of a commodity as well as all the supportive, associated, subsidiary activities that facilitate the process. *So, Value Chain is an all-inclusive and cohesive approach which takes cognizance of the processes and all the associated factors in the production of a commodity while taking advantage of the technologies, and innovations that ensure greater efficiency.*

To achieve food and nutrition security, all elements that drive the value chain in the production of any commodity must be sustainably available as and when required in adequate amounts. In attempting to achieve this, the chain generates several job opportunities, input products development opportunities, technology and innovation opportunities, and opportunities for relevant infrastructure and logistics development. A holistic structure built by the above opportunities therefore ensures that the ultimate commodity is produced in adequate amounts to sustainably play its role in the food and nutrition security milieu. The chain also identifies points of entry for entrepreneurs to participate in the production of products. For example, it is estimated that in the production of the piece of chicken in your meal, over 230 major businesses are involved and open to the private sector to exploit.

Herder-Farmer Conflict:

In Nigeria, the Herder-Crop Farmer Conflict is a major factor that has affected ruminant livestock production. Along with banditry and rustling, the Nigerian ruminant animal sub-sector faces very serious challenges. The recurring conflicts between ruminant animal herdsmen and crop farmers have basically arisen in the quest of the herdsmen to find fodder and water for their animals. This challenge has been exacerbated by climate change which is responsible for lower rainfall in the Sahel Savanna ecological zone which is home to over 80% of Nigeria's ruminant animal population. The lower rainfall subsequently results in significant reduction in grazing fodder and herbage growth, furthers overgrazing, and quickens the desertification of

the already degraded rangeland. In the absence of forage for the large herd of animals, the herdsmen move southwards through the Sudan Savannah and the Northern Guinea Savannah to the Southern Guinea Savannah where rainfall is higher and the soil is good for herbage growth. Coincidentally, this zone is the middle-belt of the country, where crop farming is the principal occupation of the people. Consequently, the animals on reaching the zone with lush fodder and grass, and in the circumstance of encroached and unclear grazing routes, the animals are likely to enter crop farms where they eat planted crops and often destroy the farms

It is also perceived that the use of heavy fire arms by the herders emanated from their attempt by the herders to protect themselves and their animals from marauding bandits and rustlers who often confront them at night killing them and stealing their animals. It is fact that these weapons have severally been used on crop farmers who attempt to chastise the herders for allowing the animals destroy their farms.

The Herder-Farmer conflict has been intractable, and certainly been a cause of major concerns for peace. Several efforts are being made to contain the sad happenings. Options in discussion are the sedentarization of the herdsmen and the establishment of grazing areas from the original gazetted grazing reserves, commercial production of fodder for the animals from the grazing reserves, and from across the country, integrated livestock-crop farm systems, stakeholder peace-building meetings involving traditional and religious leaders, private sector establishment of ranches across the nation, supporting households practicing semi-intensive management to transit to fully intensive system, establishment of Livestock Service Centres to provide communal facilities – including schools, health centres, animal health services, feedlots, religious centres – to support the welfare of the herdsmen and their animals. But any efforts that do not guarantee available feed and water for the animals will certainly fail as the two factors are the most important drivers for nomadism. As these efforts can reduce the uneconomical and risky open grazing and transhumance management system among the herdsmen; as well as limit the conflicts between cattle-rearers and crop farmers; reduce exposure to disease, bandits, and cattle rustlers; and guarantee the herdsmen opportunities for wholesome livelihood, a most important gain with the adoption of the full sedentary system is that the animals are less stressed, rest more, feed better, have water available all the time, and consequently achieve higher growth rates, higher body weights, sell for higher, and make more contribution to food and nutrition security and national development .

The Federal Ministry of Livestock Development

On July 09, 2024, the President of the Federal Republic of Nigeria made a pronouncement establishing the Federal Ministry of Livestock Development. This was at the inauguration of the Presidential Livestock Reforms Implementation Committee, which he is now personally Chairman, and Professor Attahiru Jega is the Co-Chairman. To reaffirm the pronouncement, he informed the Council of Ministers the next day at the Federal Executive Council of the establishment of the Ministry. I have mainstreamed this development as I finalise this paper to assure the Animal Science Association of Nigeria and the Nigerian Institute of Animal Science that your efforts in reforming the livestock sector in Nigeria are having impact and soon all States will also have specific Ministries of Livestock Development. Be also assured that the whole world will be waiting to hear about us solving the seemingly intractable farmer-herder clashes, seasonal poultry egg glut, astronomical rise in production inputs, high expenditure incurred on importation of dairy and meat products, unhygienic animal products processing and distribution systems, poor yield and performance of local livestock breeds, indiscriminate importation of exotic breeds and crossbreeding with local livestock breeds, and many others.

The world awaits a situation where the Nigerian livestock sector will flourish and yield for our nation, great returns in human health and welfare, as well as sustainably generate incomes well above the earnings from oil and gas. The Ministry is an elixir, and with the reform programs emanating from the Presidential Committee, there is great hope that Nigeria has finally got the right answer to a question that has tortured the sensibilities of discerning people in this nation.

Recommendations

Without doubt, the Livestock sector has the capacity to make major contributions to Nigeria's Agriculture to ensure food and nutrition security. To achieve this, the sector has to increase in numbers; increase in growth rate, mature weight, milk yield and egg production; and enhance efficiency. In essence, every segment of the sector must be positively affected - the genetics, selection and breeding, the nutrition, the quality of inputs, the physiology, the quality and hygiene of products, the welfare of operators and animals, the training of Animal Farm operators, quality and availability of essential ancillary facilities; the relevant research, innovation, and technologies; the logistics of operations, the healthcare. Consequently, recommendations have been advanced that will ensure a synergy of the several efforts resulting in sustainable production of good quality livestock products adequate to provide good nutrition for all Nigerians to live active healthy lives.

The recommendations are as follows

- Ensure consistent policies, and definition of standards for livestock breeds, feeds, processing and distribution systems as well as strengthen the Nigerian Institute of Animal Science (NIAS) to ensure effective monitoring and enforcement of standards, and NVRI to enhance disease surveillance, ensure rapid response, and effective treatment
- Conduct a Livestock Census and identification (with electronic chips) to confirm Livestock numbers as well as to aid planning, and traceability;
- Unbundle the National Animal Production and Veterinary Research Institutes (NAPRI and NVRI) into at least 10 separate mandated livestock Production and Veterinary Research Institutes to expand the scope and deepen research in mandate areas;
- Support research and training in livestock production including in livestock statistics;
- Invest in the production of Nigerian Breeds of Livestock with better (than current) genotypic and phenotypic characteristics (through AI, and Selection), while conserving existing gene pools;
- Promote the consolidation of "Shika Brown" and other Nigeria-bred egg-birds as well as the development of Nigerian meat-poultry (broiler) breeds;
- Adopt sensitive and inclusive strategies to promote the sedentarization of herders and their ruminant animals through establishment of ranches, establishment of Livestock Service Centres with communal and grazing areas, as well as the commercialization of fodder production business;
- Promote the establishment of one high capacity hatchery in each geo-political area of the country;
- Promote the establishment of modern abattoirs, cold chain and sanitary sales outlets across the states;
- Promote the establishment of a commercial feedmill for livestock feed production in each state
- Establish a livestock farm in every secondary school to expose and catch the young
- Reform and re-capitalize the Bank of Agriculture for easier access to credit to livestock farmers
- Persuade Universities of Agriculture to return to their original objectives of training agripreneurs, and support them (the universities) to certify technologies for their respective regions;
- Ensure extensive monitoring and control of livestock diseases and pests;
- Promote the expansion of livestock value chains and provide support to incorporate modern production systems, private healthcare delivery; appropriate transportation, processing and a strong marketing infrastructure.
- Institute incentive through subsidy to support establishment of new livestock facilities/farms or improvements at 30% for the first five years, seed stock (including Day-Old Chicks, piglets at 20% and feed at 20%) to encourage the establishment and sustenance of new livestock farms;
- Promote the establishment of major and peri-urban dairy plants, strictly monitor milk collection infrastructure, and drastically restrict and phase out dry milk import into Nigeria. All Dairy companies must back-integrate into Dairy farming, and in supporting local milk production;
- Promote commercial production of ancillary livestock production inputs (pastures, fodder, premixes, grains,)

- Escalate Animal Production (such as Anchor Borrower, cattle & sheep fattening) programmes to attract young entrants into livestock farming in all states
- Closely monitor climate change effects on livestock and consciously institute programmes to obviate them;
- Government, through the National Universities Commission (NUC) and Federal Ministry of Agriculture and Food Security (for Univs of Agriculture), should comprehensively review the current curriculum of the Agriculture discipline to include emphasis on value chains and entrepreneurship/agripreneurship. Government should also restore professional degrees in Agriculture, including Bachelor degrees in Animal Science, Crop Science, Soil Science, Agricultural Economics, and Agricultural Business The current curriculum and omnibus B.Agric degree with options, do not sensitively respond to current industry needs and the drive for professionalization;
- Strengthen livestock (NOT multi-commodity) extension system, including the establishment, training, and the use of Community Animal Husbandry Service Providers;
- Ensure use of mechanization and information technology (ICT) to increase efficiency and attract new young entrants into committing to livestock value chain enterprises; and
- Government should grant tuition-free scholarships and paid work aid to all Animal Science students to preferentially attract them to the profession cognizant of their importance to the achievement of food and nutrition security, and national economy.

Conclusion:

Livestock is an essential complement to crops for food and nutrition security as it contributes essential proteins, minerals and micronutrients for balanced foods. Nigeria has a large herd of Livestock but its ability to meet food and nutritional needs is limited by a milieu of challenges including poor genetic characteristics, low mature weight, inadequate feed and water, and nomadic herding of ruminant animals. Climate change is having serious negative effects on rainfall pattern. So during the dry months, the ruminant animal cannot cope without feed and water. Very often, the lack of these lead traditional herdsmen to trek their animals southwards to the middle-belt of the nation with higher annual rainfall and lush pastures. Often times, these animals stray into regular farms and destroy planted crops leading to serious fatal conflicts between the herdsmen and the crop farmers. The challenge has been difficult to manage but recent efforts of Government bring rays of hope to the solution of the problem. With possible sedentarization of the herdsmen, and provision of adequate feed and water, the animals will gain more weight and produce more milk. Associated with this is that better quality meat, milk, hides and skins, will be produced.

Very importantly, Nigeria needs to develop Nigeria breeds of Cattle, Sheep, Goats, Pigs and Poultry. The idea of Nigeria flaunting large numbers of low weight animal with low productivity cannot continue. Nigeria must consciously delve into the construction and production of new local livestock breeds with higher birth weights, growth rates, mature weights, more milk production per lactation, more eggs per year, twinning, pigs with a minimum of 15 piglets per farrow, and animals that are pests and diseases resistant, and more tolerant of alternate feeds. Nigerian scientists must stop doing just the normal, but should normalise the abnormal, to produce outstanding results. Funding institutions, like TETFund, should strategically fund this breeds' development study as a significant input into Nigeria's dream of attaining food and nutrition security.

Ladies and Gentlemen, the times are tough, the tough must get going!

Thank you, ALL!

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RNA-SEQ AND CYTOSCAPE ANALYSES DETECTED NETWORK OF BIO-MOLECULAR SPECIES INTERVENING IMMUNO-COMPETENCE OF INDIAN ZEBU CATTLE UNDER ASSAULT OF THERMAL CONDITIONS

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ABSTRACT

Heat shock (HS) impeded the productions performance of animals raised under the assaults of thermal conditions (ATCs). Findings from our previous study showed how *in vitro* thermal stress stimulation (TSS) of peripheral mononuclear cells (PBMCs) of Indian Gir Zebu provoked differential expressions of heat shock proteins genes (HSPs) including associated cytokines. In this report, we employed Cytoscape to detect network of bio-molecular species intervening immuno-competence of Indian cattle under ATCs. We performed RNA-seq analyses to enable us carryout transcriptional profiling mRNAs for Cytoscape analyses. Complex of Cytoscape networks including protein-protein interaction (PPI) detected some bio-molecular species intervening the response of PBMCs of Indian Gir cattle to different cytokines and HSPs when exposed to HS. Cytoscape graph depicting PPI detected networks of the following genes after the exposure of PBMCs of Gir cattle to ATCs: *BCL2A1, NGF, NLRC4, HYAL2, PMEL, PTGS2, THBD, LRP3, LINGO1, FOSL1, HAMP, ESR2, GPER1, RGS1, AHNAK, EDARADD, NLRC4, LPAR5, IL18, IL 1A, CSF 2, CXCL8, CXR4, CD83, SOCS1, TRAF1.* Our study found that upon TSS of cellular system of Gir cattle there was overexpression of some HSPs such as *HSP 70, HSP 90, HSP 60* etc which provoked corresponding differential expressions in some cytokines including *IL18, IL1A, CXCL8, CXCR8* etc. Therefore, cellular system (PBMCs) of Indian zebu cattle enabled us to gain insight into immune-competence of mammalian species under ATCs/HS. We concluded that there are complex of bio-molecular species including HSPs and cytokines which jointly influenced immune-competence of bovine species upon exposure to HS/ATCs.

Keyword: Heat shock protein genes, cytokines, zebu cattle, heat shock, PBMCs

INTRODUCTION

Cytoscape is a software platform for the analysis and visualization of networks of bio-molecular species intervening a particular body phenotype. In other words, Cytoscape is a complex of graphical networks including protein-protein interaction (PPI) for depicting molecular/biological species intervening a body phenotype. This graphical network visualises the activities of proteins/genes in a biological process. Among the numerous advantages of Cytoscape graph is a large collection of variety of biological problem domains, including Gene Ontology term enrichment analysis and statistical network analysis that permit visualization

of how the network of these molecular entities function within a biological process regarding a body phenotype (1, 2).

Previous authors reported that heat shock (HS) impeded the productions performance and reproduction of animals raised under the ATCs (3). HS is one of the consequences of ATCs on animals especially when exposed to long term harsh thermal conditions (4). Thermal assault has consequences on domestic animals including cattle negatively affecting fertility, feed consumption, milk yield, growth, health performance, physical and metabolic activities (3, 4). The maintenance of homeothermy state in animals and survival in the face of the existential threat posed by global warming are mitigated by thermoregulatory mechanisms of heat shock protein (HSP) genes (5, 6).

Cytokines are key modulators of inflammation, participating in acute and chronic inflammation via a complex and sometimes seemingly contradictory network of interactions (11). When animals are exposed to ATCs or elevated temperature for a long time, HSP genes regulate cellular immune response such as cytokines stimulation (7, 8, 9). In this study, we attempted to demonstrate how complex of bio-molecular species including HSPs and cytokines jointly influence immuno-competence of cellular system of bovine upon exposure to HS/ATCs.

MATERIALS AND METHODS

Twelve Indian Gir bulls aged 5–6 years were randomly sampled for blood collection (5 mL per animal) each to generate peripheral blood mononuclear cells (PBMCs). Procedures for blood collection, PBMCs isolation, thermal assault conditions (TACs), thermal stress stimulation (TSS) of PBMCs, estimation of viable PBMCs, processing and preservation of PBMCs for the extraction of total RNA, isolation of Total RNA from PBMC pellets, quality control check and RNA Integrity test for RNA-seq, quantitation of RNA for RNA-seq, mRNA enrichment and preparation of mRNA Library, quantitation of mRNA library and quality check and validation of mRNA Library for RNA-seq and next generation sequencing of transcripts/transcriptome were performed according to earlier published works (9, 10).

Transcriptome annotation, differential gene expression analysis and protein-protein-interaction (PPI) were performed according to earlier published procedures (10). The processed transcripts were assembled and aligned against indexed *Bos indicus* GCF_000247795.1 reference genome and gene model downloaded from NCBI database (https://www.ncbi.nlm.nih.gov/data-hub/genome/GCF_000247795.1/) using STAR v2.7 aligner (12). The assembled transcripts were compared with NCBI non-redundant protein database using BLASTX program. Differential expression analysis of the transcripts was performed using DESeq2 package after normalizing the data using relative log expression normalization method (12). Gene level expression values were obtained as read counts using FeatureCounts software version 2.0.0 (13). Essentially, reads are total numbers of transcripts/exons belonging to a particular gene (13). We performed retrieval of interacting proteins/genes (string) database (version10.5) to identify the PPI and the network and spectrum of the gene interactome for Cytoscape analyses (10).

RESULTS AND DISCUSSION

In this study, Cytoscape detected complex of graphical networks of some bio-molecular species intervening immune response/immunity in cellular system of zebu cattle after exposure to ATCs. These detected bio-molecular species/genes/proteins include *BCL2A1, NGF, NLRC4, HYAL, PMEL, PTGS2, THBD, NLRP3, LINGO1, FOSL1, HAMP, ESR2, GPER1, RGS1, AHNAK, EDARADD, NLRC4, LPAR5, IL18, IL1A, CSF2, CXCL8, CXCR4, CD83, SOCS1* and *TRAF1* (Fig, 2). In the heart of this biological process is *IL18* which is connected to other interacting proteins/genes involved in the biological process of immune response. This implies that some of these cytokines are thermally potent, co-expressed and interact with one another in a network of activities to influence the immunity of thermally stressed or heat shocked cellular system (10). We reported differential expression of genes (DEGs) where some selected *HSPs* 70, 90, 60 and 40 including some cytokines (interleukins) such as *IL18*, IL1A etc. were jointly upregulated and over expressed whereas cytokines (chemokines) such as *CSF2, CXCL, CXCL3* etc. were downregulated (Figure 1). This suggests that during TAC/HS, upregulation of some of these HSPs activated transcription and over expressions of some associated cytokines especially *IL18* and *IL1A*, hence the activation of the transcription and

upregulation are HSP-dependent particularly when cellular system is exposed to ATCs/HS. When cellular system including PBMCs are exposed to ATCs, major *HSPs* are upregulated thereby regulating the stimulations of thermally potent immune response genes (14). We detected downregulation of some cytokines (*CSF2*, *CXCR4* and *CXCL8*) as a result of HS. Further to the above, down regulations of some cytokines occasioned by HS permits inability of these immune response genes to respond and fight off infections, mount effective response to disease conditions and wide range of opportunistic infections (15, 16, 17).

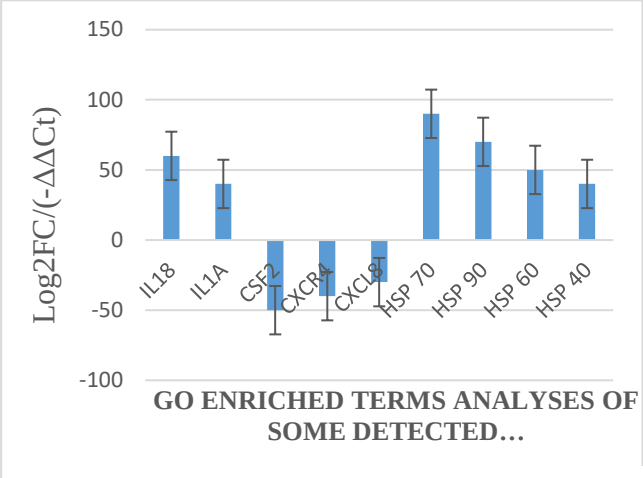

Figure 1. GO Enriched Terms Analyses Showing Some Differentially expressed cytokines and HSPs after exposure of PBMCs of zebu cattle was exposed to assault of thermal conditions/heat shock.

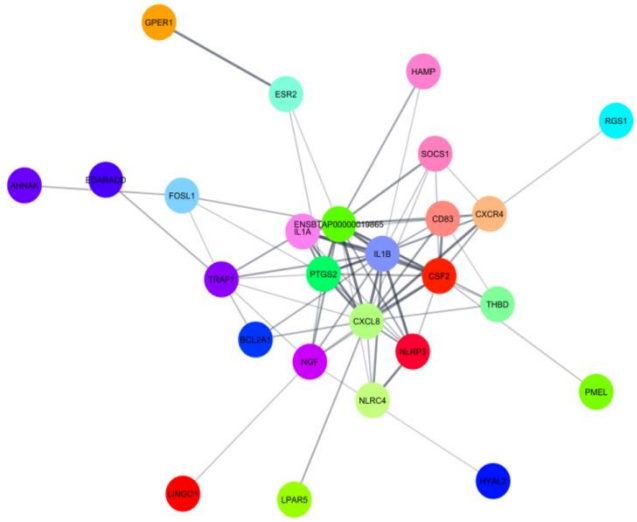

Figure 2. Cytoscape Graph depicting bio-molecular Network showing Protein-Protein interactions within cellular systems of PBMCs of Indian Zebu Cattle (Gir) after exposure to assaults of thermal conditions/heat shock

CONCLUSION AND APPLICATION

Therefore, the up regulated HSPs and cytokines can be implicated as bio-markers for management of heat stress in zebu cattle including mammalian species. Also, these over-expressed cytokines (*IL18* and *ILA*) and *HSPs* (*HSPs* 70, 90, 60 and 40) can be postulated as candidate genes for vaccine production in the management of heat stress and HS.

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Animal Biotechnology: ABT 002

EFFECT OF GENETICALLY MODIFIED FEED INGREDIENTS ON THE EXPRESSION OF MAJOR GENES INVOLVED IN IMMUNE RESPONSE IN RABBITS

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ABSTRACT

Nutrigenomics is a relatively new field of study that examines the effects of nutrients in food and feed on an animal's metabolism by modifying gene expression and regulation. It can be very well studied with quantitative real-time polymerase chain reaction (qPCR). In this study, a Nutrigenomic approach was used to evaluate the response of rabbits to a GM-based diet by examining the hepatic expression levels of genes (B2M, cathepsin S, and TGFβ1) playing a central role in immune response following 180 days of consumption of genetically modified (GM) cottonseed meal. Forty-eight (48) rabbits were randomly assigned to four dietary treatment groups and fed a diet containing different proportions of GM cottonseeds (0%, 20% 30%, and 40%). Gene expression patterns of major genes involved in immune response were not biologically influenced by the dietary substitution of GM-cottonseed in most of the dietary treatment groups. Even though, significant ($p < 0.05$) downregulation was observed in the expression patterns of most of these genes in the liver of both male and female rabbits, however, such a decrease in expression, could serve, as evidence that the GM feed consumption could not provoke an immune response in rabbit, indicating its suitability as feed for the experimental animals. Dietary substitution of GM cottonseeds could not cause significant health problems to the rabbits following 180 days of consumption.

Key words: GM-cottonseeds, Nutrigenomics, Gene expression, Immune response, Rabbits

DESCRIPTION OF PROBLEM

Genetically engineered crops expressing insecticidal and herbicide-tolerant traits offer a new strategy for improved crop production, however, at the same time present a challenge in terms of toxicology and food/feed safety(1). Various feeding studies have been conducted to evaluate the potential unintended effects of GM crops, but the outcome of the majority of such studies remains controversial (2).Thus, more comprehensive safety studies of GM crops are the need of time. Whilst whole animal feeding studies are still recognized as the 'gold standard' for the safety assessment of GM crops, such studies only provide indirect evidence for changes at the cellular/ organ/tissue level. Molecular-based approaches, on the other hand, allowed for a mechanistic understanding of toxicological or nutritional events at the cellular/ receptor level (3). The current study, therefore, employed a nutrigenomics approach to evaluate the potential unintended effects of dietary supplementation of GM cottonseed meal on the expression level of genes playing a central role in immune response in the liver of rabbits using quantitative real-time polymerase chain reaction (qPCR).

MATERIAL AND METHODS

Study area

The study was conducted at the National Centre of Excellence in Molecular Biology (CEMB), University of the Punjab, Lahore, Pakistan. The site is located between latitude 31° 34' 55.3620"N and longitudes 74° 19' 45.7536" E, at an altitude of 213 m above sea level.

Test material, Diet formulation and analysis

The test materials are mature seeds of GM cotton (*Gossypium hirsutum)* variety (VH-289) developed at CEMB through *agrobacterium* (LB-14404) mediated transformation. The transgenic line was generated to harbour the binary insect-resistant genes (*Cry1AC + Cry2A*) and the herbicide-tolerant gene (*CP4 EPSPS*). Four experimental diets were formulated with transgenic cottonseed meal at different levels- 0 (control), 20, 30, and 40% dietary levels of inclusion. The major nutritional constituents were analyzed using the AOAC) standard procedure. The details compositions of the control and experimental diets together with the analyzed components was reported in our paper (2).

Experimental Animals, Management, and procedure

A total of Forty-eight New Zealand white male and female (24 pairs) rabbits weighing an average of 570.50 ± 0.50 g were used in this study. After seven days of environmental acclimatization, rabbits were balanced for weight and randomly assigned to four dietary treatment groups namely: G1 (0% GM cotton), G2 (20% GM cotton), G3 (30% GM cotton) and G4 (40% GM cotton), with six pairs per group, for a six-month feeding trial. All animals were kept at 22±3ºC (room temperature), under a period of twelve hours (light / dark cycle) and (45-60%) humidity. At the termination of the study, rabbits were anaesthetized with chloroform and sacrificed. For the mRNA study, the liver samples were collected in sterile tubes each containing RANlater™ (Invitrogen, Cat # 00465894) to maintain the RNA integrity.
Tubes were then instantly stored at -20ºC before proceeding with the total RNA isolation.

Total RNA extraction and cDNA synthesis

For the total RNA isolation, all liver samples previously kept, were Lysed and homogenized in TRIzol™ Reagent (Invitrogen, Cat # 15596026) with the help of homogenizer. Total RNA was extracted according the CEMB optimized protocol. 1µg of RNA was used for reverse transcription with RevertAid first-strand cDNA synthesis kit (Thermo Scientific, Cat #K1621) according to the manufacturer's instructions.

Primer design, synthesis, and quantitative real-time PCR (qPCR) a

Primers specific to target genes and housekeeping gene were designed with the help of the primer design software available from NCBI (Primer3, http://http://bioinfo.ut.ee/ primer3-0.4.0/. The primers were synthesized from GeneLink™ USA in lyophilized form. The primer details are presented in Table 1.
The qPCR analysis was achieved using a PIKOREAL 96 real-time PCR instrument (Thermo Scientific). The relative expression of nominated genes was examined employing SYBR green chemistry (*Power* SYBR™ Green qPCR Master Mix, Applied Biosystems™ Cat # 1306409). Fifty Nano grams (50 ng) of the cDNA template and 1 mM primer concentration were used in a total of 10µL reaction volume. The qPCR reaction conditions were 95 °C (5 min), 40 cycles of 94 °C (20 sec), 30 seconds at the annealing temperature shown in Table 1, and 72 °C (30 sec). To check for nonspecific amplification, the melt curve analysis was performed.

Table 1. Primer details used for the analysis of hepatic gene expression

Gene	Primers Sequence (5` –3`)	T_m(ºC)	P_A (bp)	Accession number
B_2M	F: CTAGTCTTGTTCCCCTGCCTG R: CAATCTGGGGCGGATGAAAC	60	133	XM_008269078.2
Cathepsin S	F: GTTCTTGTGGTGCTTGCTG R: TGTATTGGAACGCCTCTGTC	60	174	XM_002715580.3
TGFβ1	F: TCGATGTCACTGGAGTTGTG R: GTTCATGCTGTGAATGGTGG	60	170	XM_008249704.2
GAPDH	F: ACGACATCAAGAAGGTGGTG R: GCATCGAAGGTAGAGGAGTG	60	124	NM_001082253.1

F; forward, R; reverse, Tm; annealing temperature, P_A; amplicon size

Statistical analysis

GAPDH a housekeeping gene was used as a reference control for data normalization and the relative mRNA expression was determined using $2^{-\Delta\Delta CT}$ (Ct = cycle threshold) method (4). Data analyses were done with Graph pad prims (Version 8) for Windows. Results on gene expression studies were all analysed by one-way ANOVA. "Turkey`s multiple comparison test" was used for mean separation. Significant differences were considered when $p < 0.05$. All data in the figure were reported as mean ± standard error ($\bar{x} \pm SEM$).

RESULTS

Relative expression of genes involved in immune responses

Figures 1 and 2, show that the relative expression of the B2M gene in the liver of rabbits fed different dietary levels of transgenic cottonseed is in G2, G3 and G4 diets is statistically similar ($P > 0.05$) but significantly different ($P< 0.05$) from that of the control groups after 180 days of consumption in male rabbits. A similar expression pattern of this gene (B_2M) was also observed in the experimental female fed G2, G3 and G4. Relative expression of Cathepsin S was statistically the same ($P > 0.05$) in the liver of male and female rabbits fed the G1 and G4 diets but was significantly down-regulated ($P < 0.05$) in both the G2 and G3 groups of male and female rabbits. Correspondingly, the relative expression of *TGFβ1* gene in the liver of male rabbits consumed all the types of diets was statistically the same ($P > 0.05$), but significantly ($P < 0.05$) up-regulated in the liver of female rabbits fed the G2 and G4 diets compared to that in the G1 and G3 dietary groups.

DISCUSSION

One of the major concerns raised by consumers regarding the use of transgenic crops as food or feed is the allergenicity of the transgenic proteins (5). Several studies have investigated the effects of feeding transgenic proteins in various animal species (6), but only a few focused on determining such effects concerning allergenicity more especially through gene expression analysis. Thus, in this study, the molecular response of rabbits to transgenic proteins was investigated by examining the hepatic expression levels of three important genes (*B2M*, *Cathepsin S* and *TGF-β1*) related to immune responses.

B_2-microglobulin (B_2M) is an important element of MHC (major histocompatibility complex) class I molecules, playing a critical role in the immune surveillance and modulation in vertebrate animals. (7). Deregulation of B_2M has been linked with a number of infections, including allergic diseases. In this study, the examined mRNA expression level of B_2M was not significantly affected by the dietary treatments. Similarly, the relative expression of a gene (*Cathepsin S*) involved in early immune recognition (8) was not significantly altered except for G2 and G3 males as well as G2 females in which slight down-regulation was observed. The reduced expression detected in some of the dietary groups showed that the immune system might not have been stimulated by the transgenic cottonseeds meal diet, which further ratifies the safe use of transgenic cottonseeds in the rabbits' diets. Additionally, the mRNA level of an important cytokine (TGF-β1) which plays a fundamental role in regulating adaptive immunity response (9) was also measured, and no significant changes were identified except for the G4 female, in which slightly up-regulated mRNA level was sensed. The result of this study did not concur with the earlier findings in which modifications were observed in the local as well as the systemic immune systems when transgenic maize was fed to mice for 30 days (10). Several lymphocyte subset alterations at the gut and peripheral sites were also reported in pigs, which were fed 38.9% of transgenic maize in their diet for 31 days (7).

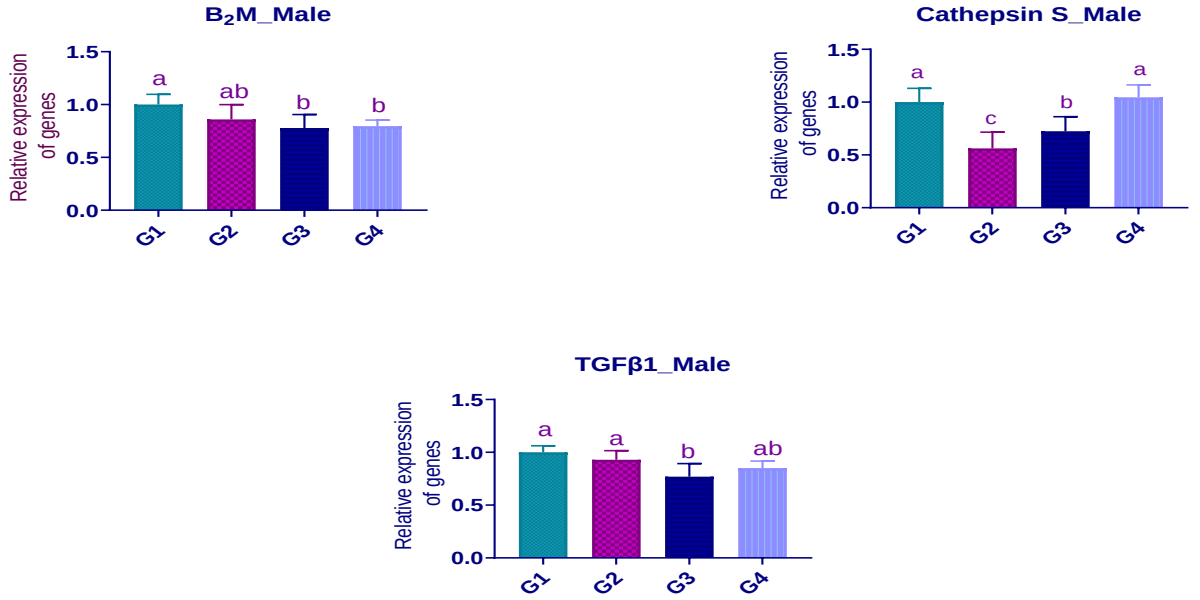

Figure 1. Relative expression of immune-related genes in the liver of male rabbits. Relative expression of genes was presented as mean ± SE. G1 represent the control groups, and G2, G3 and G4 represent 20%, 30% and 40% transgenic cottonseeds fed groups. Bars bearing different letters are significantly different ($P < 0.05$). (n =3)

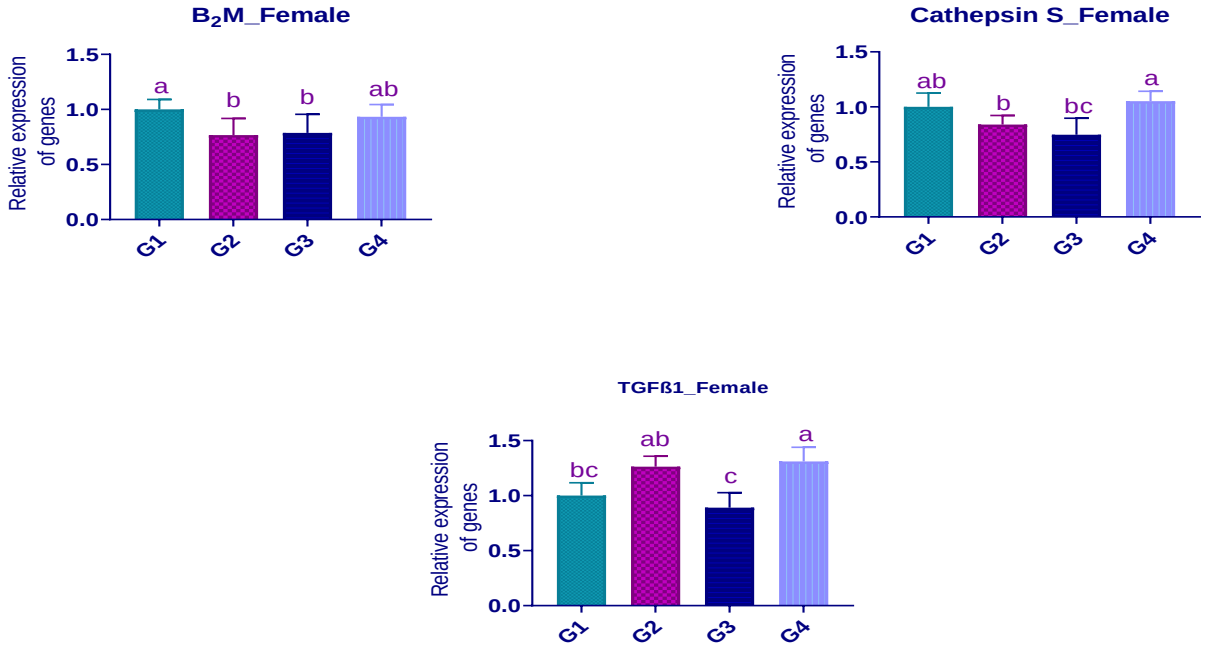

Figure 1. Relative expression of immune-related genes in the liver of female rabbits. Relative expression of genes was presented as mean ± SE. G1 represent the control groups, and G2, G3 and G4 represent 20%, 30% and 40% transgenic cottonseeds fed groups. Bars bearing different letters are significantly different ($P < 0.05$). (n =3).

CONCLUSIONS

In conclusion, our findings provide physiological indications that dietary substitution of GM cottonseeds in rabbits' diet could not biologically influence the mRNA expression pattern of biomarkers for immune response following 180-day ingestion. Even though a downregulated expression was detected in most of the examined genes, such a decrease in expression could serve as an indication that the immune system may not have been stimulated by the transgenic cottonseeds meal diet, which further confirms the safe use of transgenic cottonseeds in the rabbits' diets.

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Animal Biotechnology: ABT 003

EXPRESSION PATTERN OF TWO HEAT TOLERANT GENES IN SOME NIGERIAN INDEGENOUS CATTLE

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ABSTRACT

Gene expression profiling is one of the useful tool for identifying and predicting critical genes and pathways in animal metabolism and functions. Two genes which had been identified to be related to heat tolerance in cattle were profiled in one hundred (100) (25 each of Sokoto Gudali, Adamawa Gudali, Red Bororo and Bunaji) Nigerian indigenous cattle in Adamawa State during the hot-dry season (February- May 2023). The two genes analyzed were Heat Shock Proteins (HSP90AA1) and Prolactin Receptor gene (PLRL). The relative expression of the two genes were expressed in graph as mean ± standard error ($\bar{x}$ ± SEM). The relative expression of HSP90AA1 was higher than PLRL in the breeds studied except in Adamawa Gudali where their expressions were similar (1.0). The observed similar relative expression patterns for both HSP90AA1 and PLRL and decreased expression of both genes in Adamawa Gudali, is an indication that the breed is more adaptable to the experimental environment. It is therefore concluded that heat stress resulted in increased expression of HSP90AA1 in indigenous breeds of cattle in the environment than PRLR gene. Also, Adamawa Gudali is more adaptable to the experimental environment in the hot-dry period. It is therefore recommended that Adamawa Gudali be considered for improvement of heat tolerance in the study location.

Keywords: HSP90AA1, PLRL, expression, Nigeria, indigenous cattle,

DESCRIPTION OF PROBLEM

The increase in Temperature-Humidity Index (THI) and heat stress due to climate change play significant negative role on livestock performance and could be of greater importance in the future as climate change continues. Inter-governmental Panel on Climate Change [1] predicted that losses due to heat stress might likely increase. The panel predicted that the increase in global average surface temperature by year 2100 may be between 1.8 °C and 4.0 °C. Therefore, the improvement of animal's ability to cope with adverse environmental conditions is one of the great challenges for animal breeding in the future [2, 3]. Different approaches are used to manage heat stress in dairy cattle, these include cooling, selection, shading, and nutrition. Genetic selection program is one of the ways to improve production traits (meat, milk or eggs); however, it may increase an animal's susceptibility to high ambient temperature (Ta) because of the strong relationship between production level and metabolic heat production [4].

Gene expression profiling is one of the useful tools for identifying and predicting critical genes and pathways in animal metabolism and functions [5]. Gene expression profiling is a vital aspect of genetics because it aids in quantifying the level at which a particular gene is expressed within a cell, tissue or organism which in turn provide a lot of valuable information about the function of a particular animal [6]. In genetics, gene expression is crucial in understanding the mechanism by which genotypes give rise to phenotype. Nucleotides (genetic code) found in DNA are revealed by gene expression, while the characteristics of the expression and the properties of the expression give rise to the organism's phenotype. The phenotypes are often expressed by the activities of the proteins that control the organism's shape, or act as enzymes catalyzing specific metabolic pathways that helps in characterizing the organism [7].

Therefore, profiling the local breeds of cattle to check the expressions of two known heat tolerant genes will make it possible to identify genetic markers that can predict thermo-tolerance of the Nigerian indigenous breeds of cattle. The objective of the paper is to investigate the gene expression of Heat Shock Protein (HSP90AA1) and Prolactin Receptor Gene (PRLR) in four breeds of cow (Sokoto Gudali, White Fulani, Red Bororo and Adamawa Gudali) managed under extensive system in Nigeria.

MATERIALS AND METHODS

Study location: The study was conducted on four selected herds in Adamawa State (Mubi, Hong, Gombi and Song Local Government Areas). The location is described by [8]

Sources of experimental Animals and Management: Hundred (100) clinically healthy dairy cows consisting of twenty-five (25) individuals each, of Adamawa Gudali, Red Bororo, Sokoto Gudali and White Fulani of ages 5-6 years in selected Farms (Purposive sampling) in Adamawa State were used for the study. The experiment spaned from February to May (the hottest and dry season of the year). The animals involved were in their early lactation stage (1-60) days.

Data collection: Five (5ml) of blood samples were collected from study cows (25 from each breed) via jugular vein into 5ml syringes. The blood samples were collected into EDTA bottles and stored in ice-pack before being transferred to DNA laboratory at the DNA laboratory at Kaduna for RNA extraction. RNA isolation and cDNA synthesis, cDNA synthesis and Real PCR was done by the method described by Vincenzetti *et al*. (9). RNA extraction and reverse transcription was done according to the method reported in miRNeasy Mini Handbook, [10]. PCR quantitative and amplification efficiency was done according to the method reported by Bustin, [11]. Real-time PCR: Real- PCR was done according to the method reported by Vincenzetti *et al*. [10].

Statistical analysis: GAPDH a housekeeping gene was used as a reference control for data normalization and the relative mRNA expression was determined using $2^{-\Delta\Delta CT}$ (Ct = cycle threshold) method [12)]. Data analyses were done with Graph pad prims (Version 8.02) for windows. All data presented in the figures were reported as mean ± standard error ($\bar{x}$ ± SEM).

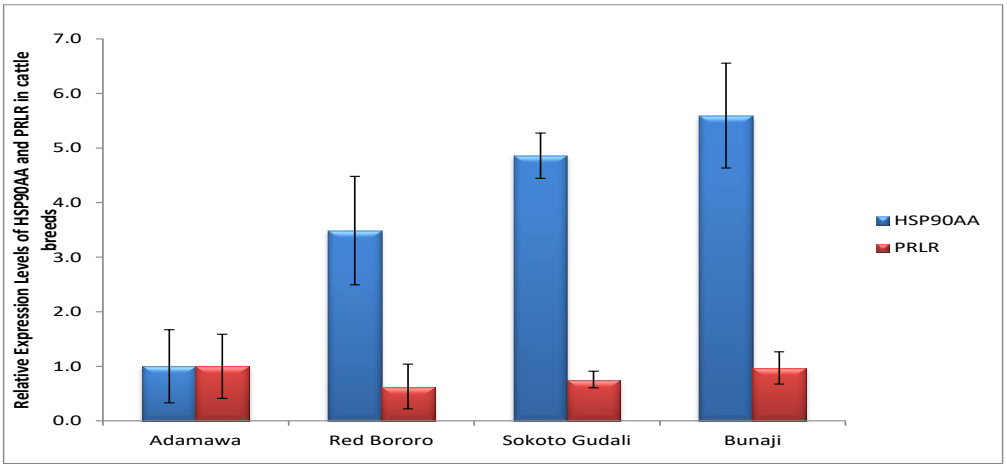

Figure 1: Relative expression levels of HSP90AA1 and PRLR in Nigerian Indigenous cattle

RESULTS AND DISCUSSION

Figure 1 depicts the relative expression of genes playing central role in the thermoregulatory responses in the studied breeds of the Nigerian Indigenous cattle. The relative expression patterns of HSP90AA1 was higher than PLRL in the Indigenous breeds studied except in Adamawa Gudali where their expression patterns were similar (1.0). The observed similar relative expression patterns for both HSP90AA1 and PLRL and decreased expression of both genes in Adamawa Gudali, is an indication that the breed is more adaptable to the experimental environment.

The high expression of HSP90AA1 as compared to PRLR in Red Bororo, Sokoto Gudali and Bunaji and superiority of the expression of HSP90AA1 in Bunaji is an indication that the three breeds were more reactive to heat stress than Adamawa Gudali. This is in agreement with the findings of Abbaya *et al*. [13] who reported that Bunaji breed were more reactive to heat stress in Adamawa State. Dauda [14] also reported different expressions of DGAT1 and Alpha Casein S1 genes in Nigerian indigenous breeds of cattle. Other authors [15] also opined that heat stress may increase the expression of genes involved in heat shock transcription factor and heat shock proteins in cattle. Present findings is in line with Bhanuprakash *et al*. [16] who reported an increase expression of HSP concentration when the cows were exposed to temperature of 42 ˚C for one hour. Present finding indicates that the HSP90AA1 exhibits more sensitive mechanisms than PRLR in facilitating homeostasis during heat stress.

CONCLUSION

Heat stress resulted in increased expression of HSP90AA1 gene than PRLR gene in indigenous breeds of cattle studied. Adamawa Gudali is more adaptable to experimental environment in the hot-dry period. It is recommended that Adamawa Gudali be considered a candidate for improvement for heat tolerance in the study location.

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GENOTYPING THE SECOND EXON OF MHC-DRB1 GENE IN SOME NIGERIAN SHEEP BREEDS

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ABSTRACT

A total of 150 adult sheep comprising three breeds 50 each of Balami, Yankasa and Uda were used for genotyping of DRB1 gene. Blood sample for DNA extraction were collected from all one hundred and fifty adult sheep through the Jugular vein, using needle and syringe (5ml) and preserved in EDTA bottle. These samples were screened for PCR-RFLP. PCR was performed on sheep genomic DNA and the PCR product was digested using restriction enzyme Rsa1. PCR-RFLP genotyping was done at the DRB1 immune gene. Two genotypes (AB and BB) were detected by the primer in three Nigerian sheep breeds. Two genotypes namely: AB and BB were detected in DRBI immune gene in the three breeds of sheep in the second exon.

Keyword: Genotype, DRB1 Gene, Sheep, Major Histocompatibility Complex.

INTRODUCTION

The major histocompatibility complex (MHC) is made up of closely connected genes that are highly polymorphic. Histocompatibility molecules, also referred to as MHC molecules, are specialized antigen-presenting receptor glycoproteins that are primarily encoded by the MHC (1). MHC gene products are important for an individual's immune system. In several animal breeds, MHC genes have been thoroughly investigated as potential genes for disease resistance (2). Located on chromosome 20, the sheep's major histocompatibility complex (MHC) gene is known as Ovar (3, 4). Class I and class II genes are the two main subfamilies of the MHC gene family (5). In the MHC region, DRB genes have been utilized and described frequently because it encodes highly variable peptide-binding sites, the second exon of the DRB gene in particular has been the most extensively researched gene region (6, 7). Animal breeding has placed a lot of emphasis on studying the MHC as potential genes for susceptibility and resistance to disease in recent years. The multigene family known as the MHC regulates immunological self and non self recognition. The genes that encode the cell surface glycoproteins that transmit foreign and self-protein peptides to T cells are among them; these proteins regulate all immunological responses, both cell- and antibody-mediated. Over 80 alleles have been found at this locus in sheep, and exon 2 of the Ovar-DRB1 gene codes for a portion of the MHC class II antigen binding cleft (8). Pathogen-driven diversity suggests a high correlation between MHC alleles and patterns of resistance to particular viral or autoimmune illnesses. This study was conducted to genotype Nigerian sheep breeds based on DRBI gene in three different sheep breeds.

MATERIALS AND METHODS

Study Area

The study was carried out at the Maiduguri Abattoir and Biotechnology Centre, University of Maiduguri, Borno State. Located on latitude 11° 5' N and Longitude 30° 09 E and an altitude of 354m above sea level. Maiduguri is the capital of Borno State (9).

Sample Collection
Blood samples were collected from a total number of one hundred and fifty (150) adult breed of sheep (50 each from Balami, Uda and Yankasa) via their Jugular vein using syringe and needle (5ml).

DNA Extraction
DNA was extracted from blood using the Wizard Genomic DNA Extraction Kit from Promega. The process involved precipitating proteins with a solution, precipitating DNA with isopropanol, washing with 75% ethanol and dehydrating with a DNA dehydration solution. The extracted DNA was stored at -20°C (short-term) and -80°C (long-term). The DNA concentration and purity were determined using a NanoDrop spectrophotometer, which measures absorbance at 260nm and 280nm. A ratio of approximately 1.8 indicates pure DNA.

Polymerase Chain Reaction for *DRB1* Gene
The primer sequence used in amplifying exon 2 of *DRB1* gene and the size of the PCR product (369 *bp*) are shown in Table 1.

Table 1: Primers used in the amplification sheep genomic DNA for *DRB1* gene analysed

DRB1 exon 2 primers	Product size	Annealing temperature (°C)
Fw: 5'-ATTAGCCTCTCCCCAGGAGTC-'3	*BP*	60
Rev: 5'-CACACACACTGCTCCACA-'3	369	60

Electrophoresis of Gel
A 1.5% agarose solution was prepared by dissolving 1.5g of agarose powder in 100ml of 1x TAE buffer. The solution was heated, cooled, and mixed with ethidium bromide. The gel was poured into a cassette, allowed to solidify, and transferred to an electrophoresis tank. Samples were loaded into the gel wells, and the machine was run for 30 minutes at 120 volts. The progress was monitored, and resulting bands were visualized under UV light using a camera. The gel was labeled to identify samples and bands were photographed for further analysis.

Evaluation of Restriction Fragment Length Polymorphism (RFLP)
RFLP evaluation was performed by incubating a reaction mixture overnight at 37°C, then visualizing fragment sizes under UV light to genotype the DRB1 immune gene using PCR-RFLP.

Data Analysis
GENEPOP was used for genotyping sheep breeds (Balami, Uda, and Yankasa) based on DRB1 gene (10).

RESULTS AND DISCUSSION

Table 2 displays the genotype distribution in Balami, Yankasa, and Uda. The findings demonstrated that all breeds had two genotypes, AB and BB. Balami, AB (0.78) and BB (0.22); Yankasa, AB (0.25) and BB (0.75); and Uda, AB (0.39) and BB (0.61) denoting genotypes and frequencies respectively. Balami's allelic frequencies were A (0.392) and B (0.61), Yankasa's A (0.125) and B (0.875), and Uda's A (0.196) and B (0.803). The genotype distribution patterns of Yankasa and Uda were similar, but Balami's was not. The results of this study agreed with the report of (11) who studied genotype of IGF1 in Balami, Yankasa and Uda and found that the allelic frequencies of Balami A (0.61) and B (0.39), Uda A (0.36) and B (0.64) and Yankasa A (0.44) and B (0.56). Balami and Yankasa had similar patterns of genotype distribution while that of Uda was different. Balami and Yankasa had high heterozygosity while Uda had high homozygosity for B. (12) had observed three genotypes (AA, AB and BB) in Mehraban sheep in Hamedan Province, Iran and Chinese sheep (small tail Han, Hu, Texel and Dorset ewes). Advantage of the heterozygote theory is that

MHC heterozygote are known to have greater immune surveillance against infectious organisms than homozygote (13). Furthermore, (14) proposed that distinct MHC alleles could show distinct associations with parasites at different phases of life, thus illustrating the intricate relationships that exist between helminth parasites and the vertebrate immune system. The authors posited that MHC is essential for the identification of foreign antigens and the immune system's reaction to infections, and that this intricate relationship may result in heterozygous individuals exhibiting the best overall fitness in vertebrates (15).

Table 2: Genotype and Allelic Frequencies of DRB I in some Nigerian sheep.

		Allele Frequency		**Genotype Frequency**		
Breed	Locus	A	B	AA	AB	BB
Balami	DRBI	0.392	0.607	-	0.78	0.22
Yankasa	DRBI	0.125	0.875	-	0.25	0.75
Uda	DRBI	0.196	0.803	-	0.392	0.607

CONCLUSION

Two genotypes were found in the DRBI immune gene in the three breeds of sheep, which are AB and BB genotypes, which may be due to the presence of alleles A and B. The genotype distribution patterns of Yankasa and Uda were similar, while allele A is more frequent in Balami followed by Yankasa and Uda.

Recommendation

Conduct a larger-scale study to deepen the understanding of the genetic diversity and disease resistance in the three sheep breeds, ultimately for informing breeding programs and improving their overall healt

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INSULIN-LIKE GROWTH FACTOR-1 (IGF-1) GENE POLYMORPHISM AND ITS EFFECTS ON EGG LAYING CHARACTERISTICS IN IMPROVED NIGERIAN INDIGENOUS CHICKEN

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ABSTRACTS

The polymorphism of insulin – like growth factors-1 gene as a candidates gene for reproductive traits growth hormone receptor and body composition which affect the egg quality traits were assessed and detected to determine their effect on egg laying trait (egg weight egg length and egg breadth). A total number of 100 improved Nigeria indigenous chickens with five different genotypes were raised till their laying stages under an intensives management system and fed ad libitum. The birds egg qualities were measured and each bird blood was collected and taken to laboratory for further experimentation. Further biotechnological laboratory techniques were carried out; extraction of DNA PCR –RFLP technique was also applied to analyze or amplify the extracted DNA using primers sequence set up by (1). Agarose gel electrophoresis was also carried out and finally genotype to associate SNPS with the egg quality traits. The three genotype AA, AC, and CC were found with different base pair. The results obtained were subjected to statistical analysis using general liner model to estimate the effect of genes on the traits ANOVA was used to test for significant difference while the genotypic effects have no significant on egg laying traits are as results of polygenic traits. The results suggest that there were no significant associated between IGF-1-SNPS and egg laying traits expect for the egg breadth of frizzle feather and the Sasso which showed a significant effect ($p<0.05$)

Keywords: Insulin like growth factor 1 growth hormone, PCR, restricted fragment length polymorphism, single nucleotide polymorphism

INTRODUCTION

The primary source of insulin-like growth factor 1 (IGF-1) is the liver, which also produces it in an autocrine and paracrine manner in target tissues. Growth hormone (GH) is responsible for controlling or stimulating it. Growth hormone insensitivity caused by under nutrition, growth hormone receptor deficiency, or malfunctions in the downstream pathway after growth hormone receptors, such as SHP2 and STAT5B, can all slow it down. IGF bp-3, the most prevalent protein, accounting for 80% of all IGF blindings; almost 98% of IGF-1 is always attached to one of the six blinding proteins (IGF-bp) (2). IGF-1 binds of IGF BP-3 in a 1:1 molar ratio. The IGF-1 is a candidate gene for growth body composition and metabolism skeletal characteristics and growth of adipose tissue and fat deposition in chickens. The IGF-1 receptor is a membrane glycoprotein mediating most biological actions IGF-1 which have an important effect on chicken growth carcass and, meat quality traits (2).

Gene polymorphism is referred to as simultaneous occurrence in the same locality of two or more discontinuous forms in such proportions that the rarest of them cannot be maintained just by recurrent mutation or immigration originally. It is the occurrence of the same population of two or more alleles at one locus each with appreciable frequency where the maximum frequency is typically taken as 1% (3). IGF 1 is produced, mainly by the liver and directly simulated by growth factors (GH) (4). Through autocrine, paracrine, and endocrine physiological mechanisms, IGF-1 also affects nutrition metabolism, reproduction, and the growth and maturation of ovaries and follicles. It has been demonstrated that IGF-1 is important for bird growth and that decreased IGF-1 levels result in slower growth rates (4). Native chickens in Nigeria have adapted to live in rural areas, where they may survive on little to no food and can fluctuate in the supply of feed (5). An earlier attempt to boost indigenous performance began in the late 1930s, with the implementation of the rural poultry improvements project, which was predicated on cockerel exchanges (5).

Improving the fertility and breeding abilities of native chickens is one strategy to raise their market value (6). The use of favorable genes in breeding tactics may help achieve this. (7) found no significant genes in the native chicken that may be used to genetic enhancement initiatives. Among them are the frizzles gene (FF), the naked neck gene (NN), and normal feather (NF) in our native chicken populations.

The enhanced Nigerian native chickens are more advantageous to poultry keepers nationwide. They have been shown to be effective growth promoters because of their environmental resistance and ability to adapt to the country's unique conditions. In addition, farmers profit greatly from the sale of chicken meat and other by products, which is undeniably important to the nation's economic advancements. As a by-product of chicken farming, eggs are a significant and indispensable source of nutrients for the body and have a positive influence on economic growth (8). It is well acknowledged that all aspects of egg quality have a genetic foundation. As a result, the economic performance of laying flocks depends only on the total quantity of quality eggs produced. Egg quality also plays a larger role in tables and hatching eggs. Studying the impact of IGF-1, which is regulated by growth factors (GH), is necessary to maintain the chickens' irreversible growth and stability in production levels at an increasing rate. This will ensure that the egg quality traits are improved in an efficient manner, meeting the market's demands for large and high-quality eggs.

The objectives of the research is to determines IGF-1 gene polymorphism and its effect on the egg laying characteristics in improved Nigeria indigenous chickens

MATERIALS AND METHODS

Experimental sites

The experiment was carried out at two different sites, at the poultry breeding unit of the directorate of university farms (DUfarms) and in the laboratory at the biotechnology laboratory of the department of animal breeding and genetics, federal university of agriculture, Abeokuta, Ogun state.

Experimental animal

A number of 100 improved Nigerian indigenous chicken with five different genotypes that were raised till their layers' stage were managed and used for the experiment, the flock of the birds comprised, kuroiler, normal feather, frizzle feather, naked neck and Sasso chicken, an even management system called intensive management system given to all birds and their growth was measured and recorded.

Data collection

During the course of the management of the birds, their growth and productivity data was measured and recorded, the parameters were:

- **Egg production**
  Data on daily egg production was taken for 6months from their laying period on regular basis; this was summed up every week and expressed as weekly hen-day egg production.
- **Egg mass**
  This was measured by weighing samples of the egg laid; the total weight of the entire sample was then determined and was divided by the number of eggs in the sample to obtain the average egg weight.
- **Egg weight**
  Mean egg weight was obtained by weighing samples of eggs from each of the genotypic groups.

Blood collection

Blood was collected from the birds through the wings or brachia vein (1m of blood) using needle and syringe and 2ml of ethylenediaminetetraacetic acid (EDTA) bottle; the EDTA in the bottle serves as anti-coagulant that is preventing the blood from being clot, after which the blood collection samples were transferred to the laboratory for further analysis.

Deoxyribonucleic acid (DNA) extraction
The blood samples that was collected from the farm was later used for DNA extraction using isolate blood DNA kits following the manufacturer procedure.

Primers
The primers that was used for the amplification of IGF 1 gene is provided by the sequence;
IGF 1 forward 5 – GAC TAT ACA GAA AGA ACA AC – 3'
IGF 1 reserve 5 – TAT CAC TCA AGT GGC TCA AGT – 3' (Nagaraga *et al.*, 2000).

Polymerase Chain Reaction
Amplification of the IGF-1 gene to generate thousands to million copies of a particular DNA sequence was done and the following PCR conditions was followed for the amplification of the IGF-1 gene, initial denaturation at 94^{0}C for 4 minutes followed by 40 cycles of denaturation at 94 ^{0}C for one minutes, annealing was also carried out at 56 degree Celsius for 45 seconds, extension at 72 ^{0}C for 60 seconds and a final extension step at 72 ^{0}C for 10 minutes.

Agerose gel electrophoresis
- 2.0% of Agarose was weighed on an electric weighing balance.
- 50ml of IXTBA buffer was poured into a beaker.
- Then the Agarose was added and then shake.
- It was then be taken into the microwave for heating and allowed to cool afterwards.
- 5.0ul of ethidium bromide was added to stain the gel and was poured into the gels electrophoresis tank.

Restricted fragment length polymorphism
Restriction digest was done using 1ul of fast digest enzyme (ECOR) according to manufacturer's (thermo scientific) recommendation and at an incubation temperature of 37 ^{0}C for 20min. The enzyme was subsequently deactivated by heating for 5min at 80 ^{0}C. The digested products were loaded on a gel. Then, the electrophoresis tank was set up and connected to electrical source to run for 20mins at 75 – 100v. The gel was removed and viewed under UV light to observe the bands. The restriction patterns were visualized by 0.75% agarose gel electrophoresis; gels are stained with gr green DNA stainer. Gels were visualized and photographed using a gel documentation system (Uvipro silver by Uvitec).

Statistical analysis
All data was subjected to a two way analysis of variance using general linear model (glm), the model is as follow; **yij= u + gi + hj + eij**

Where: yij = measured trait
u = population mean
Gi = fixed effect of ith genotype (1 = NN,NM,FF e.t.c)
Hj = the effect of IGF- 1 gene polymorphism
Eij = random error

RESULTS

Effect of genotype on egg laying characteristics on Nigerian indigenous chickens
The analysis of variance of effects shows that IGF-1 gene polymorphism had no significant ($p<0.05$) effect on the egg weight for all the genotype used including kuroiler (53.23 ± 0.86),naked neck (51.73± 0.44),normal feather (58.27 ±1.72) and frizzle feather (49.56 ± 0.09), although higher mean values were observed in these and every other trait considered but the effects were not significant. Effects on the egg length (cm) is the next and the effect had no significance (0.05) on all the genotype ; frizzle feather (49.56

± 0.09),kuroiler (53.75 ± 0.73), naked neck(52.81 ± 0.33), normal feather (51.98 ± 0.11) and sasso(53.81 ± 0.10), even though they have the highest mean values as observed in all genotype but the effect were considered not significant, meanwhile, lowest mean values were observed on the effect on the egg breadth in all genotype giving; kuroiler (42.14 ± 0.33), naked neck(54.44 ± 5.81) normal feather (45.11 ± 2.96), sasso(41.96 ± 0.06) except for frizzle feather(40.87 ± 0.04) which is considered significant. The analysis of variance of effect in the table 1 show that IGF-1 gene polymorphism had no significant effect on any of the egg laying trait (egg weigh, egg length and egg breadth) for all the genotype except for the breadth of frizzle feather genotype.

Table 1: Effect of genotype on egg laying characteristics on improved Nigerian indigenous chickens

Genotype	Egg weight(g)	Egg length(cm)	Egg breadth(cm)
Frizzle feather	49.56 ± 0.09	55.77 ± 4.46	40.87 ± 0.04
Kuroiler	56.23 ± 0.86	53.75 ± 0.73	42.14 ± 0.33
Naked neck	51.73 ± 0.44	52.81 ± 0.33	54.44 ± 5.81
Normal feather	58.27 ± 72	51.98 ±0.11	45.11 ± 2.96
Sasso	53.17 ± 0.60	53.13 ± 0.10	41.96 ± 0.06

Effect of SNPS on egg laying characteristics

The results of the analysis of variance of the gene polymorphism shows that three (3) SNPS were detected and analysis shows that the single nucleotide polymorphism had no significant ($p>0.05$) effect on the egg laying trait (egg, weight, egg length and egg breadth) which made them not to be significant different. The results shows that SNPS had no significant ($p>0.05$) effect on the egg laying characteristics of the indigenous chicken used on the egg weight (52.80 ± 0.07), egg length (52.67 ± 0.34) and egg breadth (44.27 ± 2.71) for nucleotide AA.

The nucleotide AC was also found to have no significance on the traits considered having egg weight (52.80 ± 0.47), egg length (53.36 ± 1.10) and egg breadth (44.84 ±1.72) which specifies no difference phenotypic effect.

In nucleotide CC, the results shows no significant effect on the egg laying traits having the standard mean error for the egg weight (52.10 ±0.90) and egg length (52.54 ±0.15) were close to the significant level then the egg breadth (56.30 ±9.89) yet no significant effect was shown in all the traits. The results in the table 2 shows that single nucleotide polymorphism had no significant difference on any of the traits despite the difference in the nucleotide used for all the traits.

Table 2: Effect of SNPS on egg laying characteristics of Nigerian chickens

Genotype	Egg weight	Egg length	Egg breadth
AA	52.80 ± 0.77	52.67 ± 0.37	44.27 ± 2.71
AC	52.80 ± 0.47	53.63 ± 1.10	44.84 ± 1.72
CC	52.10 ± 0.90	52.54 ± 0.15	56.30 ± 9.89

DISCUSSION

The IGF-1 gene polymorphism in the three genotypes AA, AC, and CC that exhibit fragments at the base pair (BP) employing Hinfil for PCR-RFLP was discovered in the research hens employed in this investigation. The fact that no discernible difference was found indicates that the genotypes' frequencies are similar. Through this experiment, it was discovered that the number of follicles in mice recruited to the rapid growth phase is controlled by the IGF-1 gene system (9). The IGF-1 gene polymorphism was identified in the study hens. Numerous minor genes and several large genes regulate the characteristics of chicken eggs; the minor genes are small but their effects are large in most cases. According to (9), the pace of sexual maturation is considerably more strongly correlated with body growth than with chronological age. As a result, the GH-IGF-1 system influenced the body weight and growth rate of chickens. It is also well known

that there was a large genetic association between body weight and egg weight. Egg weight and body weight at 44 weeks had a strong connection (R2=0.69), according to (5). The native chicken's genotype is a possible candidate gene linked to growth and body composition, which influences body weight. As can be observed, frizzle feathers appear when body weight approaches a substantial level.

Similar results were seen in the frizzle feather egg breadth, which was rather significant (40.87 ± 0.04), and the sasso egg width, which was quite near to the significant threshold (41.96 ± 0.06), demonstrating that in some strains of chickens, genotype has a considerable impact on egg weight and egg breadth. Despite its significant role in promoting growth, protein synthesis, cell proliferation and differentiation, and egg production, the IGF-1 gene had no effect on egg production in the research birds (10). IGF-1 has also been shown to be correlated with egg production and the number of days that eggs are laid continuously (11). IGF-1 polymorphism was shown to be substantially correlated ($p<0.05$) with egg production, average number of days of continuous egg laying, growth features, body weight, and mean daily weight gain in IGF-1 SNP homozygote compared to heterozygote. The homozygote genotype is preferable for all the qualities taken into consideration, as indicated by the single nucleotide polymorphism factors, which do not provide any discernible differences for any of the traits.

CONCLUSION

From the results obtained in this study, it can be concluded that:

- That IGF-1 gene polymorphism does not show any significant difference or variation with the egg laying traits though superiority was observed in homozygosity.
- Genotype of the chicken has no significant effect on egg laying traits except for some genotype e.g frizzle feather which were close to significant level for egg weight (NM and SS) for egg length (FF and SS) which were quietly significant and close to significant level respectively.
- Sex has huge effects on the laying traits which were only in favor of female.

Recommendation

Based on the findings of this study, this is hereby recommended:
Having generally known that IGF-1 gene could have effect on growth, body composition, cell differentiation and proliferation and body weight which directly affect the egg weight, it is therefore recommended that further research should continue on the investigation of IGF-1 gene and this should be done at specific age of maturity as IGF-1 gene could be associated with follicle size and body composition at a particular stage of growth in chickens. This investigation will in no small way improve the economy of the poultry section of the livestock industry on producing a more quality traits with high values.

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Animal Biotechnology: ABT 006

GENETIC IMPROVEMENTS FOR COST EFFICIENCY AND THE ROLE OF BIOTECHNOLOGY IN CATTLE PRODUCTION IN NIGERIA

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ABSTRACT

Given the projection that the world population will increase to 9.7 billion by 2050, with a consequent 50% increase in demand for animal products, improving cattle productivity becomes most desirable. This contributes toward combating food security and economic development challenges in Nigeria, where agriculture is a predominant livelihood. Livestock rearing contributes enormously to the Nigerian economy by producing beef, milk, and leather products; nonetheless, it is faced with a challenge which is high production costs. This review emphasizes the potential benefits of genetics and breeding technologies in increasing productivity among cattle, concentrating on genetic improvements that show improved cost efficiency. Conventional breeding, in addition to new biotechnological technologies such as genomic selection and Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR), will make it possible to achieve additional gains in feed conversion, disease resistance, and other aspects of productive efficiency. This is expected to avert disparity across different strata of society if investments in research, training, and infrastructure are made alongside policies that will foster equal access to these innovations so that the benefits are equitably distributed to develop a more resilient and prosperous cattle industry in Nigeria.

Keywords: Biotechnology; Breeding; Cattle productivity; Cost efficiency; Genetics

INTRODUCTION

The global population is expected to grow from 7.8 billion in 2020 to 9.7 billion by 2050, leading to a 50% increase in demand for animal products [1]. Considering the tremendous increase in human population and severe deficiency in nutrients, efficiency in animal production needs to be increased, and the quantity and quality of animal products need to be maximized to their full potential. In a country like Nigeria, where agriculture is not just a sector but a way of life, cattle production holds great potential [2]. Cattle keeping ranks high in the list of contributors to the economy and agriculture, offering essential products like meat, milk, hides, and traction for farming. In this regard, they play a crucial role in agricultural productivity and food security. However, some challenges face the sector: high production costs, disease epidemics, and climate change. Tackling these challenges is essential to make the cattle farming both sustainable and efficient. Genetics and breeding are essential tools for enhancing the output of cattle. Despite the benefits, traditional breeding often requires high rates to result in meaningful advances in the presence of novel problems. Genetic studies and biotechnological applications are poised to revolutionize the cattle industry by rapidly and precisely upgrading key productivity and cost efficiency factors. These include higher feed conversion rates, improved disease resistance, and enhanced reproductive performance [3, 4]. This paper explores how cattle output has been enhanced through the innovative use of genetics and biotechnology. The focus is on a specific approach to genetic improvement that holds the potential to significantly boost cost efficiencies, thereby benefiting the cattle industry at large.

GENETIC IMPROVEMENTS FOR COST EFFICIENCY

Genomic selection enhances quantitative features in breeding populations through whole genome molecular markers and high-throughput genotyping [5]. [6] developed an approach that pools genomic prediction and marker data with phenotypic and pedigree data for higher accuracy in breeding and genotypic prediction.

Genomic selection is widely applied in research and improving livestock and crops. [7] reported that Single Nucleotide Polymorphism (SNPs) used in selection accounted for most of the missing heritability in complex traits. This makes it the most effective approach to enhancing indigenous livestock species through studies, policies, and breeding programs. Single Nucleotide Polymorphism (SNPs) is more common in the genome than microsatellites, which usually have several alleles. More studies and development in this area are being conducted in Nigeria and some other African countries, while implementation needs to be improved. Proper implementation will lead to Better varieties, lines, and hybrids development in indigenous livestock and crops will increase food supply and availability to resource-poor areas. Also, an Improvement in feed conversion efficiency (FCE) can effectively reduce the cost of cattle production. This is due to the fact that improved FCE permits cattle to convert feed into body weight more efficiently, substantially lowering the total cost associated with feeding [8]. These genetic advances enhance the capacity of cattle to exploit nutritive value from feed, thus reducing feed costs and improving the economic feasibility of cattle farming [9]. Additionally, selective breeding of growth-rate-enhancing and milk-producing animals could lead to higher yields per animal and, therefore, higher profitability of cattle farming. The weaknesses and strengths of the Indigenous breed in terms of productivity may be combined through the offspring from crossbreeding with exotic breeds, known for their high productivity, to give the farmers tough and adaptable indigenous breeds that are production superior. According to [10], genetic improvement can also be directed towards increasing disease resistance. For instance, selecting genetic traits can increase an animal's immunity and resistance to common diseases such as mastitis, bovine respiratory disease, and Johne's disease. This leads to a reduction in the necessity of veterinary interventions, thereby uplifting overall herd health. Selectively breeding of cattle in order to increase resistance to diseases (such as trypanosomiasis) in a manner that promotes healthier and more resilient populations of cattle, thus lowering the prevalence of disease and, subsequently, costs [11].

Genetic Engineering and Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR)

According to [12], Genetic engineering and CRISPR are biotechnological tools that provide highly sophisticated platforms for introducing beneficial traits in cattle populations. [13] reported that it is now possible to easily alter specific genes in an organism due to the development of these advanced technologies. This alteration improves their essential characteristics, such as growth rates, milk productivity, and disease resistance. CRISPR can target the genes that make a cow susceptible to some diseases, making the animal more resistant to infectious diseases and reducing the need for antibiotics or any form of treatment. It improves animal welfare and decreases environmental impacts associated with veterinary medicines in cattle farming [14].

Genomic Selection

Genomic selection, an advanced animal breeding system based on DNA markers for predicting the genetic potential of animals for various traits, allows early identification of superior animals as parents and accelerates genetic progress in desirable characteristics [15]. The technology would be specifically invaluable for the selection and dissemination in Nigeria of cattle with genetic traits that influence increased productivity and also confer some resilience against local agroecological pressures [16]. Therefore, more informed breeding decisions can be made by focusing on genetic markers associated with specific desirable attributes, significantly improving the herds' general quality and performance.

Artificial Insemination and Embryo Transfer

Artificial insemination and embryo transfer, the two most critical biotechnological advances in reproduction over the last few decades, have brought about a complete revolution in cattle breeding [17]. These breakthroughs have not only allowed the dissemination of superior genetic material to many cows, but they also offer a promising future for cattle breeding. The process involves selection from genetically superior bulls, whose semen is used to inseminate (introduce semen) many cows. On the other hand, embryo transfer allows high-quality donor cows to give their embryos to many recipient cows [18]. These approaches optimize the spread of beneficial traits within animal populations, thereby conferring considerable gains in terms of the efficiency and productivity of breeding schemes. Consequently, they help enhance cattle

populations by making them more productive and efficient in output and resilient to biotic and abiotic factors.

CHALLENGES

Even though biotechnology offers much potential in cattle breeding, several issues must be addressed to make it effective [19]. Notable among these are the enormous costs associated with biotechnological interventions, specialization in knowledge and infrastructure, and the consideration of bioethics related to genetic modification. In this light, such advancements must be accessible to and affordable by smallholder farmers to be widely adopted within Nigeria [20]. Government agencies, research institutions, and the private sector have to collaborate in their input to facilitate and provide the resources necessary to integrate these technologies into mainstream cattle farming practices.

PRACTICAL APPLICATIONS AND CASE STUDIES

Various successful genetic improvement programs have been carried out, which have demonstrated much potential in contributing to the productivity of cattle around the world, thus providing valuable lessons to Nigeria. An example is Kenya, where the genetic improvement of dairy cattle has contributed to an increase in milk production and farmer income, highlighting the importance of programs of this kind [21]. Similar efforts for improving features like heat tolerance, disease resistance, and feed efficiency can be adopted in Nigeria [22]. When this biotechnological innovation is combined with traditional methods, the benefits of any genetic improvement are a combination that hastens development toward such robust animals appropriate for the Nigerian environment [23]. Therefore, joining genomic selection with conventional breeding will permit the rapid dissemination of desired traits and genetic improvement in much more timely ways to keep up with the needs of modern agriculture. In addition, community-based breeding that includes local farmers in the process of trait selection and dissemination will ensure that these genetic gains are more acceptable and effective. Harnessing local knowledge, the programs ensure that the breeding strategies are scientifically based and most suitable for different communities' peculiar needs and conditions.

CONCLUSION AND RECOMMENDATION

Cattle productivity improvement in genetics and breeding remains a transformative opportunity that, if adopted into cattle production in Nigeria, will result in more efficient, sustainable, and profitable farming. With advances that have been made in genetic research and biotechnology, farmers are now in a more favourable position to further enhance productivity and cost efficiency to boost food security and economic growth. Such a synergy of new technologies to traditional breeding, coupled with appropriate policies and infrastructure, can fully unleash the potential of Nigeria's cattle industry. It is, therefore, essential to make these developments accessible and beneficial to all farmers, irrespective of their socioeconomic background. Consequently, it is essential to build a resilient agricultural sector that can meet the increasing food demands of the future. Making access to these technologies affordable is essential because it not only levels the field but also contributes to the stability and growth of Nigeria's agricultural economy, fostering more inclusive and sustainable development. Training programs for farmers and extension workers should be organized to build their capacities to key into genetic and biotechnological advances. Also, access to relevant resources such as genetic testing kits, AI services, and comprehensive veterinary care is vital for spreading superior breeding practices. Policies providing access to these biotechnological tools and services are crucial, especially for smallholder farmers. This can be made possible by subsidizing the costs of genetic testing AI services and community-based breeding programs where local farmers fully engage in genetic improvement.

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OVINE INSULIN-LIKE GROWTH FACTOR (*IGF-1* AND *IGF-2)* GENE EXPRESSION IN KIDNEY OF NIGERIAN SHEEP BREEDS

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ABSTRACT

Insulin-like growth factor 1 (IGF-1) is regarded as a candidate gene associated with growth traits in livestock. Early tissue IGF-1 levels may serve as indicators of growth rate potential, aiding in the selection of fast-growing animals. However, there is a lack of information on gene expression patterns and their effects on phenotypic traits in Nigerian sheep. Tissue samples were collected from the kidneys of three breeds (Balami, Uda, and Yankasa), with five samples from each sex. The study aimed to determine the mRNA expression of the ovine IGF-1 gene in some Nigerian sheep breeds. Results showed that the gene was relatively expressed in the tissue of adult sheep, with fold changes indicating IGF-1 upregulation highest in Yankasa, followed by Balami and Uda. Yankasa had the highest IGF-1 expression in the kidney, followed by Uda and then Balami. Conversely, Uda had the highest IGF-2 expression, followed by Yankasa and Balami. This study highlights the differential abundance of IGF-1 and IGF-2 genes in kidney tissues among the three sheep breeds. Balami exhibited better IGF-1 gene expression compared to Uda and Yankasa, suggesting potential for superior performance in the Balami breed. Farmers might consider selecting Balami for further breeding improvements.

Key words; Expression Patterns, Insulin-like growth factor 1 (IGF-1), Ovine and mRNA (messenger Ribonucleic Acid).

DESCRIPTION OF PROBLEM

Molecular genetics techniques are highly valuable for identifying genetic variations in markers linked to various production and reproduction traits in farm animals (1,2). These genetic differences influence physiological pathways, leading to quantitative changes in different phenotypic traits (3,4). In the field of quantitative genetics, several single genes related to muscle growth, development, and function have been studied for their potential linkage to economically significant quantitative traits. Research on the relationship between Insulin-like Growth Factor 1 (IGF-1) and animal growth and development traits has been limited (4). The IGF-1 gene (IGF1), which encodes IGF-1, is considered a candidate marker for growth traits in livestock (5,6,7). IGF-1 exhibits non-suppressible insulin-like activity and acts as a key mediator of growth hormone effects (8). The ovine IGF-1 gene has been mapped to chromosome 3 with the identification number 443318 (9). Elevated IGF-1 levels positively impact fetal growth and birth weight in sheep (10) and are correlated with live weight gain (11).

Tissue IGF-1 concentrations at an early age may be useful indicators of growth rate potential and help in selection of fast growing animals and other useful production traits. However, there is dearth of information on gene expression of ovine *IGF-1* in the kidney as it affects phenotypic traits in Nigerian sheep breeds. There is therefore a need to undertake molecular genetic analysis of this gene and show their relationship with growth traits in these breeds of farm animals. This information is required for Marker-Assisted Selection (MAS) and breeding for their future genetic improvement. The objectives of the study is to determine Ovine *IGF-1* and *IGF-2* Expression in Kidney of Nigerian Sheep Breeds.

MATERIALS AND METHODS

The samples for the study were collected from the Maiduguri abattoir and some households in Maiduguri and analysed at the Biotechnology Centre, University of Maiduguri and African Bioscience Laboratory, Ibadan, Oyo State. Tissue samples collected from an organs (kidney) per animal from the three breeds (Balami, Uda and Yankasa) and five (5) sample from each sex, i.e. 3 X 5 X 2 = 30. Tissues samples were preserved in RNALater solution before analysis. Total RNA was isolated using Geneaid (Presto™ DNA/RNA/Protein Extraction Kit) according to the method of (12) and preserved at -20^{0}C before laboratory analyses. The extracted RNA was treated with RNase-free Dnase to remove contamination. Concentration and quality of RNA extracted was assessed on Nanodrop spectrophotometer (ND-1000). The extracted RNA was converted to cDNA using the FIREScript RT cDNA Synthesis KIT. The synthesized cDNA was amplified using the Biorad My iQ Real Time PCR machine®. A two-step Quantitative Polymerase Chain Reaction (qPCR) protocol were performed using first strand reverse transcription of extracted total RNA into cDNA. The resulting cDNA were then used as the template for the qPCR reactions using the SYBR green qPCR master mix kit. Primers were designed from the mRNA reference sequences (NM_001009774) of National Centre for Biotechnology Information (NCBI) using the Primer plus and optimized by performing a standard PCR with the cDNA as the template. Appropriate reference gene GADPH was selected as positive control due to stable expression. The comparative Circle Threshold (CT) method for relative quantification were performed for the qPCR. The generated CT values were analysed using the $2^{-\Delta\Delta CT}$ method.

RESULTS AND DISCUSSION

Relative expression of IGF-1 and IGF-2 in the kidney of some Nigerian sheep is shown in Figure 1. Yankasa had the highest expression of IGF-1 in the kidney followed by Uda then Balami. However, Uda breed had highest expression of IGF-2 followed by Yankasa and Balami. This is similar with the findings of (10), who observed that there is significant difference in the expression of IGF-1 and IGF-2 in Chinese sheep.

Table 1 displayed the Circle threshold (Ct) values for kidney tissue in Nigerian sheep breeds. The expression of the gene varied across all the breeds in this study. In both genes, Uda exhibited higher level of expression in the kidney tissue followed by Yankasa and lastly, Balami according to the fold change values.

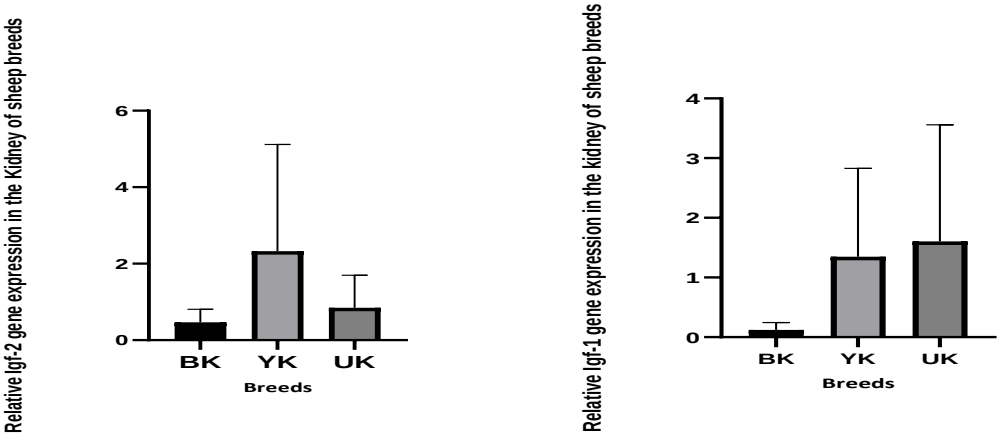

Figure 1: Relative Expression of IGF-1 and IGF-2 in the kidney of some Nigerian sheep. BK; Balami kidney, YK; Yankasa kidney and UK; Uda kidney

This suggests that *IGF-1* and *IGF-2* may be actively involved in the regulation of cellular processes in the kidney of Uda sheep, with moderate importance in the kidney tissue of Yankasa. Though they play a lesser role or less active in the regulation of cellular processes in the kidneys of Balami sheep. The differences in

mRNA expression levels of *IGF-1* and *IGF-2* in the kidney tissues of Uda, Yankasa and Balami sheep, which suggest potential differences in the regulation of these genes among the three breeds. This is in line with the findings of (13) who studied the expressions of IGFs in kidney of the three breeds of piglets at 21 days of age.

Table 1. Relative Quantification of *IGF-1* and *IGF-2* Gene Expression in Kidney Tissue of Sheep

Breed	Δ Ct IGF-1	Δ Ct IGF-2	Avg. Δ Ct IGF-1	ΔΔCt IGF-1	Avg. Δ Ct IGF-2	ΔΔCt IGF-2	2^−ΔΔ Ct IGF-1	2^−ΔΔ Ct IGF-2	Fold change IGF-1	Fold Change IGF-2
Balami	1.08	3.75	1.53	-0.45	3.15	0.60	1.36	0.39	1.14	1.60
	1.92	4.78		0.39		1.63	0.76	0.59		
	1.98	1.79		0.45		-1.37	0.73	0.60		
	0.31	2.31		-1.22		-0.84	2.32	0.20		
	2.61	5.14		1.08		1.99	0.47	0.72		
	1.27	1.16		-0.26		-2.00	1.20	0.44		
Yankasa	-5.05	-3.60	0.27	-5.32	1.05	-4.65	3.89	5.12	1.63	2.19
	-5.54	-9.68		-5.81		-10.73	5.09	7.28		
	4.50	5.41		4.23		4.36	0.05	0.05		
	-0.01	3.06		-0.28		2.01	1.22	0.25		
	6.94	7.81		6.67		6.76	0.01	0.01		
	0.78	3.31		0.51		2.26	0.70	0.21		
Uda	-0.14	-0.38	-1.31	1.17	0.52	-0.90	0.45	1.86	3.05	3.03
	0.44	2.90		1.75		2.38	0.30	0.19		
	-4.93	-1.99		-3.62		-2.50	12.30	5.67		
	-0.37	2.17		0.93		1.65	0.52	0.32		
	-3.48	-2.81		-2.17		-3.32	4.50	10.00		
	0.63	3.20		1.94		2.69	0.26	0.16		

Ct: Circle Threshold, IGF1: Insulin-Like Growth Factor-1, IGF2: Insulin-Like Growth Factor-2, Avg.: average, Δ: chang

CONCLUSION

Tissue expression pattern revealed that the IGF-1 and IGF-2 gene were obviously differentially expressed in various tissues, although it demonstrated similar expression patterns in the kidney tissues of the three sheep breeds. One suitable explanation, is that the biological activities associated with the functions of the gene were required to a different extent in different tissues at the same time.

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Animal Biotechnology: ABT 008

PREDICTING DISEASE-RELATED MUTATIONS OF NON-SYNONYMOUS SINGLE NUCLEOTIDE POLYMORPHISMS IN DQB1 GENE OF PIG

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ABSTRACT

The aim of the study was to identify deleterious non-synonymous single nucleotide polymorphisms (nsSNPs) in DQB1 gene of pigs using an in-silico assay. Amino acid sequence data of the DQB1 protein of pigs were retrieved from the National Centre for Biotechnology Information (NCBI) database. Bioinformatics prediction algorithms used for the detection of deleterious gene was PredictSNP. A total of five nsSNPs were obtained from the aligned sequences of pigs, out of which two variants A105P and S136L were predicted to be deleterious by seven algorithms using PredictSNP. These deleterious genes may distort DQB1 protein structure and function. This could be important biological markers for disease detection and therapy in pigs when these deleterious nsSNPs is validated in wet lab experimental protocols. The results may afford breeders opportunity to select against A105P and S136L mutants to boost pork production.

Keywords: DQB1, non-synonymous, pigs, mutation

INTRODUCTION

Single nucleotide polymorphisms (SNPs) are the most common type of genetic variation in living organisms (1, 2). Identification of single nucleotide polymorphisms has implications for inherited diseases as one of the major challenges in genetics (2). Genetic variation caused by these SNPs, in particular non-synonymous SNPs (nsSNPs), occurring in protein coding regions alter the encoded amino acid at mutated site and may cause structural and functional changes in the mutated protein. However, not all such structural and functional changes due to nsSNPs are potentially damaging or deleterious. Some nsSNPs affect structural properties, while others show functional consequences. In addition, some nsSNPs may be associated with a disease condition but others may not be related with any diseased phenotype, and are therefore, considered to be neutral. Functional consequences of any nsSNP to a large extent, are based on attributes of the polymorphism (3). Some attributes depend only on the sequence information, for example the types of residue found at the SNP location (3). Therefore, it is very important to use appropriate computational approaches and empirical rules based on probabilistic and machine learning to facilitate the discrimination of deleterious nsSNPs from neutral ones.

MATERIALS AND METHODS

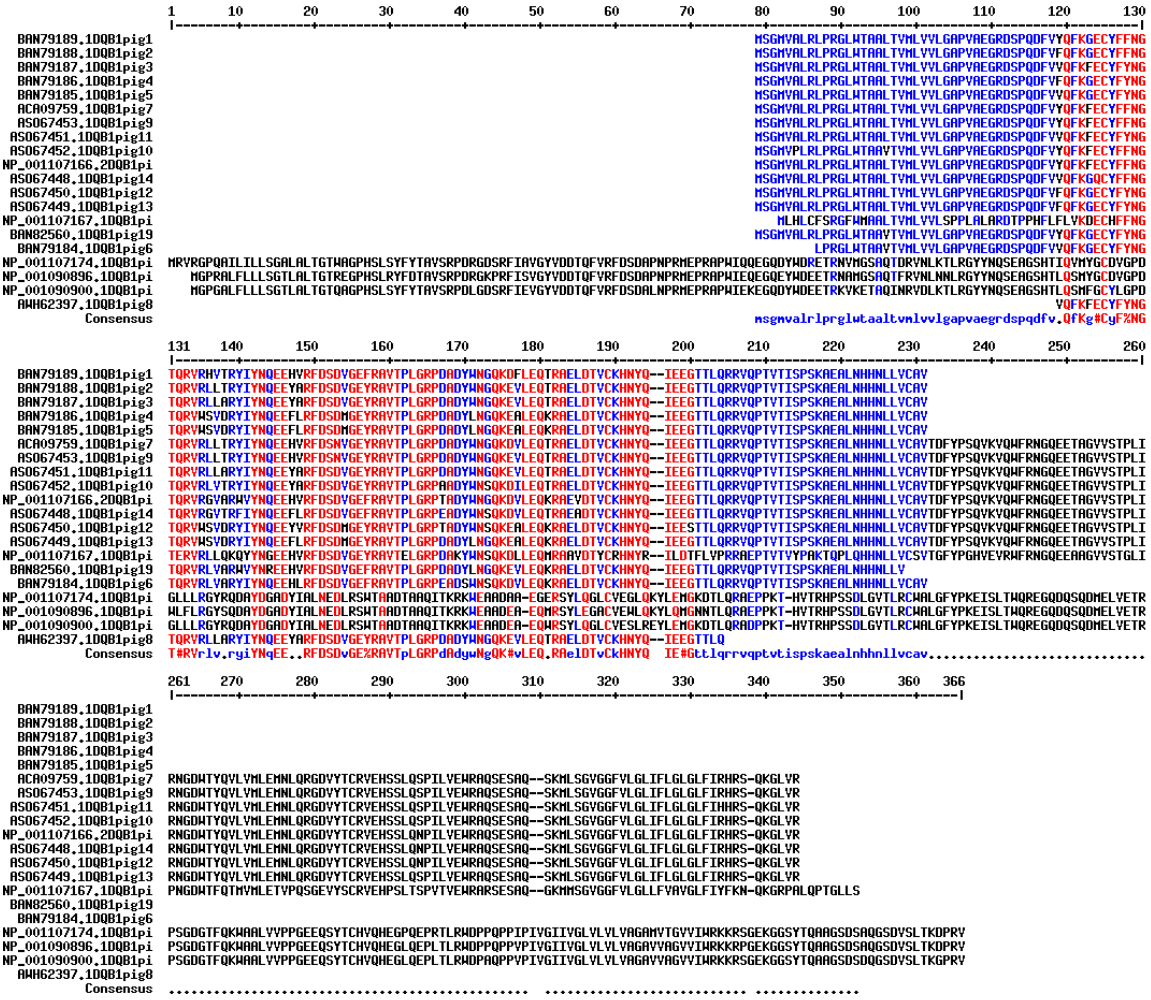
Twenty (20) amino acid sequence data of DQB1 gene of pig were retrieved from the website of the National Centre for Biotechnology Information (NCBI). The sequence was blasted to see their similarity with native gene. The sequence alignment was carried out using Multalin software (http://multalin.toulouse.inra.fr/multalin/) to obtain non-synonymous amino acid substitutions. PredictSNP (4) was used to detect disease-related mutations. The prediction was finalized by calculation of the PredictSNP confidence score.

RESULTS AND DISCUSSION

Effect of amino acid variants on disease-related mutations of DBQ1 gene using PredictSNP

Five correct polymorphic sites (P84A, P88S, A105P, L107V and S136L) were obtained from the alignment of the deduced amino acid sequences of DBQ1 gene in pig (Figure 1). There was a consensus by all seven

of the algorithms in the prediction of variants P84A, P88S and L107V as neutral while A105P and S136L were deleterious (Table 1). These two variants were therefore collectively referred to as 'Cmutant' for further confirmatory analysis.



From the results there is is an indication that these amino acid substitutions negatively affect the function of the DBQ1 gene. The use of polymorphisms within genes is fast gaining attention as a complement to the current methods of selection because of their association with traits of interest in animals (5). Biological insights into the effect differences in prediction capabilities of the algorithms used in the present study may be connected with their differing alignment procedures. The consensus in the prediction of A105P and S136L as being deleterious may be a pointer to their pathological phenotypic consequences.

This may destabilize the protein function and variants can be gained by analyzing the relationship between point mutations and protein structures, which alter the conformational dynamics of the DBQ1 protein. Knowledge of protein characteristics is imperative considering the fact that specific changes in gene sequences need to be mapped onto multiple levels of the phenotypic space, from the physicochemical properties of proteins, biological processes and pathways, up to organismal level. This will permit proper understanding of the evolutionary consequences of genetic variation through established connection between mutations, phenotypes and fitness

The presence of A105P and S136L substitutions in the conserved region of DQB1 protein is suggestive of their likely damaging impact on protein structure and function. It is possible that the difference in charge may probably disturb the ionic interaction, thereby affecting protein structure and function. The capacity of the protein to regulate slight conformational changes may also be affected. The varying interacting residues

of the native protein, substitutions P84A, P88S, A105P, L107V and S136L may suggest their differential reactions with other molecules with regard to the biological functions of protein. The score of 0.557 for S136L variant suggest this variant as possibly damaging. This means that the amino acid change from serine to leucine is unlikely to have a large impact on the protein function. Whereas A105P t has a score of 1.000, which is well above the cutoff of 0.5 for a probably damaging effect. This means that the change from alanine to proline is likely to have a large impact on the protein function. More so, L107V variant has a score of 0.000, which is well below the cutoff for a benign, which means that change from leucine to valine is beneficial. Similar scores were obtained for variants P88S and P84A showing probably damaging impact on protein function.

Table 1: Prediction of disease-related mutations using PredictSNP

Mutation	PredictSNP	Score	MAPP	Score	PhD-SNP	Score	PolyPhen-1	Score	PolyPhen-2	Score	SIFT	Score	SNAP	Score
P84A	N	0.7369	D	0.4835	N	0.5082	N	0.6688	N	0.7077	N	0.6082	N	0.5836
P88S	N	0.7529	N	0.7048	D	0.7734	N	0.6688	N	0.6276	N	0.6821	N	0.6652
A105P	D	0.8691	D	0.7661	D	0.8752	D	0.7449	D	0.6497	D	0.7928	D	0.7204
L107V	N	0.8262	N	0.8511	N	0.8925	N	0.6688	N	0.7077	N	0.8967	N	0.8306
S136L	D	0.7187	N	0.6423	D	0.6762	D	0.5945	D	0.6472	D	0.7928	D	0.5555

MAPP=Multivariate Analysis of Protein Polymorphism, PhD-SNP= Predictor of human Deleterious Single Nucleotide Polymorphisms, D= Deleterious, N= Neutral

CONCLUSION

Variants A105P and S136L showed the tendency to change the form or structure of protein. This can be confirmed in future web lab experiment before selecting against A105P and S136L in order to increase meat quality production.

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Animal Biotechnology: ABT 009

THE EFFECT OF AMINO ACID VARIANTS ON THE ALBUMEN GENE OF QUAIL USING POLYPHENE -2

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ABSTRACT

This research focused on the effect of amino acid variants on the albumen gene of quail using Polyphene-2 computational algorithms. Ovalbumin is the major egg white protein synthesized in the hen's oviduct and plays a role in reproduction and embryonic development. Twenty (20) amino acid sequence data on Ovalbumin gene of quail was retrieved from the website of the National Centre for Biotechnology Information (NCBI). The amino acid sequence alignment of the species was carried out using Multalin software to obtain non-synonymous amino acid substitutions. The functional effects of the non-synonymous single nucleotide polymorphisms (nsSNPs) of ovalbumin protein in Quail were predicted computationally using Polyphen-2. The results showed that fourteen (14) were deleterious and four (4) were benign. The four (4) mutants which were benign when fused with foreign protein can increased the production of quail eggs which has medicinal benefits.

Keywords: amino acid, albumen, polyphene-2, quail

INTRODUCTION

Quail (*Coturnix coturnix*) is a small ground-nesting game bird in the pheasant family *Phasianidae* with length of 16 – 18 cm, wingspan of 32 – 35 cm and weighing between 70 and 140 g (1). Ovalbumin is the main protein (54%) compiler of albumin, other than ovotransferrin (12%), ovomucoid (1%) ovomucin (3.5%) and lysozyme (3.5%) (2). It belongs to the Ovalbumin gene family with three homologous genes located on chromosome 2. Eggshell, egg yolk, and vitelline membrane contain Ovalbumin (3) and is mainly expressed in the oviduct (4). Quail egg albumen is becoming increasingly important due to its excellent nutritive and functional properties (5, 6). The biological roles of Ovalbumin protein have not been fully understood especially in quails. The aim of the study is to identify and screen deleterious amino acid that will have effect on ovalbumin gene of quail.

MATERIAL AND METHODS

Study was carried out using amino acid sequence data on ovalbumin gene of quail retrieved from the website of the National Centre for Biotechnology Information (NCBI). The amino acid sequence alignment of the species was carried out using Multalin software (http://multalin.toulouse.inra.fr/multalin/) to obtain non-synonymous amino acid substitutions. The functional effects of the non-synonymous SNPs (nsSNPs) of Ovalbumin protein in quail was predicted computationally using Polyphen-2 models as described in an earlier study by Yakubu *et al*. (7).

RESULTS AND DISCUSSION

Effect of amino acid variants on the albumen gene of quail using Polyphene -2

The aligned ovalbumin sequences are presented in Figure 1. Eighteen correct polymorphic sites (E151F, L233P, S241R, Q255K, K264E, L265I, E267V, S272Q, V279M, L283D, E289H, T304M, D305S, S308R, A333S, E355S, H368Y and V381L) were obtained from the alignment of the deduced amino acid sequences of Ovalbumin gene of quails (Table 1). Fourteen out of these variants in the prediction of variants E151F, L233P, S241R, K264E, L265I, E267V, V279M, L283D, E289H, T304M, D305S, S308R, E355S and

H368Y are seen as being deleterious (Table 1). These eighteen variants were therefore collectively referred to as 'Combined mutant' (Cmutants) for further confirmatory analyses (7, 8). These protein substitutions had effect on its protein work. The deleterious amino acid substitutions may cause amino acid changes in addition to altering protein function which could lead to susceptibility to disease (9). The amino acids may modify activities of enzymes, destabilize the structures of protein and or disrupt its interactions (10). The presence of variant substitutions in the conserved region of ovalbumin protein is suggestive of their likely damaging impact on protein structure and functions. This will permit proper understanding of the evolutionary consequences of genetic variation through established connection between mutations, phenotypes and fitness (11). The usefulness of nsSNPs seen in this study, proposed that genetic improvement of quails at ovalbumin locus can be achieved in the future. The use of polymorphisms within genes is fast gaining attention as a complement to the current methods of selection because of their association with traits of interest in animals (7). Polyphen-2 score aid researchers in assessing the potential functional impacts of variants guiding decisions related to disease susceptibility and treatment. Polyphen-2 score represent the probability that a substitution is damaging and is used to predict the potential impact of an amino acid substitution on the structure and function of the protein (12).

Table 1: The effect of amino acid variants on the Albumin Gene of Quail using Polyphene -2

Variant	Prediction	Score
E151F	D	0.993
L233P	D	1.000
S241R	D	0.999
Q255K	B	0.007
K264E	D	0.822
L265I	D	0.671
E267V	D	0.743
S272Q	B	0.020
V279M	D	0.916
L283D	D	1.000
E289H	D	0.980
T304M	D	0.944
D305S	D	0.993
S308R	D	0.909
A333S	B	0.098
E355S	D	0.556
H368Y	D	0.823
V381L	B	0.990

A - alanine; V - valine; H - histidine; L - lysine; M - methionine; E - glutamic acid; F - phenylalanine; R - arginine; T - threonine; I -isoleucine; K - lysine; Q - glutamine; S - serine; D - aspartic acid; N - asparagine; P - proline; D - deleterious; B - benign.

* Score range 0.0 is tolerated, 1.0 is deleterious, 0.0 to 0.15 is benign, 0.15 to 1.0 are possibly damaging, 0.85 to are more confidently damaging.

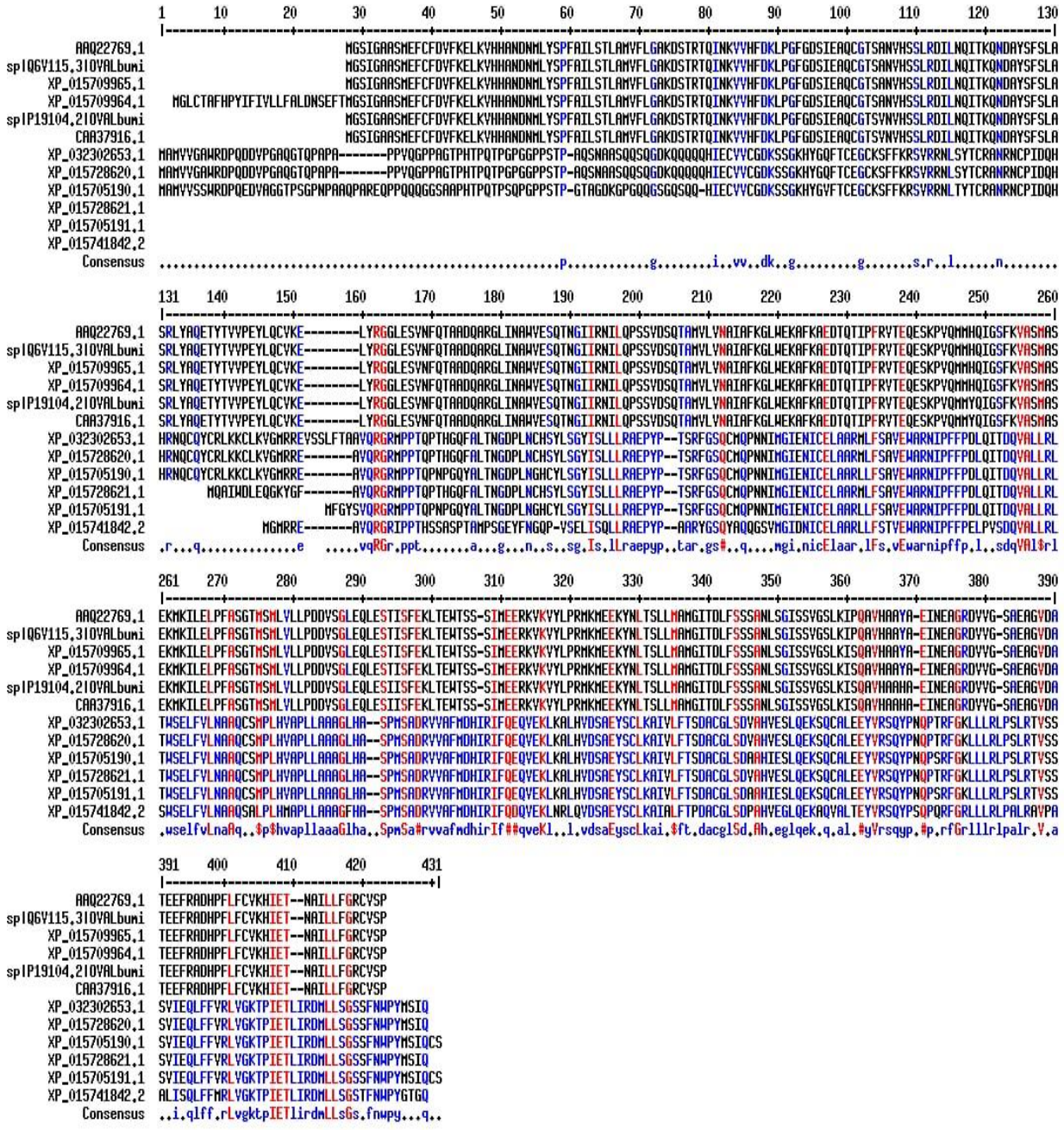

Figure 1: The Aligned Ovalbumin Quail gene Sequence

CONCLUSION AND IMPLICATIONS

The use of polymorphisms within genes is fast gaining attention as a complement to the current methods of selection because of their association with traits of interest in animals. Biological insights into the effect differences in prediction capabilities of the algorithms should be considered as they are different alignment procedures. The consensus in the prediction of some variants being deleterious may be a pointer to their pathological phenotypic consequences.

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Animal Biotechnology: ABT 010

MICROBIAL SEQUENCING OF BROILER CHICKENS FED L-THREONINE SUPPLEMENTED DIETS

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ABSTRACT

The NRC threonine requirements for broiler chicken have not been reviewed in recent years despite the notable improvements in the characteristics of modern broiler chicken production, including feed composition, management strategies, and genetic selection. These modifications have produced faster and better performance than in previous years. Therefore, the effects of dietary threonine above the NRC, 1994 requirement on gut microbiota of broiler chicken were investigated in this study. Two hundred 1-day old Ross 308 unsexed broiler chicks were randomly allotted to 4 treatments, consisting of 5 replicates with 10 birds each. Dietary treatments consisted of a basal diet that met the nutrient requirements of broiler chickens with graded levels of threonine (0%, NRC, 15%>NRC and 30%>NRC). At d-14, the jejunal microbiota population and frequency of two best performing treatments were analysed using the 16S rRNA microbial sequencing. The jejuna of six broiler chicks were sampled (three from each treatment). Across the treatments, Firmicutes, Bacilli, Lactobacillales, Lactobacillaceae were the dominant ($P<0.05$) phylum, class, order and family, respectively. Families Enterococcaceae and Streptococcaceae, and genera *Enterococcus* and *Streptococcus* were observed at 0% threonine supplementation. Pathogenic *E hirae and E cecorum* were also identified in the same treatment, whereas, these genera and species were suppressed when threonine inclusion was 15%>NRC. The study therefore found that threonine supplementation at 15%>NRC suppressed the emergency of pathogenic species of the *Enterococcus* and *Streptococcus* genera.

Keywords: L-threonine, Gut microbiota, Microbial sequencing, NRC requirements

DESCRIPTION OF PROBLEM

As an essential amino acid, threonine was reported vital in mucins synthesis (1), and the amount present in feed affects the differentiation of goblet cells and mucin production (2). It has been argued that future improvements for chickens could be achieved through manipulating their microbiome as they perform varying functions, such as, nutrient synthesis, pathogen defence, and maturation of the host immunity (3). Zhang *et al.* (4) noted that threonine is catabolised by commensal bacteria in the gut to produce acetic acid, butyric acid and propionic acid, which are essential to maintain the intestine and control immune responses. When a cocktail of amino acid that contains L-Thr was fed to rats challenged with dextran sodium sulphate, the animals displayed greater frequencies of beneficial communities of *Lactobacillus*, *Enterobacteria*, *Enterococci*, and *Bacteroides* (5). However, the influence of supplemental threonine, especially at a level higher than the NRC recommendation, on the composition and frequency of jejunal microbiota of broiler chickens has not been fully elucidated.

MATERIALS AND METHODS

Experimental site

This study was conducted in Oyo State, in the South West region of Nigeria, at the University of Ibadan's Poultry Experimental Unit of the Teaching and Research Farm.

Animals, design, diet and husbandry

Two hundred Ross 308 d-old chicks were used for this study. At arrival, the chicks were weighed, tagged and randomly assigned to 20 pens with 10 chicks in each pen in a completely randomised design (CRD). The experimental factor was L-Threonine inclusion levels and each diet represents a treatment with five replicates each. Treatment 1: basal diet + 0% threonine; treatment 2: basal diet + NRC threonine recommendation; treatment 3: basal diet + 15% > NRC threonine recommendation; treatment 4: basal diet + 30% > NRC threonine recommendation. Feed and water were supplied *ad-libitum*.

DNA extraction and 16S rRNA sequencing

At day 14, three birds were taken from each treatment and humanely slaughtered and eviscerated. Intestinal segments of the birds were removed and samples were collected from the jejunum. About 10g of the jejunal segment was cut and stored in a DNA/RNA shield to ensure its integrity before the DNA extraction. The DNA was extracted using the ZymoBIOMICS™ DNA Mini prep Kits according to the manufacturer's instructions. The quality and concentration of the DNA was measured using the NanoDrop spectrophotometer. Using a universal primer pair, 27F and 1492R, the amplification of the DNA samples was done by PCR with a focus on bacterial 16S rRNA gene (V1-V9). Pacbio M13 barcodes were applied to the resulting amplicons in order to multiplex them using limited cycle PCR. Following equimolar quantification and pooling of the resultant barcoded amplicons, an AMPure PB bead-based purification phase was carried out. The same methodology was followed in creating the PacBio SMRTbell library from the pooled amplicons. Primers were sequenced, annealed, and polymerase bound in accordance with the online SMRTlink Link software procedure, readying the library for sequencing on the PacBio Sequel IIe machine.

RESULTS AND DISCUSSION

Figure 1 shows the effect of dietary L-threonine on percentage composition and frequency of jejunal microbiota genera in broiler chickens. *Lactobacillus*, *Enterococcus* and *Streptococcus* are the three genera identified but the dominant genus was *Lactobacillus*. This result is in line with research by Stamilla *et al.* (6) who found that the jejunum had three broad microbiota types and that the *Lactobacillus* genus accounted for over 70% of these microbiota types. The percentage frequency of Lactobacillus in broiler chickens fed 0% L-threonine (EO-NE1, EO-NE2 and EO-NE3) sequenced are 96.694%, 83.051% and 98.172%, respectively. Enterococcus percentage in EO-NE1 was 2.541% while EO-NE2 and EO-NE3 were both 0.000%. Streptococcus was 1.828% in EO-NE3 while EO-NE1 and EO-NE2 were both 0.000%. However, broiler chickens fed threonine 15%> NRC recommendation (EO-NE7, EO-NE8 and EO-NR9) had Lactobacillus abundance of 100.000%, 100.000% 98.132%, respectively, and there was no record of Enterococcus and Streptococcus in the three samples assayed.

Figure 2 shows the effect of dietary L-threonine on percentage composition and frequency of jejunal microbiota species in broiler chickens. A total of 12 species were recorded in the different treatment groups. The Lactobacillus spp and their mean values in broiler chickens fed 0% threonine were *L. reuteri* (21.34%), *L. crispatus* (9.35%), *L. salivarius* (18.29%), *L. aviaries* (12.69%), *L. helveticus* (8.82%), *L. johnsonii* (9.48%), *L. oris* (0.29%); one was not identified (*Lactobacillus spp*) and another was unculture. Two identified species of *Enterococcus* were *E. hirae* and *E. cecorum* and one unidentified species of *Streptococcus spp.* The percentages of Enterococcus spp were 0.50% and 0.35% for *E. hirae* and *E. cecorum*, respectively and an unidentified species of Streptococcus was 0.61%. The mean value of Lactobacillus spp in broiler chickens fed threonine 15%> NRC recommendation were *L. reuteri* (18.70%), *L. crispatus* (25.53%), *L. salivarius* (12.09%), *L. aviaries* (0%), *L. helveticus* (3.42%), *L. johnsonii* (2.22%), L. oris (4.27%). Enterococcus and Streptococcus spp were both 0%. According to Dolka *et al.* (7), broiler chicken morbidity and mortality are now mostly caused by pathogenic strains of *Enterococcus cecorum*. Moreover, animal enterococcal strains have the potential to transmit resistance genes and pathogenicity to human and animal microecosystems, in addition to being a cause of illnesses in both species (8). According to Abed *et al.* (9), the broiler sector faces significant challenges from infectious diseases including Enterococcus and Streptococcus, which can cause high mortality rates, growth retardation.

Several strains from the genus of *Lactobacillus* have been identified as probiotics that promote chickens' growth and weight gain as well as aid in nutritional absorption processes like the synthesis of vital vitamins and the metabolism and recirculation of intestinal bile acids. However, the health of animals is affected by the presence of harmful microorganisms in the microbiome.

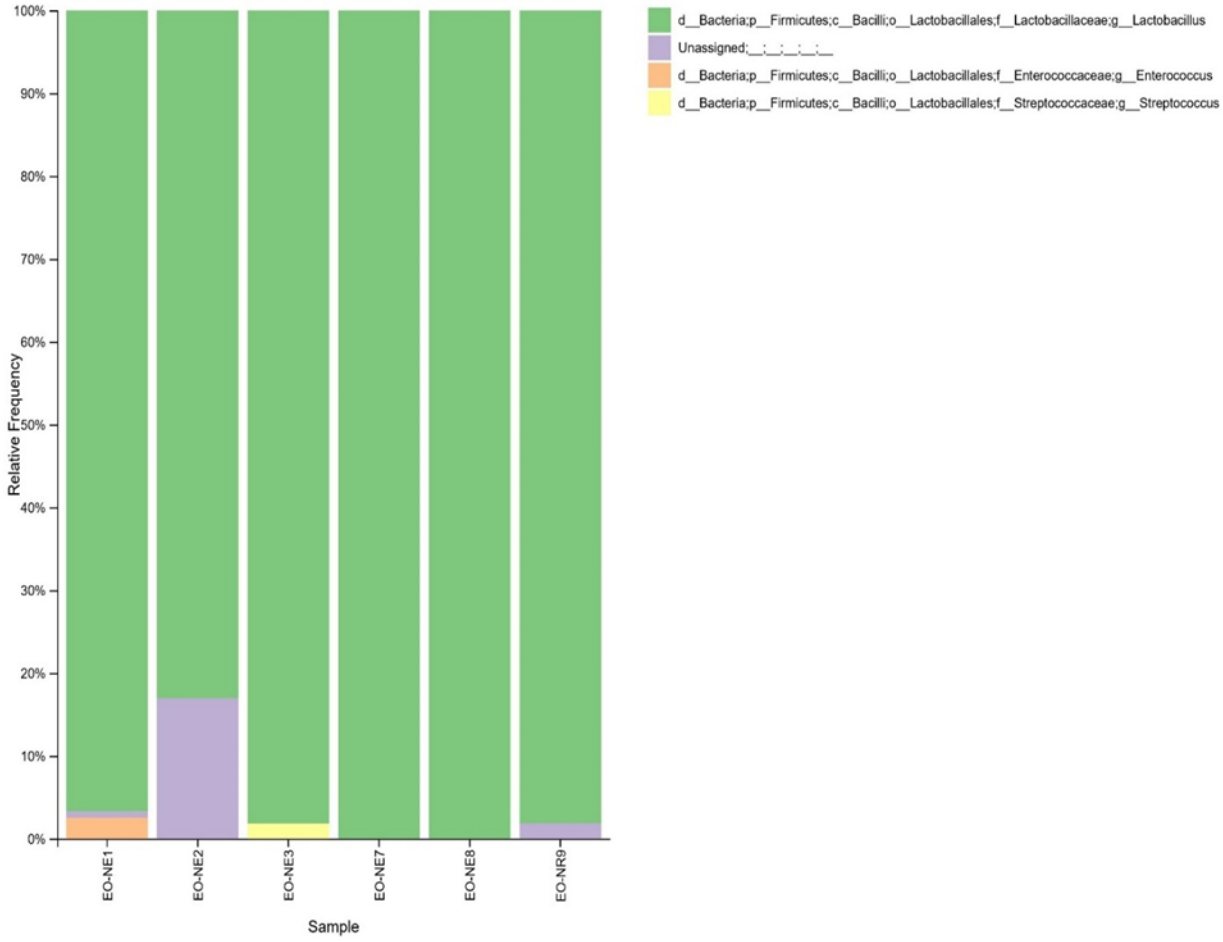

Figure 1: Influence of dietary L-threonine on the frequency and population of gut microbiota genera in broiler chickens

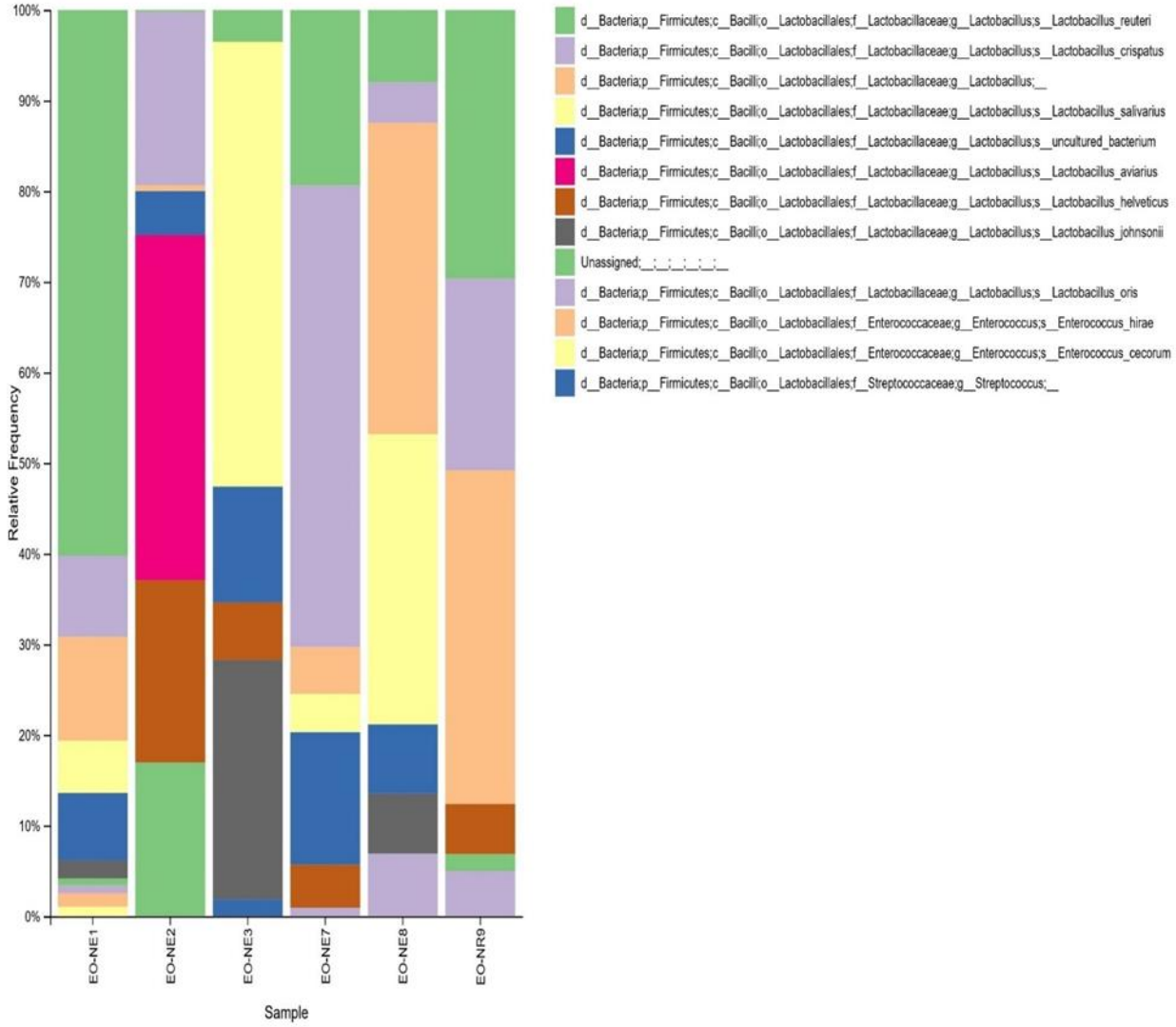

Figure 2: Influence of dietary L-threonine on the frequency and population of gut microbiota species in broiler chickens

CONCLUSION AND APPLICATION

The results of this study revealed that the inclusion of dietary L-threonine at 15%>NRC recommendation suppressed the emergence of pathogenic bacteria species of the Enterococcus and Streptococcus genera, and maximally supported the growth of Lactobacillus species in the jejunum of broiler chickens.

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Animal Breeding and Genetics: ABG 001

SEXUAL DIFFERENTIATION AND PHENOTYPIC CORRELATION IN GROWTH TRAITS OF NOILER CHICKENS

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ABSTRACT

The objective of this study was to determine phenotypic correlations and the effect of sex on body weight and linear body measurements of Noiler chicken. Data on linear body measurements and live bodyweight collected from sixty (60) Noiler chickens (30 males and 30 females) at 10th week of age were used to determine the effect of sex and phenotypic correlation among the growth traits. The effect of sex on the variables was not significantly ($p > 0.05$) different. The body weight, shank length, body length, wing length, neck length, beak length, breast girth and wing spine for female were 803.40 g, 6.30, 30.70, 19.40, 11.20, 1.98, 21.90 and 44.30 mm respectively, while the corresponding values for male were 963.60 g, 6.80, 31.60, 20.20, 11.60, 2.06, 23.10 and 47.0 mm respectively. In both sexes, the correlations between body weight and; body length, neck length, and wing span were significant, positive and high. In female the correlations ranged between 0.143 and 0.993, while in male it ranged between 0.001 and 0.903. However positive and significant correlations observed among the variables, in both sexes, indicated that improvement in one trait will lead to improvement in another.

Keywords: Noiler chicken, sex, bodyweight, shank length, beak length

DESCRIPTION OF PROBLEM

Morphometric traits also called linear body measurements or conformation traits are important parameters in predicting body weight; and this has been observed by commercial breeders and producers. Apart from body weight, a number of conformation traits are known to be indicators of growth and market valve of poultry [5]. [1] reported that most of the linear body measurements reflect primarily the long bones of the animals. Such conformation traits include shank length, breast width, kneel length, wing span, chicken height, body length, and head circumference [8].

Bodyweight and body conformations are important parameters for measuring growth in the domestic chickens. Linear body measurements have been used to predict live weights in poultry [9]. Body weight has a direct relation to the production and profitability of any livestock enterprise. It has been reported by [3] that body weight is the best parameter for making management, health and production and marketing decisions. Morphometric characteristics (linear body measurements) have been a recurring interest to livestock production either to supplement body weight as a measure of productivity or as predictors of some less visible characteristics [4]. Therefore, the objective of this study is to determine phenotypic correlation and effect of sex on linear body measurements of Noiler chicken.

MATERIALS AND METHODS

Animals and Experimental Design

The experiment was carried out at Adeomoh Farm, which is a kilometer away from Teaching and Research Farm, Olusegun Agagu University of Science and Technology, Okitipupa. Ondo State. A total of 60 day-old Noiler chicks (30 males and 30 females) were used for the study. The chicks were purchased from a reputable hatchery (Zartech) in Ibadan, Nigeria and raised on a deep litter system. They were fed with commercial feed (Top Feed) and all required vaccinations and medications were administered accordingly.

At 10th week, they were weighed individually and morphological measurements were taken as suggested by (4). The weights of the birds were obtained using a 20 kg weighing scale, while a measuring tape was used for body measurements in millimeter. Wing Length (WL) was taken from the shoulder joint to the extremity of terminal phalanx, while Shank Length (SL) was measured from the knee joint to the spur. Breast girth (BG) was taken under the wing at the edge of the sternum. Neck length (NL) was measured from the base of the head to the first rib while the Beak length (BL) was taking from the nostril to the beak tip.

Statistical Analysis
The data collected were subjected to t- test and Pearson correlation to determine the sex effect on the growth traits and correlations among the traits.

RESULTS AND DISCUSSION

Table 1 shows the effect of sex on bodyweight and linear body measurement. The body weight, shank length, body length, wing length, neck length, beak length and breast girth for females were 803.40 g, 6.30, 30.70, 19.40, 11.20, 1.98, 21.90 and 44.30 mm respectively, while the corresponding values for males were 963.60 g, 6.80, 31.60, 20.20, 11.60, 2.06, 23.10 and 47.00 mm respectively. The effect of sex on the variables was not significantly ($p>0.05$) different. This is contrary to the reports of [7] who reported significant differences between males and females of the three strains in body weight and linear body traits in all the weeks studied, except for wing length at 8 weeks.

Table 1: Effect of Sex on Body Weight and Linear Body Measurement

VARIABLES	MALE	FEMALE	SEM	p >0.05
Body Weight (g)	963.60	803.40	52.46	0.133
Shank Length (mm)	6.80	6.30	0.17	0.161
Body Length (mm)	31.60	30.70	0.69	0.547
Wing Length (mm) (mm)	20.20	19.40	0.40	0.350
Neck Length (mm)	11.60	11.20	0.31	0.545
Beak Length (mm)	2.06	1.98	0.04	0.291
Breast Girth (mm)	23.10	21.90	0.54	0.289
Wing Spine (mm)	47.00	44.30	0.82	0.102

The phenotypic correlations among the variables are shown in Table 2. The upper diagonal is for the female while the lower diagonal is for the male. The positive correlation between the body weight and other variables observed in the two sexes indicate pleiotropy which means that body weight can be predicted by any of the variables. The positive and high correlations observed among the growth traits in the male and female are in line with the reports of Djebbi et al., [2014] and Ogah [2011]. The positive correlation between the body weight and other variables indicate plieotropy which means that body weight can be predicted by any of the variables. The positive and high correlations observed among the growth traits are in line with the reports of [2].

Table 2: Phenotypic Correlation Among the Body Weight and Linear Body Measurements in Noiler Chickens

	Body wgt	Shank length	Body length	Wing length	Neck length	Beak length	Breast girth	Wing spine
Body wgt		0.727^{ns}	0.939*	0.606^{ns}	0.993**	0.546^{ns}	0.864^{ns}	0.992**
Shank length	0.893*		0.738^{ns}	0.851^{ns}	0.729^{ns}	0.153^{ns}	0.839^{ns}	0.713^{ns}
Body length	0.749^{ns}	0.808^{ns}		0.509^{ns}	0.949*	0.282^{ns}	0.969**	0.892*
Wing length	0.995**	0.898*	0.746^{ns}		0.637^{ns}	0.505^{ns}	0.596^{ns}	0.619^{ns}
Neck length	0.209^{ns}	0.480^{ns}	0.480^{ns}	0.285^{ns}		0.560^{ns}	0.884^{ns}	0.978^{ns}
Beak length	0.715^{ns}	0.423^{ns}	0.231^{ns}	0.746^{ns}	0.080^{ns}		0.143^{ns}	0.603^{ns}
Breast girth	0.640^{ns}	0.605^{ns}	0.838^{ns}	0.682^{ns}	0.654^{ns}	0.489^{ns}		0.807^{ns}
Wing spine	0.903*	0.769^{ns}	0.407^{ns}	0.895^{ns}	0.001^{ns}	0.769^{ns}	0.301^{ns}	

CONCLUSION AND APPLICATION

It could be concluded that, there was no significant effect of sex on virtually all the linear body measurements considered and the correlation between body weight and linear body measurements are positive and ranged between moderate and high in both sexes. The use of linear body measurements is hereby recommended for the prediction of live body weight of Noiler chicken at 10th week of age.

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Animal Breeding and Genetics: ABG 002

CHARACTERIZATION OF GENETIC IMPROVEMENT AND BREEDING PRACTICES OF SMALLHOLDER SHEEP FARMERS IN BAUCHI STATE, NIGERIA

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ABSTRACT

A study was conducted among 600 purposively selected smallholder sheep farmers to assess their trait' preferences in selecting breeding stocks, selection practices, and knowledge of inbreeding depression and correlated response between traits and general breeding practices. Most (75%) of the respondents practiced selection, of which 81.8% did so based on individual performance and mostly (60.0%) when the animals matured. The majority (69.2% and 81%) had elite rams in the flocks but did not know about inbreeding depression and correlated responses between traits, respectively. Almost all (97.9 %) of them culled inferior breeding stock by selling them off in livestock markets. The traits preferences for selecting breeding males were mainly (56.7%) a combination of body size, horn orientation, coat color, and tail length, while, for breeding females were mainly (61.2%) a combination of mothering ability, body-size and udder parameters in descending order of importance in both cases. Farmers practiced selection and had preferences for specific traits but did not know about inbreeding depression and correlated responses between some traits. The breeding practices of the farmers are lacking in basic genetic principles that would confer genetic gains within the flocks. A breeding scheme that would take into cognizance the preferences of the farmers should be designed and implemented in the study area.

Keywords: Correlated response, elite rams, inbreeding depression, traits, replacement stocks

INTRODUCTION

Livestock farmers in the tropics keep animals for multiple purposes and have different breeding objectives [9] and consequently a wide array of livestock production systems with different production goals, priorities, management strategies and practices are found [13]. Any breeding programmes is totally dependent on environmental condition, the production system, the culture of the people for whom the animals are sold [14].

In developing countries many important functions of livestock are embedded in traits that are not traded in the market but valuable to the keepers [18].
Smallholder farmers have very valuable knowledge about animal management and desirable traits but less knowledge on how genes are transmitted to the next generation, lack of such knowledge leads to setting up of unrealistic breeding goals and the consequences of which can put in danger the conservation of indigenous animal genetic resources [23].

In Nigeria, limited information exists on the criteria used by rural dwellers in the selection of their breeding flocks [22] and other breeding management practices [17].

MATERIALS AND METHODS

Description of Study area

The study was conducted in some selected Local Government Areas (LGAs) of Bauchi State. The LGAs covered the three Agricultural Zones of the State as demarcated by Bauchi State Agricultural Development Programme (BSADP, 2010, in [15]).

Sampling Technique

Out of the twenty (20) Local Government Areas of the State, twelve (12) were randomly selected (Four LGAs from each Agricultural Zone). Five (5) villages/communities were then purposively selected in each of the selected LGA based on accessibility and livestock population. Ten farmers/households were purposively chosen in each of the selected village/ community based on their years of experiences with the aid of extension workers and village heads, giving a total sample of 600. A sheep farmer is a person who owns the animal, involved in their maintenance and decision making concerning management, selection and disposal as defined by [7].

Data Analysis

Data obtained were sorted and analysed using SPSS Statistical Package Version 20.0 (IBM Corp, 2011). Descriptive statistics using frequency counts were performed. Cross tabulation and Chi square ($\chi^{2)}$ statistics were used to compare categorical variables between Agro- ecological zones.

RESULTS AND DISCUSSION

The results (Table 1) show that 71.5 % of the farmers practiced selection of animals that will be parents of subsequent generations. Majority (62.8%) make selections when the animals have matured, while 20.5% make selection at both young and adult stage and the remaining percentage of the make selection at early stage when the animals are young. Similarly, majority of them (81.0%) make the selection based on the individual performance records of the animals, while the remaining 19% of them combined used pedigree (9.5%) and progeny (9.5%) records. Culling method was mostly (97.9%) by selling and only the remaining percentage use slaughtering as a method of culling inferior breeding stocks.

Table 1: Selection and Culling Practices of the Farmers

Variables	N
Selection Practice	
Yes	430 (71.5)
No	170(28.5)
Stages of Selection	
Young	72 (16.7)
Matured	270 (62.8)
Multi stage	88 (20.5)
Selection method	
Individual	
Pedigree	348(81.0)
Progeny	41(9.5)
	41(9.5)
Culling method	12 (2.1))
Slaughtering	588(97.9)
Selling	

The coat color preferences revealed that 72.8% had preferences for white rams, followed by 17.3, 8.2, and 1.7 % for white and black, white and brown and red brown-coloured rams, respectively, while, none had preference for black-coloured.

The preferences for coat colour pattern as shown in Table 2 revealed high preference (46.8%) for plain coloured rams, followed by 30 and 22.7% of the farmers that had preferences for patchy and spotty ones, respectively.

Preferences for horn shape were 82.8% for spiral, 12.2% for curved and 5% for straight shaped horns. Nose profile preferences showed higher (64.0%) for convex profiled nose than flat (24.8%) and concave ones (11.2%). The preferences for adaptation traits were 50.5% for disease tolerance and 49.5% for drought tolerance. For testicular size, 51.2% of the farmers preferred compact testicles than split ones (48.8%), whereas for tail length, 88.3% had preference for long tailed rams than those with short tails.

Table 2: Traits of preferences in selecting breeding males

Variable	N
Coat Colour	
White	437(72.8)
Red brown	10(1.7)
White and brown	49(8.2)
White and black	104 (17.3)
Coat Colour Pattern	
Plainly	281 (46.8)
Patchy	183(30.5)
Spotty	136(22.7)
Horn Shape	
Spiral	497(82.8)
Curved	73(12.2)
Straight	30(5.0)
Nose Profile	
Convex	384 (64.0)
Flat	149(24.8)
Concave	67(11.2)
Testicular size	
Compact	307(51.2)
Split	293(48.8)
Tail Length	
Tall	530(88.3)
Short	70(11.7)

Figures in parenthesis are in percentage
N: Number of observations

Details of farmers' trait preferences in selecting breeding ewes are presented in Table 3. It shows that preference for mothering ability was mostly (54.3%) for multiple births, 32.3 % for short lambing interval and 13.3 % for offspring quality. Preferences for udder traits showed that majority (75.2%) of the farmers preferred large udders over thin ones (24.8%). In terms of teat length almost all the farmers (91.8%) preferred longer teats than short ones. Majority of the farmers preferred tall ewes (92.7%) with white-coloured coats (84.3%), while, none of them had preference for black coat-coloured ones.

DISCUSSION

The practice of selecting animals within flocks to serve as parents was commonly practiced in the study area. This might not be unconnected with the fact that farmers know the worth of each trait in their locality. [12] similarly, asserted that due to the selective approach of farmers, appreciable diversity exists for morphological, fertility and other traits in sheep. This assertion agrees with similar reports by [10] and [1]. However, [21] and [12] opined that when individual flocks are small, selection would be ineffective. This might in part explain the less progress in genetic gain under smallholder breeding circumstances.
The high preferences for body size, coat color, horn orientation, testicular size and tail length in selecting breeding males in all the locations is in agreement with the findings of [19], [20] and [16]. There were higher

preferences for compacted testicles by farmers in the locations which the respondents said was borne out of the fact that rams with compacted testicles gain weight faster relative to the split testicled rams. [9] reported body size as an evident selection tool for breeding rams in Ethiopia as they command premium price in the market. [4] reported preferential selection of white rams for Eid-el-Kabir rites in Niger republic. Such plain coloured rams are referred to as "*alhaji",* white rams with dark spots around their eyes, mouth and feet (locally referred to as *mai tozali)* was most preferred for Eid-el-Kabir rites in the study area. [9] observed higher preferences for horned rams to polled ones and further emphasized that the size and orientation of the horns matter in traditional selection of rams for breeding as big and twisted horned rams were highly valued.

Table 3: Traits of preferences in selecting breeding females

Variable	N
Coat colour	
White	509(84.3)
White and brown	37 (6.7)
White and black	54(9.0)
Coat color pattern	
Plainly	362(60.3)
Patchy	140(23.3)
Spotty	98 (16.4)
Mothering ability	
Short lambing interval	194(32.3)
Fecundity	326(54.3)
Offspring quality	80(13.3)
Teat length	
Long	551(91.8)
Short	49(8.2)
Udder circumference	
Thin	149(24.8)
Large	451(75.2)

Figures in parenthesis are in percentage
N : Number of observations

The higher preference for mothering ability (especially twining), body size and udder parameters in selecting breeding ewes in all locations in this study agrees with the findings of [9], [7] and [5] who in separate studies reported higher preferences for mothering ability and body size by farmers in selecting ewes. The authors further observed that the most preferred mothering ability attributes were prolificacy and fertility while, most of the farmers in this study did not have strong preference for short lambing interval, which agrees with earlier report by [9], however, [16] reported lambing interval as a selection criterion in sheep, these differences might be as result of differences in breeding objectives in the study locations. [11] explained that lambing was usually synchronized with season of feed availability and therefore it was quite logical that short lambing interval was less favoured in selecting ewes for breeding.

CONCLUSION

The farmers had knowledge of economic traits and hence had preferences. Traits' preferences in selecting breeding males were mostly conformational while in selecting breeding females was reproductive.

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Animal Breeding and Genetics: ABG 003

BODY WEIGHT AND HORN DEVELOPMENT IN BREEDS OF GOAT

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ABSTRACT

The study investigated how age, sex, and breed influence body weight and horn growth in three breeds of goats (*Capra hircus*): Kano Brown Goat (KB), West African Dwarf (WAD), and Sokoto Red Goat (SR). Conducted at Bayero University Kano's Animal Science Research farm and Janguza market Tofa LGA, the research involved 75 goats divided into three age groups (6 months, 12 months, and 18 months). Morphometric traits such as body weight (WT), left horn length (LHL), left horn width (LHW), right horn length (RHL), and right horn width (RHW) were measured using flexible tape for dimensions in centimeters and a standing scale for weight in kilograms. Data analysis used SPSS software with Duncan method for assessing differences across variables. Results indicated male SR goats tended to weigh more and have larger horns compared to females, followed by WAD and KB. Significant differences ($p < 0.05$) were observed in WT, LHW, and RHW, while LHL and RHL showed no significant difference ($p > 0.05$). Weight varied from 9.350 to 7.450, with SR having the highest (9.350a ± 0.919), then KB (8.950a ± 0.250), and WAD the lowest (7.750b ± 0.450). Horn measurements showed similar trends. The study showed sexual dimorphism in weight and horn development among goats, emphasizing the importance of age-specific management practices for optimal productivity and welfare. The interaction between sex, breed, and age is critical for effective goat husbandry and breed improvement strategies, necessitating adjustments in nutrition and housing facilities to meet goats' evolving needs as they mature.

Key words: Body weight, horn development, morphometric traits, breed, age.

DESCRIPTION OF PROBLEM

Goats (*Capra hircus*) have been essential to human civilization for millennia, and their significance extends far beyond their initial roles as providers of meat, milk, and fibers (1). Different breeds have been selectively bred to specialize in specific areas, enhancing their economic significance in various regions. Horns in goats serve as a natural defense mechanism (2). Horns contribute to the thermoregulation of goats by facilitating heat dissipation. This is particularly important in hot climates, where goats with horns may have a thermal advantage (3).

Body weight in goats is a key determinant of their economic value. Heavier goats often fetch higher prices in meat markets due to increased meat yield (4). The economic importance extends to dairy production, where heavier does tend to have higher milk production potential (5).

Identifying and addressing these gaps in existing knowledge is imperative for advancing the understanding of body weight and horn development in goats, promoting sustainable farming practices, and contributing to the overall well-being of these valuable livestock. Therefore, this study seeks to examine the body weight and horn development in breed of goat.

The objective of this study is to investigate the relationship between body weight and horn development in goats, with a focus on specific goat breeds within *Capra hircus*.

MATERIALS AND METHODS

Study Area

The study was conducted at the Teaching and Research farm of the Department of Animal science Bayero University Kano, Nigeria. Situated at latitude $11^0$59'1.59' and longitude $8^0$25'24.97". The region experiences tropical climate characterized by distinct wet and dry season, with rainfall typically occurring from May to September and dry conditions prevailing from October to April. Annual rainfall ranges between 787mm to 960mm, with temperatures fluctuating between 21^0C to 39^0C and Janguza Market Tofa LGA Kano with latitude $15^0$16'2.51' and longitude $10^0$15'14.63" known for its conducive environment for goat farming and research activities.

Sampling Techniques

To select the sample of *Capra hircus* goats for the study, a stratified random sampling technique was employed. Goats of similar age, breed, and initial body weight was stratified into homogeneous groups to minimize variability within treatment groups and enhance the comparability of results.

Data Collection

Data collection was done according to different age and sex of the different goat breads. This was done with the help of the field assistant. Weight of the animals was collected from animals from age 6 months, 12 months, 18months, the length and width of the animal's horn was also measured in each of this age's ranges, those with broken horns will be left out.

Statistical Analysis

Data analysis used descriptive and inferential methods. Descriptive stats (mean and percentages) summarized body weight and horn development. Inferential stats (analysis of variance) assessed differences and statistical significance among breeds.

RESULTS AND DISCUSSION

Effect of sex on weight and horn development in breeds of goat (*Capra hircus*)

Table 1 shows morphometric data for male and female *Capra hircus* goats. Female goats weigh 8.950±0.250 kg, slightly less than males at 9.350±0.650 kg. Female horns are smaller in length and width. Weight variability is similar between sexes, suggesting consistency within groups. Horn measurements exhibit higher variability. Despite slight weight differences, horn development shows pronounced sexual dimorphism, with males typically having larger horns. Consistency is evident across the West African Dwarf breed, the Sokoto Red breed, and the Kano Brown strain.

Effect of breed on weight and horn development in breed of goat (*Capra hircus*)

Table 2 shows the effect of breed on weight and horn development in *Capra hircus* goats. Significant differences ($p<0.05$) were found in weight (WT), left horn width (LHW), and right horn width (RHW), but not in left horn length (LHL) and right horn length (RHL) ($p>0.05$). Weight ranged from 9.350-7.450, with Sokoto Red (SR) exhibiting the highest value (9.350a ± 0.919), while West African Dwarf (WAD) had the lowest (7.750b ± 0.450). Horn measurements varied similarly, indicating breed-specific characteristics.

Effect of age on weight and horn development in breeds of goat (*Capra hircus*)

Table 3 shows the effect of age on morphometric traits in *Capra hircus* goats. At 6 months, significant differences ($p<0.05$) were observed in weight (WT), left horn length (LHL), right horn length (RHL), and right horn width (RHW), while left horn width (LHW) did not differ ($p>0.05$). At 12 months, all parameters; weight (WR), LHL, LHW, RHL, and RHW showed significant differences ($p<0.05$). At 18 months, WT, LHW, and RHW differed significantly ($p<0.05$), while LHL did not ($p>0.05$).

The study reveals clear differences between male and female goats in weight and horn development, confirming sexual dimorphism. This aligns with Ayoade *et al*. (6) in Nigerian goats and Wilson *et al*. (7) in Alpine goats. Khalil *et al*. (8) in Saudi Arabian goats and Aran *et al*. (9) in Turkish indigenous goats similarly

found sexual dimorphism. Breed-specific variations in weight and horn characteristics as in the findings of Tesfaye *et al*. (10) in Ethiopian goats, Adeyinka *et al*. (11) in Nigerian goats, and Khan *et al*. (12) in Pakistani goats. Age-related changes in weight and horn development, supported by Adegbeye *et al*. (13) and Tesfaye *et al*. (10), confirmed the dynamic nature of goat growth. This validates with Omotosho *et al*. (14), who studied Kalahari Red and West African Dwarf goats, emphasizing age-dependent morphometric traits.

Table 1: Descriptive statistics of sex, weight and horn development on morphometric characteristics of breeds of goat (*Capra hircus*)

	C.V%	Means± S.E	Minimum	Maximum
Parameters/sex				
FEMALE				
WT	12.027	8.950±0.250	8.700	9.200
LHL	12.879	4.000±0.250	4.000	4.000
LHW	17.639	3.000±0.250	3.000	3.000
RHL	13.181	4.000±0.250	4.000	4.000
RHW	16.659	4.000±0.250	4.000	4.000
MALE				
WT	12.027	9.350 ± 0.650	8.700	10.000
LHL	12.879	5.000±0.650	4.000	5.000
LHW	17.639	6.000±0.650	3.000	6.000
RHL	13.181	6.000±0.500	4.000	6.000
RHW	16.659	5.000±0.500	4.000	6.000

WT=weight, LHL=left horn length, LHW=left horn width, RHL=right horn length, RHW=right horn width, WAD=west African dwarf, SR=sokoto red, KB=kano brown

Table 2: Effect of breed on weight and horn development on the morphometric characteristics of three breeds of goat (*Capra hircus*)

	Parameters				
Breed	WT	LHL	LHW	RHL	RHW
KB	8.950^{a} ±0.250	4.000^{b} ± 0.250	3.000^{b} ±0.250	4.000^{b} ±0.250	4.000^{b} ± 0.250
SR	9.350^{a} ± 0.919	5.000^{b} ± 0.919	6.000^{a} ±0.919	5.500^{a} ±0.707	5.500^{a}±0.707
WAD	7.750^{b} ±0.450	7.750^{a} ± 0.450	5.500^{a} ±0.500	5.000^{a} ±0.500	5.000^{a} ± 0.500
P- VALUE	<0.0250	<0.0258	<0.0001	<0.0170	<0.0006

Means^{a,b} with the same letter are not significantly different at(0.05) WT=weight, LHL=left horn length, LHW=left horn width, RHL=right horn length, RHW=right horn width, WAD=West African dwarf, SR=Sokoto red, KB=kano brown

CONCLUSION AND APPLICATION

The study reveals sexual dimorphism in weight and horn development among goats, with males generally exhibiting higher weights and larger horns than females. This stresses the importance of considering sex in goat management and breeding efforts. Moreover, significant variability in weight and horn traits across goat breeds suggests breed-specific differences influenced by genetics and environment. However, horn lengths remain relatively consistent across breeds. Age also plays a key role, with notable differences in morphometric traits among age groups, highlighting the dynamic nature of goat growth. These findings stress the importance of management practices based on age, sex, and breed for effective goat farming and breeding programs.

Table 3: Effect of age on weight and horn development on three breeds of goat (*Capra hircus*).

		Parameters				
BREED	AGE(month)	WT	LHL	LHW	RHL	RHW
KB	6	8.865[a]	4.000[b]	3.000[c]	4.000[c]	4.000[b]
SR		9.367[a]	5.333[a]	6.000[a]	5.667[a]	5.667[a]
WAD		7.800[b]	5.667[a]	6.333[a]	5.667[a]	6.333[a]
P-VALUE		<0.0300	< 0.0320	<0.0300	<0.0300	<0.0340
	12					
KB		7.567[c]	4.667[b]	2.667[d]	4.667[b]	3.000[c]
SR		12.067[a]	5.333[b]	5.000[b]	5.333[b]	5.000[a]
WAD		10.167[a]	7.000[a]	7.000[a]	7.000[a]	6.667[a]
P-VALUE		<0.0300	<0.0321	<0.0380	<0.0321	<0.0321
	18					
KB		14.400[a]	9.000[a]	7.333[b]	9.000[a]	7.333[b]
SR		12.500[b]	9.333[a]	9.000[a]	9.333[a]	9.000[a]
WAD		13.400[b]	9.333[a]	8.333[a]	9.333[a]	8.333[a]
P-VALUE		<0.0331	<0.0322	<0.0332	<0.0374	<0.0352

Means[a,b,c,d] with the same letter are not significantly different at(0.05) WT=weight, LHL=left horn length, LHW=left horn width, RHL=right horn length, RHW=right horn width, WAD=west African dwarf, SR=sokoto red, KB=kano brown.

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Animal Breeding and Genetics: ABG 004

LOCATION AND SEX INTERACTION EFFECT ON HEAT TOLERANT TRAITS OF CHICKEN UNDER SMALLHOLDER FLOCK SYSTEM

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ABSTRACT

This study was aimed at evaluating the location and sex interaction effect on heat tolerant traits of chicken flocks under smallholder system. Sixty (60) indigenous adult normal feathered chicken from two locations in Nasarawa South Agricultural Zones (Doma and Lafia), comprising of 30 males and 30 females under smallholder system with similar management were randomly sampled. The birds were managed semi-intensively and fed with corn and maize grains respectively. Nasarawa State is located at the guinea savannah zone of the North Central Nigeria. It lies between latitude 08°35 N and longitude 08°33 E. Rectal temperature (RT), pulse rate (PR) and respiratory rate (RR) of birds were taken according to standard methods. Location effect showed that respiratory rate were significantly (P<0.05) higher in birds in Doma compared to their Lafia counterparts. However, pulse rate and rectal temperature were not influenced (P<0.05) by location. Sex effect was not significant (P<0.05) on respiratory rate, pulse rate and rectal temperature. Location by sex interaction effect was significant (P<0.05) on respiratory rate. In Doma, the females were superior to their male counterparts. Whereas the male birds in Lafia were superior to their female counterparts (P<0.05). The result of this findings could provide basis for understanding adaptation of birds to distinct production area in the state.

Keywords: Location and sex interaction, heat tolerant traits, smallholder, flock, chicken

DESCRIPTION OF PROBLEM

The ability of an animal to maintain homeostasis under heat stress is a valuable trait in the subtropical and tropical regions. The main indicator of heat stress is prolonged panting (6). Heat is produced by metabolism within the body, which includes maintenance, growth and egg production. Heat production is affected by body weight, species and breed, level of production, level of feed intake and to a lesser extent, by the amount of activity and exercise. These conditions reduce growth rate and production (12). The internal body temperature of domestic poultry is normally 41.2- 42.2^{o}C considerably higher than that of mammals (36–39^{o}C). The fundamental problem facing domestic poultry exposed to extremes of temperature is how to maintain their body homeostasis in order to permit the normal functioning of the chemical processes. Below the thermal neutral zone, food is used wastefully and above this zone; the bird suffer heat stress (12). Hot-dry season in the tropical environment is characterized by high environmental temperature, which sometimes exceeds 30 °C (1). Exposure of birds to high ambient temperature in poultry houses in the tropical zones elicits a series of responses generally termed heat stress (3). It is caused by high ambient temperatures that exceed the thermo-neutral zones of poultry species and when heat stress is coupled with high humidity, it has a detrimental effect on commercial broilers and layers (10). Heat stress occurs mainly in the hot-dry season and during this period, birds have limited physical resource (nutrient) for growth and reproduction in response to environmental change and voluntary feed consumption is drastically reduced (8). The adjustment to this new challenge requires redistribution of body reserves of energy and protein to thermoregulation at the cost of decreased growth and reproductive efficiency (7).

Most poultry farmers make use of commercial and synthetic anti-stress, anti-oxidants and anti-biotics to help chicken cope with heat stress. Alternatives to the use of chemicals lie in discovery and proper utilization of natural plant materials and extracts that have the necessary properties needed (2). This study was aimed at

assessing the location and sex interaction effect on heat tolerant traits of chicken under smallholder system in Southern zone of Nasarawa State.

MATERIALS AND METHODS

Location and Experimental Birds Management

Nasarawa State is located at the guinea savannah zone of the North Central Nigeria. It lies between latitude 08°35 N and longitude 08°33 E. The mean monthly temperature is 35.06°C while the mean monthly relative humidity is 74% and the rainfall is about 168.9 mm (11).

Sixty (60) indigenous adult normal feathered chickens from two locations in Nasarawa South Agricultural Zones (Doma and Lafia), comprising of 30 males and 30 females under smallholder flock with similar management were randomly sampled. The birds were managed semi-intensively and fed with corn and maize grains respectively.

Data Collection

Rectal temperature (RT), pulse rate (PR) and respiratory rate (RR) of birds were taken according to standard methods.

Rectal Temperature was measured using a clean clinical thermometer inserted into the vent for one minute after which the readings were taken (˚C) as described by (13).

*Respiration Rate*s was determined for each bird by counting the number of movements of abdominal region or vent for one minute using a stopwatch and recorded as breath/minute as described by (13).

Pulse Rate was determined by placing the finger tips under the wing vein and counting the number of beats per minute using a stop watch and recorded as beats/minute as described by (13).

Statistical Analysis

The general linear model (GLM) of SPSS (5) software was used for the analysis of data obtained from the study. The following linear model was used:

$Y_{ijk} = \mu + S_i + L_j + (LS)_{ij} + e_{ijk}$

Where;

Y_{ijk} = Individual mean population

μ = General mean of the population

L_j= Effect of location

S_i = Sex effect

$(LS)_{ij}$= Location and sex interaction effect

e_{ijk}=Error effect or term.

RESULTS AND DISCUSSION

Location effect on heat tolerant traits of indigenous normal feathered chicken under smallholder system is presented in Table 1. The respiratory rate is significantly ($P<0.05$) higher in Doma birds compared to Lafia counterparts. However, pulse rate and rectal temperature were not influenced ($P<0.05$) by location. The differences in the respiratory rate could be due to the micro environmental variation (14). Such heterogeneity (variation) in the production environments had earlier been reported for birds in five agro-ecological zones of Nigeria (14).

Sex effect on heat tolerant traits of indigenous normal feathered chicken under smallholder flock system is presented in Table 2. The results for all the parameters (respiratory rate, pulse rate and rectal temperature) were not influenced ($P >0.05$) by sex. This report is also in consonance with the observation of (4) where higher nominal pulse rate and respiratory rate values were recorded in females than males. In contrast (9) reported higher pulse rate in male free range chicken.

Table 1: Location effect on heat tolerant traits of indigenous normal feathered chicken under smallholder flock system

	Location	
Parameters	Doma	Lafia
°Respiratory rate (bpm)	30.40±0.32[a]	29.37±0.32[b]
Pulse rate (bpm)	133.53±0.92	126.77±0.92
Rectal temperature (^{0}C)	42.14±0.07	42.17±0.07

[ab]Means within the same rows bearing different superscripts are significantly different (P<0.05)
bpm = beats per minute, °bpm = breaths per minute

Table 2: Sex effect on heat tolerant traits of indigenous normal feathered chicken under smallholder flock system

	Sex	
Parameters	Male	Female
°Respiratory rate (bpm)	29.70±0.32	30.07±0.32
Pulse rate (bpm)	130.10±0.92	130.20±0.92
Rectal temperature (^{0}C)	42.20±0.07	42.11±0.07

[a]Means within the same rows bearing the same superscripts are not significant (P<0.05)
bpm = beats per minute, °bpm = breaths per minute

Location and sex interaction effect on heat tolerant traits of indigenous normal feathered chicken under smallholder flock system is presented in Table 3. There was location by sex interaction effect on respiratory rate. Doma females were superior to their male counterparts. The trend changed in Lafia. The male birds were superior to their female counterparts (P<0.05). However, there was no location by sex interaction effect on pulse rate and rectal temperatures. The significant effect of Location and sex interaction effect indicate bird's genetic ability for tropical adaptation to location. This is in agreement with earlier reports on genetic basis of thermal stress response including single genes of major effect as well as complex multigenic control (4). Increase in respiratory rate, (4) could be as a result of greater demand for oxygen as well as evaporative cooling requirements (4).

Table 3: Location and sex interaction effect on heat tolerant traits of indigenous normal feathered chickens under smallholder flock system

Parameters	Doma		Lafia	
	Male	Female	Male	Female
°Respiratory rate (bpm)	29.73±0.45[b]	31.07±0.45[a]	29.67±0.45[a]	29.07±0.45[b]
Pulse rate (bpm)	132.93±1.30	134.13±1.30	127.78±1.30	126.27±1.30
Rectal temperature (^{0}C)	42.18±0.10	42.09±0.10	42.23±0.10	42.12±0.10

[ab]Means within the same rows bearing different superscripts are significantly different (P<0.05)
bpm = beats per minute, °bpm = breaths per minute

CONCLUSIONS AND APPLICATIONS

1. Respiratory rate was influenced by location, while pulse rate and rectal temperature were not.
2. Respiratory rate, pulse rate and rectal temperature were not influenced by sex, however, there was location by sex interaction effect on respiratory rate.
3. The result of this findings could be useful in the study of adaptation of birds to distinct production areas of the state.

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Animal Breeding and Genetics: ABG 005

PHENOTYPIC CHARACTERISTICS OF LOCAL CHICKENS FOUND IN MANGU MARKET OF MANGU LOCAL GOVERNMENT AREA OF PLATEAU STATE.

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ABSTRACT

This study was undertaken to determine some characteristics of local chickens in Mangu Local Government Area of Plateau State, Nigeria. A total of 1004 adult chickens of both sexes were examined at the weekly Mangu market for four consecutive weeks. Data obtained were subjected to descriptive statistics using Statistical Package for Social Sciences (SPSS). Results obtained showed that 54.00% of the birds were females while 46.00% were males. The physical characteristics showed that their plumage comes in several types with multi-coloured plumage (25.50%) being the majority. Shank colour of the chickens also showed different colours which includes pink, white, ash, black and greenish constituting 46.71%, 21.31%, 15.64%, 11.35% and 4.98%, respectively. Also, the population of the chickens studied revealed that they possess different beak colours. The beak colours identified were mostly yellow (65.04%) and brown (25.10) .The result obtained similarly showed that normal feather constituted the majority of the types with 72.41%. In terms of comb type, single comb constituted majority in the chickens studied as they form 76.99% of the population. The result obtained in this study indicated that the local chickens showed variation in the phenotypic traits that could be exploited in improvement of these chickens.

Keywords: Mangu; characteristics; variation; phenotypic; local chickens

DESCRIPTION OF PROBLEM

The Nigeria poultry industry comprises about 180 million birds in three production systems: the extensive or free-range system (46 percent of the standing population), semi-intensive (33 percent) and intensive systems (21 percent) [1]. It is also projected that this population will increase to 900 million in 2050. Majority of these birds are the indigenous otherwise called local chickens. They have not undergone any deliberate selection, but only indiscriminately mate. . They are also described as being hardy and quite adapted to the local environment[2]. Their differentiation in terms of morphology, physiology and productivity is a product of the interaction between their genetic makeup and their prevailing environment. This interplay is vital for selection and breed improvement.[3, 4]. In order to undertake any selection or improvement in any locality, it is necessary to document the characteristics of the available chickens. Previous studies on characteristics of local chickens found in Mangu local government area is not presently available and the reason for this study.

MATERIALS AND METHOD

This study was carried out in Mangu Local Government Area of Plateau State, Nigeria located at 9°31′00″N 9°06′00″E. It has an area of 1,653 km² and a population of 294,931 at the 2006 census. Languages spoken in Mangu are Mwaghavul and Pyem.[5] It has a weekly central market which occurs every Friday. Buyers and sellers of all agricultural and non-agricultural goods converge to exchange their produce and products[6]. The sampling technique adopted was random sampling. The local chickens that were brought to the market were characterized as previously described (7,8).

The data obtained were subjected to descriptive analysis using Statistical Package for Social Sciences.[9]

RESULTS AND DISCUSSION

Table 1 showed the distribution of the local chickens based on their plumage colours. It showed that the highest plumage colour was those with multi-colours (25.50%) with 55.47% as females while 44.53% were males. This result agreed with previous studies (2, 7, 8). They suggested that a number of genes interact to determine plumage colour and probably because indigenous chickens have not been artificially selected.

Table 1: Plumage colour of Local chickens found in Mangu Market

PLUMAGE	Males		Females		Total	
COLOUR	N	%	N	%	N	%
Multi-coloured	114	44.53	142	55.47	256	25.50
Red	93	46.97	105	53.03	198	19.72
Brown	68	41.72	95	58.28	163	16.24
Black-white	65	73.03	24	26.97	89	8.86
Reddish-black	25	34.72	47	65.28	72	7.17
Black	27	44.26	34	55.74	61	6.08
Black brown	30	55.56	24	44.44	54	5.38
Ash-black	19	47.50	21	52.50	40	3.98
Ash	16	48.48	17	51.52	33	3.29
Grey	5	20.00	20	80.00	25	2.49
Whitish grey	4	30.77	9	69.23	13	1.29

N =Number of chickens found

Table 2: Shank and beak colour of local chickens found in Mangu Market

	Males		Female		Total	
Shank Colour	**N**	**%**	**N**	**%**	**N**	**%**
Pink	150	31.98	319	68.02	469	46.71
White	112	52.34	102	47.66	214	21.31
Ash	98	62.42	59	37.58	157	15.64
Black	71	62.28	43	37.72	114	11.35
Greenish	32	64.00	18	36.00	50	4.98
Beak Colour						
Yellow	295	45.18	358	54.82	653	65.04
Brown	113	44.84	139	55.16	252	25.10
Ash	27	52.94	24	47.06	51	5.08
White	22	68.75	10	31.25	32	3.19
Pink	5	41.67	7	58.33	12	1.20
Orange	1	25.00	3	75.00	4	0.40

N =Number of chickens found

The result for shank and beak colour was presented in Table 2. It indicated that majority (46.71%) of the local chickens had pink shank colour with more than 68% females. In addition, yellow colour of beak constituted the highest (65.04%) of beak colour. The high yellow shank colour that predominates local chicken in Cross River[8] disagreed with this study, the reason could be as a result of longer time the chickens stay under shade as a result of diffference in altitude between Mangu (Plateau State) and Bekwarra (Cross River).

Table 3: Feather and comb types found in local chickens of Mangu Market

	Males		Females		Total	
Feather Type	**N**	**%**	**N**	**%**	**N**	**%**
Normal	354	48.69	373	51.31	727	72.41
Naked neck	96	39.18	149	60.82	245	24.40
Frizzled	9	28.13	23	71.88	32	3.19
Comb Type						
Single	347	44.89	426	55.11	773	76.99
Pea	98	47.80	107	52.20	205	20.42
Rose	15	83.33	3	16.67	18	1.79
Buttercup	3	60.00	2	40.00	5	0.50
V-comb	1	33.33	2	66.67	3	0.30

Table 3 showed the distribution of the local chickens according to feather type and comb type. Normal feather had the majority (72.41%) with naked and frizzled feather constituted 24.40% and 3.19%, respectively. This is attributable to the cold and low temperatures that exist in the locality, Plateau State.

CONCLUSION

This study reveals that indigenous chicken in Mangu local Government Area of Plateau State exhibits heterogeneity in the morphological and phenotypic traits considered. The predominant characteristics identified are multi-coloured and normal feathers, pink shank, yellow beaks and single comb types. These variations can be utilized in further studies to reveal inherent advantageous traits.

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Animal Breeding and Genetics: ABG 006

MORPHORMETRIC DIFFERENTIATION OF UDA SHEEP IN BALI, TARABA STATE

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ABSTRACT

Morphometric (body weight, head width, head length, head depth, ear length, wither height, chest girth, body length, rump height, rump width and tail length) traits were recorded. The data for the study were analyzed using the General Linear Model Procedures of SAS using fixed effect model that incorporated breed and sex while; T- test was used to separate the means. Age and sex have effect on some phenotypic traits of uda sheep. The effect of sex on morphometric traits showed a significantly (P<0.05) higher in male than female Uda sheep except for Rump width and head width. The sex effect showed that the rams of each breed had significantly (P<0.05) higher means for all traits measured than the ewes except for rump width which the females had significantly (P<0.05) higher means than the males. The coefficient of variation within the measured traits was high for body weight (31.69) and lower in Wither height (10.19). Age and sex have effect on some phenotypic traits of Uda sheep. The CV showed high in body weight and least in wither height which could be exploited the phenotypic traits could be exploited for selection and improvement of uda sheep.

Key words: Uda, Sheep, morphometrict, Trait, Bali.

DESCRIPTION OF PROBLEM

The assessment of indigenous breed of sheep is important in terms of genetic preservation of animal in a country. In the indigenous sheep breeding, the identification of relationships among age, body weight and some linear body measurements is necessary for selecting better animals with the aim of realization of more genetic response on growth rate of animals.

Sheep biodiversity have been described using morphological measurements (1). Morphometric characters are continuous characters describing aspects of body shape (2). Morphometric differentiation between populations can provide a basis for understanding herd structure and may be more applicable for studying short-term, environmentally induced variation and thus more applicable to livestock management.

Linear body measurements together with live body weight are significantly influenced by breed, age and sex of the animal (4). Information on linear body measurements of sheep breed found predominantly in Northern Nigeria (especially Yankasa and Uda) is scarce in Bali, Taraba state. The relationships between body linear measurements and body weight of sheep and association may be useful tools for selection.

The objective of this study is therefore to evaluate the effect of age and sex on phenotypic characterization of Uda sheep in Bali, Taraba State.

MATERIALS AND METHODS

Study Area

Bali local government area (LGA) is one of the sixteen (16) Local Government Areas in Taraba State, Nigeria. It covers a total land area of about 9,146km^2 and extends between latitude 7^0 30'00'' to $8^0$10'00'' North of the equator and 5^0 45'00'' to $6^0$15'00'' East of the Greenwich meridian (5).

Experimental Animals and Management

The animals were managed under traditional extensive system with little or no supervision for shelter in the day and night. They grazed natural pasture containing forage grass during the day and supplemented with crop residue prior or after grazing

Morphometric variables measured

A total of one hundred and twenty-three (123) Uda sheep comprising of sixty-nine (69) male and fifty-four (54) female were randomly sampled from three location to obtain the morphometric data. Parameter measured were body weight (BW), head length (HL), head width (HD), head depth (HD), ear length (EL), tail length (TL), wither height (WH), chest girth (CH), body length (BL), rump height (RH) and rump width (RW).

Age Determination

The ages of the animals were estimated based on dentition, using the eruption of permanent incisors teeth (6). Animal under one year (0-1year) has 0-2 permanent teeth, for young adults (2-3yrs old) presence of two (2) pairs of permanent incisors teeth confirmed their age and 4years and above (8 permanent teeth).

Statistical Analysis

The data were analysed using the General Linear Model Procedure of SAS JMP (7) The means were compared using T- test of SAS JMP (7) given below;

$Yij=\mu+ Si + Aj + eij$

Where Yij= individual observation of each body traits;

μ = overall mean; Si = fixed effect of ith sex (i = male, female);

Aj = fixed effect of jth age (j < 1 year old, 2 years old, and > 3 years old)

eij=random residual error associated with record of each animal

RESULTS AND DISCUSSION

The results of summary of statistics and Coefficient of Variation (CV) are presented in Table 1. The CV of the phenotypic traits ranges from 10.19 – 31.69. The highest CV was recorded in body weight and the least CV was recorded in wither height.

Table 1: Summary Statistics of morphometric traits of Uda

	Uda	
Trait	**Means(±SE)**	**CV(%)**
Body weight (Kg)	26.78±1.15	31.69
Head length (cm)	19.13±0.46	17.677
Head width (cm)	6.75±0.15	17.25
Head depth (cm)	12.13±0.20	12.17
Ear length (cm)	13.15±0.24	13.85
Tail length (cm)	30.82±0.58	13.88
Wither height (cm)	64.20±0.89	10.19
Chest Girth (cm)	66.56±1.09	12.05
Body length (cm)	62.17±1.09	12.91
Rump height (cm)	66.60±0.96	11.25
Rump width (cm)	9.37±0.24	19.03

[ab] Means with different superscript within the same row differ significantly (P<0.05); SE = Standard error; CV = Coefficient of variation; cm = Centimeter

Sexual Dimorphism of Morphometric traits Uda Sheep

Table.2 shows the influence of sex on the morphometric traits of Uda. There were significant (P<0.05) differences between sexes within breeds for all the morphometric traits measured. The rams had higher mean values than that of ewes for all traits except for Head length, Head width and rump width.

Table2: Effect of Sex Phenotypic Parameters

Trait	Uda		SEM
	Ram	Ewe	
Body weight (Kg)	28.50±1.57[a]	23.84±1.43	2.99
Head length (cm)	19.09±0.57	19.20± 0.79	2.41
Head width (cm)	6.53±0.16[b]	7.13±0.32[a]	0.80
Head depth (cm)	12.57±0.23[a]	11.40±0.32[b]	1.74
Ear length (cm)	13.31 ±0.34[a]	12.88±0.33[b]	1.29
Tail length (cm)	31.60±0.81[a]	29.50±0.67[b]	2.96
Wither height (cm)	65.82±1.19[a]	61.45±1.06[b]	4.42
Chest Girth (cm)	68.11±1.38[a]	63.93±1.64[b]	5.54
Body length (cm)	63.10±1.41[a]	60.58±1.70[b]	4.70
Rump height (cm)	63.85±1.23[a]	60.48±1.44[b]	4.79
Rump width (cm)	9.12±0.26[b]	9.80±0.48[a]	1.25

[ab] Means with different superscript within the same row differ significantly (P<0.05);Kg = Kilogram; cm = centimeter

Effect of age on Phenotypic Parameters

The results of the effect of age on phenotypic traits are presented in Table 3. The result showed that age significantly (P<0.05) influenced body weight, head width, wither height, chest girth, body length, rump height and rump width with the older animals having higher values than the younger ones. Even though other phenotypic trait showed non-significant (P>0.05) difference, there were slight increase with change in age.

Table3. Effect of age on Phenotypic Parameters

Trait/years	1	2	3	SEM
Body weight (Kg)	21.33[c]	30.33[b]	37.39[a]	3.44
Head length (cm)	18.92	19.95	20.08	1.90
Head width (cm)	5.42[b]	6.70[b]	8.00[a]	0.62
Head depth (cm)	11.94	12.23	12.86	0.84
Ear length (cm)	12.88[b]	13.52[a]	13.07[a]	1.06
Tail length (cm)	28.67[b]	32.89[a]	32.57[a]	2.18
Wither height (cm)	61.5[c]	65.77[b]	71.42[a]	3.03
Chest Girth (cm)	61.00[c]	70.18[b]	76.64[a]	3.05
Body length (cm)	60.02[c]	64.16[b]	66.29[a]	4.21
Rump height (cm)	57.98	65.14[b]	72.00[a]	2.88
Rump width (cm)	8.33[c]	9.82[b]	11.43[a]	0.84

[ab] Means with different superscript within the same row differ significantly (P<0.05);

DISCUSION

Traits having high CV suggest that the traits are heterogeneous in nature hence possessing more room for genetic improvement through mass selection while traits having less CV suggest that those traits are homogenous and possesses less room for improvement.

Therefore, the variation that exists in the phenotypic traits of uda sheep could be exploited for selection and improvement of the breed since the characterization of local genetic resources depends on the knowledge of the variation of morphological traits, which have played a very significant role in classification of livestock based on size and shape (8) This finding corroborated with the report of (9) who opined that domestic animal diversity is critical for food security and essential to meet unpredictable future demand of population increase, climate change and more virulent disease pathogens, thus, a reservoir not only depends on the number of breeds but also on the genetic diversity within and between these breeds.

The effect of sex on phenotypic traits is presented in Table 2. The results showed that body weight, head depth, ear length, tail length, wither height, chest girth, body_length, rump height, rump width were significantly (P<0.05) influenced by sex effect with males having superiority over the females except head width and rump width. The superiority of male could also be ascribed to concentrations of thyroxine in comparison to females (10). This may also be due to testosterone hormone which is secreted in male animals, which stimulate growth. This result agreed with the report of (11) who reported that males were superior to females in all the body measurements. Also, the result agreed with the report of (12) who reported that male sheep were superior in meat offals than their female counterparts. This is also in line with the reports of some authors that some genetic and nongenetic factors such as breed, sex, type of birth, parity order, season of parturition, management and birth weight have been known to influence growth rate of kids which will later affect any meaningful success expected to be achieved in any improvement program (13, 14).

Rump width is significantly higher (P<0.05) in ewe because rump width is an important trait affecting the productivity of the ewe through its effect on ease of lambing, prenatal ewe and lamb mortality rates and lifetime rearing performances (15). The result from this study corroborated with the report of(16) who opined that the positive influence of age of the animals on body size and weight is not surprising since the size and shape of the animals is expected to increase with increase in age of the animals. This result also concord with the report of (17) who opined that body weight and all body measurements are affected by age.

CONCLUSION AND APPLICATION

This study has shown that significant variation exists between sex of the breeds for all the morphometric traits recorded. This variation could be used for improvement for meat production in a crossbreeding programme. Yankasa sheep expressed superior genetic potential in some of the morphometric traits than Uda sheep, while females/ewes had lower values for all morphometric traits excluding rump width in both breeds.The genetic potential of other breed of sheep should be fully exploited for the genetic improvement indigenous sheep breeds in Taraba State and Nigeria.

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BREED RESPONSE TO DIFFERENT DIETARY ENERGY-PROTEIN RATIOS IN GROWER PIGS REARED IN THE TROPICS

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ABSTRACT

To determine pig breed response to two dietary energy-protein ratios, twenty-seven (27) growerpiglets at 12 weeks of age, tagged and weighed, consisting of three breeds - 9 Large white (LW), 9 Landrace, and 9 Camborough - of average weight: 15.21±3.67 kg, were employed in a 4-week feeding trial. Pigs were randomly allocated within breed at three growers per pen. The feeding trial was conducted from 13th - 16th weeks of age. Two standard Energy-Protein Ration (EPR) diets of 202:1 and 170:1 were compared with the farm diet of 128:1 EPR diet. All pigs were offered diets at 5% of previous week's body weight. Daily split-feeding was adopted. Water was provided ad-libitum, while data were collected on daily feed intake (DFI), avearge daily gain (ADG), feed efficiency ratio (FER) and economic cost of meat production (ECM). The Complete Randomized Design in factorial was employed. Factorial ANOVA, General linear model procedure and Dunnette's Test of SAS® version 9.4 were employed for analyses (α=0.05). Significant breed by energy:protein ratio interaction ($P < 0.05$) were obtained on DFI, ADG, FER and ECM. The Landrace performed best with high and superior genetic ability on ADG, FER and lowest ECM on the high-energy 202:1 EPR diet. The Large white and Camborough breeds produced best on the medium-energy 170:1 EPR diet with lowest ECM. Landrace could be a high-energy breed, while the Large white and Camborough breeds accreted meat at the lowest cost on the medium-energy diet during the grower phase.

Key words: Large white, Landrace, Camborough, average daily gain, economic cost of meat production.

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DESCRIPTION OF PROBLEM

The study and interview on the prevailing nutritional program of Onabanjo Farms Ikorodu, revealed that the feed offered to pigs were deficient in methionine, vitamin-mineral premix, dietary energy, but contained excess crude protein. Literature show that different pig breeds reveal different nutritional requirements which could be linked to their genetic make-up [1, 2] Increasing the energy concentration of pig diet could improve pig growth performance [3]. The energy content of the diet dictates the amount of feed consumed by growing-finishing pigs. Excess protein in the diet of pigs increase protein consumption by farm animals, causes high feed cost, high release of nitrogen and odour into the environment [4, 5, 6]. Reduction of protein in the diet of pigs reduces nitrogen in the excreta [7] and amount of greenhouse gases released into the environment. A reduction in feed intake under higher energy-feed programme might be due to adjustment of the voluntary feed intake to meet the daily nutrient demand while maintaining a constant energy intake [8]. This study was conceived as an extension service to Ikorodu Pig Farmers who had been experiencing performance depression due to nutritional deficiency during the grower phase of pigs from 12 weeks upwards. It was necessary to reverse the recurrent and persistent performance depression at the growth period on Ikoodu pig farms.

The objective of this study was to determine the effect of interaction of breed by diet on the productivity of grower pigs.

MATERIALS AND METHODS

Site of Experiment, animals and Treatment Design

The research was conducted on Onabanjo Pig Farm, Lagos State Farm Settlement, Ikorodu, on Lat. 6.60^{O} N, Long. 3.50^{O} E and 5.49 metres ASL. Animals were housed in open sided, medium-walled, flow-through house, with East-West orientation, of dimensions 2.4m x 3.0m (Length x breadth, m^2). Twenty-seven (27) grower-pigs: 9 Large White (LW), 9 Landrace and 9 Camborough, at the end of 12th week, with initial average weight: 15.21±3.67 kg were used. Diets were formulated to provide energy:protein contents of 2659.4:13.2; 2298.7:13.49 and 2544.9:19.9; which provided ratios of 202:1; 170:1.0 and 128:1 in diets 1, 2 and 3. Diets 1 and 2 were formulated based on nutrient requirements for growth in pigs [9] and compared to the farm diet 3. The trial was conducted for 4 weeks (13th -16th week of life). Pigs were tagged for identification, weighed and randomly distributed within breed into experimental pens. Each breed was replicated three times. Equalized body weight of experimental units was ensured at the beginning of experiment at 13th week to serve as the initial body weight. All pigs were offered diets at 5% of previous week's body weight. Daily split-feeding method was adopted to mitigate heat stress during the hot afternoons. Water was provided *ad libitum* through automatic waterers. Experimental design was completely randomized with factorial treatment design of 3 breeds x 3 EPR diets.

Data collection and Statistical Analysis

Traits measured were daily feed intake and weekly body weight while productivity traits evaluated were: average daily feed intake (DFI, g/day), average daily gain (ADG, g/day), feed efficiency ratio (FER, g/g), economic cost of meat production (ECM, ₦/kg). Analytical procedures used were GLM and Dunett's test (α=0.05) of the SAS software® version 9.3 [10]. The null hypothesis tested was that the effect of interaction of breed by energy-protein ratio shall not be significant.

RESULTS AND DISCUSSION

Effect of interaction of breed by energy:protein ratio on productivity in pig

Table 1 revealed significant (P <0.05) interaction of breed by energy:protein ratio on all traits considered. The LW breed unearthed highest FER on the 202:1 diet, best ADG and ECM on the 170:1 EPR diet whereas the least DFI on the 128:1 EPR diet. The landrace breed showed better ADG, FER, least and best ECM on the 202:1 EPR diet. The Camborough breed revealed the best DFI, ADG, FER and lowest ECM.

Results revealed that the LW and Landrace breeds could be raised on either the 170:1 or 202:1 EPR diet at ratio 3.3:1 to 3.6:1 for DFI:ADG (kg/day). The Cambourogh breed could best be raised on the 170:1 EPR diet at 3.4:1 ratio for DFI:ADG. It thus seemed that the Camborough is a lower-energy breed than the LW and Landrace breeds. The feed efficiency ratio among breeds was highest for LW on the 202:1 and 170:1 EPR diets, followed by Camborough on the 170:1 EPR diet and Landrace on 202:1 and 170:1 EPR diets (30.24, 28.75, 29.29, 27.99 and 27.60, %) respectively. The lowest economic cost of meat production was produced by the Camborough breed on the 170:1 EPR diet, followed by Landrace breed on 202:1 EPR diet and the Large white breed on the 170:1 EPR diet (479.00, 545.00, 624.00, N/kg) respectively. This means that the Camborough breed was the cheapest and most economical to rear among the three breeds of pigs. The high average daily gain in the LW breed on 170:1 (0.278), Landrace on 202:1 (0.328) and Camborough on 170:1 EPR diets (0.362) is in line with the report of [11] that pigs fed a high-energy, low-protein diet had higher average daily gain and feed efficiency compared to those fed a low-energy, high-protein diet. Recent studies [1 and 2] reported that different breeds have different nutrient requirements and respond differently to dietary energy-protein ratios. Present finding is also in line with [12] who reported that pigs fed a high-energy, low-protein diet had significantly higher average daily gain and feed efficiency compared to those fed a low-energy, high-protein diet. [13] reported that a growing-finishing diet of 13.82 MJ/kg diet of ME with the high CP level can improve growth performance and show better fatty acids composition of pork. Findings indicate that there is significant (P <0.05) breed by energy-protein ratio interaction effect on the productivity of grower pigs. Findings showed strong breed by energy:protein ratio interaction effect on daily feed intake, average daily gain, feed efficiency ratio and economic cost of meat production in grower pigs.

Table 1: Effect of interaction of breed and energy protein ration on productivity and body traits of weaner pigs at 13 to 16 weeks of age

Breed	**Large white**			**Landrace**			**Camborough**			
EPR	**202:1**	**170:1**	**128:1**	**202:1**	**170:1**	**128:1**	**202:1**	**170:1**	**128:1**	***P***
DFI (kg/d)	0.850^{b}	0.967^{c}	0.599^{a}	1.172^{e}	1.123^{d}	1.174^{e}	0.946^{c}	1.236^{f}	1.040^{c}	0.0008
ADG (kg/d)	0.257^{c}	0.278^{c}	0.139^{e}	0.328^{b}	0.310^{b}	0.281^{c}	0.225^{d}	0.362^{a}	0.288c	0.0500
FER (%)	30.24^{a}	28.75^{a}	23.21^{c}	27.99^{ab}	27.60^{ab}	23.94^{c}	23.78^{c}	29.29^{a}	27.69^{ab}	0.0500
ECM (N/kg)	695.56^{b}	623.53^{bc}	1,167.12^{c}	545.00^{bc}	559.16^{bc}	577.33^{bc}	794.48^{b}	478.84^{a}	563.30^{a}	0.0500

DFI= Daily feed intake, ADG = Average daily gain, FER = Feed efficiency ratio, ECM = Economic cost of meat production, Values across rows with different superscripts are significantly different ($p<0.05$).

CONCLUSION AND APPLICATION

The Landrace seemed to perform best on ADG, FER and ECM on the high-energy 202:1 EPR diet, in contrast to Large white and Camborough breeds which produced meat at lowest econmic cost on the medium-energy 170:1 EPR diet during the grower phase.

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Animal Breeding and Genetics: ABG 008

HARDY-WEINBERG EQUILIBRIUM TEST AT IGF-1 GENE LOCUS OF SOME NIGERIAN INDIGENOUS BREEDS OF CATTLE

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ABSTRACT

This study was conducted to determine the Hardy-Weinberg Equilibrium (HWE) test at (IGF-1) Gene locus in some indigenous cattle breeds in Nigeria. A multistage (three stages) approach was used to select the breeds of cattle from the States with a large population of pastoralists that rear Adamawa Gudali, Sokoto Gudali, Bunaji and Rahaji cattle breeds. Four States were selected for this study. The snowball method was used to sample 96 cattle consisting of 24 Adamawa Gudali, 24 Sokoto Gudali, 24 Bunaji and 24 Rahaji cattle from pastoralists in many communities of the LGAs. Blood samples were collected from the animals through jugular venepuncture. DNA extraction was done using Zymo Quick DNA ™Mini prep kit. NanoDrop™ ND-1000 UV spectrophotometer was used to determine DNA quality and quantity using DNA purification kit. The IGF-1 genotypes were determined using the PCR-RFLP method from blood samples collected from cattle. Deviation from Hardy-Weinberg Equilibrium was tested by Chi-Square statistics to determine the genotypic frequencies for all loci. The genotypic frequencies analysis was carried using GenAIEx software package. The CC, CT and TT genotypic frequencies of IGF-1 gene found in the population were 3(1.260), 5(8.479) and 16(14.260) in Adamawa Gudali and 5(2.667), 6(10.667) and 13(10.667) in Sokoto Gudali cattle. The population distribution for Adamawa Gudali and Sokoto Gudali at polymorphic RFLP showed statistical deviations from Hardy-Weinberg equilibrium (HWE), while Bunaji and Rahaji cattle breeds populations appeared to be in equilibrium. Restriction Fragment Length Polymorphism (RFLP) marker can provide more insight into the differentiation of cattle breeds because of the high levels of genetic variations observed.

Keywords: Hardy-Weinberg Equilibrium, IGF-1 gene, Indigenous, breeds and cattle

DESCRIPTION OF PROBLEM

Insulin-Like Growth Factor 1 (IGF-1) gene has a broad tissue distribution detected by quantitative real-time PCR (qPCR), such as muscles, liver, kidney, heart, brain and intestine (1, 2). This suggests that IGF-1 gene may participate in modulation of the cellular development and proliferation of various tissues like muscle, cartilage and bones (3). The bovine IGF1 gene was mapped on chromosome 5, in the centimorgan 73.5 (4). Fotsis *et al*. (5), in a comparative study of IGF-1, a precursor between humans and bovine, identified conservation of around 93 and 96% in nucleotide and amino acid sequences, respectively. Due to its biological function, the IGF1 gene was considered to be a candidate gene for predicting growth and meat quality traits in animal genetic improvement schemes (6). The bovine IGF1 gene has two polymorphisms located in the promoter region: aCA_n microsatellite (7), and T/C transition, also known as the single nucleotide polymorphism (SNP) IGF1/SnaB1 (8, 9). This study was aimed at testing the genetic Hardy-Weinberg Equilibrium (HWE) at the (IGF-1) Gene locus in some indigenous cattle breeds in Nigeria.

MATERIALS AND METHODS

Experimental Site
The experiment was conducted in four States, which are Adamawa, Gombe, Taraba and Sokoto States in Nigeria. One (1) Local Government Area (LGA) from each of the States was purposively selected. The LGAs were Mubi North, Balanga, Yorro, and Wurno, respectively.

Experimental Population and Sampling Techniques
A multistage (three stages) approach was used to select the breeds of cattle from the States with a large population of pastoralists that rear Adamawa Gudali, Sokoto Gudali, Bunaji and Rahaji cattle breeds. Four States were selected for this study. The snowball sampling method was used to sample 96 cattle consisting of 24 Adamawa Gudali, 24 Sokoto Gudali, 24 Bunaji and 24 Rahaji cattle from pastoralists in many communities of the LGAs using a random sampling technique.

Data Collection
Blood Sample Collection
Blood samples of two-millilitres were collected from each animal through the jugular vein from 96 cattle, consisting of 24 Adamawa Gudali, 24 Sokoto Gudali, 24 Bunaji and 24 Rahaji cattle into a ten milliliter (10mL) heparinized vacutainer tubes containing Ethylene Diamine Tetra Acetic Acid (EDTA) to prevent coagulation. The blood samples were properly labelled and kept cold by placing them in ice block and care was taken to prevent exposure to extreme temperatures and thereafter carried to the laboratory of the Department of Animal Breeding and Genetics, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria for analysis.

Genomic DNA Extraction
Deoxyribonucleic Acid (DNA) was extracted using Zymo Quick DNA ™Mini prep kit. NanoDrop 1000 spectrophotometer was used to determine DNA quality and quantity using DNA purification kit according to the manufacturer's instructions (10).

Statistical Analysis
Deviation from Hardy-Weinberg equilibrium was tested by chi-square statistics to determine the genotype frequencies for all loci. The distribution of the observed and expected genotypes among the breeds of cattle was analyzed using the GenAIEx (11) statistical software package.

$$X^2 = \sum \frac{(Observed - Expected)^2}{Expected}$$

RESULTS AND DISCUSSION

The summary of the Chi-Square Test for Hardy-Weinberg Equilibrium (HWE) is presented in Table 1. The Bunaji and Rahaji cattle breed populations at polymorphic RFLP were in equilibrium at the IGF-1 gene locus. The population distribution of genotypes for Adamawa Gudali and Sokoto Gudali at polymorphic RFLP showed statistical deviations from Hardy-Weinberg Equilibrium ($p<0.05$) at the IGF-1 gene locus. This is similar to the findings of (12). The variation in the population of RFLP displaying deviation from HWE among cattle breeds populations could be attributed to genetic drift, gene mutation, or gene migration that changes normal genetic frequency within a normal population.

The tests for Hardy-Weinberg equilibrium among some indigenous breeds of cattle are shown in Table 2. Significant deviations from Hardy-Weinberg Equilibrium (HWE) at 5% level of probability ($p<0.05$) for the Adamawa Gudali and Sokoto Gudali cattle had high significant values for CT and TT genotypes. The Adamawa Gudali with the observed TT (16), CT (5) and CC (5) showed significant differences between the observed and expected genotypes. The observed and expected genotype also revealed a significant departure

from Hardy-Weinberg proportions among genotypes; TT (13), CT (6) and CC (5) in Sokoto Gudali cattle. When a population for a gene is in Hardy-Weinberg equilibrium, it is not evolving; rather, allele frequencies will not alter throughout subsequent generations. The observed and expected genotypes in Bunaji and Rahaji showed no significant differences. The latter observations are like the findings of (13) who reported a non-significant difference between expected and observed genotype frequencies of the ß-lactoglobulin gene of Iranian Najdi cattle. If HWE is not obtained, one of the genotypes (CC, CT, or TT) is over- or under-represented in comparison to the other genotypes.

Table 1. Summary of Chi-Square Test for Hardy-Weinberg equilibrium

Population	Locus	DF	X^2	P value	LOS
Adamawa Gudali	IGF-1	1	4.041	0.044	*
Sokoto Gudali	IGF-1	1	4.594	0.032	*
Bunaji	IGF-1	1	0.389	0.533	NS
Rahaji	IGF-1	1	0.011	0.917	NS

X^2: Chi-Square, DF: Degree of freedom, LOS: Level of significance, *p<0.05: Significant at 5% level of probability, NS: Non-significant at (p>0.05).

Table 2. Tests for Hardy-Weinberg equilibrium among some indigenous breeds of cattle

Population	Locust	Genotypes	Observed	Expected	X^2	DF	P value	LOS
Adamawa Gudali	IGF-1	CC	3	1.260	4.041	1	0.044	*
		CT	5	8.479				
		TT	16	14.260				
Sokoto Gudali	IGF-1	CC	5	2.667	4.594	1	0.032	*
		CT	6	10.667				
		TT	13	10.667				
Bunaji	IGF-1	CC	3	2.344	0.389	1	0.533	NS
		CT	9	10.313				
		TT	12	11.344				
Rahaji	IGF-1	CC	0	0.010	0.011	1	0.917	NS
		CT	1	0.979				
		TT	23	23.010				

X^2: Chi-square, DF: Degree of freedom, *p<0.05: Significant at 5% level of probability, non-significant at (p>0.05).

CONCLUSION AND APPLICATION

The population distribution for Adamawa Gudali and Sokoto Gudali at polymorphic RFLP showed statistical deviations from Hardy-Weinberg Equilibrium (HWE), while Bunaji and Rahaji cattle breed populations appeared to be in equilibrium.

Restriction Fragment Length Polymorphism (RFLP) marker can provide more insight into the differentiati on of cattle breeds because of the high levels of genetic variations observed.

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Animal Breeding and Genetics: ABG 009

INFLUENCE OF LITTER SIZE, SEX AND PARITY ON BODY WEIGHT AND MORPHOMETRIC TRAITS OF WEST AFRICAN DWARF GOATS RAISED IN AKWA IBOM STATE NIGERIA.

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ABSTRACT

The West African Dwarf goat is crucial to the livelihood of rural communities in Nigeria, as the sale of these animals and their products supports household income and also contributes significantly to the population's protein intake. It is important to understand the factors that influence body weight and growth rate in this goat breed to aid genetic improvement. This study was conducted to evaluate the influence of litter size, sex and parity on body weight and morphometric traits of west African dwarf goats. A total of 98 West African dwarf kids born to 70 dams were studied over a period of one year. The growth parameters studied were Body weight of kids at birth (BW) and at 3 months, the weight gain (WG) and average daily weight (ADW) at three months. Morphometric traits studied were heart girth, body length and height at wither. Data obtained from this study were subjected to analysis variance. The results indicated that kids born as single had significantly ($p<0.05$) heavier weight at birth, at three months, higher WG and ADG than twins and triplets. The male kids had significantly ($p<0.05$) heavier weight (1300±0.11g) than the female (1100±0.03). Three months body weight, WG and ADG were equally higher ($p<0.05$) in males than females. The morphometric traits of the kids were not significantly affected ($p>0.05$) by litter size, sex and parity at birth. However, at three months these morphometric traits (heart girth, body length and height at wither) were significantly ($p<0.05$) influenced by litter size, sex and parity. It was concluded that Litter size, sex and parity significantly influenced body weight and morphometric traits in West African Dwarf goat kids and should be considered in improvement programme to increase meat yield from this breed of goats.

Keyword: Litter size, Sex, Parity, Body weight, Morphometric Traits, Goat

INTRODUCTION

The west African dwarf goat plays a very vital role in the livelihood of rural populations in Nigeria as the sales of the animals and their products help to stabilize household income. The West African dwarf goat is widely distributed throughout the humid zone of West and Central African. In Nigeria, they are found in the south-south, South-West, South-East and middle belt zones (1). These goats breed throughout the year. They are raised exclusively for meat and they play a major role in the social and cultural activities of Nigerian (2). These goats are very prolific and easy to manage by both women and children. In Nigeria goats are estimated to contribute about 38% of the total meat supply (3). Therefore, there is urgent need to increase meat yield from goats and this require genetic improvement of liveweight. To achieve this goal, proper measurement of growth traits which is often difficult in rural area due to lack of weighing scales, is required. Another important thing to understand are the factors that affect bodyweight and growth rate. This study was carried out to evaluate the effect of litter size, sex and parity on kid body weight, average daily gain and morphometric trait measurements in west African dwarf goats in Akwa Ibom State.

MATERIALS AND METHODS

Experimental site

The experiment was conducted at Aba Ukpo, Ibesikpo Local Government in Akwa Ibom State, Nigeria. The research was carried out between the January to Decemberber, 2023. Twenty small holder farmers herd (with Pregnant does) were selected for this study. Aba Ukpo is located between Latitudes 4º30ºN and 5º00N and

Longitudes 70°30°E and 80°00E. The area is characterized with an average annual rainfall ranging from 3450 mm an average monthly temperature of 25°C and relative humidity between 80-90%. Aba Ukpo Ibesikpo withness two distinct seasons which are dry and rainy seasons with the latter lasting for longer periods of the calendar year. It is in the tropical rainforest zone of Nigeria. The people in the study areas depend on livestock and crop production (4).

Experimental Animals and Management

Data used for this study were collected on 98 West African dwarf kids born to 70 dams (with parity 1-4; from 20 herds and age 2-4 years) surveyed in Aba Ukpo Ibesikpo in Akwa Ibom State. The goats were managed traditionally involving tethering in the day and housing at night. They were release daily in the morning and tethered close to the house for browsing and remain outside until about 6:00Pm in the evening. Left over food within the family were also given before releasing them in the morning; drinking water were provided. During the survey, only goats within their first four parities were identified at pregnancy stage and used. Data collected on each dam at kidding were litter size and parity as well as sex of the kid.

Data Collection

A total of 98 sets of measurements were obtained for the 10 variables studied. Body weight of kids at birth and at 3 months was taken using 120kg hanging scale and the weight gain (WG) was obtained by subtracting the birth weight from 3 months weight, while average daily weight (ADW) was obtained by dividing three months body weight by the number of days involved (three months; 90days). The following linear body measurements were made on the kids at birth and at three months using the tailors tape measure.

i. Hearth girth which represents the circumference of the chest
ii. Body length which represents the distance from the eternal occipital protuberance to the base of the tail, and
iii. Height at wither which refers to the distance from the surface of a platform to the withers.

Statistical Analysis

Only kids that have completed records from birth to three months were included in the analysis. Data collection was classified on the basis of litter size, sex and parity. All data collected were subjected to analysis of variance (ANOVA) using SPSS (version 23) (5) and significant means were separated using Duncan's Multiple Range.

RESULTS AND DISCUSSION

Body weight and linear body measurement (hearth girth, body length, and height at withers) at birth and 3 months of age as well as three months weight gain (WG) and average daily gain (ADG) of kids are presented in table 1 and 2. The result indicated that birthweights were 1290 ±0.06g, 1220±0.04g and 1100±0.00g for single, twins and triplets respectively. Kids born as singles were significantly heavier than twins and triplets. The average birth weight of twins (1220±0.04g) was higher than that of the triplets (1100±0.00g). The mean average birth weight of 1203±0.36g recorded in the study is below 2000g reported by (6) but compares favorably with 1.2kg reported earlier by (7) and (8) for the same breed. However, the mean birth weight obtained in this study is lower than means reported by (9) and (10). The differences observed could be due to management conditions in the different herds. Birthweight has been reported to decrease with increase in litter size (7). In lambs, it has been reported that as the number of foetus increases, the number of caruncles attached to each foetus decreases thus reducing the feed supply to the foetus and hence the birth weight of the lambs (7).

In this study, 3 months weight of 4516±0.41g approached the 5.5kg weaning weight reported by (12) and the indigenous goats are not weaned until about 4 to 6 months of age (11). The 50.72±0.86g per day recorded for 3 months ADG was comparable to the preweaning average daily gain of 57.49g for the same breed (Alphonsus *et al*., 2010). Kids born single were heavier (P<00.05) than twins or triplets but their growth rate was slower (P<0.05). Also, males were heavier than females (P<0.01-0.05). However, parity had no significant effect on kid's body weight from birth to 3 months of age. This disagrees with previous reports

(7) and may probably be due to the fact that a substantial number of dams of the same age range was found across parities 1 to 4. Therefore, the issue of young dams giving birth to kids of smaller birth weight (12) may have been confounded by the presence of dams of similar age across parities. All the same, the significance influence of litter size and sex of kid on birth weight and ADG of kids agrees with earlier report on goats (12).

Table 1: Effect of litter size, sex and Parity on birth weight, 3 months weight, weight gain and average daily weight gain in kid

Parameter	No	Birthweight	3 months weight (g)	Weight Gain (g)	3 months ADG (g)
Litter size	70				
1	46	1290±0.06[a]	4750±0.11[a]	3460±0.12[a]	52.77±0.01[a]
2	20	1220±0.04[b]	4700±0.08[a]	3480±0.05[a]	52.22±0.03[a]
3	5	1100±0.09[b]	4100±0.06[b]	3000±0.04[b]	45.55±0.01[b]
Sex	98				
Male	53	1300±0.11[a]	4775±0.08[a]	3475±0.75[a]	53.05±0.01[a]
Female	45	1100±0.03[b]	4350±0.09[b]	3250±0.18[b]	48.33±0.12[b]
Parity	70				
1	32	1220±0.05	4500±0.04	3280±0.15	50.00±0.04
2	20	1210±0.06	4710±0.06	3500±0.23	52.33±0.03
3	12	1200±0.08	4600±0.04	3400±0.15	51.11±0.06
4	6	1200±0.08	4650±0.02	3450±1.01	51.66±0.04
Overall mean	98	1203±0.36	4516±0.41	4564±0.58	50.72±0.86

a, b Means in the same column with different superscripts differs significantly ($p<0.05$)

Table 2: Effect of litter size, sex and parity on morphometric Traits of kids

Parameter	NO	HGB	BLB	HWB	HGW	BLW	HWW
Litter size	64						
1	26	23.25±0.47	25.53±0.56	24.10±0.52	54.01±0.53[a]	56.31±0.1a	50.01±0.90
2	28	24.72±0.35	24.15±0.61	24.50±0.31	53.62±0.75[a]	54.45±0.96[a]	50.20±0.93
3	10	23.91±0.53	23.25±0.85	25.30±0.83	50.58±0.62[b]	50.01±0.81[b]	50.72±0.95
Sex	75						
Male	42	24.51±0.46	24.50±0.49	25.91±0.45	53.71±0.65[a]	54.31±1.08[a]	50.31±1.10
Female	33	23.90±0.47	23.62±0.47	25.65±0.60	49.45±0.53[b]	51.05±0.92[b]	50.31±1.25
Parity	64						
1	15	24.80±0.73	25.45±0.85	26.2±0.36	51.32±0.88	47.7±0.65b	48.71±0.47[b]
2	23	25.05±0.65	23.50±0.31	26.10±0.29	54.15±0.78	55.20±0.91[a]	53.72±1.48[a]
3	16	23.71±0.44	23.4±0.75	24.42±0.54	52.4±0.95	53.15±0.85[a]	50.55±1.35[ab]
4	10	23.5±0.36	23.7±0.45	25.35±0.41	52.5±0.59	52.72±0.89[a]	50.3±0.85[ab]

a, b Means in the same column with different superscripts differs significantly ($p<0.05$), HGB= Heart girth Body length at Weaning, HWW=Height at wither at Weaning

Litter size, sex and parity had no significance ($P>0.05$) influence on the body measurement at birth, but they significantly ($P<0.05$) affected them at 3 months of age. At three months, heart girth and body length of singles were bigger and longer, respectively than those of triplets. Males had bigger heart girth and longer body length than females. Also, kids of first parity dams were shorter than those of parity 2, 3 and 4.
The none significant effect of litter size, sex and parity on those traits at birth may suggest that maternal environment probably, may not have exerted any significant influence in the growth rate of these traits. However, at 3 months the significant influence maybe ascribed to dams mothering ability, competition amongst kids for udder sucking and available food for litter size and sex. Males tend to be more aggressive than females. The 3 months heart girth, body length and height at wither are reported to be positively and

significantly correlated with body weight (13 and 14). Consequently, selection based on the 3 months measurements will lead to improvement in mature body weight.

CONCLUSION

Litter size, sex and parity significantly influenced body weight and morphometric trait measurements in West African Dwarf goat kids and should be considered in improvement programme to increase meat yield from this breed of goats.

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Animal Breeding and Genetics: ABG 010

EFFECTS OF GENERATIONS OF SELECTION ON BODY WEIGHT IN TWO STRAINS OF INDIGENOUS TURKEY (*Meleagris Gallopavo*) AND THEIR CROSSES IN NORTHERN GUENEA SAVANNAH ZONE OF NIGERIA

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ABSTRACT

A study was conducted to determine the effects of selection on body weight in two strains of native turkeys and their reciprocal crosses. In generation 1 (G_1) 180 poults were produced from a foundation stock of white, black, main (white male X black female) and reciprocal cross (black male X white female) which make it four breeding groups, with three replicates (45 poults per breeding group). At 8weeks, 1 tom and two hens with highest body weight were selected per replicates and used as parent of generation two (G_2), while others were maintained as control group, body weight (BW) of both groups were taken at an interval of four weeks up to 36weeks. The procedure used in G1 was adopted for G_2. Data generated were subjected to the General Linear Model (GML) procedure of SAS, differences between generation and strain were compared using Duncan Multiple Range Test (DMRT). The results revealed significantly ($p<0.05$) higher BW in G_2 (46.78±0.18g to 6208.72±60.80g) over G_1 (44.21±0.27g to 6065.30±50.70g), with higher coefficient of variation (CV) observed in G_1 (4.2 to 37.68) over G_2 (2.91 to 30.29). This shows that selection for increased 8weeks BW, increases BW of indigenous turkey. Thus Breeders and Farmers can select for increased 8weeks BW to increase turkey's growth rate. Among the two strains and their crosses the reciprocal (6555.25±227.27g, 6567.20±68.25g) was the heaviest ($P<0.05$) at 36weeks followed by black strain (5333.15±188.09g to 6162.40±200.72g), then white (5240.75±212.79g to 6020.55±220.68g), while the least was recorded in main cross (5792.50±227.27g, 6048.61±69.12g) in G_1 and G_2 respectively. Thus reciprocal cross and black were recommended for growth.

Key words: Selection, Body Weight, Indigenous turkey, Two strains, Reciprocal cross.

DESCRIPTION OF PROBLEM

Turkey production remained at small holder level and not popular in Nigeria because of management problems and poor growth performance of our native strains (1). But it is considered significant next to chicken, Duck, guinea fowl, pigeon and quail in contributing to the national economy, nutritional status and food security of the increasing population of the country (2).

Selective breeding is long-term human experiments that alter the phenotypes of domesticated species and is the primary methods of genetic improvement of livestock in quantitative genetics, which is more efficient in traits that are not difficult to measure or have a high heritability, such as body size or weight (3)

Native breed provides a basis for genetic improvement and diversification due to their resistance against local diseases and adaptability to weather conditions of their country (4). However, the performances of local poultry are lower than exotic poultry. Hence native breed cannot economically compete with commercial breeds with much higher production and are therefore becoming extinct (2). This implies that there is need to check the potentiality of improving our local turkeys through selective breeding.

The objective of this study was to determine the effects of selection on body weight in two strains of turkey and their reciprocal crosses in Northern Guinea savannah zone of Nigeria.

MATERIALS AND METHODS

Animals and Experimental Design

Experimental site

The research was conducted at the Teaching and Research Farm of Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University Zaria, Nigeria. Detailed of description of the site was given by (5).

Mating design and management of experimental birds:

The foundation stock consists of 36 adult turkeys of two different strains that comprised of 12 males and 24 females, grouped into four breeding groups of white strain, black strain, main cross and reciprocal cross which were replicated trice. Eggs were collected and hatched a total of 180 (G_1) poults were produced. At 8 weeks, 12 toms and 24 hens with high body weight were selected while others were maintained as control group. The selected groups were used as the parents of the second generation. The same procedure was followed to produce the (G_2) and body weight of both the selected and the control were taken at an interval of 4weeks up to 36 weeks. .

The birds were fed starter diet that contains 2800 kcal ME/kg with 28% CP, grower diet of 2900 kcal ME/kg with 18% CP and breeder diet of 2900 kcal ME/kg with 15% CP. They were fed *ad libitum*, clean drinking water provided. Necessary medications and vaccinations were administered as when due to ensure good health and improved egg production.

Statistical Analysis

Data generated were subjected to the General Linear Model (GML) procedure of SAS, differences between generation and among strain and their crosses were compared using Duncan Multiple Range Test (DMRT).

RESULTS

Table 1 shows the effects of Generation on body weight (g) at different ages (weeks) of turkey. There was significant increase ($P<0.05$) in body weight at different ages in Generation Two over One (G_2 and G_1) at day old, 4, 8, 24, 28, 32 and 36weeks. The mean body weight at these ages ranges from 44.21±0.27g to 6065.30±50.70g in G_1 which is lower than the range of 46.78±0.18g to 6208.72±60.80g in G_2, whereas, no differences were observed in body weight at 12, 16 and 20 weeks of age from G_1 to G_2. The higher body weight observed in G_2 over G_1 shows that there was an increase in body weight due to selection. This is in accordance with the findings of (6) when they select for increased body weight at 16weeks of age in turkey. The coefficient of variation ranged between 4.2 to 37.68 and 2.91 to 30.29 in G_1 and G_2, respectively, with lower variability observed in G_2 than G_1. This shows that selection increases homogeneity of body weight and make the birds look similar in G_2. This is similar to the study of (7) that reduction in coefficient of variation shows that animals are becoming homogenous in performance.

Table 2 depicts the effects of strain and their crosses on body weight of turkeys at different ages in G_1 and G_2. In G_1, there were no significant differences in body weights among strains and their crosses, at day old, 4, 8 and 12weeks while, at later ages (16 to 36 weeks) differences were observed. This is in line with the study of (8) the authors observed no significant difference in weight among three breeds of turkey. On the other hand, significant differences ($P<0.05$) were observed at 16 to 36weeks. This is also in accordance with the work of (1) who observed a significant variation in body weight between different strains of turkey in Nigeria. Among the strains and their crosses, at early age, the reciprocal cross are heavier and their weight are statistically similar to the white strain, followed by main cross, while black strain had the least.

Table 1: Effects of Generation on body weight (g) at different ages (weeks) of turkey

Age	G_1	CV	G_2	CV	LOS
Day old	44.21±0.27[b]	4.2	46.78±0.18[a]	2.91	*
4	279.60±4.05[b]	10.14	294.05±2.32[a]	4.53	*
8	804.00±12.67[b]	8.48	838.62±6.89[a]	6.17	*
12	1513.04±34.05	22.81	1531.10±19.98	9.29	ns
16	2357.87±36.42	10.51	2409.87±20.75	7.79	ns
20	3213.58±68.56	15.29	3267.70±43.58	13.49	ns
24	4009.31±69.48[b]	20.48	4458.05±68.76[a]	19.51	*
28	4404.26±133.63[b]	26.50	4700.05±104.61[a]	24.46	*
32	5142.25±195.63[b]	32.70	5429.84±152.25[a]	30.71	*
36	6065.30±50.70[b]	37.68	6208.72±60.80[a]	30.29	*

[a,b] means with different superscript on the same row are significantly different at P<0.05 CV= coefficient of variation; G_1= Generation one; G_2= Generation two; LOS= level of significant.

Table 2: Effects of strain and their crosses on body weight (g) at different ages (weeks) of turkey in Generations One and Two

Gen	Age	White	Black	Main cross	Reciprocal cross	Sig
1	Day old	43.71±0.75	44.18±0.66	43.79±0.72	45.12±0.75	ns
	4	266.71±9.93	273.98±8.77	269.89±9.64	282.219.93	ns
	8	769.33±27.02	789.54±23.86	785.21±26.23	799.96±27.02	ns
	12	1454.79±84.05	1390.40±74.23	1454.46±81.61	1478.58±84.05	ns
	16	2402.96±79.96[a]	2291.86±70.61[b]	2297.16±77.64[b]	2402.04±79.96[ab]	*
	20	3265.04±167.34[ab]	3210.8±147.79[b]	3251.07±162.49[ab]	3333.04±167.35[a]	*
	24	3740.00±155.45[b]	3579.61±149.37[b]	3525.61±117.25[b]	4249.11±232.06[a]	*
	28	4396.75±182.39[b]	4501.99±161.09[b]	4351.68±177.11[b]	5092.42±182.39[a]	*
	32	5240.75±212.97[b]	5333.15±188.09[b]	5175.0±206.79[c]	5885.88±212.97[a]	*
	36	6020.55±220.68[ab]	6162.40±200.72[ab]	5792.50±227.27[b]	6555.25±227.27[a]	*
2	Day old	46.32±0.36[b]	46.76±0.35[b]	46.39±0.33[b]	47.74±0.33[a]	*
	4	282.94±4.49[b]	295.03±4.34[ab]	294.19±4.10[ab]	305.43±4.05[a]	*
	8	832.07±14.44[ab]	821.73±13.96[b]	841.17±13.19[ab]	862.67±13.02[a]	*
	12	1512.53±39.22[b]	1387.03±37.91[c]	1631.77±35.82[a]	1577.74±35.37[ab]	*
	16	2415.07±43.36[ab]	2324.87±41.91[b]	2445.53±39.61[ab]	2458.67±39.11[a]	*
	20	3288.36±70.01[b]	3185.84±67.67[b]	3207.63±63.94[b]	3511.21±63.14[a]	*
	24	4042.29±68.58[b]	4063.97±66.29[b]	3856.29±62.64[c]	4358.43±61.85[a]	*
	28	4718.04±77.32[b]	4921.17±74.72[ab]	4512.45±70.61[c]	5116.15±69.72[a]	*
	32	5473.13±86.69[b]	5773.45±83.78[a]	5310.96±79.18[c]	5882.94±78.18[a]	*
	36	6123.92±75.68[b]	6493.58±73.14[ab]	6048.61±69.12[b]	6567.20±68.25[a]	*

[a,b,c,d] means with different superscript on the same row are significantly different at P<0.05; Gen= Generation.

Similarly, at later age 28-36weeks reciprocal cross had heavier weight that ranged (5885.88±212.97g to 6555.25±227.27g), followed by black (5333.15±188.09g to 6162.40±200.72g), then white (5240.75±212.79g to 6020.55±220.68g) and main cross had the least weight (5175.75±206.79g to 5792.50±227.27g). In G_2, significant difference (P<0.05) was observed in all the body weight measured at different ages in the two strains and their crosses. At the early age, day old to 16weeks, the reciprocal were heavier and statistically similar to the main cross, while the two pure strains (black and white) fluctuate. As from 24-36weeks of age, the reciprocal cross maintained the superiority with a mean range of 4358.43±61.85 to 6567.20±68.25g and is statistically similar to the black strain (4063.97±66.29 to 6493.58±73.14g), while, the white strain (4042.29±68.58 to 6123.92±75.68g) and the main cross (3856.29±62.64 to 6048.61±69.12g)

shows the least range weight. The heavier weight observed in reciprocal cross (black male and white female) and the least weight recorded in main cross (white male and black female) is because of the higher body weight observed in toms of black and hens of white and vice vasa (the parents that were mated to produce each cross). Thus, resiprocal is recommended for growth. In the two pure breeds, black strain had higher body weight white strain in both generations. Thus it could be firmly stated that the black strain possesses gene for faster growth than white. This is consistent with the studies of (1) who all observed higher body weight in black over White strain of Nigerian turkeys.

CONCLUSION AND APPLICATION

Higher BW observed in G_2 (46.78±0.18 to 6208.72±60.80) over G_1 (44.21±0.27 to 6065.30±50.70), with higher coefficient of variation (CV) observed in G_1 (4.2 to 37.68) over G_2 (2.91 to 30.29) shows that selection for increased 8 weeks BW increases BW of indigenous turkey. Thus breeders and farmers can select turkey for increased 8-weeks body weight to increase their growth rate.

Among the two strains and their crosses the reciprocal (6555.25±227.27g, 6567.20±68.25g) was the heaviest ($P<0.05$) at 36 weeks followed by black strain (5333.15±188.09 to 6162.40±200.72), then white (5240.75±212.79 to 6020.55±220.68g), while the least was recorded in main cross (5792.50±227.27g, 6048.61±69.12g) in G_1 and G_2 respectively. Thus reciprocal cross and black were recommended for growth.

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Animal Breeding and Genetics: ABG 011

PERFORMANCE HERITABILITY OF WEIGHT GAIN IN CHICKEN TYPES ADMINISTERED MAHOGANY (*Swietenia macrophylla*) OIL

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ABSTRACT

This study evaluated the performance characteristics and heritability of weight gain in chicken types administered 0.5ml of Mahogany (*Swietenia macrophylla)* oil per day per bird for 7 weeks. A total number of 80 chicks of the F1 generation were used for the experiment: 40 birds for treated and 40 birds for the untreated. Result showed that the oil improved weight gain from day 1 to 6 weeks by 1,762g; this was later followed by a sudden decline and subsequent mortality of all treated birds. All hematological parameters except Mean Cell Volume (MCH) considered in the experiment were significantly lowered in treated birds. Heritability estimate obtained for performance characteristics ranged from 0.001 (0.1%) to 0.4 (40%) for spleen weight and eviscerated weight respectively.

Key words: Mahogany oil, Weight gain, Heritability, Hematological Parameters

INTRODUCTION

The traditional use of mahogany (Swietenia macrophylla) oil in folk medicine has recently sparked interest as a natural feed additive for poultry. The global poultry industry, a major source of animal protein, faces challenges such as disease outbreaks, antibiotic resistance and environmental concerns, necessitating innovative and sustainable solutions (Suganya *et al*., 2022). Weight gain is a crucial performance metric in chicken production, directly affecting profitability. Various genes, including Major Histocompatibility Complex (MHC), Natural Resistance-associated Macrophage Protein 1 (Nramp1), and Insulin-like Growth Factor 1 (IGF-1), influence growth and disease resistance (Ibe, 2019). Antibiotic resistance, exacerbated by improper antibiotic use, underscores the need for natural antimicrobial alternatives. Hematological, carcass and histological evaluations are essential for understanding bird health, nutrient metabolism and overall physiology. Studying the effects of mahogany oil on these parameters will help determine its potential benefits or risks, including any toxicity or beneficial effects at microscopic level. This research seeks to fill the gap in knowledge regarding the impact of mahogany oil on these critical health indicators (Suganya *et al.,* 2022). Heritability, the proportion of variation in a trait due to genetic factors, is vital for genetic improvement strategies in poultry. Accurate heritability estimates can guide breeding programs to enhance traits like weight gain and feed efficiency (Kennedy *et al*., 2020). The primary problem this research addresses is the lack of understanding regarding the use of mahogany oil in chicken production, focusing on its effects on weight gain, hematological and carcass parameters, and histological changes in vital organs.

MATERIALS AND METHODS

This research was conducted at Great Lift Agricultural Development Limited research farm in Kaduna, Kaduna state, with hematological and histological analyses performed at the pathology laboratory of the Department of Veterinary Medicine, Ahmadu Bello University, Zaria, Kaduna state.

Experimental Design and Diet

The trial was carried out in a disinfected, isolated room under controlled conditions using a deep litter system. The chickens were kept at a comfortable temperature based on their age, with free access to food and water. Their diet were commercial feed of corn and soybean-based pellet.

Experimental Procedure

Five female and one male each of the corresponding type from the parent generation were mated, and the resulting eggs were collected, weighed, and assessed for shell thickness and density. Some eggs were incubated, and the chicks hatched after 21 days. The day-old chicks from the F1 generation were vaccinated against Marek disease and divided into treated and untreated groups, with the treated group receiving 0.5 ml of mahogany oil daily. Blood samples were collected for hematological analysis, and the weight of the chicks were monitored throughout the experiment.

Analytical Methods

Hematological parameters were assessed using the Complete Blood Count (CBC) method with a hematological analyzer and microscopic evaluation of blood cell morphology. Carcass parameters were determined by weighing live and plucked chickens, harvesting and weighing their organs. Histological evaluation involved fixing harvested organs in neutral buffered formalin and staining with Hematoxylin and Eosin (H&E) for microscopic examination. Data were analyzed using one way Analysis of Variance (ANOVE) using the SPSS software, and heritability estimates were computed using the Minimum Norm Quadratic Unbiased Estimation (MINQUE) method, which provided the most reliable values.

RESULTS AND DISCUSSION

Table 1: Least squares means and standard errors of hematological parameters as affected by treatment of four bird types reared at GLAD farm, Agwa, off Kakuri, Kaduna State

		Haematological Parameters						
Variable	**N**	**Packed Cell Volume (%)**	**Red Blood Cells (x 10^6 µl)**	**Hemoglobin (g/dl)**	**White Blood Cells (x 10^3 µl)**	**Mean Cell Volume (Fl)**	**Mean Cell Hemoglobin (g/cell)**	**Mean Cell Hemoglobin Concentration (g/dl)**
Overall	80	25.85± 0.28	2.78± 0.26	9.14± 0.12	16.46± 0.30	98.69± 0.89	35.75±0.20	29.56±0.15
Recommended Values		22–38 (30)	2.5–3.5 (3.0)	7–13 (10)	12–30 (21)	90–140 (115)	33–47 (40)	26–35 (30.5)
Bird Type								
Noilier (1)	20	26.45	2.72	9.10	16.90	97.05	35.20^b	29.35
Isa Brown (2)	20	25.35	2.78	9.05	15.85	96.70	34.20^b	29.50
Local (3)	20	25.35	2.80	9.05	16.05	99.95	36.95^a	29.65
Broiler (4)	20	26.25	2.81	9.35	17.05	101.05	36.65^a	29.75
Sig.		ns	ns	ns	ns	ns	***	Ns
Treatment		***	**	***	*	*	ns	***
Treated## (1)	40	24.73^b	2.70^b	8.50^b	15.85^b	96.63^b	35.63^b	28.48^b
Untreated (2)	40	26.98^a	2.85^a	9.76^a	17.08^a	100.75^a	35.88^a	30.65^a

Source [1] S. Arjumand *et al*. (2021) [2] R. Firas (2019); * = P <0.05; ** = P <0.01; *** = P <0.001; ns = Not Significant
Values in parenthesis are averages ## = Birds treated with 0.5 ml of Mahogany (***Sweiteina macrophyla***) oil once daily for 7 weeks
Means for groups in homogenous subsets are similar

Results revealed that mahogany oil administration led to significant reductions in several hematological parameters in chickens. The overall mean PCV was 25.85%, within the recommended range (Arjumand et al., 2021), with treated birds showing significantly lower PCV (24.73%) than untreated ones (26.98%) (P<0.001). The mean RBC count was 2.78 x 10^6 µl, with treated birds showing a lower count (2.70 x 10^6 µl) compared to untreated ones (2.85 x 10^6 µl; P<0.01) (Firas, 2019). The mean Hb concentration was 9.14 g/dl, with treated birds having lower levels (8.50 g/dl) than untreated ones (9.76 g/dl; P<0.001) (Arjumand

et al., 2021). The mean WBC count was 16.46 x 10^3 µl, with treated birds showing lower counts (15.85 x 10^3 µl) compared to untreated ones (17.08 x 10^3 µl; P<0.05). The mean MCV, MCH, and MCHC were within recommended ranges, but treated birds had significantly lower MCV (96.63 fl vs. 100.75 fl; P<0.05) and MCHC (28.48 g/dl vs. 30.65 g/dl; P<0.001) (Arjumand et al., 2021). These findings are consistent with previous studies indicating that natural feed additives can modulate blood parameters in poultry, enhancing immune responses without adverse effects (Sugiharto *et al.,* 2016; Abdel-Fattah *et al*., 2018; Khetani *et al*., 2020; Olaniyan *et al*., 2018).

Table 2: Estimate of heritability of carcass parameters as affected by Mahogany oil at GLAD farm, Agwa, off Kakuri, Kaduna State

No.	Traits	Sir component	Dam component	Error component	Heritability (h^2)	Percentage heritability	Recommended Value
1	Live weight	0.000	195.161	2570.531	0.011	1.1	0.7
2	Pluck weight	0.000	46211.589	1267.352	0.003	0.3	0.7
3	Eviscerated weight	0.000	7.146	102.977	0.400	4.0	0.7
4	Carcass weight	0.000	-1.946	82.447	0.045	4.5	0.7
5	Heart weight	0.000	-0.14	1.035	0.0004	0.04	0.7
6	Spleen weight	0.000	-0.184	6.872	0.001	0.10	0.7
7	Liver weight	0.000	0.001	0.378	1.4	140	0.7
8	Kidney weight	0.000	0.030	0.461	0.006	0.6	0.7
9	Intestinal weight	0.000	1.023	4.578	0.100	10.00	0.7

Results revealed that heritability of live weight was estimated as 0.011, and much lower than the recommended 0.7 (Cahyadi *et al.,* 2015). This suggests a strong influence of environmental factors. Pluck weight had an extremely low heritability of 0.003, indicating ineffectiveness of genetic selection (Cahyadi *et al*., 2015). Eviscerated weight showed moderate heritability at 0.400 but still below the recommended threshold (Cahyadi *et al*., 2015). Carcass weight had low heritability (0.045), suggesting significant environmental impact (Cahyadi et al., 2015). Heart weight and spleen weight had negligible heritability (0.0004 and 0.001 respectively), indicating environmental dominance (Cahyadi *et al*., 2015). Liver weight showed notably high heritability at 1.4, indicating strong genetic influence (Cahyadi *et al*., 2015). Kidney weight had low heritability (0.006), suggesting limited genetic influence (Cahyadi *et al*., 2015). Intestinal weight had moderate heritability at 0.100, with environmental factors still predominant (Cahyadi *et al*., 2015). These findings are consistent with findings of Cahyadi *et al*, (2015) who reported low to moderate heritability for carcass traits in poultry.

CONCLUSION

It was concluded that, mahogany oil should be avoided or used with caution by limiting its application to maximum of two weeks avoid adverse effect.

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Animal Breeding and Genetics: ABG 012

HERITABILITY AND REPEATABILITY ESTIMATES OF BODY WEIGHTS OF DOMESTIC PIGEON SQUABS (*Columba livia*) IN SEMI-ARID REGION OF NIGERIA

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ABSTRACT

The study aimed to determine body weights of domestic pigeon squabs (Columba livia) and estimate their heritability and repeatability at the Poultry Unit of the Livestock Teaching and Research Farm, Ramat Polytechnic Maiduguri, Borno State. A total of 100 pairs of pigeons produced 765 squabs for the experiment. The birds were managed in monogamous pairs and fed seeds, grains, and crushed groundnuts, with clean drinking water provided *ad-libitum.* Squabs were weighed at hatch and at three-day intervals up to 30 days. Data were analysed using the General Linear Model (GLM) procedure of SAS, with means separated by Duncan's Multiple Range Test. Heritability and repeatability were estimated using the Mixed Model Maximum Likelihood Method. Results indicated that body weights of squabs increased significantly up to 18 days, then gradually slowed. High heritability and repeatability estimates, which increased with age, suggest that selecting for improved body weight is feasible at these stages.

Keywords: Body weight, Pigeon, Squabs, Heritability, Repeatability

DESCRIPTION OF PROBLEM

Live body weight is a key factor determining the market value and optimal slaughter time of animals, reflecting their overall development (1). Body weights are influenced by maternal or dominance effects, with higher heritability estimates from dam variance compared to sire variance (2). Indigenous birds are crucial for gene conservation, impacting both production systems and socio-cultural practices. However, rural poultry productivity measurements are often hindered by crossbreeding with exotic strains. Chineke et al. (3) noted that body characteristics are vital for assessing performance and carcass traits, and quantitative measures are essential for estimating genetic parameters. Estimating genetic parameters like heritability and repeatability is crucial for understanding trait variability and guiding effective genetic improvement programs (4). These parameters influence selection methods and decisions to achieve genetic progress (5). This study aims to determine the body weights of domestic pigeon squabs and estimate their heritability and repeatability.

MATERIALS AND METHODS

The study was conducted at the Poultry and Livestock Teaching and Research Farm, Department of Animal Production Technology, Ramat Polytechnic Maiduguri, Borno State, Nigeria. For the experiment, 100 pairs of breeding pigeons were used to produce 765 squabs. The pigeons were housed in predator-proof shelters with wooden cages attached externally (open house type) and were fed seeds, grains (wheat, millet, sorghum), crushed maize, and kitchen scraps, two to four times daily, with clean drinking water provided *ad-libitum.* Body weights were measured individually at hatch, and at 3, 7, 10, 14, 18, 21, 24, 27, and 30 days using a 5000 g digital scale. Data were analyzed using ANOVA via the General Linear Models Procedure of SAS (version 9.0) to compute means (±standard errors), coefficients of variation, and variance components. Heritability (h^2) estimates for growth and body weight were calculated using the interclass correlation method, focusing on sire and dam variance components (8).

From sire and dam variance components: $h^2 = \frac{2(\delta^2 s+\delta^2 D)}{\delta^2 s+\delta^2 D+\delta^2 W}$

Where: $\delta^2 s$ = the variance component for sire
$\delta^2 D$ = the variance component for dam
$\delta^2 W$ = the error variance component

The repeatability (R) of body weight was estimated using the following expression according to Becker (8).

$$R = \frac{\delta^2_\beta}{\delta^2_\beta+\delta^2_W}$$

Where: R = Repeatability
δ^2_β = Variance component due to differences among individual and
δ^2_W = within individual component of variance

RESULTS AND DISCUSSION

Body weights of pigeon squabs ranged from 15.51 g at day old to 363 g at 30 days (Table 1). This is consistent with Darwati et al. (9), who reported 16.20 g at day old and 340.00 g at 5 weeks in Indonesia. Similarly, Aliyu et al. (10) found 15.19 g at day old and 376.60 g at 27 days. Bhowmik et al. (11) observed weights of 31.68 g, 225.53 g, 275.59 g, and 324.79 g at 3, 15, 21, and 28 days, respectively. In contrast, Gao et al. (12) reported higher values: 18.7 g at day old and 487.5 g at 4 weeks. Momoh et al. (13) reported 13.17 g at day old and 108.62 g, 221.61 g, and 275.52 g at weeks 1, 2, 3, and 4, respectively. These variations may be due to differences in pigeon strains, management practices, and environmental conditions. Figure 1 shows body weight gains from day old to 30 days as 15.51 g, 46.35 g, 64.83 g, 61.53 g, 61.40 g, 47.20 g, 4.21 g, 20.68 g, 19.49 g, and 22.45 g. This aligns with Is-haq (14), who reported weekly gains of 134.666 g, 66.786 g, 43.274 g, and 4.286 g at 1, 2, 3, and 4 weeks. Ashraful (15) reported gains of 31.68 g, 193.85 g, and 225.53 g at 3, 15, and 30 days, respectively. Pigeon squabs show rapid growth up to 18 days, slowing thereafter. Their growth rate (0.1466 to 0.1945 g/d) surpasses that of chickens (0.0450 g/d) and quails (0.077 to 0.097 g/d) as reported by Sales (16). This rapid growth may be due to nutrient-rich regurgitation from parents. Figure 1 also shows that male squabs grow faster than females, with the rate slowing from 18 to 30 days. This trend is consistent with Is-haq (14) and Faraji-Arough et al. (17), who reported higher weight gains in males compared to females. This difference may be due to more efficient feed conversion and sex hormones promoting muscle development in males, or possibly higher hatching weights in males.

Heritability estimates of body weight and body measurements

Heritability estimates of body weight at different ages are shown in Table 1. The high heritability estimates (0.48 to 0.99) suggest potential for selecting and improving body weight in pigeons. Daikwo et al. (18) reported heritability estimates for hatch weight, 1 week, 2 weeks, 3 weeks, 4 weeks, and mature body weight as 0.51, 0.24, 0.28, 0.33, 0.57, 0.44, 0.41, and 0.38, respectively. Narinc et al. (19) found a heritability estimate of 0.36 for body weight at 5 weeks in Japanese quail. Manjula et al. (20) reported estimates of 0.458, 0.266, 0.161, 0.233, 0.088, 0.058, 0.042, and 0.128 for Korean native chickens. The increasing heritability with age observed in this study is consistent with Ahmed et al. (21) and Momoh et al. (13) for pigeons. However, this contrasts with the findings of Saatci et al. (22), Daikwo (23) in Japanese quails, and Manjula et al. (20) in Korean native chickens, who reported decreasing heritability with age. These differences may be due to variations in populations and methodologies used in these studies.

Repeatability Estimates of Body Weight and Body Measurements

Repeatability estimates of body weight at different ages are shown in Table 1, with values generally high (0.52 to 0.69). This is consistent with Darwati et al. (9), who also reported high repeatability for body weight at hatch and 4 weeks in domestic pigeons. Similarly, Sanda et al. (24) observed high repeatability estimates for body weight across three strains of broiler chickens, and Kabir et al. (2008) reported similar findings. In contrast, Aliyu et al. (10) found lower repeatability estimates for pigeon squabs, varying by location and sex. These differences may be due to variations in data size, environmental factors, and genotypes. The high repeatability observed in this study suggests minimal environmental influence and indicates that fewer

records are needed to assess the potential of these birds. It also implies that any individual from this population could be selected as a parent for the next generation.

Table 1: Heritability and Repeatability estimate ± S.E of body weights (g) of domestic pigeon squabs at different Age.

Age (Days)	Body weight (g)	R± S.E	h^2±S.E
0	15.511	0.511±0.002	0.68±0.11
3	61.860	0.527±0.002	0.78±0.11
7	126.690	0.542±0.002	0.99±0.03
10	188.222	0.578±0.002	0.99±0.03
14	249.618	0.615±0.001	0.99±0.03
18	296.816	0.674±0.001	0.99±0.03
21	301.022	0.646±0.001	0.99±0.03
24	321.705	0.644±0.001	0.99±0.03
27	341.194	0.698±0.001	0.99±0.03
30	363.643	0.696±0.001	0.99±0.03

SE= Standard error h^2= Heritability R= Repeatability

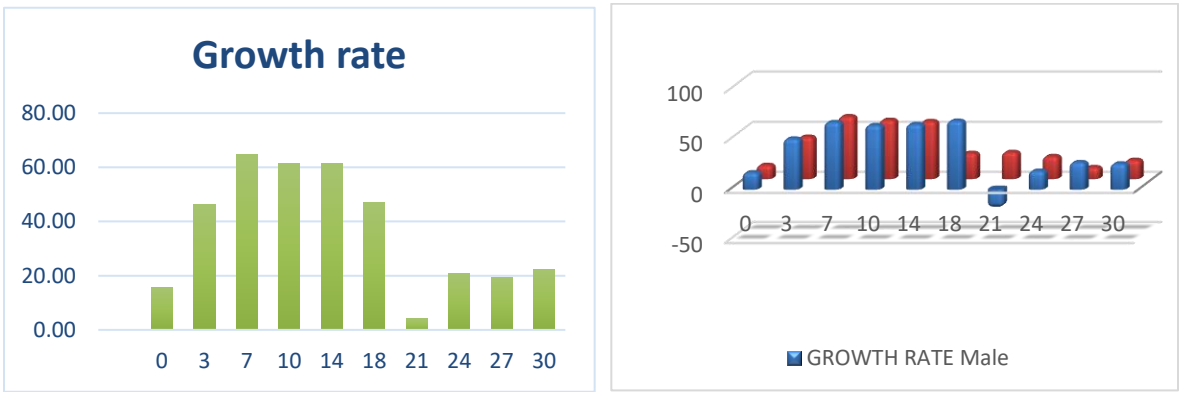

Figure 1: A bar graph showing the growth rate of squabs at different ages (g/days)

CONCLUSION

It was evident that the mean body weights of pigeon squabs remarkably increased as the squabs advanced in age up to 18 days and begin to slow down gradually thereafter. Sexual dimorphism which was in favour of males was noticed at all ages for body weight gains of domestic pigeon squabs. Heritability and repeatability estimates of body weights were high at all stage of growth and increases with increase in age. This suggests that selection for improvement of body weights can be achieved at these ages of 0 to 30 days.

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CAMELIDS: POTENTIALS AND CHALLENGES TOWARDS GENETIC IMPROVEMENT

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ABSTRACT

Camel is an important livestock species that are uniquely adapted to hot arid environments. Adaptation to harsh weather is vital for future livestock as heat stress can extremely reduce their productivity, health, and fertility. Camels produce quality and nutritive products such as milk, meat, and fiber. The management system practices in camel production are under traditional systems by traditional pastoralists, nomads, and semi-intensively by agro-pastoralists in arid and semi-arid lands. Considering the potential of camels in the production of nutritive and quality dairy and beef products, they require genetic improvement using modern methods and tools. Small herd size and scattered population is a challenge facing the genetic improvement of camels which makes it difficult to collect phenotypic data; thus creating an obstacle in camel breeding programmes. In addition, the lack of structured breeding programmes and limited research on camel genetics further complicate the advancement of its genetic potential. Implementing advanced breeding techniques such as artificial insemination, embryo transfer and genomic selection could significantly enhance genetic diversity and productivity. Hence, collaborative efforts between researchers, governments, and local communities is required to establish comprehensive genetic improvement programs. Furthermore, integrating traditional knowledge with scientific approaches can facilitate sustainable camel breeding practices. By addressing these challenges, it is possible to unlock the full potential of camels, ensuring their viability and productivity in the face of increasing climate variability and global food demands.

Keywords; Camel, Genetic Resources, Milk, Beef and Diversity

DESCRIPTION OF THE PROBLEM

Camel production serves as the basis of livelihood of millions of households across Africa, the Middle East, and Asia [1]. It is an important livestock species uniquely adapted to hot arid environments. Among the large camelids, dromedary comprises of about 95% of camel population [2]. Ecologically, arid and semiarid environment accounts for 60% of the total land mass, 20 percent of total livestock, and 11 percent of human population [3]. Adaptation to a hot climate is vital for future livestock as heat stress can extremely reduce productivity, health, and fertility [4]. Camels have developed, through the millennia, the ability to produce quality meat, milk and fiber in some of the hottest and most hostile environments on the globe [5]. With increasing human population pressure and declining per capita production of food in Africa, there is an urgent need to develop previously marginal resources, such as the semi-arid and arid rangelands, and to optimize their utilization through appropriate livestock production systems of which camel production is certainly one of the most suitable [6]. To harness the potential of camel production, an improved understanding of the genetics underlying their uniqueness is needed. The lagging effort that has been associated with camel breeding is a backward trend that has to be removed [7].

Traditional systems of management were practiced by majority of pastoralist in the arid and semi-arid lands (ASALs). According to Wilson [7], single humped camel owned by pastoralist are primarily depended on animal for transportation and supply of food. Camels are also considered as multipurpose animals in some areas with versatility in socio-economic activities, racing, as draught animal and trading [8, 9]. The majority of the traditional systems of camel production practiced by pastoralists do not in many ways contribute to camel genetic improvement [10]. The genetic endowment of camel include adaptation to harsh environments, versatility of products: milk, meat and, hair/felt. They also use for, racing, transportation, and

tourism [5]. Moreover, camels' milk and meat are highly nutritional, comparable to, and sometimes deemed better than beef and cow milk. For instance, camel meat contains less fat than lamb or beef, and its protein quality, assessed by the index of essential amino acids in meat, is the highest among red meat; its milk contains between 3 and 10 times more vitamin C than cows' milk [11, 12, 13].

Potential of Camel to Genetic Improvement.

Several species of livestock are continuously undergoing genetic improvement of production traits which reshaped the livestock industry such as cattle, sheep and goat. Camel has been left behind in genetic improvement despite its contribution to the livelihood of the society in terms of milk, meat, hide and skin. [5]. The utilize camels' potential, they need to undergo genetic improvement while sustaining their genetic diversity. Molecular characterization used in targeting camel for genetic improvement have been attempted [1]. Through multi-traits genetic improvement programs, several production traits, milk, meat, hide and skin can be improved, health traits such as resistance to diseases and other commercial traits e.g. racing ability, beauty and ease/suitability in machine milking can also be improved [14 and 15].

The presence of large variation in morphology, productive and adaptive characters in camel populations may provide basis for selection and improvement. This is corroborated by research findings that camels have high genetic variability due to low level or lack of selection; and, current and historical movement of camels between countries for trade and sometimes war [16, 17, 18 and 19].

Challenges facing Genetic Improvement of Camel.

Comparatively less attention has been paid to camels compared to other livestock species, despite their unique potential and increase in contribution to food security [20]. Most camels do not possess unique identification numbers which hampers pedigree recording, good farm management and performance recording [21]. Most of the camel populations are under traditional farming systems, although there is gradual urbanization of some of the pastoral camel populations [20]. Genomics and phenotypes are still very important and the availability of accurate and well-defined phenotypes to be used in genetic studies and evaluation programs is imperative [22]. Furthermore, most of the countries harboring camel populations are in varying developmental stages in livestock agriculture and infrastructure development. Thus, creation of intensive or camel dairy or beef industries would require immense infrastructural investment, support and coordination among all stakeholders- all of which are challenging [5]. Small herd size and scattered population is another challenge limiting genetic improvement of camel by making it difficult to collect phenotypic data.

There is no standardization of traits yet, and parameters are not yet systematically recorded. These are some of the challenges faced potential camel geneticist and breeders. These challenged thus presently limit the potentials of camels in contributing more to food security, unlike other livestock species.

The way forward to camel genetic improvement.

Camel has a wide range of potentials that have being underutilized and thus, lag behind, despite its contribution to the livelihood of many nomads, pastoralist and agro-pastoralists. This is due to the economic, political, technical, logistics challenges. But these challenges are not overwhelming, but surmountable. Much consideration should be given to exploit the productive and economic genetic potentials of this species of animals. To enhance rapid genetic improvement, some of the following recommendations should be considered be considered.

- The need for governmental, commercial stake-holder and NGOs intervention at national and international levels in to conduct systematic census of camel population, for proper and accurate planning.

- The need for scientists to develop research interest in camel production and genetic improvement of economic traits. This would lead to more sustainable livelihood of the nomads and pastoralist in the arid and semi-arid land.
- Breeding practices should be modernized and improved using modern tools and techniques. Breeding management would be achieved with proper record keeping and pastoralist should be encouraged to developed simplified means of recording
- Finally, the need for funding, supporting networking among researchers, teachers, extension agent, veterinarians, agronomists, producers, administrators, market people and the whole range of stakeholders should enhance attention towards these camelid species and improve the chances of directing research more efficiently.

CONCLUSION AND APPLICATION

Camel has a wide range of potentials, but it is underutilized due to its unimproved genetic status. However, camel stands out with good qualities that can withstand the challenges of current global warming, desert encroachment and resistance to harsh environmental conditions, and still be productive with little management from its keepers, unlike other livestock. Genetic improvement is promising in camel in order to exploit its potential fully. This improvement, needs collaboration of all stakeholders involved, with the the common interest of exploiting economics potentials of this exceptional species. The knowledge of its intrinsic economic attributes, variability would aid genetic response, be of great benefit to the industry, research scientist small-scale farmers, nomads and pastoralists who are all stake-holders in both traditional and modern system of production.

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BREED VARIATION IN LIVE WEIGHT AND LINEAR BODY MEASUREMENTS OF GOATS REARED IN THE HUMID ENVIRONMENT

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ABSTRACT

Understanding the physical characteristics of West African Dwarf (WAD) and Red Sokoto (RS) goats reared under similar conditions is crucial for their genetic enhancement and adaptability. This study examined breed variations in body weight and morphometric traits of goats in a humid environment. Thirty-two weaned goats (16 RS and 16 WAD) were monitored biweekly for body weight and linear traits using a spring balance and a metric measuring tape. RS goats consistently showed significantly ($P<0.05$) higher body weight, body length, neck length, height, breast girth, and tail length throughout the study period. The male goat of both breeds showed statistically ($P<0.05$) higher body weight due to sexual dimorphism. These findings highlight the potential genetic attributes of RS and WAD goats in humid environments.

Key words: West African Dwarf goat, Red Sokoto goat, Body weight, Humid environment

DESCRIPTION OF PROBLEM

Among the earliest domesticated animals, goats have been associated with humans for at least 10,000 years (1). Due to their adaptability to different environmental and climatic conditions, they are dispersed all over the world (2). Hence, goats are the most beneficial animals in the world, providing meat, milk, fibre, fertilizer and draft power (3). Goats survive and reproduce in a variety of extreme conditions, making them ideal species for resource. Traditionally, goats are raised for milk and meat. They are one of the most consumed meats in the world as they are an excellent source of protein (4).
The West African Dwarf (WAD) is the commonest and most important indigenous goat breed in the humid and sub-humid zones of the 15 countries of West and Central Africa (5) including Nigeria. In spite of their small size, WAD goats provide the farmers with a broad range of products and socio-economic benefits and services, such as income, source of meat, milk, gift, and manure for crops.

The Red Sokoto goat also called Maradi is the most predominant breed and accounts for about 70% of Nigeria's total goat population (6). It is commonly found with Agro-pastoralists within the northern sub-humid and semi-arid zones of the Nigeria (7). The Red Sokoto Goats are relatively small in size (Males: 60cm-65cm and Females 54cm-65cm; Weight: Males 27kg and Females 25kg). The contribution of Red Sokoto goat to national economy have been quite enormous, providing meat, milk, skin, manure, fibre and money. Maradi skin is one of the world's most valuable hide and skin, formed a major export product for Nigeria in the colonial and immediate post-colonial era. The Red Sokoto and WAD goats are native to the Northern sub-humid and semi-arid zones, and the Southern Tropical zone of the country, respectively. They both do well in their respective native environments. Therefore, it is important to rear both breeds together in the Southern Tropical zone - a hot humid environment which is alien to Red Sokoto goat to assess the growth of Red Sokoto goat in this environment. Therefore, this study was designed to investigate the variation in body weight and linear measurements of Red Sokoto (RS) and West African Dwarf (WAD) goats reared in hot humid environment.

MATERIALS AND METHODS

This experiment was conducted at the Ruminant Unit of the Teaching and Research Farm, Ambrose Alli University, Ekpoma Edo State for a period of 12 weeks. The Farm lies between latitude 6.4°N and longitude 6.8°E in Esan West Local Government Area of Edo State, Nigeria. Ekpoma is within the South-South Geo-Political Zone of Nigeria experiencing tropical climate with a mean annual rainfall of about 1,556 mm. The mean ambient temperature ranges from 26°c in December and 34°c in February, relative humidity ranges from 61% in January to 92% in August, with yearly average of about 82%. The vegetation represents an interface between the tropical rain forest and derived savannah. A total of 32-goats comprising 16 each (8 males and 8 females) of Red Sokoto goats (RSG) and West African Dwarf (WAD) goats were used. All the goats were procured between two to three months of age with average body weight range of 11-13 kg. Sex was determined through physical observation. The male goat possesses pairs of external testes and possession of mammary glands by the females. Medication and vaccination were administered. The goats were fed forages and provided with salt-leak as mineral supplements. The goats had access to feed and water *ad libitum*. The experiment was a completely randomized design with each animal as a replicate.

Body weight was measured using suspended spring balance of 50 kg capacity with 200 g precision. Body linear traits: breast girth, body length, height at withers and tail length were measured using a plastic metric measuring tape. Each animal was restrained and calmed before measurements were taken on them to ensure that they were not unnecessarily stressed. The traits were measured according to the description by Brown *et al.* (8), adopted by Orheruata and Olutogun (9). The data obtained from the experiment were subjected to a one-way analysis of variance (ANOVA) using Duncan's Multiple Range Test (DMRT) as means separation technique at 5% level of probability. Statistical procedures were carried out with the aid of SAS 99 (10) statistical package.

RESULTS

Breed effect on growth traits of WAD and Red Sokoto goats

The effect of breed on growth traits of West African Dwarf (WAD) and Red Sokoto (RS) goats is presented in Table 4.1. The results show that RS goat had significantly ($p<0.05$) higher values for body weight, body length, neck length, height, breast girth and tail length throughout the experimental period. The body weight ranged from 13.13 to 19.75 kg in RS goat and 11.35 to 15.17 kg in WAD goat from weeks 1 to 10.

Sex effect on growth traits of WAD and Red Sokoto goats

Table 4.2 shows the effect of sex on growth traits of West African Dwarf and Red Sokoto goats. The results show that the male WAD goat had significantly ($p<0.05$) higher body weight, longer Neck length, height, breast girth and tail length at week one than the female counterparts while in RS goat, the body weight was significantly ($p<0.05$) heavier in male goat (15.75 kg) than the female counterpart (13.75 kg) at week 2. The breast girth was significantly ($p<0.05$) longer in male than females of both breeds at week two. At week four, the height and tail length of male WAD goats were significantly ($p<0.05$) longer than those of female WAD while in RS goats, the male body weight is significantly ($p<0.05$) heavier (17.25 kg) than female RS goat. At week 6 the male RS goat had significantly ($p<0.05$) heavy body weight and longer tail length than the female counterpart. At week eight of the study, the male RS goat had heavier ($p<0.05$) body weight and longer breast girth than the female counterpart. At week ten of the experiment, the male WAD has longer ($p<0.05$) body length while the female WAD had longer ($p<0.05$) breast girth. More so, the body weight, height and breast girth were higher ($p<0.05$) in male RS goat than the female at week ten.

DISCUSSIONS

The higher body weight recorded among Red Sokoto (RS) goat throughout the period of experiment implies higher genetic potential for growth rate than in West African Dwarf (WAD) goats. This is in agreement with the findings of Yakubu *et al.* (11) who reported that Red Sokoto goats are heavier than

West African Dwarf goats. There were also variations in morphometric traits measured in both WAD and RS goats with the later recording better measurements in all the morphometric traits considered.

Table 4.1: Breed effect on growth traits of WAD and Red Sokoto goats

Week	Breeds	Body weight (kg)	Body length (cm)	Neck length (cm)	Height (cm)	Breast girth (cm)	Tail length (cm)
1	WAD	11.35±0.27^{b}	37.44±0.25^{b}	11.35±0.33^{a}	36.15±0.46^{b}	50.81±0.77^{b}	12.23±0.20^{b}
	RS	13.13±0.30^{a}	42.50±0.98^{a}	12.25±0.28^{a}	46.50±0.68^{a}	54.25±0.39^{a}	13.50±0.33^{a}
2	WAD	12.12±0.22^{b}	39.92±0.83^{b}	13.15±0.26^{b}	37.65±0.46^{b}	52.73±0.66^{b}	12.81±0.26^{b}
	RS	15.75±0.43^{a}	44.00±1.02^{a}	15.00±0.63^{a}	47.50±1.18^{a}	56.00±0.57^{a}	14.25±0.89^{a}
4	WAD	12.28±0.26^{b}	40.17±0.47^{b}	14.33±0.48^{b}	38.83±0.47^{b}	53.17±0.56^{b}	13.25±0.27^{b}
	RS	17.00±0.57^{a}	44.50±1.02^{a}	16.50±0.42^{a}	49.25±1.11^{a}	59.25±0.48^{a}	15.00±0.42^{a}
6	WAD	12.96±0.22^{b}	42.33±0.37^{b}	14.95±0.31^{a}	39.08±0.37^{b}	54.08±0.64^{b}	13.42±0.27^{b}
	RS	17.75±0.73^{a}	44.25±0.93^{a}	17.25±0.66^{a}	44.75±1.70^{a}	60.00±0.68^{a}	15.75±0.57^{a}
8	WAD	13.04±0.37^{b}	42.95±0.29^{b}	15.33±0.27^{b}	41.58±0.31^{b}	55.25±0.80^{b}	13.67±0.30^{b}
	RS	18.50±0.87^{a}	40.50±0.78^{a}	17.75±0.34^{a}	46.50±1.27^{a}	62.25±1.87^{a}	16.30±0.50^{a}
10	WAD	15.17±0.53^{b}	43.38±0.40^{b}	15.71±0.29^{b}	42.96±0.34^{b}	55.98±1.30^{b}	13.96±0.24^{b}
	RS	19.75±1.35^{a}	45.50±0.91^{a}	18.05±0.50^{a}	49.00±1.12^{a}	63.75±2.29^{a}	16.75±0.57^{a}

Means in the same group with different superscripts (a, b) are significant different ($p<0.05$)

Table 4.2: Sex effect on growth traits of WAD and Red Sokoto goats

Week	Breeds	Sex	Body weight (kg)	Body length (cm)	Neck length (cm)	Height (cm)	Breast girth (cm)	Tail length (cm)
1	WAD	Male	12.29±0.35^{a}	36.46±0.24^{b}	13.29±0.49^{a}	35.54±0.51^{a}	52.21±0.64^{a}	11.71±0.16^{b}
		Female	10.42±0.18^{b}	38.42±0.22^{a}	11.42±0.22^{b}	33.75±0.52^{b}	50.42±1.01^{b}	12.75±0.30^{a}
	RS	Male	12.25±0.60	42.75±2.03	12.45±0.60	42.75±1.45	56.25±0.60	12.75±0.32^{NS}
		Female	12.00±0.20	42.25±0.60	12.25±0.14	42.25±0.14	56.25±0.60	12.25±0.60^{NS}
2	WAD	Male	12.43±0.30	38.07±0.94	13.76±0.35	36.29±0.70	53.57±0.23^{a}	12.71±0.15
		Female	11.75±0.31	39.05±1.40	12.92±0.38	34.08±0.59	51.58±1.14^{b}	12.92±0.54
	RS	Male	15.75±0.32^{a}	43.75±2.03	14.75±0.32	45.25±0.60	60.25±0.59^{a}	13.25±0.14
		Female	13.75±0.32^{b}	43.25±0.59	14.25±1.16	43.75±2.03	57.75±0.32^{b}	13.05±1.74
4	WAD	Male	13.00±0.29	40.18±0.77	14.34±0.36	39.11±0.63^{a}	55.78±0.67	12.78±0.19^{b}
		Female	12.56±0.43	39.96±0.50	14.22±0.92	36.56±0.38^{b}	54.56±0.91	13.08±0.19^{a}
	RS	Male	17.25±1.16^{a}	44.25±0.60	15.25±0.59	47.25±0.14	62.75±0.32	13.75±0.14
		Female	15.25±0.14^{b}	43.75±2.03	14.75±0.32	46.25±1.74	60.75±0.88	13.35±0.88
6	WAD	Male	13.33±0.23	41.02±0.67	14.62±0.59	40.42±0.69	56.92±1.13	13.00±0.36^{NS}
		Female	12.98±0.34	40.75±0.30	14.48±0.22	37.75±0.30	55.25±0.66	13.48±0.42^{NS}
	RS	Male	19.25±0.60^{a}	45.15±1.74	16.25±0.14	49.25±3.47	63.25±0.59	14.25±0.14^{a}
		Female	16.75±0.32^{b}	44.05±0.60	15.75±1.16	47.25±1.16	61.75±0.88	14.00±0.14^{b}
8	WAD	Male	14.83±0.69	42.25±0.26	14.88±0.24	41.08±0.22	57.58±1.19	13.28±0.22^{NS}
		Female	13.25±0.27	41.35±0.53	14.78±0.49	38.08±0.55	56.92±1.09	13.75±0.53^{NS}
	RS	Male	20.25±1.16^{a}	45.75±0.60	17.25±0.59	51.75±2.03	64.75±2.31^{a}	14.85±0.14
		Female	17.75±0.32^{b}	44.75±1.45	16.25±0.14	49.25±0.14	62.25±0.59^{b}	14.55±0.88
10	WAD	Male	16.00±0.83	42.96±0.60	14.98±0.38^{a}	42.50±0.50	58.17±2.09^{b}	13.50±0.34
		Female	14.33±0.59	41.75±0.55	14.92±0.31^{b}	39.42±0.42	57.75±0.87^{a}	13.98±0.35
	RS	Male	21.25±0.60^{a}	46.25±1.74	18.75±0.32	53.75±0.88^{a}	65.25±1.74^{a}	15.00±0.32
		Female	18.25±0.14^{b}	45.75±0.88	17.25±0.14	49.25±1.73^{b}	63.25±1.16^{b}	14.75±0.88

Means in the same group with different superscripts (a, b) are significant different ($p<0.05$)

This is expected because the WAD goats are characterized by conspicuously small body stature, short legs and body parts whereas their RS goat counterparts were relatively heavier and possessed long legs (11). In

addition, the better growth traits in RS goats than WAD goats despite the fact that they were subjected to similar environmental and management conditions, suggests higher growth potential in RS goat.
Sexual dimorphism was observed in body weights and linear measurements between sexes in WAD and RS goats; with males (bucks) performing better than their female counterparts. This could be attributed to the differences in hormonal profile (12). The presence of sexual dimorphism in both breeds could be exploited through sex-linked traits in the construction of breeding objective.

CONCLUSION

This study revealed that both WAD and RS can be successfully raised in humid environment and male goats of both breeds are heavier and outwit the female counterparts in linear traits. Therefore, this information would be useful in making selection decision on suitable individuals within breed for meat production in the humid tropics.

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PREDICTION OF LIVE WEIGHT FROM LINEAR BODY TRAITS IN PIG GENOTYPES

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ABSTRACT

A total of 18 mature pigs comprising 6 Large White (LW) (1 male : 5 females), 6 Duroc (DU) (1male : 5 females) and (1male LW: 5 females DU) were used as the base population to generate the F1 piglets - LW x LW, DU x DU and LW x DU progenies. Linear body measurements [(punch girth (PG), heart girth (HG), ear length (EL), height at wither (HW), pin bone to pin bone (PB) and body length (BL)] of the progenies were regressed against body weight (BWT) using linear, quadratic and cubic models. The coefficient of determination (R2, %) of LW x LW progenies ranged from 42-89 % (linear), 44-89 % (quadratic) and 44-89 % (cubic). For DU x DU, R2 ranged from 10-90 % (linear) , 11-90 % (quadratic) and 13-90 % (cubic); while in DU x LW, R2, % ranged from 04-76 % (linear) , 15-76 % (quadratic) and 16-76 % (cubic). Regression of linear body traits against BWT of LW x LW, DU x DU and DU x LW progenies had high estimates in all the parameters except for that of BWT and EL which was moderate in LW x LW [(42% (linear), 44% (quadratic) and 44% (cubic)] and low in DU x DU [(10% (linear), 11% (quadratic) and 13% (cubic)] and DU x LW [(4% (linear), 15% (quadratic) and 16% (cubic)] and between BWT and BL of the three progenies in linear (37, 47 and 43%) for LW x LW, DU x DU and DU x LW, respectively. The result of this study showed that the best accuracy of prediction was obtained with cubic function followed by quadratic function.

Keywords: Regression, linear body traits, linear, quadratic, cubic, model

DESCRIPTION OF PROBLEM

Demand in animal protein in sub-Saharan Africa has increased with population growth, urbanization, changes in eating habits and rising living standards. It is desirable to determine the performance of different pig genotypes in order to establish the genotype that will result in highly productive progeny for meat production. However, there is paucity of reported work on the use of linear body measurements as tools for pig improvement in Nigeria (1).

The relationship between live body weight and body measurements is important for the prediction of live body weight in animals. (2) stated that the final body weight of animals is a mirror of the total sum of the weight of all its individual component parts, meaning that a change in any one of the individual parts could result positively or negatively on the final body weight depending on the direction in which the change occur. (3) stated that allometric, quadratic, cubic and linear models are commonly used to predict body weight at different ages. (4) reported that cubic function predicted body weight and other body traits accurately compared to quadratic and linear functions. The effectiveness of the models however depend on the linear body measurements under study. The objective of this study therefore, was to develop some prediction models for estimation of body weight of pigs.

MATERIALS AND METHODS

Experimental site

The experiment was carried out at the Chimereogoeze and Sons farm, Okpulo Umuobo, Aba, Osisioma LGA, Abia State. It lies between latitudes 50 5'57" and 50 19' 32"N and longitudes 70 15 '49" and 70 25'

23"E with a land area covering about 198km2. The study area is within the humid tropical climatic and rain forest vegetation zone of southern Nigeria. The rainfall regime is bimodal with peaks in July and September. The rainy or wet season of the area begins about March and lasts till October or early November. Dry season lasts from November to March. The area has an annual rainfall total of about 2200mm; a mean annual temperature of about 27°C; and an average relative humidity of about 80% (5).

Management of the piglets

A total of 18 mature pigs comprising 6 Large White (LW) (1 male : 5 females), 6 Duroc (DU) (1male : 5 females) and (1male LW: 5 females DU) were used to generate F1 piglets for the study. All piglets resulting from each genotypic line were properly identified at day-old with industrial aluminum galvanized ear tag. Vaccination and medication programs were duly observed. The piglets were fed from the sows' rations (finisher) at about the mid-lactation and continued till the piglets were weaned at 6 weeks of age.

Data collection

Parameters measured were: body weight (BWT): Each pig was weighed weekly with hanging scale of sensitivity of 100kg; Punch girth (PG): Circumference of the body was measured immediately after the abdomen just before the hind legs. Heart Girth (HG): The body circumference immediately posterior of the front legs or the body circumference on the fore ribs. Ear length (EL): The distance of the ear. Height at withers (HTW): Vertical distance from the highest point of the shoulder (withers) to the ground surface at the level of the fore legs. Pin bone to pin-bone (PBT): distance between the iliac crest on either side of the waist. Body length (BL): distance between the tip of the shoulder to the tip of the pelvic. All parameters were measured in the morning before feeding, with a tailor's tape in centimeter (cm) except BWT.

Statistical analysis

Data collected were subjected to regression analysis using SPSS (2017), version 25. Regression was carried out on body weight and each of the linear body traits to determine the growth of the body and each of the component parts in the different progenies using different regression models and the R2 obtained was used to compare the accuracy of the prediction.

The regression models were as below:

$Y1 = a + b1X + e. . .$ (Linear)

$Y2 = a + b1X + b2X2 + e . . .$ (Quadratic)

$Y3 = a + b1X + b2X + b3X3 + e. . .$ (Cubic)

Where; Y1,2,3 = Response (dependent) variable (BWT) for the different functions, a = Y-intercept, b1,2,3 = regression coefficients, X = independent variables (PG, HG, HTW, EL, PBT and BL), e = random error.

RESULTS AND DISCUSSION

The linear, quadratic and cubic regression models of body weight from body components of different pig genotypes, including coefficients of determination (R2) for the fitted functions are presented in Tables 1, 2 and 3, respectively. The regression equations were all highly significant ($P<0.01$, $p<0.001$) in all the genotypes except the linear function fitted for body length and ear length which showed no significance in DU x LW. For LW x LW genotype, the coefficient of determination (R2 %) ranged from 42 % EL to 89 % PG (linear), 44 % EL to 89 % PG (quadratic) and 44% EL to 89% PG (cubic). For DU x DU, R2 ranged from 10 % ear length (EL) to 90 % punch girth (PG) for linear, 11% (EL) to 90 % (PG) for the quadratic and 13% (EL) to 90% (PG) for cubic. For the crossbred (DU x LW), R2 ranged from 04 % EL to 76 % PG (linear), 15 % EL to 76 % PG (quadratic) and 16 % EL to 76% PG (cubic function). The relationship between BWT and PG, HTW, PBT, BL and HG were highly significant ($P<0.01$, $P<0.001$) for all models. The R2 values for EL for DU x DU and DU x LW were very low in all the models compared to the values of LW x LW, which were moderate.

Table 1: Regression of Body Weight on Ear length of the different Pig Genotypes using Simple Linear Model

Genotype	X	Equation	R^2 (%)	Std. Error	Sig
LW x LW	Punch girth	BWT = 8.486 + 1.044 X	89	0.480	**
DU x DU		BWT = 9.249 + 1.090 X	90	0.537	**
DU x LW		BWT= 8.448 + 1.140 X	76	0.807	**
LW x LW	Ear length	BWT = 3.300 + 0.237 X	42	0.362	***
DU x DU		BWT = 3.635 + 0.091 X	10	1.392	**
DU x LW		BWT = 4.798 + 0.234 X	04	1.476	NS
LW x LW	Height at wither	BWT = 8.213 + 0.987 X	78	0.689	***
DU x DU		BWT = 8.942 + 0.968 X	49	1.430	***
DU x LW		BWT = 7.279 + 1.092 X	77	0.757	***
LW x LW	Pin bone to pin bone	BWT = 9.261 + 0.832 X	75	0.624	***
DU x DU		BWT = 8.433 + 0.912 X	84	0.582	***
DU x LW		BWT = 8.418 + 1.020 X	48	1.334	***
LW x LW	Body length	BWT = 19.881 + 0.962 X	37	1.630	***
DU x DU		BWT = 17.543 + 1.002 X	47	1.563	***
DU x LW		BWT = 18.555 + 1.103 X	43	1.603	***
LW x LW	Heart girth	BWT = 9.315 + 0.848 X	69	0.742	***
DU x DU		BWT = 9.920 + 0.698 X	45	1.117	***
DU x LW		BWT = 9.309 + 0.831 X	55	0.942	***

Table 2: Regression of Body Weight on Ear length of the different Pig Genotypes using Quadratic model

Genotype	X	Equation	R^2 (%)	Std. Error	Sig
LW x LW	Punch girth	BWT = 8.862 + 0.748 (X) + 0.048 (X^2)	89	0.478	**
DU x DU		BWT = 9.701 + 0.749 (X) + 0.051 (X^2)	90	0.534	**
DU x LW		BWT = 9.148 + 0.590 (X) + 0.090 (X^2)	76	0.803	**
LW x LW	Ear length	BWT = 2.996 + 0.477 (X) + 0.039 (X^2)	44	0.360	***
DU x DU		BWT = 3.425 + 0.263 (X) + 0.026 (X^2)	11	1.393	**
DU x LW		BWT = 7.716 + 2.530 (X) + 0.373 (X^2)	15	1.396	**
LW x LW	Height at wither	BWT = 8.977 + 0.384 (X) + 0.097 (X^2)	79	0.679	***
DU x DU		BWT = 8.908 + 0.994 (X) + 0.004 (X^2)	49	1.440	***
DU x LW		BWT = 8.156 + 0.403 (X) + 0.112 (X^2)	78	0.748	***
LW x LW	Pin bone to pin bone	BWT = 9.666 + 0.511 (X) + 0.052 (X^2)	76	0.653	***
DU x DU		BWT = 8.220 + 1.072 (X) + 0.024 (X^2)	84	0.588	***
DU x LW		BWT = 6.808 + 2.286 (X) + 0.206 (X^2)	50	0.630	***
LW x LW	Body length	BWT = -13.634 + 5.894 (X) + 0.793 (X^2)	68	1.168	***
DU x DU		BWT = 13.359 + 4.160 (X) + 0475 (X^2)	60	1.356	***
DU x LW		BWT = 11.151 + 6.925 (X) + 0.947 (X^2)	80	0.965	***
LW x LW	Heart girth	BWT = 8.000 + 1.885 (X) + 0.167 (X^2)	72	0.707	***
DU x DU		BWT = 8.705 + 1.615 (X) + 0.138 (X^2)	48	1.101	***
DU x LW		BWT = 8.255 + 1.660 (X) + 0.135 (X^2)	57	0.554	***

The differences observed in the values of R2 is in agreement with the report of (3) that strain influences accurate prediction of body weight from linear body traits. (6) observed that all the linear body measurements of pre-weaned crossbred pigs were highly statistically significant (P<0.001) for both linear and quadratic models. (6) also reported that fitted quadratic equation was found with R2 value of 90.0% on heart girth, which is higher than the R2 value obtained in this work. The results obtained show that PG is important for estimation of pigs' live body weight. However, for HTW, LW x LW and DU x LW had high R2 in all the models regressed. For PB, the R2 values were higher in all models for LW x LW and DU x DU. With BL, the highest R2 was seen in the cubic function, followed by the quadratic function while the linear model reported the least R2 values. For HG, the highest R2 value was seen in LW x LW. HG could thus provide an accurate live body weight on prediction when used alone in LW x LW. The magnitude of the R2 obtained indicated the relative contributions of each linear body trait to BWT prediction of the pigs. The higher R2 values obtained in the quadratic and cubic functions imply that the relationships between BWT, HTW, PB, BL and HG were best described by cubic function.

Table 3: Regression of Body Weight on Ear length of the different Pig Genotypes using Cubic Model

Genotype	X	Equation	R^2 (%)	Std. Error	Sig
LW x LW	Punch girth	BWT = 9.540 + 0.169 (X) + 0.405 (X^2) + 0.041(X^3)	89	0.479	***
DU x DU		BWT = 10.186 + 0.164 (X) + 0.257 (X^2) + 0.021(X^3)	90	0.536	***
DU x LW		BWT = 9.523 + 0.086 (X) + 0.287 (X^2) + 0.023(X^3)	76	0.809	***
LW x LW	Ear length	BWT = 3.284 + 0.089 (X) + 0.113 (X^2) + 0.017 (X^3)	44	0.479	***
DU x DU		BWT = 3.898 + 0.312 (X) + 0.176 (X^2) + 0.021(X^3)	13	0.536	**
DU x LW		BWT = 10.132 + 5.773 (X) + 1.643 (X^2) + 0.146(X^3)	16	0.809	**
LW x LW	Height at wither	BWT = 9.397 + 0.183 (X) + 0.318 (X^2) + 0.025 (X^3)	79	0.479	***
DU x DU		BWT = 10.507 + 0.949 (X) + 0.680 (X^2) + 0.071(X^3)	50	0.536	***
DU x LW		BWT = 8.778 + 0.432 (X) + 0.439 (X^2) + 0.038(X^3)	78	0.809	***
LW x LW	Pin bone to pin bone	BWT = 10.259 + 0.287 (X) + 0.363 (X^2) + 0.036(X^3)	76	0.627	***
DU x DU		BWT = 7.046 + 2.499 (X) + 0.527 (X^2) + 0.052(X^3)	85	0.578	***
DU x LW		BWT = 7.494 + 1.364 (X) + 0.1655 (X^2) + 0.042(X^3)	50	1.323	***
LW x LW	Body length	BWT = 9.749 + 11.133 (X) + 2.837 (X^2) + 0.233(X^3)	70	1.136	***
DU x DU		BWT = 7.137 + 11.722 (X) + 3.138 (X^2) + 0.276(X^3)	68	1.228	***
DU x LW		BWT = 7.951 + 11.223 (X) + 2.630 (X^2) + 0.194(X^3)	81	0.947	***
LW x LW	Heart girth	BWT = 8.047 + 1.822 (X) + 0.142 (X^2) + 0.003(X^3)	72	0.712	***
DU x DU		BWT = 8.531 + 1.826 (X) + 0.212 (X^2) + 0.008(X^3)	48	1.109	***
DU x LW		BWT = 9.339 + 0.205 (X) + 0.435 (X^2) + 0.066(X^3)	57	0.935	***

LW x LW= Large White x Large white, DU x DU= Duroc x Duroc, Du x LW= Duroc x Large White, BWT= Body weight, Sig = significance at P<0.01, P<0.001

CONCLUSION AND APPLICATION

The results of this study revealed that BWT can best be predicted from any of the linear body traits using different regression models, except EL and BL. The magnitude of R2 % obtained in this study ranged from low to very high estimates in all the progenies. Prediction of body weight from punch girth was best described by the three models with same R2 values. Prediction from HTW was best described by the cubic and quadratic functions, whereas prediction of BWT, BL and HG were best described by cubic function. It is therefore recommended that the cubic function be used in predicting body weight of pigs, as this could ensure accurate prediction of body weight for selective breeding purpose.

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HERITABILITY ESTIMATES FOR BODY WEIGHT AND MORPHOMETRIC TRAITS OF NIGERIAN INDIGENOUS CHICKENS IN BORNO STATE

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ABSTRACT

This study was carried out to estimate heritability for body weight and morphometric traits of indigenous chickens in Nigeria. The experimental birds consisted of 120 hens and 30 cocks housed in deep litter pens in a mating ratio of 1:4. Body weight and morphometric traits were measured weekly from 4 – 24 weeks of age. The results revealed that the effect of sex was significant ($P<0.05$) for all traits at all ages. Males were superior to females for body weight and morphometric traits at all ages. The body weight of males ranged from 114 to 1350 g from 4 to 24 weeks of age while the corresponding range for females was 107 to 984 g. Similar trend was observed for chest girth, body length, thigh and shank lengths. Thus, sexual dimorphism was in favour of males for all the traits considered in the population. Generally, low to high heritability estimates were recorded for body weight (0.07 to 0.89) and morphometric traits (0.07 to 0.77). Moderate to high estimates at 8 and 12 weeks (0.30 and 0.50) of age may indicate that body weight is influenced by additive gene effects and rapid progress in selection can be achieved at these ages. Thus, selection for improvement of body weight and conformation of the indigenous chicken may best be carried out at these ages.

Keywords: chickens, heritability, body weight, morphometrics, sexual dimorphism

INTRODUCTION/DESCRIPTION OF THE PROBLEM

Poultry keeping is of great importance to Nigerian households (1) and the country is richly endowed with a large population of local chickens (about 80% of the poultry birds in Nigeria). More than 80% of the poultry productions are found in the rural households (2). The author also indicated that in recent years, poultry have assumed a much greater role as supplier of animal protein for both rural and urban dwellers. Poultry is the only affordable species to be slaughtered at home by resource poor farmers, as the price of other species is too high and have increased substantially (3). Thus, quite often local poultry stocks serve as major source of animal protein to the poor since they are accessible to landless and low-income households. It may be an effective enterprise for transferring wealth from the high-income urban consumers to the poor rural and peri-urban members of the community.

The local chicken is a pool of heterogeneous individuals, which differ, in adult size, body weight, feather and plumage pattern and have remained genetically unimproved (4). Variation in body weight within a flock can be attributed to genetic variation and environmental factors that impinge on individuals. Body weight in poultry is known to be moderate to highly heritable, hence the selection of heavier individuals in a population of Nigerian light local chicken ecotype for example, should result in genetic improvement of the trait. (5) reported that these chickens have high genetic variability within their populations indicating a high potential for genetic improvement through selective breeding. (6) concluded that the Nigerian local chicken is a potential broiler, whose small size resulted probably from natural selection over a period of time. Similarly, (7) observed that the growth pattern of the live body weight of the Nigerian local chickens resembled more that of the broiler than egg-type chickens. This study was designed to estimate heritability for body weight and morphometric traits of indigenous chickens in Nigeria. These will provide baseline information for improvement of these traits.

MATERIALS AND METHODS

The study was carried out at the Livestock Teaching and Research Farm, University of Maiduguri, Maiduguri, Borno State, Nigeria. Maiduguri is located on Latitude 11.833^0 N and Longitude 13.150^0 E and at an altitude of 345 m. A total of 185 birds were procured from the rural areas of Borno and Yobe states but the experimental birds consisted of 120 hens and 30 cocks. The chickens were allowed an adaptation period of 4 weeks since they respond poorly to confinement. They were housed in labelled deep litter pens in a male to female ratio of 1:4 and fed a breeders' diet containing 18% crude protein and 2650kcal/kg of Metabolizable energy. Feed and water were provided *ad libitum*. Eggs were collected daily and stored for incubation. Each egg was labelled based on the cage label. The collected eggs were set in the incubator with the broad ends up for 18 days before moving them into the hatcher where they hatched into chicks. A forced air automatic electric incubator was used for hatching with the temperature and humidity set at 37.5^0C and 60%, respectively. Soon after hatching, several coloured markers were used to identify birds from a particular sire to prevent the chicks belonging to the different sire and dam families from mixing up. After brooding, the chicks were transferred to rearing pens. The rearing pens were in an open sided rearing house. The chicks were managed on deep litter until sexual maturity using standard management procedures.

Data collection: After hatching, the body weight of each chick was recorded individually using a weighing balance and body morphometrics; a simple tape rule calibrated in cm according to (8) as follows:

Chest girth (CG): This was measured as the circumference of the breast region, through the anterior border of the breast bone crest and the central thoracic vertebra.

Body length (BL): This was obtained through measuring the distance from the base of the neck, through the body trunk to the tip of the pygostyle.
Thigh length (TL): The thigh length was taken as the distance between the hock and pelvic joints.

Shank length (SL): Shank length was taken as the distance between the hock joint to the tarsometatarsus. The body weight and morphometric traits were measured weekly until maturity (0-24 weeks).

Statistical Analysis
Data collected were subjected to T-test using Statistix 9.0 software to determine sex effect.
Heritability was estimated using a sire model.
The model for the analysis was as follows:
$Y_{ijk} = \mu + S_i + Є_{ijk}$
Where,
Y_{ijk} = the record of the jth progeny of the j_{th} dam mated to the ith sire.
μ = the overall population mean for the trait being considered
S_i = random effect of the ith sire
$Є_{ijk}$ =random error / uncontrolled environmental and genetic deviations attributable to the individuals within sire groups.
All effects apart from the μ were random, normal, and independent with expectations equal to zero.

Heritability was estimated from sire and error variance components as follows:

$$h^2_s = \frac{\sigma_s^2}{\sigma_p^2}$$

Where:
h^2 = Heritability;
σ_s^2 = Sire variance component,
σ_p^2 = Total phenotypic variance component

Standard error (S.E.) of the estimate was calculated according to the formula given by (9).

RESULTS AND DISCUSSION

The mean body weights and morphometric traits of indigenous chickens are presented in Table 1. The effect of sex was significant (P<0.05) for all traits at all ages. Males were superior to females for body weight and morphometric traits at all ages. The body weight of males ranged from 114 to 1350 g from 4 to 24 weeks of age while the corresponding range for females was 107 to 984 g. Similar trend was observed for chest girth, body length, thigh and shank lengths. Thus, sexual dimorphism was in favour of males for all the traits considered in the population. The body weights reported in this study were lower than those (312.06 to 1635.08 g from 4 to 16 weeks of age) reported by (10) were higher than those of this study. The significant effect of sex on body weight has also been reported by various authors (1). All authors observed heavier males than females. Cocks were always bigger and heavier than hens, probably due to effect of hormonal differential on growth, which promotes greater skeletal and tissue growth in cocks relative to the hens (11).

The values of chest girth for males ranged from 6.34 to 23.45 cm, while body, thigh and shank lengths were 9.92 to 28.8, 6.23 to 18.21 and 3.30 to 9.77, respectively. The corresponding values for females were 5.61 to 22.67, 9.54 to 26.4, 5.42 to 16.76 and 3.2 to 9.22 cm. Thus, males had higher values (p<0.05) for all morphometric traits than females. (12) in their study concluded that male chickens were superior to females in all measurement of the body. (10) observed that body length in normal feathered chickens ranged from 28.52 to 44.29 cm which was much higher than values obtained in this study. The shank lengths for male and female reported in this study were lower than those (1.92 to 12.50 and 1.92 to 9.78 cm, respectively from 0 – 20 weeks) reported by (13). The wide variation in values of body weight and morphometric traits attest to the fact that the indigenous chicken population is genetically diverse and unselected.

Estimates of heritability for body weight and morphometric traits

The heritability estimates for body weight and morphometric traits at different ages are presented on Table 2. Generally, heritability estimates for body weights were low to high (0.11 - 0.50); low estimates were recorded at the early and late ages, and moderate to high (0.30 to 0.50) at mid ages (8 and 12 weeks). Heritability estimates of 0.08 and 0.80 for body weights at 4 and 12 weeks of age, respectively were reported by (14) in Ghanaian native chicken which are similar to the results of the present study. (7) also recorded low to high heritability estimates which ranged from 0.01 to 0.81 for body weights in normal feathered chickens aged from day old to 8 weeks. Similarly, (8) reported low to moderate estimates (0.05 to 0.45) for body weights of normal feathered chickens aged 0 to 20 weeks of age.

Differences in heritability estimates could be attributed to method of estimation, breed, environmental effect and sampling error due to small data set or sample size (15). The low estimates at the early and late stage of growth in this study correspond with the lower estimates recorded by (8) at 0 to 4 weeks and this may indicate that body weight, to a very large extent is a function of environmental factors at these ages. Moderate to high estimates at the mid ages may indicate that body weight is influenced by additive gene effects and rapid progress in selection can be achieved at these ages. Thus, selection for improvement of body weight can be carried out at these ages.

Heritability estimates for morphometric traits were generally low to high (0.07 to 0.77). The heritability estimates for chest girth ranged from 0.12 to 0.71, while the corresponding estimates for BL, TL and SL were 0.12 to 0.67, 0.07 to 0.77 and 0.08 to 0.62, respectively. (7) reported low to high estimates ranging from 0.08 to 0.68 for breast girth in normal feathered chickens at 0 to 8 weeks of age. Moderate estimate for breast girth (0.36) was also reported by (16) in Nigerian local chickens at 6 weeks of age. With respect to estimates for body length, (8) recorded estimates that were close to those reported in this study. Differences observed among the values reported could be attributed to sample size, environmental factors and methods of estimation. It could also be due to the fact that heritability estimates are not constants but quantities that vary depending on the environment.

Table 1: Means ± SE of Body Weights (g) and morphometric (cm) traits of male and female Indigenous Normal Feathered Chickens at Different Ages (weeks)

		4	8	12	16	20	24
Body weight	Male	114.18 ±3.65^{a}	350.43 ±8.22^{a}	586.28 ±14.12^{a}	796.30 ±25.72^{a}	1218.36 ±22.22^{a}	1350.31 ±25.44^{a}
	Female	107.61 ±3.56^{b}	309.62 ±7.56^{b}	544.52 ±14.44^{b}	689.81 ±15.56^{b}	905.32 ±21.64^{b}	984.35 ±21.00^{b}
Chest girth	Male	6.34 ±0.05^{a}	10.66 ±0.12^{a}	15.52 ±0.12^{a}	18.32 ±0.17^{a}	20.66 ±0.32^{a}	23.45 ±0.19^{a}
	Female	5.61 ±0.04^{b}	9.91 ±0.12^{b}	14.71 ±0.12^{b}	16.99 ±0.17^{b}	19.54 ±0.30^{b}	22.67 ±0.20^{b}
Body length	Male	9.92 ±0.09^{a}	13.40 ±0.10^{a}	16.85 ±0.15^{a}	22.43 ±0.27^{a}	24.70 ±0.29^{a}	28.80 ±0.42^{a}
	Female	9.54 ±0.09^{b}	12.68 ±0.10^{b}	16.00 ±0.15^{b}	20.54 ±0.29^{b}	22.44 ±0.24^{b}	26.40 ±0.33^{b}
Thigh length	Male	6.23 ±0.14^{a}	9.68 ±0.11^{a}	12.41 ±0.14^{a}	14.63 ±0.15^{a}	16.88 ±0.16^{a}	18.21 ±0.18^{a}
	Female	5.42 ±0.13^{b}	8.89 ±0.13^{b}	11.25 ±0.18^{b}	13.42 ±0.17^{b}	15.66 ±0.21^{b}	16.76 ±0.17^{b}
Shank length	Male	3.30 ±0.05^{a}	4.97 ±0.07^{a}	5.99 ±0.07^{a}	7.49 ±0.07^{a}	8.57 ±0.06^{a}	9.77 ±0.07^{a}
	Female	3.20 ±0.06^{b}	4.62 ±0.06^{b}	5.64 ±0.06^{b}	6.91 ±0.09^{b}	8.00 ±0.07^{b}	9.22 ±0.07^{b}

a,b means in a subset within columns with different superscripts are significantly different (P<0.05)

Table 2: Heritability Estimates of Body Weights and Linear Body Morphometrics of Normal Feathered Chickens at Different Ages (weeks)

Traits	4	8	12	16	20	24
Body weight	0.11±0.14	0.30±0.22	0.50±0.32	0.12±0.14	0.10±0.12	0.12±0.14
Chest girth	0.12±0.14	0.71±0.38	0.58±0.31	0.32±0.26	0.21±0.19	0.15±0.16
Body length	0.67±0.29	0.29±0.22	0.35±0.24	0.15±0.13	0.34±0.33	0.12±0.15
Thigh length	0.51±0.12	0.44±0.33	0.77±0.20	0.16±0.16	0.35±0.23	0.07±0.11
Shank length	0.62±0.34	0.10±0.10	0.42±0.22	0.08±0.09	0.27±0.21	0.18±0.17

CONCLUSION

This study concluded that selection for improvement of body weight and morphometric traits should be done between 8 and 12 weeks of age in Nigerian indigenous chickens.

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ANALYSIS FOR PRODUCTIVE AND REPRODUCTIVE TRAITS IN SOME RABBIT BREEDS AND THEIR CROSSES

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ABSTRACT

The study evaluated the genetic parameters estimates for productive and reproductive traits using diallel analysis in four rabbit strains: New Zealand White (NZW), the Chinchilla (CHL), New Zealand Red (NZR) and the FCEABK-α (K-α) a newly developed rabbit strains through diallel crossbreeding experiment that generated 16 genotypes involving 4 straight bred and 12 crossbreds respectively. A diallel analysis was used to compute and estimate genetic parameters. The results indicated that productive and reproductive traits varied among the rabbit strains due to the differences in their genetic makeup. Chinchilla and K-α improved strain and their crosses performed better relative to other strains studied due to heterotic effect. The results of dominances (2.63 ±0.02;3.25±0.04 and 2.46±0.07,2.39±0.09) over 0.87±0.00 and 0.84±0.06 (additive) at birth and weaning ages showed that its significance was more pronounced with increase in age of the animals. Recommendations were therefore made that variations that existed in this rabbit population should be thoroughly exploited through crossbreeding and selection programmes. This is desirable to take advantage of heterosis in enhancing numerical doe's reproductive efficiency. The study therefore underscored the importance of strain influence on productive and reproductive traits in rabbits, as a panacea for improving animal agriculture for food and nutrition security in Nigeria.

Key Words: Breeding, Diallel crossing, Correlation, Genetic parameters, Heritability.

INTRODUCTION

Essentially, agriculture remains the bedrock of health and socio-economic transformation of the ever-increasing populations in many African countries due to its great contributions toward solving the problems of pandemic and post pandemic food crisis, in terms of malnutrition and undernutrition which is on the alarming rate (1; 2). In meat type rabbit production, the efficiency of production and the profitability of farms to a large extent depend on the rate of genetic gain or reproductive success, which in turn is controlled by fertility, gestation length, litter size and litter weight. Fertility can be considered a trait of the female, male, or both sexes. Several authors have shown that there is genetic variation in mating or conception rate in cattle (3;4) and in pigs (5), but in rabbits, more information are however needed in the literature on studies concerning repeatability, heritability and genetic correlations among productive and reproductive parameters using diallel crossbreeding program.

In rabbits worldwide, in several productive reproductive variables, parent and offspring measurements, genetic and environmental parameters have been determined that influence the animal's productivity (6; 7; 8). In Nigeria, rabbit production is an economical alternative in rural and urban areas of the country. However, its productivity is limited by the climatic conditions themselves (9). Rabbit production systems present little information on the genetic material available for production, which has caused producers to subjectively select replacement animals (10). In animal genetic improvement programs, quantitative tools are applied that facilitate the selection of the best animals based on their breeding values to increase their productive and reproductive efficiency genetically (11). Estimation of heritability (h^2), repeatability (R), and correlations

(r_{xy}) among the traits of economic importance at the zootechnical level define the appropriate selection method; they also constitute determining factors in the selection response (11; 8). For this reason, their estimation must be as precise as possible (12). Thus, it is necessary to carry out genetic evaluation work of the reproducers, which requires estimating the genetic parameters in both the productive and reproductive traits of some strains of rabbits involving diallel crossings.

MATERIALS AND METHODS

The research was carried out at the Rabbitry Unit of the Department of Agricultural Education, School of Secondary Education (Vocational and Technical), Federal College of Education, Osiele, Abeokuta, Nigeria. Osiele ($7^0$10'N and $3^0$2'E) is in Odeda Local Government Area of Ogun State, Nigeria. The experiment was conducted using 16 does and 4 bucks from each of the pure line and their crosses. These animals were raised between February 2023 and January 2024 in an experiment that lasted for 52 weeks.

Management of the experimental animals The experimental rabbits comprised 20 each of four strains; the New Zealand White (NZW) and the American Standard Chinchilla (CHL), New Zealand Red (NZR) and the FCEABK-ALPHA (K-α), a newly TETFund funded developed rabbit line were used for the study. These rabbit breeds were sourced from the TETFund funded Rabbit Breeding and Multiplication research farm, Federal College of Education, Abeokuta, Ogun State. Twelve genotypes, inclusive of straight and reciprocal crosses were generated from the 4 x 4 diallel crossing of these rabbit breeds. The pure line served as the control line to all the crosses. A total of 25 growing rabbits per strain averaging 10 weeks in age and 950g – 1050g in body weight were reared till 18 weeks of age when the average body weight reaches 1450g - 1550g and used as parents.

Data Collection and performance characteristics:
Data on reproductive and productive (litter) traits at birth (0 day) and at weaning age (21 days) in all the genetic groups were pooled together and average recorded. These were arc-transformed into percentages and used to generate means and other genetic parameters.

Statistical analysis
The Strain effect on performance traits was estimated from two-way analysis of variance with sub samples using a General Linear Model procedure of the Statistical Analysis System (13) version 9.0 was used to analyze fixed effects. This further generated significant differences among the means. In order to estimate genetic parameters among the rabbit breeds, a diallel analysis was set up (14) using (15), Dial98 package (16). Mixed-model Least Square and Maximum Likelihood Computer Programme (17) which uses Henderson's method 3 (18) was used to estimate observable variance components due to sire (δ_s^2) and error (δ^2_e) by equating computed mean square to their expectations and solving for the components of variances.

RESULTS AND DISCUSSION

Table 1 presents the genetic parameter estimates for average litter size and litter weight at birth and weaning (week 6). Results showed that dominant variance values for litter size were significantly ($P<0.05$) higher than additive variance both at birth and at weaning. Environmental variance was significantly ($P<0.05$) present 0.34 ±0.01 and 0.26 ±0.02). Broad sense heritability and narrow sense heritabilities estimates are high at birth and weaning age (0.73±0.01 and 0.90 ±0.02) and (0.950±0.01 and 0.74 ±0.875) respectively. The results of dominances (2.63 ±0.02; 3.25±0.04 and 2.46±0.07, 2.39±0.09) over 0.87±0.00 and 0.84±0.06 (additive) at birth and weaning ages showed that its significance was more pronounced with increase in age of the animals. The proportion of dominant (kd/(kd+kr)) genes for this trait 2.61 ±0.08 and 3.26 ±0.11) showed a slight increment in the effect of dominant genes as the animals aged. Among breeds and across week dominance exhibited by New Zealand White, Chinchilla, New Zealand Red and K-α are -0.13, -0.27. -0.36 and 1.19; -0.17, 0.82, 0.81 and 1.08 for weeks 0 and 6 respectively. K-α was recorded to have obtained the highest proportion of dominant genes for the weeks. The result of the parent- Vr+Wr correlation, which is the parental size and parental order of dominance, which is a measure of association between the signs of

dominant genes and therefore recorded the following values: -3.93 and 6.59 vividly showed that the positivity effect of dominant genes increased with increase in age of rabbits across the genetic groups. Similar trend was also observed in litter weight at birth and weaning age respectively. The orders of dominance among the breeds for the weeks is K-α > Chinchilla >New Zealand Red > New Zealand White respectively. This observation is in line with the findings of (19) and (20).

Table 1: Means ±SEM of genetic parameters estimate for reproductive and productive indices at birth and weaning ages.

PARAMETER	NAMES	ALZ (0)	ALZ (6)	ALW (0)	ALW (6)
D	Additive variance	0.87±0.00	0.84±0.06	0.268±0.01	0.983±0.37
H1	Dominance variance 1	2.75±0.31	4.46±0.55	2.426±0.04	6.466±0.37
H2	Dominance variance 2	3.76±0.17	3.99±0.32	2.245±0.03	3..392±0.29
F	Products of add. by dom. effects	0.84±0.09	-1.88±0.46	-0.152±0.15	-0.024±0.30
Hh	Square of difference parents and whole diallel	3.93±0.18	6.59±1.23	1.623±0.04	0.049±0.01
E	Environmental variance, whole	0.34±0.01	0.26±0.06	0.045±0.01	0.091±0.02
$(H1/D)^2$	Average degree of dominance	0.96±0.05	2.30±0.05	3.007±0.01	0.689±0.28
Kd/(kd+kr)	Proportion of dominant gene	2.61±0.08	3.25±0.11	3.452±0.04	4.491±0.10
H	Average direction of dominance	2.63±0.02	3.25±0.04	1.285±0.08	-0.330±0.06
Uv	Balance of positive and negative alleles	0.25±0.09	0.22±0.01	0.231±0.00	0.210±0.03
D/(D+E)	Heritability in a true sense	0.84±0.09	0.76±0.26	0.856±0.09	0.915±0.04
H^2b	Heritability for diallel in a broad sense	0.73±0.02	0.90±0.02	0.950±0.01	0.875±0.03
H^{2n}	Heritability for diallel in a narrow sense	0.69±0.03	0.85±0.08	0.632±0.05	0.741±0.08
Cor. (Pr(Vr+Wr)	Correlation between variance and covariance signs of dominant genes	-0.69	-0.36	-0.302	-0.553

ALZ (0) = Average Litter size at birth; ALZ (6) = Average Litter size at weaning (week 6)
ALW (0) = Average Litter Weight at birth; ALW (6) = Average Litter Weight at weaning (week 6)

CONCLUSION

Breed differences observed in the reproductive and productive traits showed that the rabbit lines all exhibited different breed advantages. Heritability is largely a function of breed characteristics. Dominance gene action favoured both the reproductive and productive traits in the cross breeds; this premised that standard selection procedures such as mass selection for sires with superior traits of economic importance should be highly considered for genetic improvement and better performance in rabbits.

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Animal Breeding and Genetics: ABG 018

PHENOTYPIC CHARACTERIZATION OF INDIGENOUS GOATS IN AFIKPO NORTH

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ABSTRACT

One hundred West African Dwarf Goat (WAD) indigenous to Afikpo North Local Government of Ebonyi State, Nigeria was used for this research. It investigated the phenotypic characterization of these indigenous goats. The Morphometric measurement of these goats were taken using tailors' measuring tape. The body parts measured, the body weight (BWT), height at wither (HW), body length (BL), paunch girth (PG), heart girth (HG) and ear length (EL) was characterized to predict the body weight of the goats The objectives of this study is to determine the phenotypic characteristics of these indigenous goats in Afikpo North and to use these physical characteristics to predict the body weight using liners body measurements of the goats. The data collected were subjected to statistical analysis using descriptive statistics (mean). The findings of the study revealed that the correlation of the different body parts of the breed are all positively correlated P<0.0001 significant. The RW has the highest CV of 25.6 while EL was lowest in CV (9.14). CG is highest in mean=24.4 with a SD of 4.86. EL is also lowest in mean (3.62).

Key words: Goat, indigenous, phenotypic, morphometric, Afikpo

INTRODUCTION

Small ruminants in general and goats in particular are an under-used and poorly understood resource; an interest in goat production in the tropics has grown in recent years. There is a need for a greater understanding of their role, capabilities and outputs that will contribute to the overall productivity of tropical farming systems (1). Identification, characterization and documentation of goat breeds are important for any type of development or improvement work. Without such documentation, it would be difficult to know the animals and their potential (2). Appropriate design of breeding programmes is impossible for breeds/types that have not been adequately characterized either phenotypically and/or genetically (3).

Goats are valued for milk, meat, fibre (hair, cashmere and mohair), skin and other miscellaneous Products. The importance of goats becomes more apparent when one considers the distribution of the world's goat population. About 57 percent of the world's goat population is found in Asia and 32 percent in Africa (4). The temperate regions of the world carry only 11 percent of the world's goats (4). The goat stands out to be a better alternative due to the increased goat meat demand. At present, the demand for goat meat is in excess of supply, which in turn is associated with relatively high prices (4). Characterization of indigenous livestock species is the key to development of proper strategies for long-term maintenance and use of genetic variation, and for guidance in decisions about future utilization and conservation strategies (5).

MATERIALS AND METHODS

Experimental Location

This research work was conducted in Afikpo North which is located within the rain forest agro- ecological zone of Nigeria. Afikpo north lies between latitude 5'53 35'N and longitude 7'56 14"4. It has an annual rainfall, temperature and humidity 6km/h. (GPS coordinates of Afikpo, Nigeria)

Experimental Animals

A total number of 100 goats was used for the study. The goats were collected in various locations. The goats were measured using measuring tape. The body parameters measured included body weight (BW), height at wither (HW), body length (BL), paunch girth (PG), heart girth (HG) and ear length (EL).

Duration of Study
This study lasted for 30 days.
Source of Animal Management
The West African Dwarf Goats were sourced from different household at the early hours of the morning before the goats are let out to feed.

Statistical Analysis
This study utilized descriptive statistics (ANOVA) to predict the body weight

Experimental Design
Taking the measurements of goats

Morphology parts measured includes
The body parameters measured included body weight (BWT), height at wither (HW), body length (BL), paunch girth (PG), heart girth (HG) and ear length (EL).

RESULTS AND DISCUSSION

Table 1: Descriptive Statistics for body parts measured

Variable	N	Mean	SD	SE	CV
CG	100	24.4	4.86	0.49	19.93
BL	100	17.83	1.93	0.19	10.81
WH	100	17.58	2.15	0.22	12.24
RH	100	19.12	3.37	0.34	17.63
RW	100	8.74	2.24	0.22	25.6
EL	100	3.62	0.33	0.03	9.14

CG= Chest girth, BL = Body length, WH = Wither height, RH = Rump height, RW = Rump width and EL = Ear length. While SD= Standard deviation, SE= Standard error, and CV= Coefficient of variation.

Table 2: Correlation Coefficients for the different body parts

	BL	WH	RH	RW	EL
CG	0.74*	0.78*	0.78*	0.87*	0.86*
BL	-	0.80*	0.63*	0.77*	0.84*
WH		-	0.59*	0.73*	0.91*
RH			-	0.82*	0.71*
RW				-	0.81*
EL					-

CG= Chest girth, BL = Body length, WH = Wither height, RH = Rump height, RW = Rump width and EL = Ear length. While SD= Standard deviation, SE= Standard error, and CV= Coefficient of variation.

Table 1 shows the descriptive statistics for the different body parts of WAD measured. RW has the highest CV of 25.6 while EL was lowest in CV (9.14). CG is highest in mean=24.4 with a SD of 4.86. EL is also lowest in mean (3.62).

Table 2 shows the correlation of the different body parts of WAD, they are all positively correlated, but the highest correction is between El and CG is 0.86 at $p<0.0001$ significant, its lowest correlation is between RH and WH at 0.59 at $p<0.0001$ significant.

CONCLUSION

Understanding the Phenotypic characteristics of West African dwarf goat populations and their distinct traits will improve the implementation of sound management practices to enhance phenotypic improvement and help to design of livestock improvement schemes which will contribute to the improvement of breeding objectives and development of sustainable breeding standard amongst farmers in the locality.

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Animal Breeding and Genetics: ABG 019

CORRELATION BETWEEN EGG WEIGHT AND HATCH WEIGHT IN FULANI ECOTYPE CHICKEN, FUNAAB ALPHA CHICKEN AND THEIR RECIPROCAL CROSSES

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ABSTRACT

The study was conducted to evaluate the relationship between egg weight and Hatch weight in Fulani ecotype and FUNAAB Alpha with their reciprocal crosses. The experiment was carried out at the University of Abuja Teaching and Research Farm. A total number of 28 birds were divided into four treatments in a completely randomized design (CRD). The experiment lasted for a period of 12 weeks. Data were collected on egg weight and hatch weight. Data were subjected to statistical analysis using SPSS statistical package. The correlation analysis showed a positive and significant relationship between egg weight and hatch weight across the various treatments, with treatment 1 having the highest hatch weight and treatment 4 having the lowest hatch weight. The study observed that treatments with higher egg weight resulted in higher hatch weight. The study recommends that egg weight should be given priority in selection due to their ability to influence hatch weight.

Keywords: Correlation, Egg Weight, Hatch Weight, Reciprocal crosses

INTRODUCTION

Poultry production remains the widest spread of all livestock enterprises and its pivotal to food security improvement as well as socio-cultural and economic development in most countries (1.2).
Egg weight has been a key factor in the quality of hatched chicks in most hatcheries and in most local chicken specie, the relationship between egg weight and hatch weight has fascinated researchers. According to Atteh (3) and Meijerhof (4), egg weight is a key determinant factor of hatch weight and hatch time as small egg size leads to smaller hatched chicks, and tends to hatch earlier than the standard eggs while extra-large egg size tends to hatch later

The economic potential indigenous poultry production is linked to improved productivity through specially designed breeding programs. The indigenous chicken stock is better adapted due to their adaptability to harsh weather conditions, easy style of production, better resistance to endemic diseases and low cost of production (5).

The Fulani Ecotype chickens have been confirmed to have superior weight compared to other indigenous chicken in Nigeria are known for their superiority in economic traits when compare with other indigenous chickens (6,7). However, the FUNAAB Alpha is an improved Nigerian indigenous breed of chicken through with superior characteristics compared to its unimproved counterparts (8,9).

The evaluation of the relationship between egg weight and hatch weight in both the local and hybrid specie of chicken is paramount. Hence, the study was designed to determine the relationship existing between egg weight and hatch weight in Fulani ecotype chicken and FUNAAB Alpha chicken and their reciprocal crosses.

MATERIALS AND METHODS

Experimental Site

The experiment lasted for a period of 12 weeks and was conducted at the teaching and research farm of the University of Abuja, Faculty of Agriculture, located in Gwagwalada Area Council of the Federal Capital Territory Abuja.

Experimental Birds

A total of 28 chickens comprising of Fulani ecotype (FEC Chickens) and FUNNAB Alpha chickens (FUA Chickens) (4 male to 10 females each) were sourced and used as parent stock for the experiment. They were divided into four mating groups.
T1 (FUAM x FUAF), T2 (FECM x FECF), T3 (FUAM x FECF), T4 (FECM x FUAF).
This was necessary to produce F1 chicks for further studies.

Management of Experimental Birds:

A total Fourteen (14) Nigerian indigenous Fulani chicken ecotype (4 males to 10 females), fourteen (14) hybrid FUNAAB Alpha chickens (4 males to 10 females) at the point of lay were allowed to mate naturally in separate pens at a mating ratio of 2 males to 5 females. The birds were randomly allotted into four breeding groups identified as T1 T2, T3 and T4.

The birds were fed with commercial layer's diet and water was provided ad-libitum. All routine management practices were utilized throughout the experimental period. Eggs for incubation commenced from 5 days of mating to ensure that most eggs collected were fertile.
Hatch able eggs were collected daily and were identified according to breeding group and stored in a cool environment for 4 days. The eggs were fumigated and set in different trays (with respect to the breeding groups) in the incubator till hatch day.

Experimental design/ Breeding design:

The experiment was carried out using completely randomized design (CRD) where each genotype served as treatment group.
Treatment one: FAM x FAF (funaab alpha male and funaab alpha female).
Treatment two: FEM × FEF (Fulani ecotype male and Fulani ecotype female chicken).
Treatment three: FAM x FEF (funaab alpha male and Fulani ecotype female).
Treatment four: FEM x FAF (Fulani ecotype male and funaab alpha female).

Data Collection

The following parameter was collected;
Egg Weight: The weight of the eggs was collected using an electronic sensitive scale. These weights include PIW (Pre Incubation Weight) and weights at 5th, 10th and 15th day of incubation.
Hatch Weight: The weight of the newly hatched chick and recorded using a sensitive scale weighing scale.

Data Analysis

The data collected was subjected to correlation analysis using SPPS software

RESULTS AND DISCUSSION

Table 1 presents correlated relationship between egg weight and hatch Weight of Fulani ecotype, FUNAAB alpha and their reciprocal crosses. The result shows a positive and significant correlations among all the treatment in all parameters measured. Meanwhile the higher positive correlation was obtained between T_1,

T_2, T_3 and T_4 with the highest correlation of hatch weight in T1 ($r = .984^{**}$: $P < 0.01$) showing that each trait influences another.

Table 1: Correlated Relationship Between egg weight and hatch weight of Fulani Ecotype, Funaab Alpha and Their Reciprocal Crosses at 8 Weeks of Age.

		PIW	D5	D10	D15	HW
T1	PIW	1				
	Day 5	.996**	1			
	Day 10	.996**	.998**	1		
	Day 15	.994**	.995**	.999**	1	
	HW	.972**	.975**	.980**	.984**	1
T2	PIW	1				
	Day 5	.964**	1			
	Day 10	.950**	.927**	1		
	Day 15	.922**	.913**	.946**	1	
	HW	.938	.897*	.912**	.934**	1
T3	PIW	1				
	Day 5	.992**	1			
	Day 10	.992**	.995*	1		
	Day 15	.915**	.945**	.926**	1	
	HW	.760**	.831**	.806**	.920**	1
T4	PIW	1				
	Day 5	.934**	1			
	Day 10	.970**	.953**	1		
	Day 15	.822**	.720**	.797**	1	
	HW	.628*	.570*	.657**	.203*	1

PIW = pre incubation weight, HW = hatch weight, D5=day 5, D10=day 10, D15=day 15 xx highly significant ($P<0.01$) (g)

Egg weight is one of the indices that need to be considered in hatching eggs. The mass of Day-Old Chick produced from hatching will be directly relational to the influence of hatching egg weight (10). Based on the findings of this study egg weight is also strongly correlated to hatched weight and this is in agreement with the findings of Narushin *et al.* (10).

The Correlation between egg weight and hatch weight of Fulani ecotype, FUNAAB alpha and their reciprocal crosses presented in table 1 shows that the correlation coefficient value between egg weight and hatch weight was positive and significant ($P <0.01$). higher positive correlation was obtained between T_1, T_2, T_3 and T_4 with the highest correlation of hatch Weight in T1 (972^{**}) and lowest in T_4 (628^{**}). Based on this value, there is a reliable correlation between the egg weight and the hatch weight resulting from the crossing of FUNAAB alpha and Fulani ecotype. The higher the egg weight, the higher the hatch weight because it has a directly proportional relationship. The finding of this study was in agreement with the findings of Duman and Şekeroğlu (11) also found similar observation that egg weight was positively correlated with chick hatch-weight. However, based on the correlation findings in this study, it can be observed that the weight of a large hatching egg will produce a large hatch weight and vice versa and this could be attributed to the finding of Williams (12) whom proposed that the phenomena can be attributed to the fact that heavier eggs may contain more nutrients than small eggs, which resulted in developing embryos from heavier eggs

having more nutrients for their growth requirements. However other factors play significant roles in producing a significant mass of hatching eggs include poultry, feed, environment, and others (13).

CONCLUSION

Egg weights are advantageous in the production of day-old chick as they positively correlate with hatch weight. They are excellent factors in hatch weight prediction because they determine the market values of the animals.

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Animal Breeding and Genetics: ABG 020

A REVIEW OF THE IMPROVEMENT AND CONSERVATION STUDIES FOR THE MUTURU, NDAMA and WHITE FULANI CATTLE BREEDS OF WEST AFRICA

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ABSTRACT

The study reviewed improvement and conservation efforts for the Muturu, Ndama and White Fulani cattle breeds of West Africa. The review noted that indigenous cattle breeds were characterised by low productivity, and low heritability estimates, the review reported some genetic improvement and conservation works on the White Fulanu, Muturu and Ndama and reported genetic progress on the improvement efforts for the white Fulani breed as well as conservation efforts for the Ndama and Muturu breeds. The study also noted the significant reduction in the population of the Ndama and Muturu breeds, due mainly to competition for land use, crop farming and cattle theft/rustling and thus at risk of extinction .It was concluded that. Aggressive conservation programmes for the Ndama and Muturu breeds is urgently needed. The recommendations were that Land tenure and use arrangements that are favourable to cattle owners, climate change mitigation strategies as well as adequate security measures should be instituted

Keywords: Conservation, Improvement, Muturu, Ndama, White Fulani , Cattle

1.0 Introduction

Indigenous cattle breeds of West Africa have been reported to be of low productivity (Norezzine,*et al* 2019. Several attempts to improve the productivity of the Nigerian Indigenous cattle breeds such as cross breeding with exotic breeds, Artificial insemination, improved nutriiton etc have been reported. Raji *et al* 2006;). These attempts did not produce encouraging results due to factors such as poor programme implementation, environmental factors, socio-cultural constraints, nutritional problems , pests and diseases etc (USAID, 2006 ; Huley 2005) The indigenous breeds of cattle have low heritability estimates, indicating that appreciable improvements can not be possible by individual selection. USAID (2006) stressed that it would be difficult to develop the dairy industry using the local breeds alone. Norezzine *et al.,* (2019) reported a high degree of genetic diversity and genetic progress in their study on the white Fulani breed of Nigeria .Studies by Adoligbe *et al.,*((2020) and Bosso *et al.,* (2007)reported a significant reduction in the population of the Muturu and Ndama breeds, thus putting them at risk of extinction due to changes in land use , encroachment by crop farmers , cattle theft , pests and diseases etc , thus , making conservation efforts urgent. Ductroty *et al.,* (2016) reported that cattle management practices and productivity, in the last 40 years have remained largely unchanged Oladipo *et al.,* (2018) stated that population characteristics of selected indigenous cattle breeds have not been well documented

Given the above scenario, further genetic improvement and conservation of these cattle breeds may help in fashioning out genetic and productivity improvement programmes. (Ocheja *et al.,* 2023) Consequently this paper reviews the improvement and conservation efforts of the Muturu, Ndama and White Fulani breeds of cattle of West Africa' .with a view to stepping up the planning and implementation of genetic and productivity improvement as well as conservation programmes

2.0 MATERIALS AND METHODS

Relevant literature were assembled and collated, from Journal publications, Conference papers , Bulletins, books, as well as from the internet, they were then discussed and reviewed

DISUSSION AND REVIEW

3.1 Improvement of the White Fulani

The white Fulani (Bunaji) is the most numerous and most widely distributed cattle breed in West Africa .Norezzine, *et al ,(* 2019) evaluated heterozygosis in cattle population and characterized the white Fulani breed by identifying DNA markers considering microsatellites, they reported a high degree of genetic diversities and thus a highly informative source of genetic analysis , they stated further that the result could be applied in dealing with the conservation and sustainable application of genetic resources in the Nigerian cattle population.

3.2 Conservation and Improvement Studies on the Ndama Breed

The N'Dama, , is a hump less Longhorn *(Bos Taurus longifrons*) cattle . N'Dama cattle are believed to have originated from the Fouta Djallon plateau in Guinea, and are now found in the whole of coastal West and Central Africa: . Bosso *et al., (*2007),carried out a participatory rural appraisal study using a bio- economic model of utilizing all known biological and economic relationships with a view to determining the overall breeding goal of the farmers, they reported encouraging result in the Ndama genetic improvement programmes in the Gambia which played an important role in the conservation and utilization of the Ndama cattle , the programme significantly influenced the utilization and development of the Ndama breed .

3.3 Genetic Improvement and Conservation of the Muturu Breed.

The breed is a variety of West African Shorthorn. Generally, two types of Muturu cattle have been identified: a larger Savannah-type and a Dwarf-Forest type, which appears to have evolved through adaptation to the humid forest environment. Most of the Muturu cattle of Nigeria belong to the Savannah type, spread over Benue , plateau, and smaller numbers are found further to the Southwest in Oyo and Kwara. This breed is also found in Southeastern coastal area of Ghana. The distinction between the strains of the breed is not yet clear, however, DAGRIS (2005) classified the Muturu cattle breed into four separate cattle populations. .Adoligbe *et al*., (2020), conducted an explanatory survey to understand breeding practices and breeding objectives as well as constraints as a first step towards developing breeding strategies for the conservation of the Muturu in Queme, a small holder farming area of South Benin, using an electronic animal genetic research characterization inventory and monitoring tool. They reported a significant reduction in the number of Muturu cattle , this they further reported was due to competition for land use for crop cultivation and also animal theft and Cattle rustling , this position was also supported by the report of Ocheja *et al.,* (2023). They recommended that a participatory management schemes be designed and implemented for *in situ* conservation of the Muturu cattle breed in Benin.

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

The Muturu and Ndama breeds are at risk of extinction, thus requiring aggressive conservation efforts. Some genetic progress was achieved with the White Fulani breed

4.2 Recommendations

Genetic improvement and conservation efforts on the Muturu ,Ndama and White Fulani breeds should be stepped up . Land tenure and use systems that are favourable to cattle owners should be worked out as well as instituting adequate security measures to curb cattle theft/rustling
Climate change mitigation strategies should be put in place.

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Animal Physiology, Reproduction and Health: APH001

SERUM METABOLITES OF NOILER CHICKEN AS AFFECTED BY AGE AND SEX

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ABSTRACT

This study investigated the effects of sex and age on serum metabolites of Noiler chicken. A total of sixty (60) Noiler chicken were used to study the effect of sex and age on serum metabolites. The male and female birds were identified through the vent method and grouped into males and females. Each group was replicated three times (10 birds per replicate) in a Randomised Complete Blocked Design (RCBD). Each bird was leg banded for individual identification. Data on serum metabolites were collected at 6, 8 and 10 weeks respectively. The serum metabolites that were observed were total protein; albumin cobalt binding, globulin, albumin-globulin ratio (AG), aspartate aminotransferase, alkaline phosphatase, alanine aminotransferase, chloride (CHLOR.), urea and creatinine. At the 6th and 10th weeks, it was observed that sex had no significant effect ($p>0.05$) on the serum metabolites. Similarly, same trend was also observed at 8th week except AG and CHLOR. which were significantly different ($p<0.05$). Age appeared to be a more prominent factor in influencing these parameters, with some parameters showing significant differences at specific developmental stages and as the birds advanced in age.

Keywords: Serum metabolites, noiler chicken, age, sex.

DESCRIPTION OF PROBLEM

Poultry farming plays a vital role in meeting the ever-increasing demand for animal protein worldwide (11). As a result, the quest for improved meat production and quality has garnered significant attention among poultry researchers and producers (1). The Noiler chicken breed has gained significant attention in recent years due to its potential for dual-purpose use, combining both egg-laying and meat-producing abilities (2). Originating from Nigeria, the Noiler chicken is a crossbreed between local Nigerian chickens and commercial broiler breeds. This hybridization aims to harness the local chicken's resilience and adaptability to the African environment while improving its meat and egg production capabilities (2). As poultry farming continues to be an essential component of global agriculture, understanding the serum biochemistry of various chicken breeds, including the Noiler, becomes crucial for efficient meat production and meat quality. Serum metabolites refer to the small molecules found in the bloodstream of animals (3). These metabolites are important indicators of various physiological processes, including nutrient metabolism, energy utilization, and overall health status (3). Monitoring serum metabolites can provide valuable insights into the metabolic state of chicken and help optimize their nutritional management. The serum metabolites parameters are investigated to understand the metabolic status and nutritional requirements of chicken (4). Sex differentiation significantly affects growth rates and body composition in poultry. Male Noiler generally exhibit faster growth and greater final body weight compared to females. Differences in growth patterns are associated with variations in feed conversion efficiency, muscle development, and fat deposition (5; 6). The hormonal and genetic factors underlying these growth differences are complex and involve interactions between sex steroids, growth hormone, and insulin-like growth factors. The age and sexual differentiation in serum metabolites of Noiler chickens are regarded as crucial parameters for evaluating the overall health and productivity of the animals (7). The potential existence of sexual differentiation in said features may have significant implications for the management of Noiler chickens and their utilization in the field of poultry production. However, there exist a notable dearth of knowledge regarding the effect of age and sex

on the serum metabolites. Therefore, the aim of this study was to investigate the effect of sexual differentiation and age on serum metabolites in Noiler chicken.

MATERIALS AND METHODS

Site of the experiment

The experiment was carried out at the Teaching and Research Farm of Olusegun Agagu University of Science and Technology, Okitipupa. Ondo State.

Experimental birds and management

A total of 60 days – old Noiiler chicks (30 males and 30 females) were purchased for this study. The birds were identified and separated into males and females using vent inspection method. Each bird was leg banded for individual identification. Each group was replicated thrice (10 birds per replicate) in a Randomised Complete Blocked Design (RCBD). The birds were raised in deep litter system. They were uniformly fed standard diets *ad libitum* (starter diet of 21% crude protein level and grower diet of 18% crude protein level) formulated to supply nutrient requirements according to NRC recommendation.

Data collection and analysis

Data on serum metabolites were also collected at 6th, 8th and 10th weeks. Blood samples were collected with 2 ml syringe through veins from the wings. The blood samples were centrifuged to get the serum which was analysed to get data for each metabolite. The serum metabolites were determined using methods described by (12). Serum metabolites observed were total protein; albumin cobalt binding, globulin, albumin-globulin ratio (AG), aspartate aminotransferase, alkaline phosphate, alanine aminotransferase, chloride (CHLOR.), urea and creatinine. Data were analyzed using SAS (version 9.13, SAS 2004) to determine the effect of age (6, 8, and 10 weeks) and sex (Male and female) on serum metabolites. The two-way ANOVA procedure was carried out. Duncan Multiple Range Test (DMRT) was used to separate the means when significant differences existed between them at 5% significant level.

RESULTS AND DISCUSSION

Table 1 shows the effect of age on serum metabolites. At 6 to 10 weeks of both sexes, it was observed that age had no significant difference ($p<0.05$) across the weeks in some parameters except in ACB, AG, ALT and between weeks 8 and 10, AST values were significantly different ($p<0.05$) as observed in female. Also, there was no progressive increase as there was fluctuation in their increase. Similarly, same trend was also observed in some parameters except urea, which were significantly different ($p<0.05$) as observed across all the weeks in male.

Table 2 shows the effect of sex on serum metabolite at 6th , 8th and 10th weeks. At the 6th and 10th weeks, it was observed that sex had no significant effect ($p>0.05$) on the serum metabolites. Similarly, same trend was also observed at 8th week except AG and CHLOR. which were significantly different ($p<0.05$).

The study demonstrates that the effect of age on serum metabolites varies between male and female during the developmental period from 6 to 10 weeks. In female noilers, there was generally no significant difference in most parameters, except for ACB, AG, ALT, and AST between weeks 8 and 10 which was in line with (7), who reported that certain metabolites may exhibit fluctuation rather than a linear increase during this time frame. According to (8), the significant difference observed in AST levels between weeks 8 and 10 in female noiler could be indicative of specific developmental events or processes occurring during this period. Furthermore, it was reported by (9) that male noilers exhibited a more consistent change in urea levels across all weeks, indicating that this parameter is subject to age-related alterations. Also, there was a notable difference between male and female Noiler chickens at various ages. With the report of (10), there are instances of positive correlations, where an increase in one metabolite is associated with an increase in another which may be explained in their study that ALT's levels tend to rise along with other metabolites in most cases but decrease when glucose or urea levels increase.

Table 1: Effect of age on Serum Metabolites of Noiler chicken on sex basis

Sex	Age (wk)	TP	ACB	GLOB	AG	AST	ALT	ALP	GLU	CHLOR	UREA	CREAT
	6	72.50^{a}	39.50^{a}	33.00^{ab}	1.25^{a}	6.50^{b}	8.00^{b}	14.50^{b}	5.10^{a}	93.50^{a}	4.65^{a}	75.75^{a}
		^{b}±2.02	±0.29	±2.31	±0.09	±0.87	±0.58	±0.87	±0.06	±2.02	±0.26	±4.30
F	8	74.50^{a}	37.50^{b}	37.00^{a}	1.05^{b}	7.00^{b}	5.50^{c}	19.00^{a}	5.15^{a}	93.35^{a}	4.85^{a}	72.40^{a}
		±2.02	±0.29	±1.73	±0.03	±1.15	±0.87	±1.15	±0.03	±1.53	±0.03	±0.58
	10	68.50^{b}	40.00^{a}	28.50^{b}	1.40^{a}	11.00^{a}	11.00^{a}	18.50^{ab}	4.77^{a}	96.17^{a}	4.47^{a}	80.27^{a}
		±0.29	±0.00	±0.29	±0.00	±0.0	±0.58	±1.44	±0.20	±0.49	±0.09	±5.69
	6	75.00^{a}	39.00^{a}	36.00^{a}	1.10^{a}	9.00^{a}	8.00^{a}	16.00^{a}	5.50^{a}	95.00^{a}	4.30^{b}	78.75^{a}
		±0.00	±0.58	±0.58	±0.00	±1.15	±1.15	±0.58	±0.35	±0.00	±0.23	±0.20
M	8	75.50^{a}	36.00^{a}	39.50^{a}	0.90^{a}	9.50^{a}	9.50^{a}	16.50^{a}	6.05^{a}	99.00^{a}	6.05^{a}	85.85^{a}
		±2.02	±1.15	±0.87	±0.00	±0.87	±2.02	±0.29	±0.61	±0.58	±0.60	±9.15
	10	74.00^{a}	38.50^{a}	35.50^{a}	1.17^{a}	6.50^{a}	9.50^{a}	17.00^{a}	5.40^{a}	95.30^{a}	3.87^{b}	70.87^{a}
		±0.48	±2.02	±2.59	±0.15	±0.29	±0.87	±1.15	±0.40	±2.14	±0.55	±11.92

Means with different superscript on the same row are significant ($p<0.05$) difference. TP: total protein; ACB: albumin cobalt binding; GLOB: globulin; AG: albumin globulin; AST: aspartate aminotransferase; ALP: alkaline phosphate; ALT: alanine aminotransferase; Cholrd: chloride; creat: creatinine.

Table 2: Effect of Sex on Serum Metabolite of Noiler chicken on age basis

Age	Sex	TP	ACB	GLOB	AG	AST	ALT	ALP	GLU	CHLOR.	UREA	CREAT
6	F	72.50^{a}	39.50^{a}	33.00^{a}	1.25^{a}	6.50^{a}	8.00^{a}	14.50^{a}	5.10^{a}	93.50^{a}	4.65^{a}	75.25^{a}
		±2.02	±0.29	±2.31	±0.09	±0.87	±0.58	±0.87	±0.06	±2.02	±0.26	±4.30
	M	75.00^{a}	39.00^{a}	36.00^{a}	1.10^{a}	9.00^{a}	8.00^{a}	16.00^{a}	5.50^{a}	95.00^{a}	4.30^{a}	78.75^{a}
		±0.00	±0.58	±0.58	±0.00	±1.15	±1.15	±0.58	±0.35	±0.00	±0.23	±0.20
8	F	74.50^{a}	37.50^{a}	37.00^{a}	1.05^{a}	7.00^{a}	5.50^{a}	19.00^{a}	5.15^{a}	93.35^{b}	4.85^{a}	72.40^{a}
		±2.02	±0.29	±1.73	±0.03	±1.15	±0.87	±1.15	±0.03	±1.53	±0.03	±0.58
	M	75.50^{a}	36.00^{a}	39.50^{a}	0.90^{b}	9.50^{a}	9.50^{a}	16.50^{a}	6.05^{a}	99.00^{a}	6.05^{a}	85.85^{a}
		±2.02	±1.15	±0.87	±0.00	±0.87	±2.02	±0.29	±0.61	±0.58	±0.60	±9.15
10	F	68.50^{a}	40.00^{a}	28.50^{a}	1.40^{a}	11.00^{a}	11.00^{a}	18.50^{a}	4.77^{a}	96.17^{a}	4.47^{a}	80.27^{a}
		±0.29	±0.00	±0.29	±0.00	±0.00	±0.58	±1.44	±0.20	±0.49	±0.09	±5.69
	M	74.00^{a}	38.50^{a}	35.50^{a}	1.17^{a}	6.50^{b}	9.50^{a}	17.00^{a}	5.40^{a}	95.30^{a}	3.87^{a}	70.87^{a}
		±0.48	±2.02	±2.59	±0.15	±0.29	±0.87	±1.15	±0.40	±2.14	±0.55	±11.92

CONCLUSION AND APPLICATION

1. Age appeared to be a more prominent factor in influencing these parameters, with some parameters showing significant differences at specific developmental stages.
2. However, as Noiler chickens approached the 10th week mark, age-related variations became less significant, suggesting a degree of physiological stability.
3. These findings have implications for poultry management practices, emphasizing the need for age-specific care and monitoring, particularly during the early growth stages at the early developmental stage.
4. Sex did not strongly influence serum metabolite levels, these findings provide insights into the early stages of development, indicating that both male and female exhibit relatively similar metabolic profiles.

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Animal Physiology, Reproduction and Health: APH002

EFFECT OF ASCORBIC ACID ON THE ONSET AND DURATION OF XYLAZINE MIDAZOLAM ANESTHESIA IN WEST AFRICAN DWARF GOATS

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ABSTRACT

This research seeks to provide insights into optimizing anesthesia protocols for better management of pain and stress in research and surgical practice. The study was conducted over a period of nine (9) weeks to evaluate the effect of ascorbic acid (A_{300}) on the onset and duration of xylazine – midazolam (XM) anesthesia in West African Dwarf (WAD) goats. A total of 10 sexually mature WAD goats of both sexes were randomly allotted into two treatment groups of five WAD goats each; Group 1: Xylazine + Midazolam (XM) and Group II: Xylazine + Midazolam + Ascorbic acid (XMA_{300}). Group I (XM) were administered xylazine and Midazolam (XM) intramuscularly at a dose rate of 2mg/kg and 1mg/kg respectively. Group II (XMA_{300}) were administered ascorbic acid intramuscularly at a dose rate of 100 mg/kg, followed by concurrent administration of XM. Ascorbic acid was administered 10 minutes prior to xylazine- Midazolam (XM) injection. The intramuscular administration of drugs carried out in this study was done using 21 gauge needles. Data on the onset and duration of anesthesia were collected and subjected to one way analysis of variance (ANOVA) using Statistical Analysis Software (SAS 2004). Results revealed significant effect ($P<0.05$) on the onset and duration of WAD goats. Goats administered with XMA_{300} had the shortest ($P<0.05$) onset of action at 1.00 ± 0.00 minute followed by the XM at 2.00 ± 0.00 minutes. Goats administered with XMA_{300} had the longest ($P<0.05$) duration of anesthesia (265.60 ± 2.07 minutes) followed by WAD goats administered XM (244.00 ± 1.58 minutes). It can be concluded that ascorbic acid should be administered prior to xylazine, midazolam anesthesia in goat especially when the animal is to remain anaesthetized for long period.

Keywords: Anaesthesia, Animal welfare, Ascorbic acids, Midazolam, Xylazine,

DESCRIPTION OF PROBLEM

Pain management in animals, particularly during animal experimentation and surgical procedures, is crucial for ensuring their welfare and reducing physiological stress. Pain, defined as an aversive sensory experience resulting from actual or potential tissue damage, triggers significant physiological and behavioral changes aimed at reducing harm and promoting recovery (1). Pain causes discomfort, impairs functions and immune responses in the body (2), resulting in negative consequences on livestock production. Effective pain management not only alleviates suffering but also enhances recovery and productivity in animals (2). In animal experimentation and veterinary practice, sedatives like xylazine and midazolam are commonly used to facilitate anesthesia in ruminants such as goats so as to manage pain. Xylazine is an alpha-2-adrenoreceptor agonist with analgesic, sedative, and muscle relaxant effects, and is used commonly in veterinary practice (3) while Midazolam (MDZ), due to its high water-soluble property is able to cross the blood-brain barrier rapidly to produce central muscle relaxant effect. It produces its effect by potentiating inhibition of neurone, which is mediated by Gamma Amino Butyric Acid (GABA) (4; 5). These agents make handling and induction of anxious animals safer, reduces the anaesthetic dose requirement, provision of pre-emptive analgesia and muscle relaxation, counteract the side effect of other drugs and facilitate smooth recovery (6). However, their use can lead to side effects including oxidative stress (7; 8), respiratory depression and cardiovascular instability (9). Oxidative stress induced during anesthesia can lead to cellular damage and compromise post-operative outcomes (10). Ascorbic acid, known for its potent antioxidant properties, has been extensively studied for its role in mitigating oxidative stress and enhancing recovery in various physiological conditions (11). Despite its potential benefits, the specific effects of ascorbic acid on

the onset and duration of xylazine-midazolam anesthesia in West African Dwarf goats remain largely unexplored. Understanding the interplay between antioxidants like ascorbic acid and sedatives will not only enhance anesthesia efficacy but also mitigate stress induced by anesthesia, improve post-operative recovery and animal welfare. This study investigated how ascorbic acid supplementation influences anesthesia, induced by xylazine and midazolam in West African Dwarf goats.

MATERIALS AND METHODS

Experimental site and duration

The experiment was conducted at the Teaching and Research Farm, Federal College of Animal Health and Production Technology, Moor Plantation, Apata, Ibadan. Ibadan lies within the forest-savannah transition zone and is located at longitude 3° 53' 47" E and latitude 7° 23' 47" N. The temperature and relative humidity ranges from 35°C-40°C and 76-78% respectively. The study was conducted in March 2023 to May 2023 over a period of nine weeks, with 10 sexually mature WAD goats of both sexes.

Experimental Animals and their management

A total of 10 West African dwarf (WAD) goats of both sexes were purchased from Akinyele market in Ibadan, Oyo state. Prior to the arrival of the animals, the pens were thoroughly washed and disinfected with Povidone-iodine. The goats were confined in individual pen and quarantined for a period of four (4) weeks prior to the onset of the study. Fresh cool clean water, cassava peel and grasses were made available *ad libitum*. The WAD goats were given prophylactic treatments. After adaptation period, the ten animals were randomly allotted into two treatment groups of 5 animals per treatment. Group 1: Xylazine + Midazolam (XM) and Group II: Xylazine + Midazolam + Ascorbic acid (XMA_{300}).

Data Collection

Anaesthetic Protocol

Prior to anaesthesia induction, the WAD goats were fasted for food and water for 12 and 24 hours, respectively. They were weighed individually and divided into two groups. Group I (XM) was administered xylazine (Alfasanwoerden-holland, supplied at 30mL per vial.) and Midazolam (Dormicum, Hoffmann-La Roche Ltd, Basel, Switzerland) intramuscularly at a dose rate of 2mg/kg for xylazine and (1mg/kg) for Midazolam respectively. The intramuscular administration of drugs was done using 21 gauge needles. Group II animals (XMA_{300}) were administered with Ascorbic acid (Tianjin Kingyork group Hubei Tianyao Pharma.Co.,Ltd., No. 99 Hanjiang Bei Road, Xiangyang, Hubei, China) intramuscularly at a dose rate of 100 mg/kg, followed by concurrent administration of XM . Ascorbic acid was administered 10 minutes prior to xylazine- Midazolam injection. Time of anaesthetic administration was recorded. This was used as reference to describe the changes in various reflexes over time of induction. The time taken for onset of induction, duration of anaesthesia and recovery time of the reflexes from anaesthetic condition to normal reflexes and complete recovery from anaesthesia were recorded according to the procedure of (12).

Statistical Analysis

All data obtained were subjected to one way analysis of variance (ANOVA) using Statistical Analysis Software (SAS 2004) (13). The means among the variables were separated using Duncan multiple range test of the same statistical package

RESULTS

Presented in **Table 1** is effect of Xylazine, Midazolam Combination with Ascorbic Acid on the onset and duration of anesthesia in WAD goats. The results showed that WAD goats administered with XMA_{300} had the shortest ($P<0.05$) onset of action 1.00 ± 0.00 minute while the longest ($P<0.05$) onset of action 2.00 ± 0.00 minutes was observed in WAD goats administered XM. Furthermore**,** WAD goats administered with XMA_{300} had the longest ($P<0.05$) duration of anesthesia (265.60 ± 2.07 min) followed by those on XM having the shortest ($P<0.05$) duration of anesthesia (244.00 ± 1.58 min).

Table 1: Effect of ascorbic acid, xylazine and midazolam on onset of anesthesia and duration of anesthesia in West Africa dwarf goats

Parameters	XM	XMA_{300}
Onset of action (minutes)	2.00 ± 0.00^{a}	1.00 ± 0.00^{b}
Duration of anesthesia (minutes)	244.00 ± 1.58^{b}	265.60 ± 2.07^{a}

[a,b] Means along the same row with different superscripts are significantly different (P<0.05). XM: group induced with Xylazine and Midazolam, XMA_{300}: group induced with ascorbic acid, Xylazine and Midazolam

DISCUSSION

This study indicated that goats administered with the combination of xylazine, midazolam, and ascorbic acid (XMA_{300}) exhibited a significantly shorter onset of anesthesia (1.00 ± 0.00 minute) compared to the goats administered with xylazine and midazolam alone (XM) (2.00 ± 0.00 minutes). This suggests that ascorbic acid accelerates the onset of anesthesia. The duration of anesthesia was significantly longer in goats administered with XMA_{300} (265.60 ± 2.07 minutes) compared to those administered with XM (244.00 ± 1.58 minutes). This indicated that ascorbic acid not only enhances the onset but also prolongs the duration of anesthesia. This confirms the earlier findings of (14), who found that pretreatment of rabbits with ascorbic acid administered intramuscularly at 30, 60, and 240 mg/kg, followed by ketamine 40 mg/kg, had a substantial effect on the onset and duration of ketamine anaesthesia. This was similar to the observation of (15) on Ascorbic acid; pre-medication enhancing the anaesthetic effect of ketamine-xylazine in rat. The findings in this study are also consistent with the result reported by (16), who found that administering ascorbic acid at different times following xylazine anaesthesia affected the onset and duration of anaesthesia in rabbits. The underlying mechanisms by which ascorbic acid influences anesthesia may involve its antioxidant properties, which could stabilize cellular membranes and enhance drug efficacy.

However, further research is needed to elucidate these mechanisms and to explore the optimal dosing and administration protocols for different species and anesthetic combinations.

Clinical and Practical Implications:
The findings from this study have important implications for veterinary practice and animal research. The consistent enhancement of anesthesia by ascorbic acid across various species, including rabbits and rats, underscores its potential utility as an anesthetic adjunct. By incorporating ascorbic acid into anesthetic protocols, veterinarians and researchers can achieve more efficient and prolonged anesthesia, reducing the need for additional doses and minimizing the risk of anesthetic complications. This is particularly beneficial for surgical procedures that require extended durations of anesthesia, as it ensures better pain management and animal welfare.

CONCLUSION

The value of onset in animal administered ascorbic acid, xylazine and midazolam was shorter and the duration of anesthesia was elongated.

Recommendation
Ascorbic acid should be administered prior to xylazine, midazolam anesthesia in goats especially when the animal is to remain anesthetized for long period.

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Animal Physiology, Reproduction and Health: APH003

IMPLICATIONS OF LIGHTING COLOUR ON PERFORMANCE OF LAYING HENS AT THE EARLY LAYING PHASE

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ABSTRACT

Effects of lighting colour on the performance of laying hens in the early laying phase were investigated in this study. Isa Brown birds (n=150) at 18 weeks of age were randomly allotted into five treatments: T1 = Natural Photoperiod (control), T2 = White light, T3 = Red light, T4 = Green light, and T5 = Blue light, in a completely randomized design. The birds were exposed to four hours of artificial lighting in different colours in addition to the natural photoperiod. Body weight was recorded weekly, and egg production was collected daily. Data were analysed using descriptive statistics and ANOVA at $\alpha_{0.05}$. Results showed that birds in T2 had a significantly higher ($p<0.05$) egg mass (44.96g) and a more efficient feed conversion ratio (2, 6) compared to other groups. Higher feed intake was recorded in the T3 group (117.16g). There was no significant difference in the hen-day egg production among the groups, although the control group showed a lowered hen-day egg production (60.67%). Birds in T1, T2, T4 showed high liveability (100%). Therefore, exposure of birds to different lighting colours resulted in an increase in egg production compared to natural daylight.

Keywords: Photoperiod, hen-day egg production, Feed conversion ratio, egg mass

INTRODUCTION

Light is one of the most important environmental factors that greatly influence the growth, development, and production performance of laying hens. (1) In poultry production, lighting is a crucial management tool and its impact on the physiology of birds, behaviour and performance is largely due to three key aspects: the wavelength or colour of light, the brightness or intensity of the light, and the length of time the birds are exposed to light each day. (2) Proper lighting is vital for the development and normal functioning of the reproductive system and the overall growth of poultry birds. (3) Thus, the use of artificial lighting with varying durations and intensities is widely adopted in poultry houses to enhance the performance and productivity of laying birds (4).

The primary sense organs in poultry are their eyes, and vision is one of the key ways in which birds are affected. Studies have shown the impacts of different light sources on poultry performance, behaviour, and reproduction (5,6). Poultry species can detect light using both the photoreceptors in the retina of the eyes as well as photosensitive cells in their brains (hypothalamic or extra-retinal photoreceptors). The growth and behavioural responses in poultry are primarily influenced by the photoreceptors located in the retina, while the photosexual responses are mainly controlled by the extra-retinal light receptors (7). Notably, Light exposure stimulates the release of reproductive hormones in laying hens. These hormones play a crucial role in regulating the sexual maturation and egg-laying cycles in these birds (8).

Research conducted by Mobarkey *et al*. (9) found that stimulating the retinal photoreceptors had an inhibitory effect on the reproductive function of broiler breeder hens while stimulating the extra-retinal photoreceptors had an activating effect on their reproductive performance in breeder hens. The differential effects of light stimulation on the retina versus extra-retinal photoreceptors are determined by the retina's sensitivity to different wavelengths of green, yellow, and red light, as well as the ability of these wavelengths

to penetrate the birds' body tissues (10). It is well-documented that red light stimulates the development of reproductive organs in poultry, while blue and green light spectra have little to no effect on the activity of the reproductive system. (11,12,13).

Proper lighting programs are vital for optimising egg production and performance in laying hens. Thus, there is a need to adopt suitable lighting conditions in Nigeria poultry production. The current understanding of how photoperiod (duration of light exposure) and light intensity affect the behaviour and performance of laying hens is quite extensive. However, information on the importance of lighting colour on the performance of laying hens is still limited. Therefore, the objective of this study is to determine the implication of different lighting colours on the performance of laying hens

MATERIALS AND METHODS

Experimental location

The experimental site was the Poultry Unit, Teaching and Research Farm, University of Ibadan, Ibadan, Nigeria. The study area lies between longitude 7°27.05 north and 3°53.74 of the Greenwich Meridian east at an altitude 200 m above sea level. The average temperature and relative humidity ranges of the location are between 23-42 °C and 60-80%, respectively.

Experimental Pullets and Management

Isa Brown pullets (n=150) at 1.4kg±0.07 with a track record of medication, vaccination schedule, and productive performance from 18 weeks old were used for this experiment. The pullets were raised in a conventional battery house. Each cage in the three-tier cage which measured 40 × 41 × 32 cm. The pullets were allotted to red, blue, green, and white colours in addition to receiving natural daylight for four hours and the control group received only natural photoperiod in a completely randomized design to produce 5 treatments. Each treatment was replicated five times, a replicate comprised six pullets.

Data collection

All the birds were weighed and recorded by using a Camry Spring Dial Mechanical scale, made in China to get the initial body weight just after their arrival. Weekly body weights were recorded and the average weight per bird (each replicate was weighed as a whole, then the average weight was calculated) according to their corresponding replicates was calculated after each week. Feed intake was calculated by dividing the refusal of the whole week by the total feed offered during that period. Efficiency of conversion of feed to eggs and percent hen-day production were calculated.

Statistical Analysis

Data were analysed using descriptive statistics and one-way Analysis of Variance using the SPSS statistical package for Windows version 16.0 (IBM Corp., Armonk, NY, USA). Duncan's multiple range test was applied to the separate means. Statistical significance was considered at $p<0.05$.

RESULTS AND DISCUSSIONS

Effects of lighting colours on performance parameters in laying birds at the early laying phase are shown in Table 1. Feed intake was significantly higher in the red colour group. This finding thus suggests that the red colour could improve feed consumption in laying birds. Birds in the white colour group showed a higher egg mass and feed conversion ratio than other groups. There was no significant effect ($p>0.05$) of lighting colour on Hen Day Egg percentage among the groups which ranged from 76.67% in blue light colour to 79% in red light colour ($P<0.05$) which is higher than those in the control groups. These findings align with earlier observations (14), that light colour had no impact on egg production. Although, Min *et al*. (15) reported higher hen-day production in layers kept in red light and white light colours which corresponded with the result of this experiment. The positive impact of red light on egg production may be due to its longer wavelengths, which penetrate the skin and skull more effectively than shorter wavelengths in the blue-green

spectrum. This enhanced penetration could contribute to improved performance in birds (16). Previous studies reported no statistical differences in body weight gain or FCR when comparing pullets exposed to red, green, and white lights (17,18,19). However, Firouzi *et al*. (20) showed that blue light had a negative effect on FCR which is in accordance with our findings.

Table 1: Performance indices of birds exposed to different lighting colour

Parameters	T1	T2	T3	T4	T5	SEM
Feed Intake(g)	112.57^{bc}	116.15^{ab}	117.16^{a}	114.21^{abc}	111.91^{c}	
Egg Mass (g)	34.21^{b}	44.96^{a}	37.51^{ab}	41.76^{ab}	36.90^{ab}	1.44
FCR	3.34	2.60	3.20	2.74	3.06	
						2.32
HDEP (%)	60.67^{b}	78.33^{a}	79.00^{a}	77.33^{a}	76.67^{a}	
Liveability (%)	100.00	100.00	97.00	93.00	100.00	

^{abc}Means of treatments along the same row with different superscripts are significantly different ($p<0.05$) SEM=Standard Error of Means, FCR=Feed Conversion Ratio, HDEP=Hen-Day Egg Production, T1=Control, T2=W10, T3=R10, T4=G10, T5=B10

CONCLUSION AND RECOMMENDATION

Evidence suggests that specific light colours, especially red, could improve the feed intake and production performance in laying hens while green and white light could increase liveability.

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Animal Physiology, Reproduction and Health: APH004

GASTROINTESTINAL HELMINTHS IN GOATS: A CASE STUDY OF DAMATURU, YOBE STATE, NIGERIA

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ABSTRACT

The challenge of helminth infection has been a global problem affecting livestock productivity, especially, small ruminants. Against this background, a study was conducted to ascertain the occurrence of gastrointestinal helminthiasis among goats in Damaturu. A two-year clinical record was collected from the Township Veterinary Clinic, Damaturu. Data was analysed and presented on monthly basis. The results indicated that during the first year (2021), a total of 4,992 goats were brought to the clinic for various clinical reasons. Out of this number, 1,044 (20.91%) were suspected of helminthiasis, with the highest prevalence during the rainy months. Similarly, in 2022, 1,058 (25.46%) goats showed obvious clinical signs suggestive of helminthiasis out the 4,155 goats brought to the clinic. It was therefore concluded that gastrointestinal helminthiasis is a prevalent clinical problem affecting more than 20% of goats in the study area.

Keywords: Gastrointestinal, helminths, Goats, Damaturu.

DESCRIPTION OF THE PROBLEM

Throughout the world, livestock production has been considered as one of the many ways by which poverty can be reduced through improvement of peoples' financial status. It also provides a good and reliable source of protein and raw materials for industries (1). However, productivity is usually being\challenged by the menace of gastrointestinal (GI) helminths which often lead to economic losses especially in small ruminants which constitute a significant portion of the Nigeria's livestock population. According to (2), goats constitute the highest number of ruminant livestock in Nigeria with a population of about 57.4 million.

Gastrointestinal worms usually affect livestock through contaminated feeds and water, especially in the presence of inadequate and poor hygiene (3). Most infected goats may exhibit asymptomatic signs and hence may not be detected and given the desired prompt attention. Helminthiasis is a serious health threatening disease that affects the productivity of small ruminants due to the associated morbidity, mortality, cost of treatment and control measures (4). According to (5), approximately 95% of goats and sheep are infected with helminths. (6) asserted that the prevalence of gastrointestinal helminths in goats varies from place to place depending on environmental and other management-related factors. However, there is limited data on the prevalence of goat gastrointestinal helminthes in Damaturu, Yobe state. The aim of this study was to evaluate the prevalence of gastrointestinal helminthes among goats in Damaturu town.

MATERIALS AND METHODS

Study Location

The study was carried out at the Township Veterinary Clinic, Damaturu, Damaturu Local Government Area, Yobe State. Damaturu is within the GPS location of Latitude: 11° 44' 49.1856" N and Longitude: 11° 57' 58.2912" E. (7).

Data Collection and Analysis

Using a structured questionnaire, data was collected from daily clinical records covering a period of two years, beginning from 1st January, 2021 to 31st December, 2022. The main data items captured in the questionnaire were that of number of goats brought to the clinic and number of suspected cases of

gastrointestinal helminthes. From these two parameters, percentages of goats suspected of helminthes were determined using the formula.

$$P = \frac{TC}{SC} x\ 100$$

Where P = Percentage of goats suspected of gastrointestinal helmithes
TC = Total number of goats brought to the clinic in a particular year
SC = Suspected cases in a particular month.
Daily records for all the above parameters were summarized on monthly basis.

RESULTS AND DISCUSSION

Results for prevalence of gastro-intestinal helminths in goats in Damaturu are presented in Tables 1. A total of 4,992 goats were brought to the clinic for treatment. Out of this number, 1,044 (20.91%) suspected of gastrointestinal helminthes. This is far lower than 56.3% reported by (8) for global prevalence. Similarly, it is lower than 98.4% (9). The relatively lower percent value obtained in this study could be as a result of the method used in data collection.

The month with highest prevalence was August, which had a total of 132 cases representing 47.83%, followed by November 37.91%, then September (32.47%). This could be attributed to season. (10) and (11), asserted that environmental factors such as rainfall influence the prevalence of helminths in small ruminants. The lowest rate of prevalence was recorded in January (13.66%).
Result for prevalence of gastrointestinal helminths in goats in 2022 are present in Table 2. In this year, a total of 4,155 of goats were brought to the clinic. Out of this number, 1,058 (25.46%) were suspected of gastrointestinal helminths. This is a little higher than 20.91% reported for the previous year. The month of September had the highest prevalence rate (58.12%), followed by October (41.93%) while February which had 12.67% was the lowest. Generally, the values obtained in this study are lower than those reported in literature for various places across the world. Main reason for this, could be the method used in data collection.

Table 1: Record of Goats Suspected of Helminthiasis at the Township Veterinary Clinic, Damaturu in 2021

Month	No. Goats Brought to the Clinic	No. suspected cases	Percentage
January	483	66	13.66
February	521	74	14.2
March	367	73	19.89
April	440	86	19.55
May	346	84	24.28
June	459	94	20.48
July	507	128	25.25
August	276	132	47.83
September	388	126	32.47
October	472	129	27.33
November	306	116	37.91
December	427	103	24.12
Total	**4992**	**1044**	**20.91**

Table 2: Record of Goats Suspected of Helminthiasis at the Township Veterinary Clinic

Month	No. Goats Brought to the Clinic	No. of suspected cases	Percentage
January	354	50	14.12
February	371	47	12.67
March	405	43	10.62
April	324	66	20.37
May	381	79	20.73
June	247	88	35.63
July	302	90	29.8
August	403	120	29.78
September	277	161	58.12
October	384	161	41.93
November	326	90	27.61
December	381	63	16.54
Total	**4155**	**1058**	**25.46**

CONCLUSION

Based on the results obtained in this study, it was concluded that the prevalence of goat helminthiasis in Damaturu is lower than the global rate of 56.3%. The study also concluded that there was higher prevalence in 2022 than 2021 probably due to higher rainfall which was reported to be a high predisposing factor.

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Animal Physiology, Reproduction and Health: APH005

PREVALENCE OF CRYPTORCHIDISM AMONG INDIGENOUS BREEDS OF BULLS IN KANO: A SEMI ARID ENVIRONMENT

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ABSTRACT

This study was carried out with the aim of determining the prevalence of cryptorchidism among bulls slaughtered at the Kano Main Abattoir. Out of 228 indigenous bulls examined, the breeds identified were Keteku, Kuri, Muturu, Red Bororo, Sokoto Gudali, and White Fulani; 6 bulls were identified as cryptorchid, resulting in a prevalence rate of 2.63%. The low prevalence suggests that cryptorchidism was not highly prevalent in the studied indigenous bull population. Bilateral cryptorchidism was observed in one case, representing 16.67% of the total cryptorchid instances. In this condition, both testicles were affected. On the other hand, unilateral cryptorchidism dominated the findings, constituting the majority with 5 cases and a prevalence rate of 83.33%. Unilateral cryptorchidism is characterized by the presence of cryptorchidism in only one of the testicles. The study concludes that cryptorchidism was observed at a prevalence of 2.63%, with unilateral cryptorchidism occurring more frequently. Among the breeds, Red Bororo had the highest prevalence at 66.66%, while Sokoto Gudali and White Fulani each had a prevalence of 16.67%. Bulls aged 21-40 months were more affected. Overall, the prevalence of cryptorchidism among these bulls is low. Potential contributing factors include genetic predisposition, environmental conditions, and the critical age range of 21-40 months.

Keywords: Cryptorchidism, Prevalence, Indigenous bulls, Unilateral cryptorchidism, Fertility implications.

DESCRIPTION OF PROBLEM

Cryptorchidism is a congenital abnormality that is the failure of one or both testes to be positioned in the scrotum at the time normal for a species of animal and is usually detected at birth or shortly thereafter (1). It can be unilateral or bilateral even though unilateral are generally common (2). The cryptorchid testicle may be located at any point along the normal path of descent (abdominal or inguinal cavity or subcutis) or it may be diverted to an ectopic location (3). Emerging evidence suggests that cryptorchidism is more multifactorial than a single disease entity since it provides early evidence of other phenotypic defects such as tumours and defects in spermatogenesis (1). In Nigeria, there is paucity of information on the occurrences of cryptorchidism in bulls. Apart from the report of Ayodeji and Suwaiba (4) in Sokoto and Kumi-Diaka (5) in selected parts of northern Nigeria, no other report exists in Kano or other parts of Nigeria to the best of our knowledge. However, cryptorchidism has been reported in buck (6), camel and ram (2), where lesions suggestive of infertility have been observed.

The prevalence of cryptorchidism among cattle in Kano metropolis is a crucial consideration due to its potential impact on fertility and subsequently, the growth rate of cattle herds. However, there is a significant lack of available data to effectively understand and manage the prevalence of cryptorchidism in Kano. Therefore, this study aims to assess the extent of cryptorchidism prevalence within Kano metropolis. By determining the level of prevalence, this research seeks to provide essential insights into the necessity for management strategies to address this condition effectively.

The objective of the study was to determine the prevalence of cryptorchidism in bulls slaughtered at Kano metropolitan abattoir.

MATERIALS AND METHODS

Animals and Experimental Design

The indigenous breed of cattle presented for slaughter at the abattoir was used to conduct the study between September, 2023 to January, 2024. A total of Two hundred and twenty-eight bulls were used for the study; twenty-two of Keteku, one of Kuri, five of Muturu, one hundred and twenty of Red Bororo, thirty of Sokoto Gudali and fifty of White Fulani all ranging in age from 6 to 84 months.

Statistical Analysis

Data generated were analyzed using descriptive statistics employing SPSS, version 21 as the analytical tool.

RESULTS AND DISCUSSION

Examined Breeds of Animals

Table 1 shows the distribution of breed from the sample collected. Among the surveyed breeds, Red Bororo bulls emerge as the predominant group, constituting 52.63% of the total population with 120 individuals. White Fulani (Bunaji) bulls follow closely behind, representing 21.93% of the sample, accounting for 50 bulls. Sokoto Gudali (Bokoloji) bulls display a moderate presence, comprising 13.16% with 30 bulls. Keteku, Kuri, and Muturu breeds exhibit lower population counts, contributing 22, 1, and 5 bulls, respectively. This distribution reflects the common breeds found in Nigeria, with Red Bororo being particularly prevalent due to its adaptive traits and economic importance (7)

Prevalence of Cryptorchid

The study involved the examination of 228 indigenous bulls in Kano. Out of this sample, 6 bulls were identified as cryptorchid, resulting in a prevalence rate of 2.63%. This indicates that approximately 2.63% of the examined bulls exhibited cryptorchidism (Table 2).

Prevalence of Cryptorchid Type

Among the examined bulls, the data reveals a total of six cases of cryptorchidism, constituting a prevalence rate of 100%. Further exploration into the specific types of cryptorchidism exposes an interesting distribution within the affected population. Bilateral cryptorchidism is observed in one case, representing 16.67% of the total cryptorchid instances. In this condition, both testicles are affected. On the other hand, unilateral cryptorchidism dominates the findings, constituting the majority with five cases and a prevalence rate of 83.33%. This trend is consistent with other studies, which also report higher incidences of unilateral cryptorchidism (4, 8). Unilateral cryptorchidism is characterized by the presence of cryptorchidism in only one of the testicles. (Table 3)

Examined Breed with Cryptorchid

Table 4 illustrates that among the examined breeds, Red Bororo bulls show the highest prevalence of cryptorchidism, with 4 cases constituting 66.66% of the total cases. Sokoto Gudali (Bokoloji) and White Fulani (Bunaji) bulls each contribute 1 case, representing 16.67% prevalence for each breed. The grand total of cryptorchid cases is 6, encompassing the examined bulls from all breeds, resulting in an overall prevalence rate of 100%. These findings highlight breed-specific vulnerabilities, as noted in other studies where Red Bororo and Sokoto Gudali are particularly susceptible to reproductive disorders (7, 9).

Age of Examined Bulls with Cryptorchid

The data in table 5 reveals that the prevalence of cryptorchidism varies across different age groups of the examined bulls. The highest prevalence is observed in the 21-40 months age group, with 3 cases constituting 50% of the total cases. The 41-60 months age group follows with 2 cases and a prevalence of 33.33%. The youngest age group (5-20 months) has the lowest prevalence, with 1 case representing 16.67%. These age-related trends suggest that cryptorchidism can be detected early, which is critical for timely intervention and management (8).

Table 1: Breeds of Animals Examined

S/N	BREEDS	NUMBER	PERCENTAGE
1	Keteku	22	9.65%
2	Kuri	1	0.44%
3	Muturu	5	2.19%
4	Red Bororo	120	52.63%
5	Sokoto Gudali (Bokoloji)	30	13.16%
6	White Fulani (Bunaji)	50	21.93%
GRAND TOTAL		**228**	**100%**

Field Survey, 2024

Table 2: Number of Cryptorchids Presence

S/N	Number Examined	Number Cryptorchid	Prevalence
1	**228**	**6**	**2.63%**

Field Survey, 2024

Table 3: Types of cryptorchids Prevalence

S/N	Type of cryptorchidism	Number cryptorchid	Prevalence
1	Bilateral	1	16.67%
2	Unilateral	5	83.33%
GRAND TOTAL		**6**	**100%**

Field Survey, 2024

Table 4: Breeds of Animals Examined with Cryptorchids

S/N	Breed	Number cryptorchid	Prevalence
1	Red Bororo	4	66.66%
2	Sokoto Gudali (Bokoloji)	1	16.67%
3	White Fulani (Bunaji)	1	16.67%
GRAND TOTAL		**6**	**100%**

Field Survey, 2024

Table 5: Age of Animals Examined with Cryptorchids

S/N	Age (months)	Number cryptorchid	Prevalence
1	5-20months	1	16.67%
2	21-40months	3	50.00%
3	41-60months	2	33.33%
GRAND TOTAL		**6**	**100%**

Field Survey, 2024

The prevalence of cryptorchidism in indigenous bulls in Kano is 2.63%, a significant finding that emphasizes the presence of this condition in Nigerian cattle. Similar studies, such as those conducted by Ayodeji and Suwaiba (4), reported a prevalence of 1.74% in bulls at the Sokoto metropolitan abattoir, further confirming the widespread occurrence of cryptorchidism in indigenous breeds across different regions of Nigeria. This study found that unilateral cryptorchidism (83.33%) is more prevalent than bilateral cryptorchidism (16.67%). This finding aligns with the findings by Ayodeji and Suwaiba (4), who also reported a higher incidence of unilateral cases in their sample. The predominance of unilateral cryptorchidism suggests that while cryptorchid bulls may retain some reproductive functionality, targeted veterinary care is crucial to manage and mitigate the impact of this condition on overall herd fertility. Red Bororo bulls exhibited the highest prevalence of cryptorchidism at 66.66%. This finding is supported by Oladepo *et al*. (8) and Kubkomawa (7), as they have documented that breeds such as Red Bororo and Sokoto Gudali show higher

occurrences of certain reproductive disorders, including cryptorchidism. These breed-specific predispositions highlight the need for genetic research and management practices to improve the health and productivity of these cattle populations.

CONCLUSION AND APPLICATION

In conclusion, cryptorchidism was observed at a prevalence of 2.63% among indigenous bulls in the semi-arid region of Kano, with unilateral cryptorchidism occurring more frequently. Red Bororo bulls had the highest prevalence at 66.66%, while Sokoto Gudali and White Fulani each had a prevalence of 16.67%. Bulls aged 21-40 months were more affected. Overall, the prevalence of cryptorchidism among these breeds is low.

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Animal Physiology, Reproduction and Health: APH006

PREVALENCE OF COCCIDIOSIS IN POULTRY FARMS IN LAFIA, NASARAWA STATE NIGERIA

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ABSTRACT

Coccidiosis is one of the most important parasites that cause very high economic loss in poultry farms in Nigeria. This study aimed to detect the prevalence of coccidiosis in chicken in Lafia, Nasarawa State. The present study investigated the prevalence of Eimeria spp. in chicken through fecal examination and the diagnosis was based on microscopic techniques and post mortem examinations followed by sporulation of unsporulated oocyst for identification of Eimeria spp. A total of 150 chicken were sampled, and 113 birds were infected with Eimeria species with the prevalence rate of 75.33%. The incidence rate in Broiler chickens was (77%) and in Layer was (72%). The highest percent of infection was between the ages of 15 - 30 days (49.35% in Broiler and 58.33% for Layer). The species that were detected are E. acervulina (the highest prevalence rate) followed by E. tenella, E. necatrix followed by E. mitis (lowest prevalence rate). Control measures should be put in place to overcome this disease.

Keywords: Poultry farms, coccidiosis, prevalence, parasites, Lafia

DESCRIPTION OF PROBLEM

Avian coccidiosis is an enteric parasitic disease, causing production loss, high morbidity (due to acute, bloody enteritis) and mortality rates (10). A parasitic infestation brings about thriftiness, poor feed conversion ratio and growth, decreased egg production, and in severe cases, death (10). Poultry coccidiosis is an economically important disease in chicken, caused by the intracellular protozoa parasite of the phylum Apicomplexa, order Eucoccidiorida, family Eimeridae, and genus Eimeria (12). Eimeria is a single celled obligate intracellular protozoan parasite in the epithelial cell of the intestine. About 1800 Eimeria species affect the intestinal mucosa of different animals and birds. Chickens are highly susceptible to about eleven different species of the genus Eimeria. The most common species are *Eimeriatenella*, which causes caecal coccidiosis, while *E*. acervulina and *E. maxima* cause chronic intestinal coccidiosis. In Nigeria, the disease is caused by *Eimeria tenella*, *E. necatrix*, *E. bruneti*, *E. acervulina*, *E. mitis* and *E. praecox* (5). Coccidiosis remains one of the most expensive and common diseases in poultry production which has caused a huge loss of at least $1.5 billion every year to the world's commercial chicken producers (2). There is paucity of information regarding the incidence of these gastrointestinal parasites in poultry farms in Lafia, the capital of Nasarawa State. Such knowledge is essential in understanding the epidemiology of the disease as well as designing appropriate control measures. Hence, the importance of this study on prevalence of coccidiosis in poultry farms in Lafia, Nasarawa State.

MATERIALS and Methods

Study Area

Nasarawa State is located at the guinea savannah zone of the North Central Nigeria. It lies between Latitude 08°35 N and Longitude 08°33 E. The mean monthly temperature is 35.06°C while the mean monthly relative humidity is 74% and the rainfall is about 168.9 mm (6).

Sampling Method

Samples were collected for the study from the eleven council wards of the Lafia Local Government Area. At least five farms were visited in each of the eleven-council ward on weekly basis during the eight months of the study. The samples comprised of the faecal material, entire length of the gastrointestinal tract of infected birds and the entire dead bird for post mortem examination at least 10 samples from each farm suspected to have coccidiosis were collected. A total of 150 fresh faecal samples were collected and examined during the month of September, 2022 to April 2023. The faecal samples were collected into properly labeled sterile bottles and conveyed immediately to the laboratory of Animal Science at College of Agriculture, Science and Technology Lafia for the detection of coccidiaoocysts.

Direct Microscopic Examination

Direct microscopic examination was carryout by placing a very small quantity of faecal dropping on a glass slide using a tooth pick and emulsifying with a drop of normal saline and Lugol's iodine on different slides and placed with a cover slip to view on the microscope (11).

Post Mortem Procedure

- Carcass was placed on its right side with head pointed towards the examiner and dampened with disinfectant.
- Transverse incision cranial to the proventriculus and the whole intestinal tract in a caudal direction was removed.
- Transverse incision 1-2cm cranial to the cloaca and the entire intestines was removed.
- The serosal surface of the intestines was examined and the intestines in a caudal direction starting from the proventriculus was then opened for further diagnosis.

Statistical Analysis

The prevalence (P) in percentage was calculated using the formula: P=n/N x 100. Where; n is the number of positive samples analyzed at that point in time, and N is the total number of chickens sampled at that point in time. Data obtained were analyzed using R Console software (Version 3.2.2). The P-values < 0.05 was considered statistically significant.

RESULTS AND DISCUSSION

This study revealed that about 113 birds were infected with Eimeria species from 150 parasitological examined diseased chickens, with a prevalence rate of 75.33%. The incidence rate in Broiler chickens was 77% (77/100) and in Layers was 72% (36/50) as shown in Table.1. This incidence of Eimeria species infection among the diseased chickens was indicative to endemicity of the coccidia infection among chickens. The result of this study was similar to the work of (7) who reported the prevalence rate of Eimeria to be 61.25% and 69%.

Table 1: Total prevalence of Eimeria spp in both broiler and layer.

Chicken	Prevalence (%)	p-value
Broiler	77(77/100)	<0.000***
Layer	72(36/50)	0.12

In relation to effect of age on the prevalence of infection, there is no infection with Eimeria sp. from 0 to 15 days. The highest percent of infection was at the age of (15-30) day (49.35% in Broiler and 58.33% for Layer), followed by (41.56% in Broiler and 13.89% for Layer) at the age of 30-45day while the lowest infection was detected at the age higher than 45 days (0.08% in Layer and no infection for Broiler) as shown in Table (2).This study agrees with report made by (3) and disagree with (9). Absence of infection in age from 0 -15 days return protection by maternal immunity, GIT of bird is efficient to crush and digest the oocysts. Moreso, young bird were unable to take sufficient number of oocysts to produce infection.

Table 2: Prevalence of Eimeria spp according age among layer and broiler

			Age (days)		
Chicken	0 – 15days	15 – 30 days	30 – 40 days	>45 days	P value
Broiler (No/T)	0/77(0)	38/77 (49.35)	32/77(41.56)	0/77(0)	<0.0001***
Layer (No/T)	0/36(0)	21/36 (58.33)	5/36 (13.89)	3/36 (0.08)	<0.000*
Total (No/T)	0/113(0)	59/113 (52.21)	37/113 (32.74)	37/113(32.74)	3/19(3.03)

In relation to Mixed infection (infection with more than one species of Eimeria) only about (8/37) from Layer and (21/76) from Broiler were infected with more than one type of Eimeria. There was mixed Eimeria infection of 21.62% in Layer and 27.63% in Broiler while the rest of examined infected chicken were infected with one species of Eimeria with 83.78% in Layer and 81.58% in Broiler as shown in (Table 3). This study showed that there were different species of Eimeria found within the same bird (Mixed infections) and this result agree with (1), who reported that multiple infections with two or more Eimeria spp. were observed in some of the positive cases. In this study, single infection was observed more than mixed infection and this was parallel to study in Romania (4).

Table 3: Single and mixed infection among layer and broiler

	Single Eimeria infection		Mixed Eimeria infection		Total	P value
	N	%	N	%	N	
Layer	31	83.78	8	21.62	37	<0.0001***
Broiler	62	81.58	21	27.63	76	<0.000***

CONCLUSIONS AND APPLICATIONS

1. In Conclusion, this study indicated that coccidiosis is a serious parasitic disease that affect the poultry production in Lafia, Nasarawa State
2. Control measures should be put in place to overcome this disease.

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Animal Physiology, Reproduction and Health: APH007

EFFECT OF ETHANOL EXTRACT OF *Spondias mombin* ON HAEMATOLOGY OF COCKEREL FED DIETS WITH AFLATOXIN B1

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ABSTRACT

One hundred and fifty (150) cockerel was used to investigate the effect of Extract of Hog Plum (*Spondias mombin)* – (EHP) on heamatological indices in birds fed diet with Aflatoxin B1. The birds were allotted into five treatments, replicated thrice with ten (10) birds each in a Completely Randomized Design (CRD) and divided into two phases. Each phase lasted three weeks each. The birds in Treatment (T1), the positive control received 0 µi of Aflatoxin B1+ 0 ml of EHP throughout the experiment. Birds in T2, the negative control received 50 µi Aflatoxins per kg of feed + 0ml EHP. T3 received 1ml EHP per litre of water + 0 µi of Aflatoxin B1 at first phase while 50 µi of aflatoxin + 0 ml 0f EHP at the second phase. Treatment 4 received 50 µi of Aflatoxins per kg of feed + 1ml EHP per liter of water initially but no aflatoxin nor EHP while Treatment 5 birds received 50 µi Aflatoxins per kg of feed without EHP at first phase but at second second received EHP only. At the end of the experiment, blood samples were collected and subjected to haematological analysis. All the parameters were significantly influenced by the addition of hog plum and aflatoxins in the diet of cockerel chicken. Birds in Treatment 1 had the highest PCV (46.60%), Hb (14.26g/dl), RBC (4.58), WBC (30500.30), platelets (197366.0) lymphocytes (93.53 %) heterophils (47.33%) and monocytes (5.50%) values while those in treatment 3 had the least values (24.13%, 7.87gldl and 2.43) of PCV, Hb, and RBC respectively.This study shows that hog plum can mitigate negative effects of aflatoxin in cockerel chicken.

Key Words : Aflatoxin B1, Hog Plum, Cockerel, Haematology, Feed

DESCRIPTION OF PROBLEM

Fungal disease is one of the diseases of poultry birds and other livestock caused by *Aspergillus* species, *Fusarium* species, *Penicillium* species and *Alternaria* species (1). They cause disease and also produce mycotoxins which are of great concern to farmers. Aflatoxins are mycotoxins produced as secondary metabolites by various *Aspergillus* species such as *Aspergillus flavus, Aspergillus parasiticus* and *Aspergillus.nominus* (2, 3, 4). The safety of food and feed is impacted by aflatoxins, which are highly hazardous by-products found in tropical and subtropical regions of the world, including Nigeria. According to (5), these fungi typically infect cereal crops like wheat, walnut, corn, cotton, peanuts, and tree nuts. They can pose serious risks to the health of both humans and animals by resulting in a number of complications like hepatotoxicity, teratogenicity, and immunotoxicity (6, 7). Aflatoxin B1 is the most typical and has been reported to be the most common and toxic classified human carcinogen (8).

Spondias mombin, or hog plum, is a tropical fruit tree identified for its medicinal and nutritional properties (9). The potential of natural substances like hog plum to lessen the negative effects of mycotoxins, especially aflatoxin B1, in the animal feed is on the increase. This study aims to investigate the effect of Hog Plum supplementation on the haematological indices of Cockerels that have been fed aflatoxin B1-contaminated feed. Hematological indices play a crucial role in assessing the overall health and physiological status of animals, making them valuable markers for evaluating the impact of dietary interventions on animal health (10).Understanding how Hog plum supplementation influences haematological parameters in Cockerels exposed to aflatoxin B1 can provide valuable insights into the potential protective effects of this natural

remedy against mycotoxin-induced toxicity. This research has the potential to contribute to the development of novel strategies for mitigating the adverse effects of mycotoxins in poultry production, ultimately enhancing animal welfare and productivity. This study therefore investigated the effect of hog plum extract on haematological indices of cockerel fed aflatoxin B1 contaminated feed.

MATERIALS AND METHODS

Experimental site

The experiment was conducted at the Training and Research Unit of the Agricultural Technology Department, The Federal Polytechnic, Ilaro, located in Yewa South Local Government area of Ogun State, Nigeria.

Preparation of Experimental Extract

10 g of the hog plum powder was added to 100ml of ethanol in an air tight container and allowed to stay for 24 hours. The solution was filtered and extract of hog plum (EHP) was stored in a container and used for the experiment.

Experimental Animal and Management.

One hundred and fifty (150) day-old cockerel chicks were purchased from a reputable commercial hatchery. They were kept in the brooding pen for twenty one days. After which they were allotted to five (5) treatments. The treatments were replicated three times with thirty (30) birds per replicate. Standard routine and management practices for chickens were strictly adhered to. Commercial feed and water was given *ad-libitum* throughout the experimental period. The experiment lasted for 42 days.

Experimental Design

The design of the experiment was Completely Randomized Design (CRD). From day one to twenty (1 – 21), each treatment received the test ingredient as follows:
Treatment (T) 1: 0 ml of EHP + 0 µi of Aflatoxins
Treatment 2: 50 µi Aflatoxins per kg of feed
Treatment 3: 1ml EHP per liter of water
Treatment 4: 50 µi of Aflatoxins per kg of feed + 1ml of EHP per liter of water
Treatment 5: 50 µi Aflatoxins per kg of feed
At day twenty two to forty two (22- 42) each treatment received the test ingredient as follows:
Treatment 1: 0 ml of EHP + 0 µi of Aflatoxins
Treatment 2: 0 µi Aflatoxins per kg of feed
Treatment 3: 0 ml of EHP + 50 µi of Aflatoxins
Treatment 4: 0 ml EHP per liter of water + aflatoxins
Treatment 5: 1 ml of EHP per litre of water + 0 aflatoxins

Data Collection: Blood Collection

On the 42th day corresponding to the end of the experiment, two birds from each replicate were randomly selected, after 12 hours fasting period. 2ml of blood was collected from each chick with a sterile syringe via the brachial vein into well labeled EDTA bottles for evaluation of hematological indices.

Statistical Analysis.

The data collected was subjected to analysis of variance (ANOVA) and the treatment means was separated using Duncan test. Statistical significance was assumed at $P < 0.05$.

RESULT AND DISCUSSION

Effect of hog plum extract on heamatological parameters of cockerel fed aflatoxin B1 contaminated feed.
In this study, all the parameters were significantly influenced by the addition of hog plum and aflatoxins in the diet of cockerel chicken as presented in the table below. Treatment 1 had the highest PCV (46.60%), Hb (14.26g/dl), RBC (4.58), WBC (30500.30), platelets (197366.0) lymphocytes (93.53 %) heterophils

(47.33%) and monocytes (5.50%) values. Treatment 3 had the least values (24.13%, 7.87gldl and 2.43) of PCV, Hb, and RBC respectively. This could be due to the effect of aflatoxin B1 in the diet of the birds at this phase. However, T4 and T1 had the least values of 53.20 % and 29.25% for lymphocytes and heterophils respectively. Haematological values of avian species are used as performance index in determining 10the poultry feed ingredients throughout the world (11, 12, 13). At levels of even less than one ppm, they damage cells within the organism and depressed growth performances in animals (14). The parameters obtained in this study are within the normal ranges of the haematological parameters in chickens: RBC: 2.5-3.5 x10^6 µl, PCV: 22-35 %, Hb: 7-13 g/dl and WBC: 12-30 x 10^3 µl (15**).** This could be due to the concentration of the aflatoxin the birds were exposed to, duration of exposure and supplementation with hog plum. This is in agreement with the findings of (16) which stated that the degree of aflatoxicosis depend on the doses of aflatoxin ingested, duration of exposure, and a variety of other factors including physiological status of the animal and other environmental and disease factors that impact on the uptake, biotransformation, deposition and excretion of aflatoxin.

Table 1: Effect of extract of hog plum on heamatological parameters of cockerel fed aflatoxin B1 contaminated feed

Parameters	T1	T2	T3	T4	T5	SEM
PCV (%)	33.25^{b}	30.25^{c}	24.13^{d}	29.83^{c}	46.60^{a}	0.75
Hb (gldl)	10.73^{b}	9.65^{c}	7.87^{d}	9.27^{c}	14.26^{a}	0.06
RBC (*10^6)	3.23^{b}	3.12^{b}	2.43^{d}	2.84^{c}	4.58^{a}	0.01
WBC (*10^3ul)	15150.00^{c}	14987.50^{c}	19465.70^{b}	20896.30^{b}	30500.30^{a}	970300.6
Platelet (ul)	1.78× 10^{3}.^{b}	1.85 × 10^{3b}	1.54 ×10^{3b}	1.86×10^{3b}	1.97 ×10^{3a}	4.29× 10^{3}
Lymph (%)	65.50^{b}	61.25^{c}	61.25^{c}	53.20^{d}	93.53^{a}	0.39
Heterophils (%)	29.25^{e}	32.50^{d}	40.23^{b}	35.20^{c}	47.33^{a}	0.86
Monocytes (%)	2.75^{c}	3.00^{c}	3.50^{c}	2.56^{c}	5.50^{a}	0.07
Eosinophils (%)	0.00^{b}	0.50^{a}	0.00^{b}	0.00^{b}	0.00^{b}	0.00
Basophils (%)	2.50^{b}	3.00^{b}	2.60^{b}	1.53^{c}	4.00^{a}	0.10266667

CONCLUSION AND APPLICATION

This study shows that hog plum *(Spondias mombin)* can mitigate the negative effects of aflatoxin in cockerel chicken. It is suggested that further study should be carried out in other breeds of chicken and at other doses to ascertain its usefulness in the poultry industry.

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Animal Physiology, Reproduction and Health: APH008

VELVET BEAN (M*ucuna pruriens*) A NATURAL HEALTH REMEDY: A REVIEW OF ITS ANTIOXIDANT PROPERTIES, HEALTH BENEFITS, AND POTENTIAL LIMITATIONS

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ABSTRACT

Velvet beans (*Mucuna pruriens* L.) are renowned for their diverse applications in both food and medicine, boasting a rich composition of nutritional and non-nutritional compounds. Among these, antioxidants play a crucial role in safeguarding against oxidative stress-related diseases. The antioxidant activity in *Mucuna pruriens* stems primarily from its phenolic and diverse bioactive compounds, showcasing notable radical scavenging capabilities. Notably, these antioxidants exhibit neuroprotective effects, restoring dopamine and norepinephrine levels, it also, demonstrate efficacy in combating Parkinson's disease. Additionally, Mucuna seeds offer a spectrum of health benefits beyond their antiparkinsonian properties, including neuroprotection, anti-inflammatory effects, and antimicrobial properties. Velvet beans present a potential adverse effect associated with certain constituents, such as L-Dopa, which can induce toxicity. This research investigates the antioxidant potential of *Mucuna pruriens*. An alternative feed resource with promising health benefits. It delves into its capacity to combat oxidative stress and their role in maintaining overall wellness. By reviewing the antioxidant properties, significance, and potential limitations of this plant, this study further aims to shed light on its importance as natural remedies for disease prevention and health promotion plant.

Keywords: Velvet beans, Antioxidants, Phytochemicals, L-Dopa, Oxidative stress,

INTRODUCTION

Velvet beans (*Mucuna pruriens* L.) are legumes renowned for their multifaceted applications in both culinary and medicinal realms. Their distinctive pods, typically green or brown, are enveloped in rigid hairs notorious for inducing intense itching upon contact [1]. Velvet beans stand out as a rich source of nutritional constituents, including carbohydrates, starch, and protein, alongside an array of non-nutritional compounds such as antioxidants, L-Dopa (with anti-Parkinson's activity), phenolics, flavonoids, tannins, micronutrients, and more. [2] The significance of antioxidants in both food preservation and dietary supplementation cannot be overstated. These compounds serve as guardians against the detrimental effects of oxidation, combating oxidative stress in the human body [3]. Categorized by its mechanisms, antioxidants manifest as primary agents, intercepting free radicals; secondary antioxidants, which impede chain initiation; and tertiary antioxidants, involved in biomolecule repair [4]. Plants are reservoirs of various antioxidants, essential for mitigating diseases associated with free radicals [5]. Phytochemicals often referred to as 'plant-chemicals,' constitute the non-nutritive components of plants, offering an array of health benefits and disease-preventive properties [6]. In livestock, the correlation between disease onset and diminished antioxidant levels is well-established [7]. Oxidative stress emerges as a pivotal factor in pathological conditions affecting animal health, welfare, and productivity [8]. Recent studies have explored the efficacy of plant-derived additives as natural substitutes for synthetic antioxidants, highlighting the potency of natural extracts, essential oils, and plant by-products in bolstering oxidative stability and extending shelf life across various livestock species [9;10;11]

Antioxidant Properties of Velvet Beans (*Mucuna pruriens*)

The antioxidant potential observed in *Mucuna pruriens* is primarily attributed to its rich phenolic and diverse bioactive compounds present in the seeds [12]. Notably, compounds like 9,12-octadecadienoic acid, oxalic acid cyclohexyl pentyl ester, and n-Hexadecanoic acid demonstrate significant antioxidant capacity, as

evidenced by radical scavenging activity with IC50 values ranging from 5.1 to 11.3 µg/ml across different *Mucuna* seed varieties [13]. *Mucuna pruriens* has been validated for its antioxidant prowess owing to its phytochemical composition, including alkaloids, saponins, flavonoids, coumarin, and alkylamines. The ability of *Mucuna pruriens* to mitigate hepatocellular necrosis, cellular infiltration, and vacuolation by inhibiting lipid peroxidation has been shown in an in vivo study [14] This hepato-protective effect is attributed to the stabilization of hepatocellular membranes, prevention of cell leakage, and subsequent hepatic cell regeneration, with alkaloids and saponins playing key roles in inhibiting lipid peroxides induced by free radicals [15].

The methanol extract of *Mucuna pruriens* (MEMP) demonstrates hydrogen-donating ability, as evidenced by its scavenging activity against 1,1-diphenyl-2-picryl-hydrazyl radical. Ethyl acetate and MEMP extracts, enriched with phenolic compounds, exhibit potent antioxidant and free radical scavenging activities [16]. Reactive oxygen species (ROS) readily react with free radicals, leading to oxidative damage to lipids, proteins, and DNA. Antioxidants play a crucial role in protecting living organisms from such damage by controlling ROS production and mitigating lipid peroxidation, protein damage, and DNA strand breakage. The alcohol extract of *Mucuna pruriens* demonstrates significant antioxidant activity comparable to standard ascorbate, as evidenced by its total phenol content [17].

Importance of Antioxidants Properties of (*Mucuna pruriens*)

Mucuna pruriens has demonstrated neuroprotective effects, particularly in Parkinson's disease, by significantly replenishing dopamine levels in the substantia nigra and norepinephrine in the nigrostriatal tract [18]. This plant exhibits antiparkinsonian and neuroprotective properties in animal models, this is attributed to its antioxidant activity evidenced by scavenging DPPH (2,2-Diphenyl-1-Picrylhydrazy**)** radicals, ABTS (2,2'-Azino-bis (3-ethylbenzothiazoline-6-sulfonic acid) radicals, and reactive oxygen species. Additionally, it effectively inhibits lipid and deoxyribose sugar oxidation [18]. Research by [19] suggests that *Mucuna pruriens*' neuroprotective and neurorestorative effects may stem from its antioxidant activity, independent of its symptomatic effects**.** Moreover, Mucuna seeds offer neuroprotection by supporting the proper functioning of the mitochondrial electron transport system [20]. Beyond their antiparkinsonian properties, these seeds harbor a plethora of health benefits, including anti-venom effects [21], anti-inflammatory properties [22;23], and antimicrobial and anti-epileptic effects [24]. Additionally, they exhibit anticancer, antidiabetic, skin protective, anti-anemia, and antihypertensive properties [25].

Potential Challenges to *Mucuna Pruriens* Antioxidant

The detrimental impacts of Mucuna species have been documented across their leaves, pods, and seeds. Notably, the presence of mucunain protein in the pod's fine hairs induces itching, significantly dampening the acceptance of Mucuna as a viable food crop [26].

The anti-nutrients found to be present in *Mucuna pruriens* are L-DOPA, amylase inhibitors, alkaloids, saponins, sterols, phytic acid, tannins, terpenoids, glycosides, and protease inhibitors [27]. While the levels of L-Dopa in leaves and pods remain relatively low, compared to mature dry Mucuna seeds, their consumption can pose adverse effects [28]. These anti-nutritional compounds are toxic, and non-palatable which decrease the bioavailability of nutrients by inhibiting the activity of digestive enzymes such as α-amylase, trypsin, chymotrypsin and lipase, complex formation of phenolic with iron resulting in rupture of the mucosal cell wall of the digestive tract [29]. Ingesting excessive amounts of L-Dopa holds the potential for toxicity [30], especially for individuals deficient in the glucose-6-phosphate dehydrogenase enzyme, where even small doses can trigger hemolytic anemia [31]. Moreover, L-Dopa has been linked to hallucinations and severe gastrointestinal disturbances, such as nausea, vomiting, and appetite loss [32]. The conversion of L-Dopa into its oxidized form, dopamine, within the peripheral nervous system, contributes to these adverse effects [33].

CONCLUSION

Mucuna pruriens is an alternative feed resource with extraordinary properties, offering a wide range of applications in food and medicine. *Mucuna pruriens*, also known as velvet beans, contains antioxidants, L-Dopa, phenolics, flavonoids, tannins, and micronutrients, making it a prosperous source of nutritional and non-nutritional compounds. The antioxidant properties of *Mucuna pruriens* have been demonstrated through its ability to scavenge radicals, inhibit lipid peroxidation, and protect against oxidative stress. However, potential challenges to the usage of the plants include the harmful effects of Mucuna species, such as itching and toxicity non availability in market as it mostly source from research institute, but due to it uniqueness as feed and its antioxidant capacity there need to include such material in diet to combat oxidative stress and improve performance of animal, however theirs is need to further research on the safety when included in feed, the optimum level to be used for specific animals and the best processing method as regarding the safety of this unique plants. Despite these challenges, the antioxidant properties of *Mucuna pruriens* and the nutritional compositions make it's a valuable resource for feed, natural antioxidants and potential therapeutic agents.

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Animal Physiology, Reproduction and Health: APH009

AN OVERVIEW OF ANIMAL WELFARE AND THE BEEF INDUSTRY IN NIGERIA.

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ABSTRACT

The beef industry is a vital component of Nigeria's agricultural sector, contributing significantly to the economy and serving as a major protein source. Despite its importance, concerns about animal welfare, which affects both ethical standards and meat quality, are rising. The regulatory framework for animal welfare in Nigeria, guided by the Animal Diseases (Control) Act and the Meat Inspection Law, remains underdeveloped and poorly enforced. International standards highlight the gaps in Nigeria's approach. Research indicates that improved welfare practices can enhance meat quality, reduce mortality, and increase productivity. This review explores the development of Nigeria's beef industry, the impacts of welfare practices on meat quality, and challenges in implementing welfare standards. It proposes recommendations for policy enforcement, education, infrastructure upgrades, and stakeholder collaboration. By addressing these issues, the review aims to promote sustainable practices and improve the beef industry's contribution to Nigeria's economy and food security.

Keywords: Animal welfare, Beef industry, Stress, Meat quality, Nigeria.

DESCRIPTION OF PROBLEM

The beef industry is a significant component of Nigeria's agricultural sector, contributing to the economy and providing a major source of protein for the population. As the industry grows, concerns about animal welfare have become increasingly pertinent. Animal welfare, which encompasses the physical and psychological well-being of animals, is crucial not only for ethical reasons but also for ensuring the quality and safety of meat products [1].

The regulatory framework governing animal welfare in Nigeria is still in its nascent stages. Although the Animal Diseases (Control) Act and the Meat Inspection Law provide some guidelines, enforcement remains weak and inconsistent [2]. Comparatively, international standards such as those outlined by the World Organisation for Animal Health (OIE) and the European Union (EU) emphasize more stringent welfare requirements, highlighting the gaps in Nigeria's approach [3]. Improving animal welfare in the beef industry is not only a moral obligation but also has practical benefits. Research indicates that better welfare practices can lead to improved meat quality, reduced mortality rates, and increased productivity Moreover, consumer awareness and demand for ethically produced meat are rising, suggesting that enhanced welfare practices could also have positive market implications [4].

This review delves into various aspects of animal welfare in Nigeria's beef industry, including livestock management, slaughterhouse conditions, and the impact of welfare practices on meat quality. It will also explore the challenges faced in implementing welfare standards and propose recommendations for improvements. By providing a thorough understanding of these issues, this review aims to contribute to the ongoing discourse on animal welfare and promote sustainable practices in Nigeria's beef industry.

Development of the Beef Industry in Nigeria

The beef industry in Nigeria has deep historical roots, closely intertwined with the country's cultural, social, and economic fabric. The origins of cattle rearing in Nigeria can be traced back to the trans-Saharan trade

routes, which facilitated the movement of livestock across regions and contributed to the establishment of pastoralism in various Nigerian communities [5]. Traditionally, the Fulani people, who are renowned for their nomadic lifestyle, have been at the forefront of cattle rearing in Nigeria. The Fulani's extensive knowledge of cattle management and their migratory practices have significantly influenced the beef industry's development.

During the colonial period, the British administration introduced various agricultural policies and infrastructures that impacted the beef industry. These included the establishment of veterinary services and the introduction of more structured cattle markets [6]. Post-independence, the Nigerian government continued to support the beef industry through various initiatives aimed at improving livestock production and management. Nigeria has one of the largest cattle populations in Africa, estimated at around 20 million heads, predominantly reared for meat as of recent data [7]. Despite these efforts, the industry has faced numerous challenges, including disease outbreaks, inadequate infrastructure, and fluctuating market prices.

Animal welfare and its implications for the Nigerian beef cattle industry.

Animal welfare is a critical aspect of livestock management that significantly influences the health, productivity, and overall well-being of cattle. The link between animal welfare and stress is particularly relevant in the beef cattle industry, as stress can have substantial impacts on meat quality and production efficiency. In the context of Nigeria, addressing welfare issues is crucial for improving the beef industry.

Stress in animals is a physiological and psychological response to adverse conditions or stimuli. Stress can be acute or chronic and affects various systems in the body, including the endocrine, immune, and nervous systems [8]. In cattle, stress responses can lead to increased levels of stress hormones such as cortisol and adrenaline, which impact health and productivity [1]. In Nigeria, beef cattle are predominantly exposed to stressors from; production system, transportation and handling, slaughtering process and distribution practice, which contributed immensely to meat quality:

Production System: The Nigerian cattle production system is primarily extensive, with cattle often grazing in extensive rangeland environments. The Fulani herders, in particular, follow a nomadic or semi-nomadic lifestyle, moving their cattle across vast areas in search of grazing land and water [5]. This practice, while sustainable in many ways, often leads to conflicts with farmers due to competition for land and resources. In terms of animal husbandry, veterinary care is often limited, relying on indigenous knowledge and herbal remedies. Housing conditions are rudimentary, with cattle usually kept in open fields or simple enclosures made from local materials [8]. Feeding practices are also basic, with cattle grazing on available vegetation and crop residues. This system can lead to stress due to inadequate shelter, poor nutritional resources, and exposure to harsh environmental conditions [9]. Stressors such as high temperatures, inadequate water, and poor pasture quality can contribute to decreased meat quality.

Transportation & Handling: Transportation is a significant source of stress for cattle in Nigeria. Long distances, overcrowded vehicles, and inadequate ventilation during transport can exacerbate stress and impact meat quality. Factors such as vehicle design, space allowance, ventilation, and travel duration significantly influence stress levels [4]. Stress during transportation leads to elevated cortisol levels and can result in poor meat quality, through:

Muscle Glycogen Levels and pH: Stress during transportation can lead to a rapid depletion of muscle glycogen reserves, which is critical for maintaining normal muscle pH levels post-slaughter. Stress-induced glycogen depletion results in higher final pH levels in meat, leading to the development of Dark, Firm, and Dry (DFD) meat, characterized by undesirable color and texture [10]. DFD meat is less appealing to consumers and is considered lower quality.

Meat Tenderness and Texture: Stress affects meat tenderness through its impact on muscle physiology. Elevated stress hormones can lead to inadequate muscle relaxation and increased rigor mortis, resulting in tougher meat [11]. The physical handling and stress experienced during transportation contribute to these changes, impacting the final texture and quality of the meat.

Carcass Temperature and Cooling: During transportation, elevated body temperatures can persist, leading to incomplete rigor mortis and poor meat quality [1]. Proper cooling and handling immediately post-slaughter are essential to prevent further quality degradation. Inadequate cooling can exacerbate problems related to muscle contraction and texture.

Slaughtering Practices: In Nigeria, traditional slaughtering methods are commonly used. These methods often involve manual processes and limited technology. Cattle are typically slaughtered in open slaughter slabs or abattoirs with basic facilities. Common practices include the use of knives or manual equipment for cutting, and the absence of standardized stunning procedures [9]. While there are modern abattoirs in Nigeria, they are not uniformly distributed or well-equipped. Modern facilities that are available might employ more advanced methods, such as electrical stunning and mechanized equipment, but these are often not the norm across the country [12]. Effective stunning is crucial for ensuring humane slaughter and reducing stress, which in turn affects meat quality. Without proper stunning, cattle may experience prolonged periods of distress, which can lead to adverse meat quality outcomes such as dark, firm, and dry (DFD) meat [10]. The cleanliness and hygiene of slaughter facilities play a critical role in meat safety and quality. Many traditional slaughtering environments in Nigeria lack proper sanitation and hygiene practices, increasing the risk of contamination and spoilage [12]. Poor hygiene can lead to microbial contamination and affect meat safety and shelf life.

Distribution: The conditions under which meat is handled and distributed can significantly affect its quality. In Nigeria, many distribution practices involve the use of open vehicles or inadequate packaging, which exposes meat to environmental contaminants and temperature fluctuations [9]. The distribution phase in Nigeria often involves lack or inadequate refrigeration and extended transport times, which can further impact meat quality. Improper storage and handling during distribution can lead to spoilage, changes in meat color and texture, and overall degradation of quality. Maintaining appropriate temperatures and hygienic conditions throughout the distribution chain is crucial for preserving meat quality [9]. Improper temperature control during distribution can lead to increased microbial growth, affecting meat safety and quality. Pathogens such as *Salmonella spp*, *E. coli*, and *Listeria spp* can proliferate in meat if not maintained at safe temperatures [12].

Strategies and Practices to Improve Animal Welfare, Meat Quality, and Beef Production in Nigeria
Improving animal welfare, meat quality, and beef production in Nigeria requires a multifaceted approach that addresses policy and legislation, awareness, infrastructure and technological upgrades, and collaboration among stakeholders. Each of these factors plays a crucial role in advancing the Nigerian beef industry, ensuring humane treatment of animals, and enhancing the quality of beef products;
Policy and Legislation: Enforcing and implementing robust animal welfare laws is essential for improving the treatment of livestock and ensuring humane practices throughout the beef production chain. Effective legislation should cover aspects such as housing conditions, handling practices, and slaughter methods. Policies should align with international standards, such as those outlined by the World Organisation for Animal Health (OIE), to promote best practices in animal welfare [3].

Awareness and Education: Implementing educational and training programs for farmers, handlers, and abattoir workers is crucial for improving animal welfare and meat quality. Training should focus on humane handling techniques, proper animal care, and best practices for slaughter and processing [1]. Raising public awareness about the importance of animal welfare and meat quality can drive consumer demand for ethically produced beef. Engaging stakeholders, including industry leaders, government officials, and NGOs, in discussions about animal welfare and meat quality can facilitate the development of effective strategies and policies [12]
Infrastructure and Technological Upgrades: Upgrading slaughter facilities with modern equipment and technology is essential for improving meat quality and ensuring humane practices. Facilities should be equipped with effective stunning devices, refrigeration systems, and sanitation technologies to enhance animal welfare and meat safety [12]. Embracing intensive or semi-intensive production systems, such as

providing adequate housing, feeding systems, and veterinary care facilities, is vital for promoting animal welfare and improving beef production [11].

Collaboration and Stakeholder Engagement: Collaboration between the government, private sector, and industry associations can drive improvements in animal welfare and beef production. Public-private partnerships can facilitate investment in infrastructure, technology, and training programs, and support the development of industry standards and policies [9]. Engaging with international organizations and adopting global best practices can enhance the Nigerian beef industry. These organizations can play a key role in promoting standards, advocating for policy changes, and supporting members in adopting improved practices [12].

CONCLUSION

The beef industry in Nigeria holds substantial economic and nutritional importance, yet it faces significant challenges in animal welfare and meat quality. Current regulatory frameworks are insufficient and poorly enforced, leading to widespread welfare issues that negatively impact meat quality and industry productivity. Addressing these challenges through enhanced policies, education, infrastructure upgrades, and stakeholder collaboration is essential. Adopting international best practices and improving enforcement can lead to better animal welfare, higher meat quality, and increased consumer trust. Ultimately, these improvements will contribute to the sustainability and growth of Nigeria's beef industry, bolstering its economic contribution and ensuring a reliable protein source for the population.

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Animal Physiology, Reproduction and Health: APH010

LIVER AND KIDNEY HISTOLOGY OF BROILER CHICKENS FED WITH YOHIMBE (*Pausinystalia yohimbe*) SUPPLEMENTED DIETS AND LARVICIDE

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ABSTRACT

The study accessed the histological (microscopic) analysis of key organs (Liver and Kidney) in chickens fed diets enriched with larvicide and Yohimbe (*Pausinystalia yohimbe*). The experimental diets include: basal (control), larvacide (5 mg/kg cyromazine), and Yohimbe at doses of 60, 120 and 180 mg per kilogram diet. Chickens were fed for 8 weeks with the respective supplemented diets, while their kidneys and livers were harvested at the 52nd day and preserved using alcohol reagent. Pictures of the assessed parts were obtained using digital research photographic microscope. Results showed that Larvacide inclusion caused portal congestion of the liver while 120 mg Yohimbe supplement caused focused tubular degeneration of the kidney. It is therefore concluded that the inclusion of larvacide should be discourage in chickens' feed, while the inclusion of Yohimbe is healthy.

Key words: Yohimbe, Larvicide, Liver, Kidney, Chickens

DESCRIPTION OF PROBLEM

Improvement in growth rate and reduction in the risk of illness, are the plausible contribution of natural and synthetic feed additives to the production of chickens (1). Apart from the deposition of metabolic residue, some of these additives influence the morphology of animals, with consequential impart on their welfare. Eweka *et al*., (2010) observed a progressive distortion in the cell structure of the kidney cortex from experimental rats fed with Yohimbe, a natural feed additive.

This study intends to evaluate the tissue morphology of liver and kidney from chickens fed with yohimbe and larvacide supplements.

MATERIALS AND METHODS

Chickens fed experimental diets were slaughtered at the 52nd day of live and their kidney and liver were harvested. The samples were preserved in alcohol reagent till the laboratory evaluation was carried out. The renal and hepatic tissues were dehydrated in an ascending grade of alcohol (ethanol 70%) cleared in xylene and embedded in paraffin wax after the method of (3). Serial sections of 7 micron thick were obtained using a rotator microtome. The deparaffinised sections were stained routinely with hematoxylin and eosin. Photomicrographs of the desired results were obtained using digital research photographic microscope.

RESULTS AND DISCUSSION

Plate 2 shows severe distortion of the cellular architecture of the liver of chickens fed diet supplemented with Larvicide, while Plate 1, 3, 4 and 5 showed no significant distortion of the liver tissue. Plate 7 and 9

showed localized tubular degeneration of the nephrons in the kidney from chickens fed Larvicide and 120mg of Yohimbe while Plate 6, 8, and 10 showed no significant degeneration of kidney nephrons from chickens fed control, 60 and 180mg of Yohimbe.

The histological (microscopic) analysis of key organs in chickens given diets enriched with larvicide and Yohimbe (*Pausinystalia yohimbe*) was investigated with the goal to use histopathology methods to evaluate the possible impact of these dietary inclusions on the health of the liver and kidneys. The chickens fed diets supplemented with Yohimbe (60, 120, and 180mg) had very few apparent lesions on their livers. This discovery indicates a positive result, especially the absence of hepatocellular necrosis (cell death). The liver's functional units, known as hepatocytes, are in charge of several processes, such as bile generation, protein synthesis, and detoxification. The lack of severe lesions indicates that Yohimbe does not cause the liver parenchyma (functional tissue) to have a damaging reaction at the doses that were supplied. The results of (4), who found that yohimbe appears to be safely digested and removed by the body, are consistent with these observations.

On the other hand, the livers of chickens whose feed were supplemented with larvicide showed a extreme portal congestion in chickens fed larvicide supplement. The hallmark of this syndrome is an irregular accumulation of blood in the portal vein, which is in charge of transferring nutrient-rich blood from the intestines to the liver. According to (5), congestion may be a sign of more severe issues such liver damage and portal hypertension, which is a rise in pressure inside the portal vein. An inflow of several cell types, such as fibroblasts (engaged in scar tissue development), hematopoietic cells (precursors to blood cells), and inflammatory cells, into the liver frequently occurs concurrently with the portal vein becoming clogged. These cellular infiltrations imply even more that the potentially harmful characteristics of the larvicide may have provoked an inflammatory reaction.

Yohimbe's effects on the kidneys seem to be more complex. Histopathological examination only showed modest localized tubular degeneration in chickens served larvicide and 120mg Yohimbe supplemented diets. The kidneys are essential for preserving overall health because they filter out waste materials and hazardous compounds from the blood. The tubules that make up the nephrons, the tiny functional units of the kidney, carry out these excretory tasks. Localized regions of the tubules that show atrophic changes—often marked by a reduction in cell size and function informs that Yohimbe has a mild consequential effect at the levels of its administration (6). According to (7), this type of localized tubular degeneration may be a sign of increased renal activity. Two possible causes for this increased burden are as follows: Yohimbine, the main alkaloid found in yohimbe, has been shown to occasionally raise blood pressure. Since the kidneys are essential in controlling blood pressure, their increased activity may be a reaction to Yohimbe's hypertensive effects. Another reason could be the excretion of Yohimbine from the body may be connected to the observed tubular degeneration. The kidneys may experience a period of increased activity during their attempt to remove Yohimbine from the bloodstream, which might result in moderate localized degeneration.

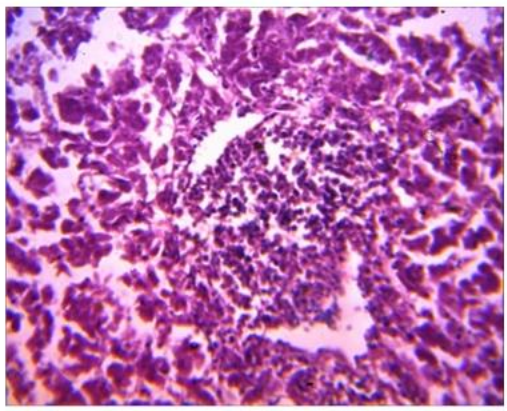

Plate 1: Liver histology of broiler chickens on control diet

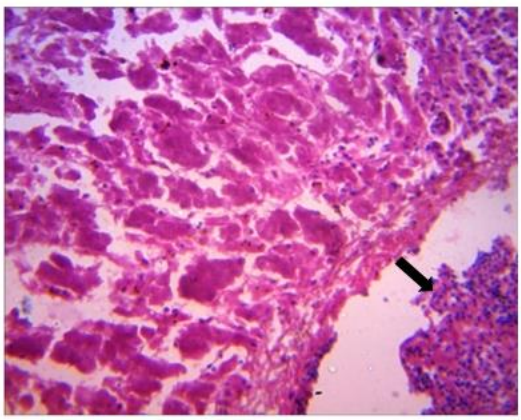

Plate 2: Liver histology of broiler chickens on diet containing larvacide

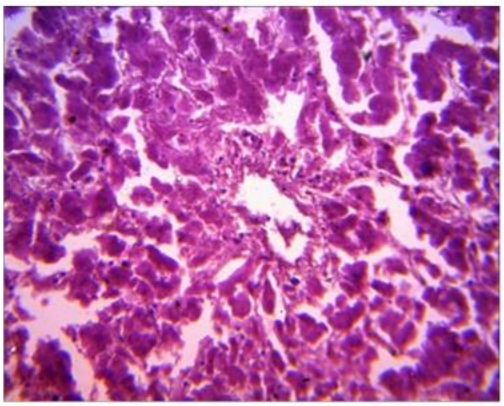

Plate 3: Liver histology of broiler chickens on diet containing 60mg Yohimbe

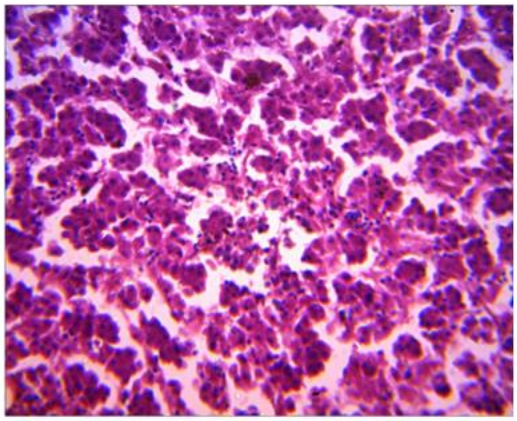

Plate 4: Liver histology of broiler chickens on diet containing 120mg Yohimbe

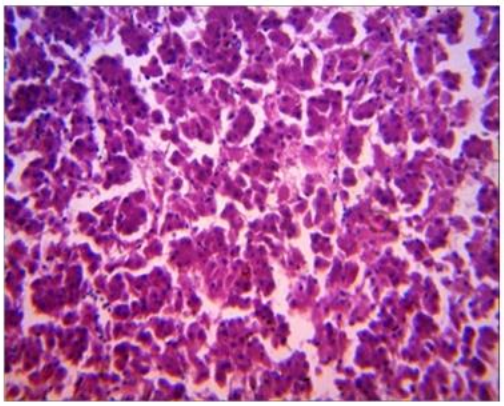

Plate 5: Liver histology of broiler chickens on diet containing 180mg Yohimbe

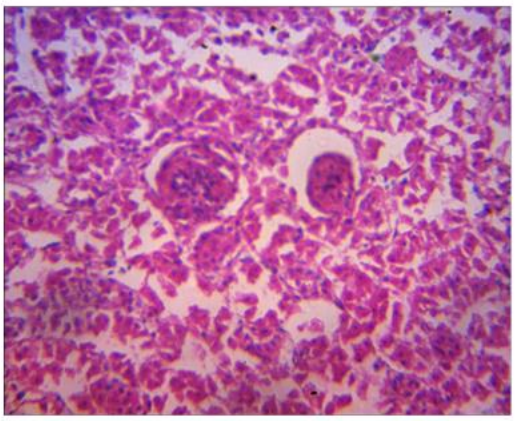

Plate 6: Kidney histology of broiler chickens fed control diet

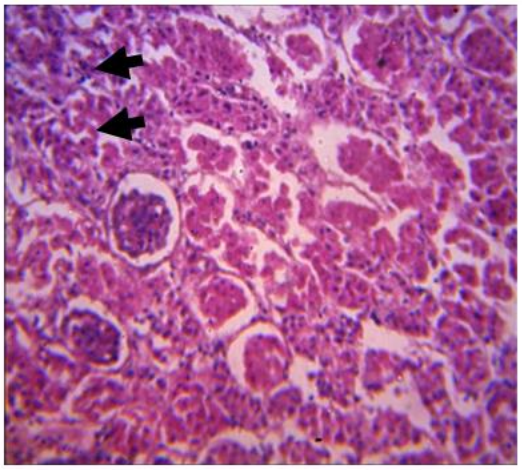

Plate 7: Kidney histology of broiler chickens on diet containing Larvacide

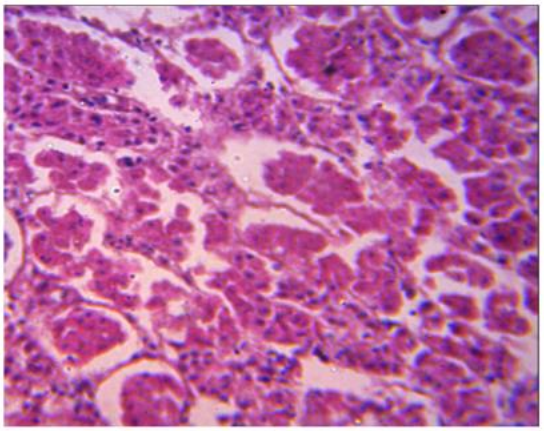

Plate 8: Kidney histology of broiler chickens on diet containing 60mg Yohimbe

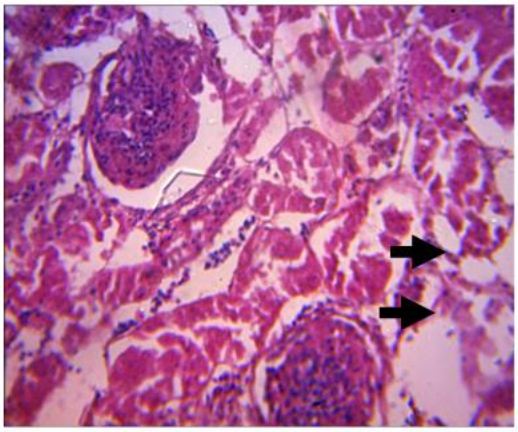

Plate 9: Kidney histology of broiler chickens on diet containing 120mg Yohimbe

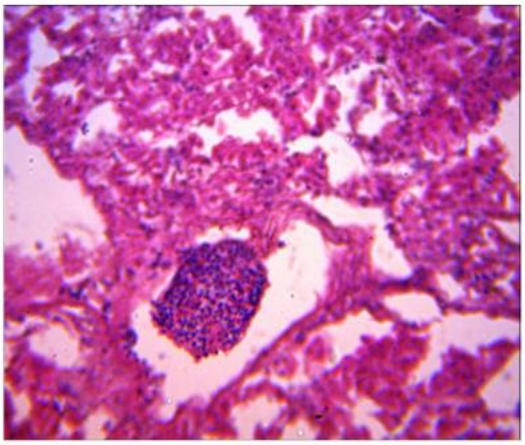

Plate 10: Kidney histology of broiler chickens on diet containing 180mg Yohimbe

CONCLUSION AND APPLICATION

The study conclude that the inclusion of yohimbe has mild influence on the liver from chickens fed 60, 120, and 180mg of the compound, while the inclusion of larvicide caused negative reactions on the liver and kidney tissue.

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Animal Physiology, Reproduction and Health: APH011

EFFECT OF COLLECTION METHODS AND STORAGE TIME ON THE QUALITY OF CAUDAL EPIDIDYMAL SPERM CELLS OF RED BORORO CATTLE

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ABSTRACT

This study was designed to determine the effect of sperm recovery method and storage time on quality of caudal epididymal sperm of Red Bororo Bulls in Maiduguri. Fifteen paired testicular samples of Red Bororo Cattle were collected from the Maiduguri abattoir and then transported to the Animal Science Laboratory, University of Maiduguri for further processing. Slicing and swim up technique or mincing and flushing technique were used for sperm recovery from the caudal epididymis. The caudal epididymal homogenates were divided into in to three groups replicated thrice each and stored for 0, 24 and 48 hrs in a Tris-Sodium Citrate buffer at 4 – 8^{O}C. Data on motility, sperm concentration, live and dead and normal and abnormal sperm cells were collected for the different sperm collection method and each storage period. The experiment was laid out in a 2 X 3 factorial arrangement in a Completely Randomized Design (CRD). Sperm concentration was significantly ($p<0.05$) higher for the mincing method (969.95 X 10^6) compared to the slicing method (451.96 X 10^6). Motility dropped from 72.17% at 0 hour to 55.83% after 48 hours of storage. While, percentage abnormal and dead sperm cells significantly ($p<0.05$) increased with increase in storage time. It was concluded that mincing method of caudal epididymal sperm collection gives higher sperm concentration without lowering motility. It was also shown that sperm from caudal epididymis of red Bororo cattle can be stored up to 48 hours at 4 – 8^{O}C and still maintain motility of 55.83%.

Key Words: Epididymis, sperm motility, liquid storage, Red Bororo,

DESCRIPTION OF PROBLEM

collection and storage of semen or sperm cells is essential in reproductive biotechnology methods such as artificial insemination, embryo transfer, cryopreservation, cloning and *ex-situ* management of genetic diversity (1). According to Mogheiseh *et al.* (2), the caudal epididymal sperm reservoir serves as a valuable source of functional male gametes in cases of obstructive azoospermia, sudden death or after emergency castration, which can lead to complete loss of valuable genetics/traits Sperm from the epididymis has been productively used for artificial insemination (AI) and for *in vitro* production of embryos in cattle and several species (*3; 4).* It was noted by (5) that it is also possible to recover viable sperm with 41% forward motility from the caudal epididymis of bulls stored at room temperature of 18-20^{O}C for 30hours. Similarly, (6) reported that epididymal sperm remain viable with adequate fertilizing ability up to 48h after the death of the animal. Hence, retrieved epididymal sperm can be stored under refrigeration temperature (4 ^{O}C) (short term storage), cryopreserved for long time or used immediately for artificial insemination. Different epididymal sperm recovery methods have been proposed in several animal species including the dog, goat, stallion and the bull (7; 8; 2). However, recovery methods are different in terms of total sperm recovery and the quality of the recovered sperm cells (2). This study was therefore designed to determine the effect of sperm recovery method and storage time on quality of caudal epididymal sperm of Red Bororo Bulls in Maiduguri.

MATERIALS and Methods

The study was conducted in Maiduguri, Borno State, Nigeria. Maiduguri is located within the Sahelian (semi-arid) region of West Africa. The area is situated latitude at 11.51^{0} N and longitude 13.05^{0} E at an average elevation of 354 m above sea level in the North Eastern part of Nigeria (9).

Samples from fifteen (15) matured Red Bororo cattle were collected from the Maiduguri abattoir located at the cattle market within Maiduguri metropolis. The samples were then transported to the Animal Science Laboratory, University of Maiduguri for further processing.

Two methods of sperm recovery from the caudal epididymis were used. Regardless of right or left, one testicle from each pair was processed using slicing and swim up technique, while the other one was processed using mincing and flushing technique as described by (10).
In the first method (Slicing and swim up technique) the parietal tunic was removed and the tail (caudal) of the epididymis was sliced longitudinally half way using sterile razor blade and immediately drop in to a 50 ml volume Petri dish containing 15 ml of sodium citrate solution The solution was allow to stand for 5-10 min for epididymal sperm to swim- up to the upper part of the sodium citrate solution, the flushed solution was then transferred to a 10ml conical tube as described by (10). In the second method (Mincing and flushing technique) the cauda epididymis was minced in to 4-8 pieces in a sterile Petri dish and the exposed surface areas were flushed with sodium citrate solution. The solution was also allowed to stand for 5-10 min, for the epididymal sperm to move out by themselves. The flush solution was emptied and transfer in to a sterile conical tube as described by *(*11).

To obtain the buffer, 2.9g of Tris-Sodium Citrate was dissolved in sterile distilled water in a volumetric flask up to 100 ml mark to make 2.9% solution of Tris-Sodium Citrate ($Na_3C_6H_5O_7.2H_2O$). The solution was kept overnight in a dark cupboard. Freshly laid eggs were collected and disinfected with 70% ethyl alcohol The eggs were then be cracked and poured in to the egg-yolk separator which was then separated the albumen from the egg-yolk. The yolk was thoroughly mixed and a portion was used to form the diluent as follows; 80 ml of the sodium citrate buffer were gradually added to 20ml of egg yolk in conical flask. The diluent was then well mixed and stored until needed (12). The caudal epididymal sperm samples were divided into in to three groups replicated thrice each and stored for 0, 24 and 48 hrs at 4 – 8^{O}C in a refrigerator.

The motility of spermatozoa and sperm concentration were determined as described by (13) while live and dead and normal and abnormal sperm cells were counted on an eosin/negrosin stained slides of the sperm samples as described by (14).

The experiment was laid out in a 2 X 3 factorial arrangement in a Completely Randomized Design (CRD). All data collected were subjected to Analysis of Variance using SPSS 20.0 (15) and where means differed Least Square Difference (LSD) of the same software was used to separate them.

RESULTS AND DISCUSSION

Table 1 shows the effect of spermatozoa retrieval method and storage time on quality of caudal epididymal sperm of Red Bororo bulls in Maiduguri. Sperm concentration was significantly ($p<0.05$) higher for the mincing method (969.95 X 10^6) compared to the slicing method (451.96 X 10^6). This is similar to the report of (2) who noted that total sperm recovery was significantly affected by collection method when they compared three recovery methods. The caudal epididymal sperm spermatozoa retrieval methods (Slicing or mincing) had similar sperm motility. Percentage abnormal and dead sperm cells were also similar for both methods. The lower concentration of recovered sperm cells makes the slicing method inappropriate for reproductive procedures in which higher numbers of sperm cells are required like intrauterine insemination or sperm cryopreservation.

Storage time of caudal epididymis sperm had significant ($p<0.05$) effect on motility. Motility dropped from 72.17% at 0 hour to 55.83% after 48 hours of storage. While, percentage abnormal and dead sperm cells significantly ($p<0.05$) increased with increase in storage time. This drop in motility confirms the report of by (16).

A possible cause of the decrease in epididymal sperm quality after 48 hours of storage may be because of difference in the osmotic pressure of the epididymal fluid and buffer used for storage (17) and probably

handling conditions (18). The decrease in motility confirms earlier reports by (6, 8). Result of interaction effect showed that mincing at 0hrs gave the highest sperm concentration and best motility and at 48 hrs after storage, motility was similar for both collection and storage methods.

CONCLUSION AND APPLICATION

It was concluded that mincing method of caudal epididymal sperm collection gives higher sperm concentration without lowering motility. It was also shown that caudal epididymal sperm from the red Bororo cattle can be stored up to 48 hours at 4 – 8^{O}C and still maintain motility of 55.83%. Further study should be carried out to include insemination of the stored caudal epididymal sperm to determine its fertilizing ability.

Table 1: Effect of collection method and storage time on quality of caudal epididymal sperm cells of Red Bororo bulls in Maiduguri

Parameter	Motility (%)	Concentration (X10^6)	Abnormal sperm (%)	Death sperm (%)
		Methods		
Slicing	62.26	451.96^{b}	5.67	3.63
Mincing	65.07	969.95^{a}	6.70	5.15
SEM	3.39	49.57	1.00	0.53
LS	NS	NS	NS	NS
		Storage Time		
0hrs	72.17^{a}	929.37	3.72^{b}	1.28^{c}
24hrs	63.00^{ab}	699.84	6.00^{ab}	3.89^{b}
48hrs	55.83^{b}	503.65	8.83^{a}	6.50^{a}
SEM	4.15	428.14	1.22	0.65
LS	*	NS	*	*
		Interactions		
Slicing X 0hrs	68.22^{ab}	339.30	3.44^{b}	1.22^{c}
Slicing X 24hrs	60.44^{ab}	533.20	5.56^{ab}	3.44^{bc}
Slicing X 48hrs	58.11^{b}	483.40	8.00^{ab}	6.22^{a}
Mincing X 0hrs	76.11^{a}	1519.50	4.00^{b}	1.33^{c}
Mincing X 24hrs	65.56^{ab}	866.50	6.44^{ab}	4.33^{ab}
Mincing X 48hrs	53.56^{b}	523.90	9.67^{a}	6.78^{a}
SEM	5.87	605.48	1.73	0.93
LS	*	NS	*	*

SEM – Standard error of mean; LS – Level of significance

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Animal Physiology, Reproduction and Health: APH012

EFFECT OF GARLIC (*ALLIUM SATIVUM*) ON HEMATOLOGICAL INDICES AND REPRODUCTIVE BEHAVIOR OF RABBIT BUCKS DURING PEAK HOT HUMID PERIOD

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ABSTRACT

The effect of garlic (*Allium sativum*) as a supplementary feed component in breeding rabbit bucks diets during peak hot humid period of the year was examined for its impact on hematological and reproductive indices. Fifty-four (54) pre-pubertal cross-bred (New Zealand X Chinchilla) rabbit bucks aged 10-12 weeks were randomly assigned to three dietary groups of 18 rabbit bucks per diet and replicated three times in a completely randomized design (CRD). The diets consisted of 0% (T1- control), 1% (T2) and 2% (T3) respectively of garlic powder per 100kg of rabbit concentrate feed. The experimental period was 90 days during the peak hot humid period in Nigeria between December 2023 and February 2024. The rabbit bucks were put in a 3-tier hutch housed in naturally cross-ventilated high-roofed house. Data on hematology, libido and reaction time were collected and subjected to Analysis of Variance. The results obtained showed that rabbits fed diet T3 recorded significant ($P<0.05$) higher packed cell volume (39.50%), hemoglobin (12.30g/dL), red blood cell ($4.06x10^3$µl), white blood cell ($5.70x10^3$µl) and 0.02 of heterophils/lyphocytes ratio. The libido score (sex drive) was also significantly ($P<0.05$) higher (4.667) in T3 group with the least significantly lower reaction time (57.33 seconds). These results proved a positive hematological response by garlic on rabbit bucks at 2% inclusion level as well as induces higher sex drive and reproductive performance of rabbit bucks during peak hot humid periods of the year.

Keywords: Garlic, immunology, Reproduction, Rabbit, hot-humid

DESCRIPTION OF PROBLEM

Rabbits are susceptible to heat stress since they have few functional sweat glands and have difficulty in eliminating excess body heat when the environmental temperature is high. The thermal zone of comfort for rabbit is about 21°C and their productive and reproductive performance could be weakened when the temperature-humidity index is over 27.8 value, which infer the beginning of heat stress (1).

Therefore, there is a research need to investigate the impact of garlic on immunological response and reproductive behavior of rabbit bucks under a prevailing increased ambient temperature and relative humidity conditions of its environments especially at peak periods. This is because the immunity and reproduction of rabbit have been reported to be largely affected by nutrition, drugs, hormones and environmental factors (2).

MATERIALS AND METHODS

The study was carried out at the Rabbit Unit of the Teaching and Research Farm, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria. The experiment lasted for a period of 90 days (Dec. 2023 to February, 2024). The design for the study was Completely Randomized Design (CRD) with three (3) treatments designated as Treatment 1 (T1), Treatment 2 (T2) and Treatment 3 (T3).Routine management practices were also carried out appropriately while feed and clean drinking water were provided ad libitum. The concentrated diet containing the garlic was given only in morning and forage at noon. The dried garlic

chips were manually grinded into fine powder and stored in an air-tight polythene bag as a method adopted by (3) and were incorporated into the concentrate diet at varying inclusion levels of T1(0%), T2(1%) and T3(2%) respectively. The relative proportion of the various feed materials in percent inclusion is presented in Table 1. At the end of the study, 2 rabbits were selected from each replicate group, starved of food but not water for 12hours. 2mls of blood were collected from the two selected rabbits using disposable syringes. The blood collected at the end of the experiment was transferred into sterile test tubes containing EDTA and used to determine red blood cell (RBC), white blood cell (WBC), Packed Cell Volume (PCV), haemoglobin (Hb), Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Haemoglobin Concentration (MCHC) as reported by (4). All the data collected during the experiment were subjected to analysis of variance (ANOVA) as reported by (5). Significant means were separated as reported by (6).

Table 1: Proximate Composition of Experimental Diets

Component	**T1**	**T2**	**T3**
Maize (kg)	49.50	48.50	47.50
Soybean (kg)	11.00	11.00	11.00
Palm Kernel Cake (kg)	36.00	36.00	36.00
Bone meal (kg)	2.00	2.00	2.00
Salt (kg)	1.00	1.00	1.00
Vitamin Premix (kg)	0.50	0.50	0.50
Garlic powder (kg)	0.00	1.00	2.00
Total (100kg)	100.00	100.00	100.00
Calculated proximate analysis			
	T1	T2	T3
Crude Protein%	16	16	16.17
Crude Fibre %	6.035	6.04	6.021
Metabolizable Energy%	2,797	2,779	2,762.6

T1= Treatment 1 with diet containing 0% inclusion of garlic, T2= Treatment 2 with diet containing 1% inclusion of garlic, T3= Treatment 3 with diet containing 2% inclusion of garlic.

Table 2: Libido Grades for the experimental bucks

Grading	**Score**
Very high	5
High	4
Moderate	3
Low	2
Poor	1

Adopted from (7)

Table 3: Mean environmental Conditions During The Study

Month	Year	Av. Temp. (°C)		Rel. Humidity (%)	Rainfall (mm)
		Max.	Min.		
December	2023	31.3	23.2	85	111
January	2024	32.4	23.2	82	88.09
March	2024	30.0	23.1	83	66.11

Source: (8)

RESULTS AND DISCUSSION

The result on immunological response of rabbit bucks fed garlic (*Allium sativum*) during peak hot humid period is presented in Table 4.

Table 4: Effect of garlic (Allium sativum) on the hematological response of rabbit bucks during peak hot humid period.

Parameter	T1	T2	T3	SEM
Packed Cell Volume (PCV) (%)	31.50^{c}	33.50^{b}	39.50^{a}	0.71
Red Blood Cell (RBC) (10^3µl)	10.55^{c}	11.86^{ab}	12.30^{a}	0.55
Haemoglobin (Hb) (g/dL)	3.18^{b}	3.94^{a}	4.06^{a}	0.17
White Blood Cell (WBC) (10^3µl)	3.55^{c}	4.85^{b}	5.70^{a}	0.05
MCV (fl)	56.36	56.36	56.48	0.07
MCH (pg)	23.26^{b}	25.30^{a}	25.35^{a}	0.82
MCHC (g/dl)	32.95	33.05	33.05	0.07
Lymphocytes (%)	30.48^{c}	38.43^{b}	46.78^{a}	0.45
Heterophils (%)	1.27^{b}	1.40^{a}	1.40^{a}	0.16
H/L ratio	0.04	0.03	0.02	0.07

^{abc} Means within the rows differ significantly at P<0.05; SEM- Standard error of the mean. MCH: Mean Corpuscular Haemoglobin, MCHC: Mean Corpuscular Haemoglobin Concentration.
T1-treatment 1, T2-treatment 2, T3-treatment 3.

The result on reproductive behavior of rabbit bucks fed garlic (*Allium sativum*) during peak hot humid period is presented in Table 5.

Table 5. Effect of garlic (*Allium sativum*) on reproductive behavior of rabbit bucks during peak hot humid period of tropical environment.

Parameter	T1	T2	T3	SEM
Libido score	2.667^{c}	3.667^{b}	4.667^{a}	0.333
Reaction time (sec.)	74.000^{c}	67.000^{b}	57.33^{a}	3.255

^{abc} Means within the rows differ significantly at P<0.05; SEM- Standard error of the mean.

Decreased concentration of PCV typically influences blood formation (9). The significantly highest value in RBC observed in T3 agrees with the findings of (10) who reported a slight increase in RBC with increase in the level of garlic in broiler chicken diet The significantly (P<0.05) higher values for WBC in the treated groups suggest that garlic supplementation was not indicative of any disease challenge to the rabbit bucks but enhanced cellular immunity. The higher heterophil-lymphocyte (H/L) ratio observed in the control group has been reported to be an indication of stress according to (11). This result could be further explained as described by (12) who reported that high temperature causes inhibition of the synthesis of T and B lymphocytes.

The significantly (P<0.05) highest value of libido score in T3 show that they had the strongest sexual drive. This supports the report by (13) that improved nutrition induces higher libido. The values obtained for reaction time in this study are in line with the report of (14). However, the highest value in reaction time recorded by rabbit bucks in T1 could be attributed to exposure to increased ambient heat load and increased relative humidity as shown in the mean environmental conditions in Table 2 during the experimentation. This could have had direct adverse effect on sexual drive (libido) of these rabbit bucks. This assertion is corroborated by earlier reports by (15) who stated that heat stress causes major reproductive failure in rabbits

and that of (16) who reported that heat stress produces a series of drastic changes in the biological functions of rabbits which in turn impairs its production and reproduction.

CONCLUSION AND APPLICATION

The results of this study concluded that during peak hot humid periods of the year, garlic (*Allium sativum*) is effective in improving the immunological status and reproductive behavior of rabbit bucks in tropical and subtropical environments. Garlic powder may be a promising additive that could be used in commercial rabbit breeding and production, during the peak hot humid periods of the year.

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Animal Physiology, Reproduction and Health: APH013

PROXIMATE AND AMINO ACIDS COMPOSITION OF AQUEOUS EXTRACTS OF *PARQUETINA NIGRESCENS* LEAF: POTENTIALS IN LIVESTOCK PHYSIOLOGICAL MANIPULATIONS

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ABSTRACT

Herbs and plant extracts have been shown to promote the growth of good bacteria while reducing the activity of harmful bacteria in the gastrointestinal tract. The aqueous extract of the leaves of *Parquetina nigrescens* was evaluated for proximate and amino acids compositions. The fresh leaves of *Parquetina nigrescens* were harvested around 6:00hrs and 6:30hrs, thereafter, they were washed. 50g of the fresh leaves harvested was blended with 1000ml of water using a blender. The blending was done for about 3 minutes after which the blended samples was filtered using filter papers (Whatman paper No.1). The filtrate was then analyzed for chemical compositions. The results revealed that the aqueous extracts of P. *nigrescens* leaf (AEPNL) contained appreciable amounts of crude protein (24.60%), crude fibre (5.60 %), ash (3.60 %) and carbohydrate (62.30 % respectively) but low amount of crude lipid (2.60). AEPNL contained appreciable amounts of essential amino acids (histidine, isoleucine, leucine, lysine, methionine, phenyalanine, threonine and valine) and non-essential amino acids (alanine, arginine, asparagine, cysteine, glutamic acid, glycine, proline, serine and tyrosine). The results showed that AEPNL are of high nutritional quality and could serve as supplements in animal production and these have huge potentials in the manipulations of physiological activities of poultry and livestock species.

Keywords: Manipulations, *Parquetina nigrescens*, Physiology, Potentials

INTRODUCTION

Parquetina nigrescens, a plant native to West Africa, has been traditionally used for various medicinal purposes. *Parquetina nigrescens* belongs to the Perplocaceae family (1). It is a perennial shrub found in the secondary forest around villages in Senegal as well as in Nigeria (2, 3). In some Nigerian languages, *P. nigrescens* is called ewe ogbo (Yoruba), kwankwanin (Hausa), mgbidimgbe (Igbo), Olilia or Ovieukpakoma (Etsako) (4). The leaves, seeds, fruits, stem, roots and the latex of the plants are commonly used in traditional medicine (5). The plant is a climber usually planted by the rural dwellers for its health benefits. The leaf is sometimes freshly crushed for its juice or as a decoction. It has been used in traditional medicine practice for treatment of gonorrhea, gastrointestinal disorders (GIT), menstrual disorders, wound healing, and to boost blood shortage (6). *Parquetina nigrescens* has been reported to be useful in the treatment of sickle cell anaemia (6) and gastro-intestinal disorders (GIT) (7).

A series of studies have explored the use of *Parquetina nigrescens* leaf extracts in livestock production with little emphasis on the nutritive and bioactive substances. (8) found that the administration of these extracts had no significant impact on growth parameters in Japanese quails, but did affect feed conversion ratio and final live weight. This suggests a potential for physiological manipulation. Similarly, (9) demonstrated the ability of the extracts to manage diet-induced iron deficiency in weanling rats, with significant increases in haemoglobin concentration and changes in serum protein levels. (6) and (10) highlighted the nutritional potential of *Parquetina nigrescens*, with the former identifying high crude protein content and the latter confirming the presence of antioxidant phytochemicals and vitamins. These findings collectively suggest

that *Parquetina nigrescens* leaf extracts have the potential to influence livestock physiology, particularly in the context of iron deficiency and growth parameters. This study is therefore aimed at determining the proximate and amino acid compositions of the aqueous extracts of *Parquetina nigrescens* and its potential influence in physiological manipulations of livestock.

MATERIALS AND METHODS

Fresh *Parquetina nigrescens* leaves were harvested from Ilishan-Remo, Ikenne Local Government Area in Ogun State, Nigeria. The plant was identified and authenticated by a botanist in the Department of Basic Sciences, Babcock University, Ilishan-Remo, Ogun State, Nigeria. The fresh leaves of *Parquetina nigrescens* were harvested around 6:00hrs and 6:30hrs, thereafter, they were washed. 50g of the fresh leaves harvested was blended with 1000ml of water using a blender. The blending was done for about 3 minutes after which the blended samples was filtered using filter papers (Whatman paper No.1). The filtrate was then analyzed for chemical compositions. This research was carried out at Animal Science Laboratory, Babcock University, Ilishan-Remo, Ogun State, Nigeria. Ilishan-Remo is located in Nigeria's rainforest zone, with an annual rainfall of about 1500mm and a mean temperature of 27 degrees Celsius.

Determination of Proximate Composition:The aqueous extract of *Parquetina nigrescens* leaves were analyzed for proximate composition (dry matter, ash, crude fat, crude fibre and crude protein contents) using the methods of Association of Official Analytical Chemists (11).

Determination of Amino Acids Profile: The amino acid profile of the aqueous extracts of the leaves of *Parquetina nigrescens* was determined by standard method described by (12). The samples were dried to constant weight, defatted, hydrolysed, evaporated in a rotatory evaporator and loaded into the Technicon Sequential Multi-Sample Amino Acid Analyzer (TSM).

Statistical Analysis
All analyses were performed in triplicate, and the results were expressed as mean ± standard deviation. All data were analyzed using SPSS Version 22.

RESULTS

Table 1 showed the results of proximate analysis of the aqueous extracts of *P. nigrescens* leaves. The results revealed that P. nigrescens leaf extracts contained appreciable amounts of crude protein (24.60%), crude fibre (5.60 %), ash (3.60 %), carbohydrate (62.30 %) and gross energy (371.00 Kcal/100g) but low amount of crude lipid (2.60 %).

Table 1. Proximate Analysis of Aqueous Extracts of *Parquetina nigrescens* Leaves

Parameter	
Moisture (%)	7.80± 0.20
Total ash (%)	3.60 ± 0.20
Crude Protein (%)	24.60± 0.30
Crude Lipid (%)	2.60± 0.20
Crude Fiber (%)	5.60± 0.20
NFE (%)	62.30±0.03

Key: NFE – Nitrogen Free Extracts

Table 2 showed the amino acids composition of the extracts of *Parquetina nigrescens* leaf. The extracts contained appreciable amounts of the essential amino acids (histidine, isoleucine, leucine, lysine, methionine, phenyalanine, threonine and valine) and non-essential amino acids (alanine, arginine, asparagine, cysteine, glutamic acid, glycine, proline, serine and tyrosine).

Table 2: Amino acid profile of Aqueous Extracts of *P. nigrescens* Leaf

Parameter	(%)
Histidine	2.30±0.01
Isoleucine	3.06±0.02
Leucine	6.90±0.10
Lysine	6.60±0.10
Methionine	3.93±0.01
Phenylalanine	2.07±0.00
Threonine	2.40±0.00
Valine	5.40±0.01
Alanine	2.40±0.01
Arginine	12.15±0.15
Asparagine	6.46±0.18
Cystine	13.30±0.25
Glutamic acid	20.23±0.32
Glycine	3.20±0.02
Proline	5.20±0.03
Serine	3.50±0.01
Tyrosine	1.45±0.00

DISCUSSION

The proximate analysis of aqueous extracts of *P. nigrescens* leaf reveals significant amounts of crude protein, crude fiber, ash, and carbohydrates, with a low amount of crude lipid. *P. nigrescens* with a crude protein of 24.60% is exceptionally high compared to many other plant-based feed ingredients. The crude protein content of the extract was also higher than 8.40% reported by (13). Aqueous extracts of *P. nigrescens* leaf contained 5.60% crude fiber as observed in this study and this implies that it has moderate fiber content. The values of crude fiber from this study was lower than 9.38% reported for *P. nigrescens* leaf extracts (PNLE) by (13). The presence of 3.60% ash reflects its mineral content but lower than the values reported for *P.nigrescens* extract (6.08%) by (13) but in proximity with 3.67% reported for *Moringa oleifera* seed meal (14). This suggests that despite its low ash contents it can still contribute to the overall mineral balance in the diet of monogastric animals.

The study also showed that the aqueous extracts of *Parquetina nigrescens* leaf also contained 32.30% nitrogen free extracts, that is, non-fiber carbohydrates and this was in proximity with 40-45% carbohydrates for *Moringa oleifera* leaves (15), 30-35% for alfalfa (16) but lower than 81.83% for *Pterocarpus milbraedii* (17). The carbohydrate content of *P. nigrescens* is comparable to other plant sources, providing a valuable energy source for monogastric animals.

The crude lipid of 2.60% showed that PNLE has low lipid content. The lipids content was lower than 9.38% for *Parquetina nigrescens* leaf extracts (13). The results however suggest that *Parquetina nigrescens* leaf extract cannot be used as the sole source of fat. The low lipid content is consistent with other plant-based feeds. This suggests that additional fat sources might be necessary to meet the energy needs of monogastric animals if PNLE is to be incorporated in the feed of monogastric animals.

The implication in the physiological manipulations of monogastric animals if AEPNL is to be used is in its potentials in stimulating growth and development because of the observed high crude protein. The significant protein content in AEPNL can enhance growth rates and muscle development in monogastric animals such

as pigs and poultry. Adequate protein is essential for young animals to reach their full genetic potential in growth and productivity (18). Also, it has potentials in contributing to the digestive health of monogastric animals because of the moderate crude fiber of AEPNL**.** The fiber content supports gut motility and health, promoting a balanced gut microbiome. This is crucial for preventing digestive issues and ensuring efficient nutrient absorption (19). Also, it has potential for mineral supplementation. The minerals in the ash content can contribute to bone development and metabolic processes, ensuring overall health and vitality (20). It could also aid in energy provision. The carbohydrate content provides a readily available energy source, essential for daily activities and metabolic functions, ensuring animals maintain their energy balance (21).

The proximate analysis of AEPNL suggests that this plant could be a valuable addition to the diets of monogastric animals. Its high protein content, moderate fiber, and carbohydrate levels, along with essential minerals, provide a balanced nutrient profile that can support growth, digestive health, and overall physiological functions. When compared to other plant-based feeds like *Moringa oleifera* and alfalfa, *P. nigrescens* stands out for its high protein content, making it a particularly attractive option for enhancing protein intake in monogastric animals.

The values obtained for amino acids in this study are different from the values reported by (3). The variation could be due to different nutrient contents of soil, location and perhaps the age of the plants. Following the report of (22) as well as (23), the consumption of these leaves, based on their high leucine contents, would support the regulation of blood sugar concentrations, growth and repairs of tissues. Amino acids have long been associated with the anti-sickling activity of compounds (24). Phenylalanine has been reported to be the predominant anti-sickling agent in C. *cajan* seed extract (25). In this study, amino acids indicated in glutathione formation (cysteine, glutamic acid) were found to be present in both fresh and dried leaves of *P. nigrescens*. Glycine, cysteine and glutamic acid are known precursors of glutathione, a naturally occurring protein that protects every cell, tissue and organ from toxic free radicals and diseases. It could however be implied that the intake of fresh and dried leaves of *P. nigrescens* would supply the required amino acids for glutathione production, as well as the antioxidant nutrients needed to protect the red blood cell membrane from lysis and destruction.

CONCLUSION

The results showed that AEPNL are of high nutritional quality due to its high crude protein, carbohydrates, and amino acids, and could serve as feed additives in animal production and these have huge potentials in the manipulations of physiological activities of poultry and livestock species.

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Animal Physiology, Reproduction and Health: APH014

EVALUATION OF SERUM BIOCHEMICAL INDICES ON HEAT STRESSED NIGERIAN INDIGENOUS GOATS BREEDS IN SOUTH-WEST AGRO-ECOLOGICAL ZONE

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ABSTRACT

Environmental degradation has led to fluctuations in climatic conditions, which is capable of disrupting the physiological mechanism of livestock across breeds. A total of 45 goats were used in the study, consisting of 6 males and 9 females. Their ages ranged from 5 to 6 months, with an average weight of 12 kg, for each breed of Red Sokoto (RS), West Africa Dwarf (WAD) and Sahel goats (SH) were allotted into treatments of temperature variation to evaluate its effect on serum blood indices. Goats were allotted into; T1- 0 hours (control group), T2- 4 hours (10 am to 2 pm heat exposure in grazing), T3- 8 hours (9 am to 5pm heat exposure in grazing). Roughage, concentrate and water were supplied ad libitum for 6 weeks. Blood samples were collected aseptically on days 0, 3, 6, 9 and 12 after acclimatization and analyzed for serum biochemical parameters. Mean (± SEM) for each group was calculated and compared for significant differences using one way ANOVA at $p<0.05$. Mean values obtained for ALT (11.53 ± 8.62(u/l), 8.07 ± 3.33 (u/l)), creatinine (0.99 ± 1.06 (mg/dl), 2.23 ± 1.90(mg/dl)) and cortisol levels (8.33 ± 2.98(ug/dl), 10.69 ± 3.49(ug/dl)) were significantly higher ($p<0.05$) in SH and RS respectively than the values obtained in WAD breed of goats. The albumin values (3.90 ± 0.46(g/dl), 3.80 ± 0.54(g/dl)) for 4 hours and 8 hours treatment group respectively were significantly higher ($p<0.05$) than the 0 hour treatment group. Mean values for total protein and glucose were significantly increased ($p<0.05$) across the days than the other serum biochemical parameters. Results suggested that RS and SH goats experienced a higher magnitude of stress, which can be attributed to high humidity (cold) as compared to WAD breeds. WAD breed exhibited adaptive potential to the agroecological zone. However, further studies should be carried out to ascertain this observation and boost production of these indigenous breeds across different agroecological zones in Nigeria.

Keywords: Goat, serum-biochemical, breed, heat stress.

DESCRIPTION OF PROBLEM

Climatic variations and global warming threats are becoming a major problem that affects the sustainability of livestock production systems. Stress is considered as the reaction of the body to stimuli that disturb homeostasis often with detrimental effects [1]. It induces many unfavorable damages, ranging from discomfort to death of the animal [2]. Solar radiation, high ambient temperature, and humidity are the most important environmental stressing factors in animals. Heat stress can markedly affect animal welfare, the productive and productivity performances of animals in tropical and subtropical regions [3]. However, research argues that goats are adversely affected by cold temperatures with different extents of thermal tolerance depending on the breed [4].

Goats are important small ruminant resources in the tropics, where they play a predominant role in the sustenance of the livelihoods of impoverished families especially in the rural areas. The Sahelian goat is commonly found with the agro pastoralist mainly within the northern sub-humid and semi-arid zones of the country. The sokoto red, Kano brown or Maradi goat is probably the most widespread and well known type

in Nigeria. It is found in Semi-arid areas with a single rainfall season of 4-6 months duration. West African dwarf goats are confined to humid forest zones in Nigeria. The goat's breeds have different adaptive features, hence, the need to ensure successful breeding of this goats across different agro-ecological zones.
Serum biochemical parameters are good indices of the physiological status of animals and changes in the values of these parameters can be used to assess the response of animals to various physiological situations. Biochemical variables of blood are generally used to monitor and evaluate health, nutritional and physiological status of ruminants [5]. The evaluation of blood constituents has been widely used as a marker to determine the efficacy of feed nutrient content and supplements but also an index of stress. The biochemical profiles can also be used to assess the immunity status in goats. This study was therefore designed to provide further information on the effect of heat stress on serum biochemical indices of the West African Dwarf Goat, Sahel and Red Sokoto. This study is expected to contribute to existing knowledge and enhance production of these indigenous goats across agro-ecological zones in Nigeria.

MATERIALS AND METHODS

The study was conducted at Bowen University farm, Iwo, Osun State, Nigeria on coordinate Latitude 70 38' 6.97" N and Longitude 40 10' 53.62" E. The study area is located in a Derived Savanna agro-ecological zone with average day temperature of 32.2^{o}C and average night temperature of 23.0^{o}C with vegetation that were interphase between Rainforest and Savanna Grassland and are characterized with double maxima rainfall and mixture of deciduous trees and tall grasses. 45 goats, with 6 males and 9 females for each breed of Red Sokoto, West Africa Dwarf and Sahel goats were purchased at a reputable farm. All goats were kept in a controlled environment for three days and fed their respective rations to ensure they were well rested. All the goats were kept in three groups of each breed (one group consists of two male and three female animals). Roughage, concentrate feed and water were supplied every day *ad libitum*. Three treatment groups was made as follows; T1- 0 hours (control group), T2- 4 hours (10 am to 2 pm heat exposure in grazing), T3- 8 hours (9 am to 5pm heat exposure in grazing). The experimental animals were allowed to acclimatize for a week before data collection and were managed through intensive and semi-intensive systems. They were fed roughages and concentrate from point of purchase through-out the experimental period PPR vaccine and other prophylactics were administered before data collection. Data was obtained from each animal on days 0, 3, 6, 9 and 12 after acclimatization. Mean temperature was measured on the days of data collection using a digital thermometer. Blood samples were collected aseptically at the stated day's interval. 4 ml of the blood sample was collected via the jugular vein from each treatment using 5mls syringe and 21G needles. Blood samples were collected into a plain sample bottle and taken to the laboratory for serum biochemistry analysis. Serum samples were analyzed as described by [6].

Statistical Analysis: The data collected on biochemical parameters were subjected to one way ANOVA analysis. Differences between means were separated with the New Duncan Multiple Range test at 5% probability level using SPSS (2020) version 22.

RESULTS AND DISCUSSION

The mean temperature for day and night during data collection is expressed in table 1. The mean temperature for day and night was measured at 1pm and 8pm respectively. The temperature lowest values were seen on day 9 and day 12 of data collection. This may have a great influence on the serum biochemical indices of the goats.

As reported in table 2, the significant highest value ($p>0.05$) for ALT, Creatinine and cortisol was seen in sahel and red sokoto breed of goats which could be as a result of cold shock which is contrary to the findings of [7]. According to [8] sahel and red sokoto breed of goats are well adapted to the sub-humid and semi-arid regions of the country, the atmospheric temperature in the tropical region may be too low compared to where they are bred

Table 1: Mean temperature data during data collection

PARAMETERS	DAY 0	DAY 3	DAY 6	DAY 9	DAY 12
DAY	35^0C	34^0C	35^0C	33^0C	33^0C
NIGHT	25^0C	26^0C	25^0C	27^0C	26^0C

Table 2: Effect of environmental stress on the biochemical indices of goats across breed

PARAMETERS	SAHEL	RED SOKOTO	WAD
AST (U/L)	52.73 ± 17.49	45.80 ± 22.09	52.40 ± 13.21
ALT (U/L)	11.53 ± 8.62^b	8.07 ± 3.33^{ab}	6.67 ± 2.13^a
T.PROTEIN (g/dl)	6.85 ± 1.02	7.51 ± 1.04	7.27 ± 1.00
ALBUMIN(g/dl)	3.40 ± 0.95	3.81 ± 0.34	3.71 ± 0.56
GLUCOSE (mg/dl)	42.87 ± 8.29	42.33 ± 10.85	46.93 ± 10.57
CREATININE (mg/dl)	0.99 ± 1.06^a	2.23 ± 1.90^b	0.87 ± 0.83^a
UREA (mg/dl)	17.47 ± 9.29	21.93 ± 14.86	23.00 ± 16.61
CORTISOL (ug/dl)	8.33 ± 2.98^{ab}	10.69 ± 3.49^b	6.33 ± 2.28^a

^{abc} values along the same row with different superscripts are significantly different ($p<0.05$)

According to table 3, the serum biochemical values did not show any significant difference except for albumin. Thus, the albumin levels for goats showed a significant ($p>0.05$) highest values in 4 hours and 8 hours treatment which may be as a result duration of exposure to sunlight. This result corresponds with the findings of [9] which indicates an increase in albumin when goats are subjected to heat stress.

Table 3: Effect of treatment on the serum biochemical indices of sahel, red sokoto and WAD goats

PARAMETERS	0 HOUR	4 HOUR	8 HOUR
AST (U/L)	53.73 ± 17.52	49.13 ± 20.37	48.07 ± 16.11
ALT (U/L)	8.80 ± 5.93	7.47 ± 4.02	10.00 ± 6.97
T.PROTEIN (g/dl)	6.89 ± 1.19	7.57 ± 0.88	7.17 ± 0.96
ALBUMIN (g/dl)	3.22 ± 0.79^a	3.90 ± 0.46^b	3.80 ± 0.54^b
GLUCOSE (mg/dl)	40.60 ± 6.90	46.87 ± 12.98	44.67 ± 8.61
CREATININE (mg/dl)	1.59 ± 1.70	1.44 ± 1.60	1.07 ± 1.02
UREA (mg/dl)	20.13 ± 11.36	22.53 ± 12.44	19.73 ± 17.69
CORTISOL (ug/dl)	8.26 ± 3.25	8.40 ± 3.58	8.68 ± 3.68

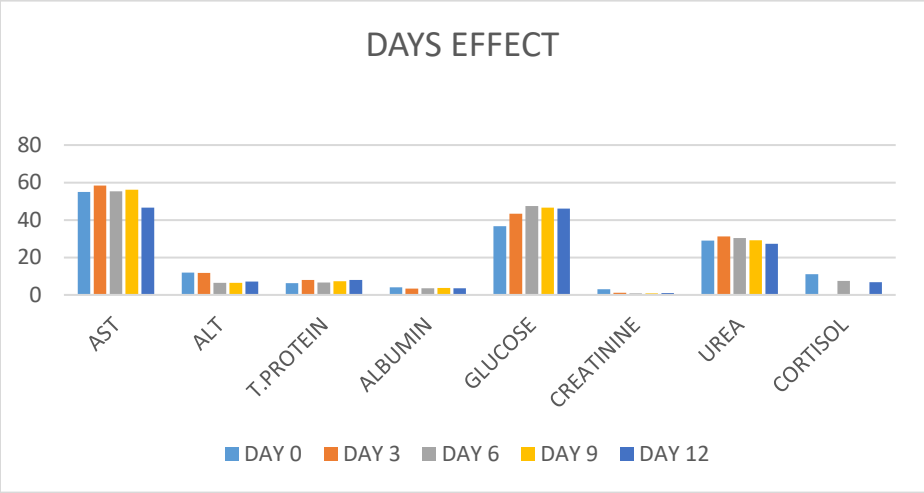
^{abc} values along the same row with different superscripts are significantly different ($p<0.05$)

As shown in figure 1, all parameters reduced across the days. However, glucose and total protein increased across the days. Heat stress increased total protein and albumin levels due to increase respiration rate in goats for enhancing evaporative cooling [9]. Low albumin (hypoalbuminemia) maybe caused by liver disease, nephritic syndrome, burns, protein losing enteropathy, malabsoprtion, and genetic variations.

CONCLUSION AND APPLICATION

The results obtained for various variables revealed that the Red sokoto and sahel breed of goats were more stressed, which could be as a result of high humidity (cold) compared to WAD breeds. However, more studies should be carried out to evaluate the adaptability of this indigenous goat breeds in southwest agro-ecological zone.

Fig 1: Effect of days on the serum biochemical indices on the goats



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Animal Physiology, Reproduction and Health: APH015

REPRODUCTIVE PERFORMANCE OF NEWZEALAND RABBITS WITH VARYING LEVELS OF PROTEIN IN A TROPICAL ENVIRONMENT

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ABSTRACT

Thirty *(30)* does aged between 7 and 8 months were randomly divided into 5 groups of 6 does per treatment. The five (5) treatments were allocated each to the 5- iso caloric diets consisting of five(5) varying protein levels of 15, 18, 21, 24,and 27% CP. The does were fed ad-libitum with weighed experimental diets for two weeks before and after mating. The does were thereafter placed on diet containing 18% CP throughout the gestation period. The results obtained showed that there was non-significant difference among the treatment means for weight gain of does during gestation while there were significant effects on the following parameters measured: Daily feed intake, gestation length, litter size, mortality at birth and average litter weight at birth. It was therefore concluded that it is more beneficial to flush does with diets containing 24% CP levels as it resulted in larger litter size, average litter weight at birth and lower kit mortality at birth and beyond 24% CP has no significant effects on reproductive parameters measured.

Keywords: Crude Protein, Reproductive performance, Flushing effect, Newzealand Rabbits,litter size.

INTRODUCTION

The human population growth in developed countries is stabilizing while that of developing countries including Nigeria is still increasing rapidly. Thus, the search for alternative sources of protein to meet up the population challenge is imperative. Economic indices indicate that as this population trend continues, more people are to be fed. Agricultural outputs needs to be increased rather than through food importation into such countries (1). In order to maximize food production and meet protein requirements in Nigeria, viable options need to be explored and evaluated (2). Among such alternatives is the use of livestock species that are yet to play a major role in animal production within these countries. Fast-growing livestock such as rabbits possess a number of features that might be of advantage in the small holder subsistence – type integrated farming in developing countries.

Rabbit farming in Nigeria is faced with myriad of problems, which have resulted to a gross shortage of meat to meet up the population challenge in our country (3). The growth rate of the Nigerian agricultural sector is below the potentials of natural and human resources due to high cost of inadequate functional infrastructural facilities, inconsistencies of government agricultural policies, inadequate private sector participation, poor mechanized farming and little or no adoption of some simple agricultural technologies developed by scientists (3). In Nigeria, consumption of animal protein remains low at about 6.0-8.4 g/head/day which are far below the 13.5g per day prescribed by the WHO (4).

Rabbit production is a veritable way of alleviating animal protein deficiency in Nigeria (5). The rabbit has immense potentials and good attributes which include high growth rate, high efficiency in converting forage to meat, short gestation period, and high prolificacy, relatively low cost of production, high nutritional quality of rabbit meat which includes low fat, sodium, and cholesterol levels. It also has a high protein level of about 20.8% and its consumption is bereft of cultural and religious biases (6). The presence of caecal microbes enables the rabbit to digest large amounts of fibrous feed as most

Feeding sheep high protein supplements 6 - 10 days before estrous has also been reported to enhance ovulation rates (7). Smith (8) however reported minimal effects of specific protein on ovulation rates similar to conventional flushing diets of short duration.
(9) reported that there was non significant effect of flushing on does weight, feed intake, litter size at birth, kits alive at birth 7 and 14 days post partum, but reported significant effect on litter weight at 7, 14 and 21 days post partum. These workers also reported that does flushed with 20% CP diet had kits with significantly higher litter weight at 7, 14 and 21 day post partum than those flushed with 16 and 18% CP diets.

This study was designed therefore, to investigate the effect of flushing using different crude protein levels on the reproductive performance of Newzealand rabbits.

MATERIALS AND METHODS

Thirty (30) Newzealand does aged between 7 and 8 months were randomly divided into five groups of 6 does per treatment and thereafter allocated to each of the iso-caloric diets consisting five (5) varying protein levels of 15, 18, 21, 24 and 27% crude protein (CP). The does were housed in individual wire hutches.
The does were fed 15% CP diet for 3 weeks prior to mating. Thereafter the does were served *ad-libitum* with weighed experimental diets (Table 1) for two weeks before and after mating. The does were fed twice daily at 08:00 and 16:00 hours. The leftover feed was collected and weighed before each fresh feeding. After flushing, all the does were fed *ad-libitum* with a diet containing 18% CP during gestation and lactation periods. Water was served *ad-libitum* throughout the duration of the experiment.

Does were introduced to bucks individually. Pregnancy in the does was confirmed after two weeks of mating by abdominal palpitation. Wooden kindling boxes were introduced to each of the hutches on 26th day of mating. Data collected were daily feed intake (gm), daily weigh gain (gm), gestation length (day), litter size, mortality at birth and average litter weight at birth.

Data on each parameter was subjected to the analysis of variance (ANOVA) for completely Randomised Design (CRD) and were significant differences were indicated, the means were separated using Hsu's MCB (Multiple Comparison with the Best) method (10).

RESULTS AND DISCUSSION

The results of the experiment are presented in Table 2. The results obtained showed that increasing level of crude protein in the diet significantly ($p<0.05$) reduced feed intake. However, there were no significant difference ($p>0.05$) among the treatment means for weight gain of the does during gestation periods. This result is in agreement with (9) who reported non-significant effect among does for weight gain served different CP levels between 15 and 24%.

There was a significant effect ($p<0.05$) on gestation length as this reduces with increase in crude protein levels of the diet. The results of the present study conflicts with the report of (11) that different levels of protein in the diets of rabbits did not significantly affect gestation length.
The current study noticed a significant increase ($p<0.05$) in litter size as the protein level in the diet increased from 15 to 21%CP levels. This result agrees with (12); (13) and (9) who reported slightly higher litter size as protein level increased. (14) reported non-significant difference in litter size when does were fed 15 and 20% CP diet.

Kit mortality at birth was significantly unaffected ($p<0.05$) when the feed contained 24 and 27% CP. Kit mortality was observed to increase from 15 to 21% CP, (9) reported an increase in kit mortality at birth with increase in protein level up to 20% CP. The high incidence of kit mortality with low protein diets in the present study may have been due to insufficient protein during gestation and hence foetal liveability twenty one days (21) days post partum.

Average litter birth weight was not significantly influenced ($p>0.05$) by the protein level (15 and 18%) in the diet. It was observed that increasing the level of protein in the diet significantly ($p<0.05$) increased the average litter weight at birth. (9) Reported that kits from does flushed with 24% CP had a higher individual weight than those on 20 and 18% CP. Also, (14) reported that giving a diet low in protein to a doe during pregnancy resulted in reduced birth weight.

CONCLUSION

It's therefore, concluded from this study that flushing does with 24% crude protein diets produced larger litter size, average litter birth weight and lower kit mortality at birth. While increasing CP level up to 27% in the diet breeding does has no significant effects on the reproductive parameters of rabbits.

Table 1.0: Composition of the Experimental Details

	Treatments C% CP)				
Ingredients	**T_1(15)**	**T_2 (18)**	**T_3 (21)**	**T_4 (24)**	**T_5 (27)**
Maize	22.62	15.10	4.98	4.09	3.09
Soyabeans	16.72	27.82	38.60	50.41	58.41
Rice Bran	57.43	53.83	53.16	42.27	35.25
Bone meal	2.50	2.50	2.50	2.50	2.50
Methionine	0.25	0.25	0.25	0.25	0.25
Pre-Mix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
CP (%)	15.01	18.00	21.00	24.01	27.00
DE (Kcal/kg	2354.40	2400.40	2403.00	2416.45	2450.04
CF (%)	8.55	8.56	8.87	8.13	8.56

Table 2.0: Results of Flushing on the Reproductive Performance of Newzealand Deos

	Treatments (%CP)					
Parameters	**T_1(15)**	**T_2 (18)**	**T_3 (21)**	**T_4 (24)**	**T_5 (27)**	**SEM**
Daily Feed in take (g)	89.00^{b}	75.57^{ab}	62.64^{a}	65.43^{a}	62.86^{a}	0.18
Daily Wt.gain (g)	12.50^{a}	12.98^{a}	12.50^{b}	12.50^{a}	12.53^{a}	0.05
Gestation Length (Day)	33.00^{a}	30.00^{b}	29.50^{b}	30.50^{b}	30.46^{b}	0.12
Litter size	4.00^{b}	5.00^{a}	5.50^{a}	5.00^{a}	5.05^{a}	0.15
Mortality at birth	0.50^{b}	0.50^{b}	1.50^{c}	0.00^{a}	0.00^{a}	0.20
AV. Litter Wt. (g) at birth	32.50^{d}	33.30^{c}	41.00^{b}	50.00^{a}	49.04^{a}	0.18

a,b,c and d means followed by the same superscript in horizontal rows are not significantly different from one another ($p>0.05$).

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Animal Physiology, Reproduction and Health: APH016

EFFECT OF SELENIUM, VITAMIN E AND SELENIUM + VITAMIN E SUPPLEMENTATION ON HAEMATOLOGICAL AND BIOCHEMICAL PARAMETERS OF POSTPARTUM BUNAJI COWS

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ABSTRACT

A total of twenty Bunaji cows with an average weight of 300±5 kg were used for this study. The animals were grouped into four treatments with each treatment containing five cows. Treatment I served as the control with no administration of either selenium or vitamin E. Treatment II was administered 3 mg of feed grade selenium. Treatment III was administered 20 mg of feed grade Vitamin E. Treatment IV received a combination of 3 mg feed grade selenium + 20 mg of Vitamin E/ 100kg diet. Two sets of blood samples were taken from the animal via jugular venipuncture using a 10 ml syringe fitted with a needle. Ten ml blood samples collected were put into sample bottles containing heparin as anticoagulant for the determination of haematological parameters. Blood samples for serum analysis were collected into heparin free bottles and allowed to coagulate at room temperature. The supernatant sera was then harvested and stored in a freezer for subsequent biochemical analysis. Data generated were analyzed using the General Linear Model of SAS. Significant means were compared using Dunnett. The packed cell volume, haemoglobin, red blood cells, white blood cells, eosinophil, monocytes, basophil, lymphocytes and neutrophil were similar ($P > 0.05$) with Se, Vitamin E and Se + Vitamin E supplementation in Bunaji cows after calving. The packed cell volume (24.18 – 25.24%), haemoglobin (8.22 – 9.02g/dl), red blood cells (5.29 – 5.67x$10^{12/L}$), white blood cells (12.14 – 13.08x$10^{9/L}$), eosinophil (7.00 – 8.30%), monocytes (3.62 – 4.88%), basophil (0.56 – 1.02%), lymphocytes (63.10 – 65.26%) and neutrophil (20.50 – 23.38%) were within the normal range. From the findings of the present day study, it was concluded that supplementation of Se (3mg), vitamin E (20mg) and Se (3mg) + vitamin E (20mg) was effective in maintaining the blood metabolites within the reference points for postpartum cows except for the biomarkers parameters.

Keywords: Postpartum, Cows, Haematological, Biochemical, Bunaji

INTRODUCTION

Vitamins and minerals perform vital roles in the growth and reproductive health of animals. During the last 10 years, understanding of the importance of selenium and vitamin E for dairy cattle has increased tremendously. Scientific experiments have established that vitamin E and Selenium (Se) can influence the function of certain immune cells, reduce calf mortality and morbidity, and improve reproductive and mammary gland health in adult dairy cows. Vitamin E functions as an intra-cellular antioxidant scavenging for free reactive oxygen and lipid hydroperoxidases, and converting them to non-reactive forms, thus maintaining the integrity of membrane phospholipids against oxidative damage and peroxidation (1).

Selenium is an integral component of the enzyme, glutathione peroxidase (GSH-px) which is an important part of the cellular antioxidant system, but GSH-px is water soluble and is found in the cytosol of cells, not in cellular membranes (2). Physiological functions of Selenium are mediated in particular by seleno-proteins (3). Insufficient selenium intake by the organism is manifested by numerous biochemical changes, such as reduced selenium concentration and GSH-Px activity in blood and tissues, and increased activity of creatine kinase (CK), aspartate aminotransferase (AST) and lactate dehydrogenase (LD) in serum due to muscular damage, increased production of reactive forms of oxygen and final products of lipoperoxidation in blood

and tissues (malonyl dialdehyde, thiobarbituric acid reactive substances (TBARS, F2-isoprostanes), as well as other possible secondary changes like shift in T3 : T4 ratio (3). Vitamin E also has an immune enhancing effect by virtue of altering arachidonic acid metabolism and subsequent synthesis of prostaglandin, thromboxanes and leukotrienes. Under stress conditions, increased levels of these compounds by endogenous synthesis or exogenous entry may adversely affect immune cell function (4). Therefore the objective of the study was to evaluate the effect of feed grade selenium and vitamin E supplementation in cows.

MATERIALS AND METHOD

Location
The studies were conducted at the Dairy Research Programme farm of the National Animal Production Research Institute (NAPRI), Ahmadu Bello University, Shika-Zaria, Nigeria.

Experimental management and design
A total of twenty Bunaji cows with an average weight of 300±5 kg were used for this study. The animals were grouped into four treatments with each treatment containing five animals.
Treatment I served as the control with no administration of either selenium or vitamin E. Treatment II was administered 3 mg of feed grade selenium. Treatment III was administered 20 mg of feed grade Vitamin E. Treatment IV received a combination of 3 mg feed grade selenium + 20 mg of Vitamin E. The treatments diets were administered throughout the third trimester of the cows at weekly interval.

Blood sample collection: Two sets of blood samples were taken from the animal via jugular venipuncture using a 10 ml syringe fitted with a needle. Ten ml blood samples collected were put into sample bottles containing heparin as anticoagulant for the determination of haematological parameters. Blood samples for serum analysis were collected into heparin free bottles and allowed to coagulate at room temperature. The supernatant sera was then harvested and stored in a freezer for subsequent biochemical analysis.

Blood analysis: Packed cell volume (PCV) and haemoglobin (Hb) concentration was determined following the Procedures outlined by (5). Red blood cells (RBC) and total white blood cells (WBC) were also determined as described by (6). Serum total protein, serum urea N, globulin and creatinine was determined using the Method described by (7). The activity of the alanine amino transferase (ALT), aspartate amino transferase (AST) and alkaline phosphate (ALP) was analyzed using spectrophotometric linked reaction method (8). Glutathione peroxidase (GSH-Px), Se and Vitamin E was analyzed according to the procedure described by (9).

Statistical Analysis
Data generated were analyzed using the General Linear Model of SAS (10). Significant means were compared using (11).

RESULTS AND DISCUSSION

The result of effect of Selenium, Vitamin E and Selenium + Vitamin E supplementation on biochemical parameters of Bunaji cows after calving is shown on table 1. The packed cell volume, haemoglobin, red blood cells, white blood cells, eosinophil, monocytes, basophil, lymphocytes and neutrophil were similar ($P > 0.05$) with Se, Vitamin E and Se + Vitamin E supplementation in Bunaji cows after calving. The packed cell volume (24.18 – 25.24%), haemoglobin (8.22 – 9.02g/dl), red blood cells (5.29 – 5.67x$10^{12/L}$), white blood cells (12.14 – 13.08x$10^{9/L}$), eosinophil (7.00 – 8.30%), monocytes (3.62 – 4.88%), basophil (0.56 – 1.02%), lymphocytes (63.10 – 65.26%) and neutrophil (20.50 – 23.38%) were within the normal range. Selenium and Vitamin E as antioxidants prevent oxidative tissue damage and aid in scavenging for free radicals in the body. This improves the immunity of the animals thereby keeping them in good health.
Table 2 shows the result of effect of Se, Vitamin E and Se + Vitamin E supplementation on biochemical parameters of Bunaji cows after calving. There existed similarity ($p>0.05$) in glucose, serum protein,

albumin, globulin, urea N, creatine, MDA protein, SOD, AST, ALT, ALP, and GSH-Px with Se, vitamin E and Se + vitamin E supplementation.

Metabolic, health, nutritional and physiological status of animal can be detected by analysis and monitoring the blood and other fluids by the use of clinical pathology and chemistry procedures (12; 13). The glucose (45.90 – 52.28g/dL), serum protein (5.12 – 5.34), albumin (2.48 – 2.62), globulin (2.26 – 2.76), urea N (4.70 – 5.50), creatine (1.20 – 1.30), MDA protein (12.22 – 13.40) were within the normal physiological range, while SOD (47.44 – 53.74), AST (25.20 – 31.80), ALT (17.40 – 18.80), ALP (52.00 – 59.40), and GSH-Px (34.26 – 43.46 µ/ml) were slightly lower or above the normal range values. This could be an indication that the animals were stressed or agitated during blood sample collection. The increase in proteins observed in treatment II could also be as a result of the fact that almost about 80% of Se ingested is absorbed by the body and integrated into the body proteins, irrespective of its original form or source (14).

Table 1: Effect of Selenium, Vitamin E and Selenium + Vitamin E supplementation on biochemical parameters of postpartum Bunaji cows

Parameters	**Control**	**Se**	**Vit-E**	**Se + Vit-E**	**Normal Range**	**SEM**	**P-value**
Packed Cell Volume (%)	24.18	25.24	24.62	24.70	18-46	1.12	0.9279
Haemoglobin (g/dl)	9.02	8.24	8.54	8.22	8-20	0.30	0.2449
Red Blood Cell ($x10^{12}$/l)	5.67	5.35	5.53	5.29	3-10	0.27	0.7359
White Blood Cell (x 10^9/l)	13.08	12.14	12.16	12.32	4-13	1.04	0.961
Eosinophil (%)	8.30	7.58	7.00	8.34	0.0-24	0.71	0.5056
Monocytes (%)	3.86	4.88	3.62	3.88	0.25-8.4	0.36	0.1102
Basophil (%)	0.64	1.02	0.56	1.02	0.0-0.2	0.23	0.3628
Lymphocytes (%)	65.26	63.10	63.86	64.10	45-75	0.23	0.3628
Neutrophils (%)	20.50	23.38	25.96	21.20	15-45	2.09	0.2820

PCV=packed cell volume, Hb=heamoglobin, RBC=red blood cell, WBC=white blood cell, EOS=esinophils, MON=monocytes, LYMP=Lympocytes, Se-Selenium, Vit-E-Vitamin E, SEM-Standard Error of Mean.

CONCLUSION/APPLICATION

From the findings of the present day study, it was concluded that supplementation of Se (3mg), vitamin E (20mg) and Se (3mg) + vitamin E (20mg) was effective in maintaining the blood metabolites within the reference points for postpartum Bunaji cows except for oxidative markers as well as liver function enzymes indicating stress on the animals.

Table 2: Effect of Selenium, Vitamin E and Selenium + Vitamin E supplementation on biochemical parameters of postpartum Bunaji cows.

Parameters	Control	Se	Vit-E	Se + Vit-E	Normal Range	SEM	P-value
Glucose (g/dL)	52.28	50.20	45.90	50.54	40-75	4.88	0.8190
Total Protein (g/dL)	5.12	5.18	5.34	5.16	6.7-7.4	0.22	0.8944
Globulin (g/dL)	2.60	2.62	2.48	2.54	3.0-3.5	0.18	0.9481
Urea N (mg/dL)	2.76	2.26	2.64	2.42	3.0-4.0	0.18	0.2302
Albumin (g/dL)	5.50	4.70	5.16	5.04	2.0-3.5	0.47	0.6966
Creatine (mg/dL)	1.24	1.28	1.20	1.30	0.8-1.7	0.08	0.8310
MDA Protein (Mmols/mg)	12.68	12.22	13.40	13.18	10.0-15.0	0.51	0.3867
SOD (u/ml)	53.56	47.44	53.74	51.76	40.0-45.0	2.59	0.3161
AST (IU/L)	31.80	31.40	28.20	25.20	35-132	2.06	0.1724
ALT (IU/L)	15.80	18.00	17.40	18.80	11-40	1.31	0.4429
ALP (IU/L)	53.00	52.00	52.00	59.40	0.0-48	5.19	0.7063
GSH-Px (µ/ml)	34.26	42.02	39.32	43.46	20.0-25.0	2.97	0.1778

Urea N-urea nitrogen, MDA- Malondialdehyde Protein, SOD-superoxide dismutase, AST-amino transferase, ALT-alanine aminotransferase, ALP-alkaline phosphate, GSH-Px-Glutathione peroxidase, Se-Selenium, Vit-E-Vitamin E, SEM-Standard Error of Mean.

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Animal Physiology, Reproduction and Health: APH017

CHEMICAL COMPOSITION OF EGGS FROM PULLETS EXPOSED TO VARYING LIGHT COLOURS AT THE EARLY LAYING PHASE

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ABSTRACT

The chemical composition of eggs of pullets exposed to varying light colours at the early laying phase was assessed in this study. Isa - Brown pullets (n=150), weighing 1.3±2 at week 18 of age were allotted to five varying colours; T1= no light colour, T2 = White, T3 = Red, T4 = Green and T5 = Blue in a completely randomized design. Each treatment was replicated five times and a replicate had six pullets. At week 32, an egg was sampled from each replicate at the same day of lay and analysed for their chemical composition using standard methods. Results revealed that the chemical compositions of the eggs were lowered significantly ($p<0.05$) by the different lighting colours. The crude (%) and true protein (%) contents of the eggs were respectively 10.92 and 6.07, 11.04 and 5.90, 10.44 and 4.73, 10.33 and 5.43, 10.52 and 4.92 for T1, T2, T3, T4 and T5. Ash contents (%) were significantly higher ($p<0.05$) in eggs from pullets on T1(1.25) and T2(1.28) than T4 (1.13) while T3 (1.06) andT5 (1.09) were significantly lower ($p<0.05$). Values for metabolizable energy and fat followed similar trends for crude protein, true protein and ash. Therefore, pullets not exposed to extra light colour (natural photoperiods) tended to have better nutritional composition. Result in this study therefore suggests that, varying light colours lowered the egg nutritional composition.

Keywords; Light colour, Photoperiod, Crude protein, True protein, Metabolizable energy and Egg nutritional composition

INTRODUCTION

Physiology of birds has been discovered to be regulated by different colours of light they are exposed to during housing. Egg internal and external quality can be influenced by factors such as diet, age and environmental conditions including light colour (1). Growth, egg production, stress, fertility and egg quality are influenced by the wavelength of light (2). (3) reported that red light of longer wavelength has a higher potential to penetrate the skull and promote hypothalamic photoreceptors and egg production in birds. (4, 5) reported that raising laying hens under red light resulted in both early laying and higher egg production than in raising birds under white or green light. The chemical composition of eggs which includes protein, lipid, and mineral content is of great importance to consumer's well-being and industrial applications. Though the implications of various colours of LED lights on body weight gain and egg production of laying hens have been documented (2), information on the specific effects of light colours on chemical composition of eggs at early laying phase is still limited. This study was therefore carried out to determine the chemical composition of the eggs from pullets exposed to varying light colours at early laying phase by analysing the protein, lipid, and mineral content of the eggs, to show the impact of light colours on egg quality, providing valuable report for poultry farmers and the egg industry.

MATERIALS AND METHODS

The experiment was carried out at the Poultry Unit of the Teaching and Research Farm, University of Ibadan, Ibadan, Nigeria. The study area lies between the longitude 7º27.05 N and 3º53.74 of the Greenwich Meridian East, at an altitude of 200m above sea level. One hundred and fifty, sixteen-weeks Isa Brown (n=150) were acquired and placed on a commercial layer diet for two-weeks after which the experimental lights were

provided for additional 4 hours to natural photoperiod of 12 hours. At week-eighteen, birds were randomly allotted to five treatments of 5 replicates each with 6 birds per replicate. Birds were reared in a cage and all the birds were from the same flock and no experimental interventions were applied during the rearing period. Birds were distributed equally among three cages (50 pullets/pen) within the same room (three pens). Pens were separated by wire panelling with shade cardboard for hens' visual isolation and to prevent the scattering effect of the supplemental lights between pens. Five bulbs of different colours labelled T1 = no light colour, T2 = White colour, T3 = Red colour, T4 = Green colour and T5 = Blue colour were experimentally used. At week thirty-two, an egg was sampled from each replicate on the same day of laying for chemical evaluation. The egg parameters evaluated were Crude Protein, True Protein, Crude Fat, Ash, Moisture and Gross Energy as assessed by (6)

Statistical analysis

Data were subjected to descriptive statistics and analysis of variance using Statistical Package for Social Sciences (SPSS) version 26.0 (IBM Corp., Armonk, NY, USA). Means were separated using Duncan's multiple range test option of the same software at α=0.05.

Table 1**;** Chemical composition of eggs from pullet subjected to varying light colour at early laying phase

Parameters	T1	T2	T3	T4	T5	SEM
Moisture content (%)	74.62^{bc}	74.36^{c}	74.88^{b}	75.26^{a}	74.82^{b}	0.09
Crude Protein %	10.92^{a}	11.04^{a}	10.44^{b}	10.33^{b}	10.52^{b}	0.08
True Protein %	6.07^{a}	5.90^{a}	4.73^{c}	5.43^{b}	4.92^{c}	0.14
Crude Fat %	8.65^{ab}	8.87^{a}	8.28^{c}	8.15^{c}	8.35^{bc}	0.02
Ash content %	1.25^{a}	1.28^{a}	1.06^{c}	1.13^{b}	1.09^{c}	0.08
Gross Energy (ME/kcal)	1.35^{a}	1.36^{a}	1.32^{bc}	1.31^{c}	1.32^{bc}	0.01

^{a,b,c,d}- Mean values with different superscript on the same column are significantly different ($p<0.05$). SEM-Standard error of means, T1-Control, T2-white, T3- red, T4- green, T5- blue.

RESULTS AND DISCUSSION

The eggs were lowered significantly ($p<0.05$) by the different lighting colours. Results revealed that the chemical compositions of the eggs were lowered significantly ($p<0.05$) by the different lighting colours though there was no significant difference between T1 and T2 across the parameters. The crude (%) and true protein (%) contents of the eggs were respectively 10.92 and 6.07, 11.04 and 5.90, 10.44 and 4.73, 10.33 and 5.43, 10.52 and 4.92 for T1, T2, T3, T4 and T5. The significant differences ($p<0.05$) among the treatments indicate that the varying light colours had a considerable effect on protein synthesis in pullets. This is in agreement with (7) who reported that light quality, including colour and intensity, has been documented to influence protein metabolism in laying hens. Ash content (%) were significantly higher ($p<0.05$) in eggs from pullets on T1 (1.25) and T2 (1.28) than T4 (1.13) while T3 (1.06) and T5 (1.09) were significantly lower ($P<0.05$). This suggests that T1 and T2 provide more favourable condition for the deposition of mineral matters in the egg. This is consistent with the report from (8) that lighting conditions can affect mineral utilization in hens. The crude fat contents also followed a similar trend, with T2 (8.87%) having the higher value, followed by T1 (8.65%), while there were no significant differences between T3 (8.28), T4 (8.15) and T5 (8.35%). The significant differences among the treatments suggest that varying light colours could influence fat deposition in the eggs, with T1 and T2 providing conditions that favoured higher fat content. This is in agreement with findings (9) that lighting programs could impact lipid metabolism in poultry. Moisture content showed an inverse pattern compared to other parameters, with T4 (75.26%) having the higher value of moisture content, followed by T3 (74.88%), T5 (74.82%), then T1 (74.62%) and T2 (74.36%). The significant differences indicate that the light colour influenced the water

content in the eggs, with T4 resulting in the higher moisture levels. Higher moisture content in eggs has been linked to increased metabolic water production, influenced by environmental factors such as light (10). Gross energy content was higher in T2 (1.36 kcal) and significantly different from T3 (1.32 kcal), T5 (1.32 kcal) and T4 (1.31 kcal), but not significantly different from T1 (1.35 Kcal). This suggests that the metabolic energy available in the eggs was higher under T1 and T2 conditions, reflecting the overall better nutrient composition. This is in line with the (11), who noted that lighting programs could impact the energy content of eggs by influencing feed intake and metabolism.

CONCLUSION AND RECOMMENDATION

Pullets not exposed to extra light colour (natural photoperiods) tended to have better nutritional composition. Results in this study therefore suggests that, varying light colours lowered the egg nutritional composition.

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Animal Physiology, Reproduction and Health: APH018

MITIGATING OXIDATIVE STRESS AND ENHANCING REPRODUCTIVE HEALTH IN *Oryctolagus cuniculus* USING ORAL SUPPLEMENTATION OF *Carica papaya* and *Bixa orellana L* FORMULATION.

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ABSTRACT

Oxidative stress is known to detrimentally impact rabbit reproductive health by compromising sperm quality, hormonal balance, and testicular integrity. This study investigated the effects of *Carica papaya* (PS) seed and *Bixa 206rellana L* formulation (BF) extract, on oxidative stress markers and reproductive hormones in rabbits. Findings demonstrate that 50 mg/kg oral supplementation with these extracts significantly ($p<0.05$) affects antioxidant enzyme activities, reducing levels of superoxide dismutase (SOD) and glutathione peroxidase (GPx) while increasing glutathione (GSH) and glutathione S-transferase (GST). These results indicate a notable reduction in oxidative stress. Hormonal analysis reveals dose-dependent effects of papaya seed methanol extract (PS), with lower doses (25 mg/kg) enhancing testosterone, luteinizing hormone (LH), and follicle-stimulating hormone (FSH) levels, suggesting improved Leydig cell activity and pituitary function. Conversely, *Bixa 206 rellana* extract (BF) shows less pronounced testosterone impacts but enhances LH and FSH, indicating potential indirect benefits on testicular function. These findings underscore the therapeutic potential of specific plant extracts in mitigating oxidative stress and modulating reproductive hormones, highlighting the importance of dosage specificity. The study emphasizes the need for further research to investigate the bioactive compounds of these extracts and their various mechanisms of action, as related to optimizing the reproductive performance in rabbit farming.

Keywords: *Carica papaya*, *Bixa orellana L*, oxidative stress, reproductive hormone, rabbit

DESCRIPTION OF PROBLEM

Oxidative stress significantly impacts rabbit reproductive health by affecting sperm quality, hormonal balance, and testicular structure. Studies have shown that oxidative stress leads to a decrease in sperm quality indicators, such as motility and ejaculate volume, while also increasing the content of morphologically abnormal sperm [1]. Furthermore, oxidative stress disrupts hormonal balance by reducing sex hormone levels like FSH, LH, and testosterone, which are crucial for reproductive function [2]. Improving reproductive patterns is important for both welfare and economic reasons, as raising young bucks is costly. Optimizing reproductive performance ensures a high yield in rabbit farms.

Plant extracts are increasingly recognized for their antioxidant properties, making them valuable in various applications. Studies have shown that plant extracts rich in antioxidants, such as polyphenols and flavonoids, neutralize free radicals, thereby protecting cells from oxidative stress and damage. This protection is essential in reproductive tissues, where oxidative stress can impair fertility and embryonic development [3]. These extracts have been found to exhibit strong antioxidant activities, with some showing the ability to down regulate reactive oxygen species production and activate antioxidant pathways like Nrf2/HO-1 signaling [4].

Carica papaya, Azadirachta indica A. Juss., and *Bixa orellana L* extract has been extensively studied for its antioxidant properties. Research has shown that papaya fruits, seeds, and leaves contain bioactive

compounds with potent antioxidant effects [3, 4]. These compounds include phenolic compounds, flavonoids, alkaloids, terpenes, and fatty acids [4, 5, 6]. These plant extracts are dose specific and their relative effect on endocrine activities and as an anti-oxidant is worth elucidating.

MATERIALS AND METHODS

Fresh *Carica papaya* seeds were source on Bowen University campus. Seeds were air dried, grinded and kept inside an air tight container. The pulverized material (900g) was extracted with methanol using the maceration technique. *Bixa orellana L* formulation (BF) was acquired from Next Era Health, at 11, Julius Kadir Street, Ifako Gbagada, Lagos, Nigeria. The ingredients of BF formulation were *Carica papaya*, *Azadirachta indica A. Juss*., and *Bixa orellana L*. The Regulatory staff created the formulation following regular operating practices. 350 g of the BF formulation (powder) was extracted using 100% methanol. The setups underwent periodic shaking and agitation, which was left for 72 hours for the methanol extraction process to take place at room temperature (between 26 and 30 °C). The formulation and the seed were extracted into a crude methanol extract using a cotton plug and Whitman filter paper, and the filtrates were concentrated in a rotary evaporator at 40 °C in vacuo. The two extracts (PS and BF extracts) were stored in a sealed container until they were used.

Twenty-five (25) adult male rabbits (Chinchilla) were obtained and acclimatized for 14 days in an animal house, at Bowen University, Iwo, Nigeria. The weights of the rabbits were about 1.9 to 2.5 kg. The rabbits were randomly allocated into five groups, 5 rabbits each, and fed *ad libitum*. The five groups are; Group I: (control group): the rabbits received 0mL of the extract. Group II (BF 25): received 25mg/kg of BF Extract. Group III (PS25): the rabbit received 25mg/kg of *Carica papaya* seed extract. Group IV (BF 50): the rabbit received 50mg/kg of BF formulation extract. Group V (PS 50): the rabbit received 50mg/kg of *Carica papaya* seed extract. The rabbit received the administration orally daily for 14 days. On the last day of the experiment blood samples were collected from all groups through the jugular vein into plain bottles, blood sample undergone centrifuging at 1,000-2,000 x g for 10 minutes and resulting supernatant (serum) were stored in the refrigerator prior to further analysis.

Statistical Analysis: The collected data were analyzed using, a complete randomized design (one-way) ANOVA, and the level of significance was a probability of $p < 0.05$, using Duncan's multiple range test (DMRT).

RESULT AND DISCUSSION

As shown in Table 1, the results indicate that oral supplementation with pawpaw seed and BF extract significantly affects antioxidant enzyme activities in rabbits. Specifically, 50mg/kg supplementation of pawpaw seed and BF extract resulted in lower levels of superoxide dismutase (SOD) and glutathione peroxidase (GPx) compared to 25mg/kg and control groups, suggesting a reduction in oxidative stress markers. SOD is crucial in catalyzing the dismutation of superoxide radicals into oxygen and hydrogen peroxide, thereby protecting cells from damage [7]. GPx reduces hydrogen peroxide to water and lipid peroxides to their corresponding alcohols, further safeguarding cells from oxidative damage. Conversely, higher levels of glutathione (GSH) and glutathione S-transferase (GST) were observed at 50mg/kg supplementation, indicating enhanced antioxidant capacity. GSH, a vital intracellular antioxidant, maintains redox homeostasis and detoxifies harmful compounds. GST plays a key role in the conjugation of GSH to a variety of electrophilic compounds, facilitating their excretion and protecting cells from toxicants [8].

In Table 2, all measured parameters were significantly ($p<0.05$) affected by treatments. At 25 mg/kg PS, testosterone, LH and FSH increased ($p<0.05$) as compared with control, while 25 mg/kg follow the same trend except for LH.

TABLE 1. Effect of oral supplementation of pawpaw seed and BF extract on serum oxidation enzymes of treated rabbit.

PARAMETERS	I(0ml)	II (25%BF)	III (25%PS)	IV (50%BF)	V (50%PS)
SOD (mmol/min/mg)	27.95±0.12^{b}	42.13±1.97^{a}	29.02±1.35^{b}	29.33±1.29^{b}	23.03±0.29^{c}
GPx (mU/mg)	3.43±0.39^{c}	5.22±0.064^{a}	4.79±0.12^{b}	3.54±0.20^{c}	3.05±0.085^{c}
GSH (mmol/mL)	96.43±1.04^{bc}	82.97±3.22^{c}	93.47±4.34^{b}	95.51±1.56^{b}	102.86±0.49^{a}
GST (mU/mg)	9.69±0.46^{b}	5.88±0.14^{c}	10.06±0.02^{b}	9.73±0.27^{b}	12.33±0.16^{a}

^{abc} values along same row are significantly different ($p < 0.05$) from each other. *Where SOD - superoxide dismutase, GPx - glutathione peroxidase, GSH – glutathione, GST - glutathione S-transferase*

In addition, at 50% PS dilution, testosterone and FSH decreased ($p<0.05$), except for LH with a significant ($p<0.05$) increase. The values of aforementioned parameters were inversely to that of BF at the same concentration. However, values for 17β-hydroxysteroid dehydrogenase and serum protein decreased ($p<0.05$) at 25% dilution for both PS and BF extract and increased ($p<0.05$) at 50% dilution as compared to control

TABLE 2. Effect of oral supplementation of pawpaw seed and BF extract on serum reproductive hormones of treated rabbit treated.

Parameter	I-0mls	II-(25%BF)	III-(25%PS)	IV-(50%BF)	V-(50%PS)
Testosterone(ng/L)	3.61±0.014^{cd}	7.68±0.579^{b}	9.66±0.304^{a}	3.22±0.35^{d}	5.79±0.97^{c}
LH (mlU/mL)	10.16±0.014^{cd}	6.82±1.14^{d}	17.16±0.30^{b}	16.16±0.028^{b}	46.57±2.69^{a}
FSH (mIU/mL)	4.55±0.014^{c}	6.78±0.19^{b}	8.12±0.056^{a}	3.52±0.339^{d}	3.78±0.19^{d}
17B-HSD (nmol/min/mg)	9.52±0.212^{b}	7.36±0.39^{c}	9.45±0.106^{b}	10.59±0.54^{a}	10.42±0.078^{a}
Serum protein (mg/dL)	33.19±0.21^{c}	22.74±1.55^{a}	29.69±0.388^{b}	33.55±0.933^{c}	38.27±1.18^{d}

^{abc} values along same row are significantly different ($p < 0.05$) from each other. *Where LH – luteinizing hormone, FSH – follicle stimulating hormone,* 17B-HSD *– 17beta-hydroxysteroid dehydrogenases.*

Pawpaw seed (PS) and Bixa orellana L (BF) formulation, impact reproductive hormone dynamics in rabbits. The observed dose-dependent effects of PS extract on testosterone, LH, and FSH levels highlight its potential as a modulator of male reproductive function. At lower doses (25 mg/kg), PS extract notably increased testosterone synthesis, which is crucial for spermatogenesis and male fertility. This suggests that PS extract may enhance Leydig cell activity, possibly through antioxidant mechanisms that protect against oxidative stress-induced damage to testicular cells involved in hormone production. The corresponding increases in LH and FSH levels further support PS extract's role in stimulating the pituitary gland, which regulates hormone secretion essential for reproductive health [9].

Conversely, BF extract exhibited different dosage effects, with less pronounced impacts on testosterone levels compared to PS extract. This variability underscores the importance of dosage specificity in leveraging plant extracts for reproductive health interventions. The observed increases in LH and FSH with BF extract suggest a potential indirect influence on testicular function, possibly through antioxidant-mediated improvements in pituitary hormone synthesis [5, 6]. These differential effects highlight the need for further research into the specific bioactive compounds within these extracts and their mechanisms of action on reproductive physiology.

CONCLUSION

In conclusion, the study's focus on oxidative stress provides insights into how antioxidants derived from plant extracts can mitigate reproductive dysfunction associated with oxidative damage. By protecting cellular integrity and hormone synthesis pathways from oxidative stress, PS and BF extracts offer promising avenues for enhancing reproductive outcomes from plant extracts. Future investigations could explore optimal dosage regimens, synergistic effects with conventional therapies, and long-term reproductive health impacts to refine their application in livestock management and fertility enhancement strategies.

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Animal Physiology, Reproduction and Health: APH019

SEMEN QUALITY CHARACTERISTICS OF RABBIT BUCKS FED CHICKEN BIO-SLURRY BASED DIETS

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ABSTRACT

This study was conducted to assess the effect of chicken bio-slurry based diets on the semen quality characteristics of male rabbits. Sixteen (16) mixed breed rabbit bucks were allocated to four (4) dietary treatments with four (4) animals per treatment in a completely randomized design (CRD). The formulated diets with four (4) inclusion levels of chicken bio-slurry were; 0% (T1, control), 5% (T2), 10% (T3) and 15% (T4). The animals were kept in galvanized wire cage provided with nipple drinker and mortar feeders, diets and water were *ad-libitum*. Data obtained were subjected to Analysis of Variance (ANOVA) and means separated by Duncan Multiple Range Test at $P \leq 0.05$. It was observed that, diets supplemented with bio-slurry had significant (P = 0.0315, 0.0452) impact on semen concentration and progressive motility with the highest value obtained in T2 ($192.70 \pm 6.01 \times 10^6$/ml) and T3 (79.22±0.96%), respectively. Experimental diets did not have a significant influence on the semen volume, mass motility, live sperm and sperm abnormalities. Based on the result of this study, it was concluded that chicken bio-slurry can be incorporated into the diets of rabbit bucks up to 15% with no deleterious effect on the semen quality indices.

Keywords: Bio-slurry, semen quality, sperm morphology, rabbit bucks,

DESCRIPTION OF PROBLEM

Continuous increase in the price of conventional feedstuffs/ingredients in Nigeria has become unbearable, most especially for small and medium scale livestock farmers. Rabbit farming like other livestock production enterprise is not left out of this ugly situation. This has necessitated the urgency to double up on the efforts at finding alternative feed ingredients that can replace the conventional ones which are in high competition with humans. The domestic rabbit is a pseudo-ruminant (monogastric-herbivore or hind gut fermenter) that feeds on grains/concentrates, forages, kitchen wastes, tubers, peels and some agro-industrial by-products [1, 2]. One of the promising agro by-products that can be tested in rabbit feeding is the chicken bio-digested slurry, which is one of the by-products of a biogas system. The digested biogas slurry contains essential elements such as potassium, zinc, iron, manganese and copper among others [3]. So, bio slurry contains a considerable amount of both macro and micro nutrients as well as amino acids, vitamins, minerals and beneficial biology active matter [3]. The bio slurry is dried and milled with other feed ingredients. This will not only reduce the cost of feeding, but also environmental wastes/pollution. When incorporating new ingredient into the diet of an animal, the overall effect on growth, health, reproduction, product quality and so on need to be examined. Few works reported on the use of animal bio-slurry as an alternative source of feed ingredient have mainly focused on growth parameters [4, 5, 3]. Several researchers have also reported significant [6, 7, 8] and non-significant [9, 10] effects of incorporating various alternative feed ingredients into the diets of rabbits on the semen quality characteristics. Assessment of male fertility is based on the evaluation of sperm. Semen evaluation measures various sperm quality parameters as fertility indicator [7]. Although, several works have been carried out on the use of various alternative feed ingredients in the diets of rabbits, however, the use of bio-digested chicken slurry on the semen quality characteristics have not been reported. Therefore, the objective of this study is to evaluate semen quality characteristics of rabbit bucks fed chicken bio-slurry based diets.

MATERIALS AND METHODS

Location: This study was carried out at Rabbitry unit of the Teaching and Research Farm, Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria. Laboratory analyses was done at the Animal Reproduction Laboratory, Department of Animal Sciences, Obafemi Awolowo University, Ile-Ife.

Experimental design: In a completely randomized design, sixteen (16) adult rabbit bucks (mixed breeds) with body weight 2.7 to 2.8kg at 30 weeks of age were allocated to four (4) experimental diets/treatments. There were four (4) animals per treatment, each serving as a replicate.

Chicken bio-slurry processing: Wet faecal droppings from chickens were collected, mixed with water and loaded into the biodigester (2000L Storex tank buried 90% into the soil) for anaerobic decomposition. This produces combustible gases, sulphur gas and water vapour channeled out of the bio-digester. After three (3) days, the bio-digester is reloaded with fresh droppings which pushes out the previous digested faeces, known as slurry through the outlet. The collected slurry is allowed to dry, grounded and packaged for use.

Experimental diets: Four (4) experimental diets were formulated with 0% bio-slurry, designated as control diet (T1), 5% bio slurry (T2), 10% bio slurry (T3) and 15% bio slurry (T4). The gross composition of the experimental diets (Table 1) is shown below.

Table 1: Gross composition of the experimental diets

Ingredients	Inclusion levels of chicken bio-slurry			
	T1 (0%)	T2 (5%)	T3 (10%	T4 (15%)
Bioslurry	0	5	10	15
Maize	16	16.3	18	19.5
Soya bean meal	6	6	5.2	4.2
Wheat offal	15.7	9.4	4	2.5
PKC	30	32.8	34	32.3
Rice bran	29.8	28	26.3	24
Fish meal	0.5	0.5	0.5	0.5
Salt	0.25	0.25	0.25	0.25
Limestone	1	1	1	1
Bone meal	0.5	0.5	0.5	0.5
*Premix	0.25	0.25	0.25	0.25
Total	100	100	100	100
Calculated analysis				
Crude protein	15.02	15.05	14.99	14.97
Crude fibre	10.44	10.03	9.99	9.56
Metabolizable energy (Kcal/kg)	2573	2537	2510	2495

*Vitamin-mineral premix provided the following per kg of feed: Vit. A, 1500 IU; Vit.D3, 3000 IU; Vit.E, 30 IU; Vit.K, 2.5mg; Thiamine B1, 3mg; Riboflavin B2, 6 mg; Pyrodoxine B6, 4 mg; Niacin, 40 mg; Vit. B12, 0.0 mg; Pantothenic acid, 10 mg; Folic acid, 1mg; Biotin, 0.08 mg; Chloride, 0.125mg; Mn, 0.0956 g; Antioxidant, 0.125 g; Fe, 0.024 g; Cu, 0.006 g; Se, 0.24 g; Co, 0.24g

Animal housing and management: Sixteen heterogeneous rabbit bucks were properly tagged and housed in galvanized metal cage with mortar feeder and automatic drinker. Feed and good quality water were supplied *ad-libitum*. Daily, routine and other standard livestock management practices were strictly observed.

Data collection: After six weeks of feeding trial, semen collection was done twice in a week for three consecutive weeks. Using a teaser do, semen was collected through the use of rabbit artificial vaginal known as OLIRAV [11].
Physical appearance: appearance such as semen colour and viscosity were observed and recorded.

Semen volume: this was read directly from 5ml graduated collection tube.
Sperm motility: This was examined as quickly as possible after collection, by placing a drop of the semen sample on a glass slide, cover slipped and examined at ×20 magnifications of Handycope microscope (ES0702KB0313, Freedom and Challenge Inc., South Korea). The evaluation was done subjectively.
Semen concentration: This was determined using Neubauer haemocytometer as described by [12]. Micropipette was used to aspirate 10 µl of semen and diluted with 90µl of distilled water in a collection tube to make a dilution factor of 10. A cover slip was placed on the haemocytometer and 10µl of the diluted semen was placed under the cover slip on each side of the haemocytometer. It was then examined using a light microscope at ×40 magnification and the sperm cells were counted in five diagonal squares of the chamber (i.e. the five diagonal squares of the E-zone of haemocytometer). The semen concentration was calculated as follows: Concentration (sperm cells/mL) = Number of sperm cells counted in the haemocytometer × dilution factor × multiplication factor [13].
Live to dead: This was determined as described by [14]. A drop of semen was placed on a glass side, two drops of 2:1 eosin-nigrosin stain was then added. A thin smear of the mixture was then made on the glass slide and allowed to dry. This technique was based on the principle that eosin-nigrosin penetrates and stains dead sperm cells while live sperm cells repel the stain. Dead spermatozoa stained pinkish or reddish while live spermatozoa remained colourless. Counting was done in five fields of light microscopy at x40 magnification and average percentage of live spermatozoa was estimated.
Sperm morphology: The same set of slides used for live to dead evaluation were used here. In the same manner, five fields of light microscope were selected for counting. Primary abnormalities such as double head, cytoplasmic mid-piece, double tail, pyriform head etc. and secondary abnormalities such as broken head, broken tail, bent mid-piece were recorded. The average percentage was then evaluated.

Statistical analyses: All data collected were analyzed using General Linear Model Procedure of SAS, Version 9. Significant differences among means were compared using Duncan Multiple Range Test at $p \leq 0.05$

RESULTS AND DISCUSSION

Table 2 shows the effect of chicken bio-slurry based diets on the semen quality parameters of rabbit bucks. The result showed that, highest significant (P = 0.0452) progressive motility of 79.22% was recorded in the bucks with 10% slurry diet, but was not statistically different from those on 5% (79.20%). This is followed by the bucks on 15% slurry diets and the lowest result (73.50%) was obtained in the control group. The highest significant (P=0.0315) semen concentration, 192.70×10^{6}/ml was recorded in the bucks with 5% slurry diet, followed by bucks in 10% (168.22×10^{6}/ml), 15% (150.06×10^{6}/ml) inclusion levels, while the lowest significant value (140.38×10^{6}/ml) was observed in the control group. Slurry based diets did not have a significant (P>0.05) influence on semen volume, mass motility and viability. The range of sperm concentration, 140.38 to 192.70×10^{6}/ml recorded in this study is higher than 100.67 to 183.12×10^{6}/ml reported by [7] for the rabbit bucks fed graded levels of raw and fermented Jatropha seed meal. However, this result is in the range of 100 to 500×10^{6}/ml reported by [13] for the normal range of semen concentration in rabbit bucks. This implies that, incorporating chicken bio-slurry into the diets of rabbit bucks supports acceptable/recommended semen concentration. Semen volume of 0.80 to 0.99ml reported in this study is higher than 0.51 to 0.60ml reported by [15] who fed rabbit bucks with *Rubia curdifolia*, lower than 0.67 to 1.55ml in the report of [16] where rabbit bucks diets were supplemented with ginger rhizome powder. The numerical increase (0.80 to 0.99ml) recorded across the supplemented groups suggests that, chicken bio-slurry used still have considerable amount of nutrients, especially, vitamin B complex in support of spermatogenesis as earlier revealed by [3]. Mass and progressive sperm motility are crucial determinants of sperm ability to fertilize egg. The percentage progressive motility (73.50 to 79.22) observed in this study is higher than 65.00 to 86.00% [17] and 62.50 to 75.00% [9] when 5 to 15% water spinach leaf meal and *Moringa oleifera* leaf meal were fed to rabbit bucks in the studies. The reason for the significant progressive motility in the supplemented groups could be that, the gut microbial fermentation of the slurry, exerted probiotic effects which could have led to the proliferation of beneficial microbes that support the production of short chain fatty acids (SCFAs). These SCFAs have been reported to be involved in testicular

development and support the process of spermatogenesis [18]. Good semen sample have been reported to have ≥75% live sperm [15]. As a result, the percentage live sperm (88.91 to 89.78) in this study can be termed highly suitable for efficient reproduction.

Table 2: Semen quality characteristics of rabbit bucks fed bio-digested chicken slurry

Parameters	Inclusion levels of bio-slurry (%)				±SEM	P-value
	0 (T1)	5 (T2)	10 (T3)	15 (T4)		
Semen volume (ml)	0.83	0.80	0.91	0.99	0.05	0.4799
Sperm concentration (×10^6/ml)	140.38^d	192.70^a	168.22^b	150.06^c	6.01	0.0315
Mass motility (%)	83.38	86.00	85.56	79.89	1.05	0.1397
Progressive motility (%)	73.50^b	79.20^a	79.22^a	74.22^{ab}	0.96	0.0452
Live spermatozoa (%)	89.62	88.91	89.78	89.39	0.25	0.6389

abcd: means in the same row with different superscripts differ significantly at P≤0.05;
SEM – standard error of mean

Sperm abnormality status of bucks fed chicken slurry based diets is shown in Table 3. The effect of the diets on the sperm abnormalities was not significantly different (P>0.05) among each other and from the control treatment. Sperm defect is attributable to the activities of free radical [8]. The activities of the radicals resulted in conditions like lipid peroxidation, protein peroxidation, DNA damage and cellular degeneration; which can be reduced or eliminated by incorporation/supplementation of antioxidants in the feed [8, 19]. The residual presence of antioxidants in the slurry [3] and good semen handling might have resulted to the lower sperm abnormalities observed in this study. Generally, it can be deduced that, chicken bio-slurry used in this present study still possess considerable amount of nutrients such as protein, energy, vitamins and minerals, as well as probiotic and antioxidant properties to support the production processes of good quality semen for mating and artificial insemination (3, 18). This shows that, chicken bio-slurry up to 15% used in this study did not have any adverse effect on rabbit semen production.

Table 3 Sperm abnormalities of rabbit bucks fed chicken bio-slurry based diets

Parameters	Inclusion levels of bio-slurry (%)				±SEM	P-value
	0 (T1)	5 (T2)	10 (T3)	15 (T4)		
Head (%)	2.44	2.28	2.22	2.28	0.11	0.9264
Mid-piece (%)	2.81	2.77	2.96	2.81	0.11	0.9451
Tail (%)	3.27	2.88	3.13	2.87	0.13	0.7064
Total	8.44	7.93	8.31	7.96	0.31	0.9253

Means with different superscripts in the same row are significantly (P≤0.05) different;
SEM – standard error of the mean

CONCLUSION AND APPLICATIONS

1. This study showed that chicken bio-slurry can be incorporated into the diets of rabbit bucks up to 15% with no deleterious effect on semen quality indices.
2. Well processed chicken bio-slurry can be an alternative source of feed ingredient for supplementation of rabbit diets to reduce cost of production and environmental waste

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Animal Physiology, Reproduction and Health: APH020

BIOMETRIC STUDY ON ORAL CAVITY OF ADULT WHITE FULANI CATTLE

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ABSTRACT

The present study was done to document biometric data on oral cavity of adult White Fulani Cattle (WFC). Ten (10) heads of apparently healthy ones of both sexes were procured from local slaughter house in Mokwa town. The samples were collected immediately after the animals were slaughtered and heads were separated from the carcasses for biometric studies. The weight, length, thickness and width of the oral cavity were considered for the study. The parameters measured were: the transverse ridges over the hard palate, length of the hard palate (Upper Roof), width of hard palate at Anterior part, Middle part, Caudal part and Narrowest part, length and width of papillae incisive, dental pad, length of buccal floor, width of frenulum linguae and distance between the frenulum and caruncles over the buccal floor. The data of the oral cavity obtained were expressed as mean ± SEM (Standard Error of mean). The mean (±SEM) weights, lengths, widths and thicknesses of hard palate and buccal floor parts of White Fulani cattle studied have similar biometric patterns though with some variations. The hard palate is the longest portion of the oral cavity in WFC

Key Words: Biometry, Cattle, Oral Cavity, White Fulani

DESCRIPTION OF PROBLEM

Ruminant animals are disseminated all over the world, because of their adaptability to varying environmental conditions and the different nutritional regimens under which they were evolved. The White Fulani cattle are characterized by white body coat colour on a black skin with black eyes, ears, muzzles, hoof, horn tips and tip of the tail, their thoracic or sometimes intermediate hump and dewlap are well developed. The head is long, wide and across the forehead and with a straight or concave appearance; average adult wither height is 130 cm; the neck is strong providing upward carriage for the head; horns are slender medium to long [81 to 107 cm], lyre shaped: curved outward and upward, with an outward turn at tip (1). The oral cavity is the first section of the alimentary tract that receives food. It provides the digestive functions of prehension, mastication and salivation. It also plays a role in the respiratory system through oral breathing. The oral cavity consists of accessory structures; the teeth, the tongue and the wall enclosing the oral cavity (2). The oral cavity is bordered rostrally by the lips and caudally by the pharynx at the level of the platoglossal arches. The outer vestibule of the teeth and jaw merge medially and the lips and cheeks laterally. The ramus of mandible and masseter muscles caudally, inside the dental arches. The palate dorsally and the teeth gums and jaw margin laterally the tongue margin ventrally. (1) and (2) reported in goats, the mean biometrical values of the hard palate i.e. number of transverse ridges; length of the hard palate; width of the hard palate at the anterior part, middle part, caudal part and at the narrowest part; length of the papilla 215ncisive; width of the papilla 215ncisive and length of the dental pad to be as right =10, left =11; 11.80±1.05 cm; 2.29±0.59 cm, 2.93±1.10 cm, 3.82±0.79 cm and 2.0±0.09 cm; 0.58±0.97 cm; 0.62±1.00 cm and 1.51±1.31 cm,

respectively. The size can be altered by raising or lowering the tongue and floor of the oral cavity when the mouth is closed (3). It is known that environmental diversification of ruminants and their consecutive way of nourishment as well as the sorts of food they feed on, constitute a source of great variety in the structure of their oral cavity (4), and oral cavity characteristic of some ruminants have been reported (5, 6, 7). However, there are scanty reports on the biometry of oral cavity in cattle. Thus, this study is undertaken with the aim of documenting the biometry of the oral cavity in White Fulani Cattle.

MATERIALS AND METHODS

The study was conducted in the Anatomy Laboratory, Department of Animal Health and Production Technology, Niger State College of Agriculture, Mokwa, North central, Nigeria. Mokwa is located at latitude $9^0 19' 38''$ North and longitude $5^0 3' 16''$ East (8). Ten (10) heads of apparently healthy adult White Fulani cattle, of both sexes were procured from local slaughter house in Mokwa town. The samples were collected immediately after the animals were slaughtered and heads were separated from the carcasses for biometric studies. The weight, length, thickness and width of the oral cavity in White Fulani Cattle were considered for the studies. The weight was measured after removing the surrounding connective tissues and fats, by using a sensitive electronic weighing balance in gram (g). The length and width were measured with the help of thread and ruler in centimeter (cm) while thickness was measured with the help of a digital vernier caliper in millimeter (mm) respectively. The transverse ridges over the hard palate were noted and counted. The hard palate (Upper Roof) was measured from anterior papilla incisive part to the soft palate or velum palatinum part (Posterior part of soft palate). The width of hard palate was measured from the following points; Anterior part, Middle part, Caudal part and Narrowest part. Also, the length and width of papillae incisiva and dental pad were measured. The length of buccal floor was measured from rostral prefrenular part to the frenulum linguae, also the width of frenulum linguae, behind incisors, the distance between the frenulum and caruncles over the buccal floor were measured accordingly. The data of the oral cavity obtained were expressed as mean $\pm$ SEM (Standard Error of mean).

RESULTS AND DISCUSSION

The mean biometric measurements of Oral Cavity parts are presented in Table 1. The present results on mean (± SEM) lengths of transverse ridges of 15.20 ± 0.86 are higher than the ranges reported earlier by (9) in Black Bengal goat and Garole sheep, while the mean numbers of transverse ridges in those breeds of sheep and goats are lower than what were obtained in this present study. This difference could be due to genetic and/or species variations. The present results on the means length of hard palate of WFC to be 28.20 ± 0.81cm is higher than the range mean lengths of 11.80 ± 1.05cm and 12.10 ± 0.08cm in sheep and goats respectively by (10). The mean length of Papilla Incissiva in 1.10 ± 0.10cm obtained in this study is within the range mean lengths obtained in Uda sheep and Red Sokoto goat by (11). The present result on mean lengths of dental Pad obtained here (6.22 ± 0.58) is higher than to the mean lengths of 2.70 ± 0.31cm and 1.51 ± 0.31cm earlier reported by (11) in Uda sheep and Red Sokoto goat. The present result on the mean lengths of rostral prefrenular part in WFC to be 7.62 ± 0.96cm is lower than the values of 33.45 ± 1.31cm and 16.05 ± 0.02cm respectively reported by (12) in goat and sheep. The present results on mean widths of the rostral prefrenular part at frenulum linguae in WFC to be 5.56 ± 0.39cm and width of rostral prefrenular part behind the incisors 6.08 ± 1.30cm respectively are lower than the mean values of 19.06 ± 1.01cm and 22.37 ± 0.97cm respectively obtained in by (13) in Samba deer. This difference could be due to genetic and/or species variations. The present result on mean distance between frenulum and caruncles of WFC to be 4.18 ± 0.32cm is lower than the mean values of 11.68 ± 2.21cm and 10.55 ± 2.10cm respectively obtained in sheep and goat by (12). This difference could be due to genetic and/or species variations. The present result in mean lengths of sublingual Caruncles in WFC of 1.62 ± 0.17cm is lower than the mean values of 7.40 ± 1.20cm and 4.67 ± 0.40cm respectively obtained in sheep and goat by (11). This difference, could be due to genetic and/or species variations.

Table 1: Mean (± SEM) of Morphometry of Oral Cavity in White Fulani Cattle

PARAMETERS		
HARD PALATE (UPPER ROOF)	No. of Transverse ridges (cm)	15.20 ± 0.86
	Length of the hard palate (cm)	28.20 ± 0.81
	Width of the hard palate at the anterior part (cm)	7.44 ± 0.43
	Width of hard palate at the middle part (cm)	7.72 ± 0.15
	Width of the hard palate at the caudal part (cm)	7.68 ± 0.46
	Width of the hard palate at the narrowest part (cm)	5.80 ± 0.29
	Length of papilla 217ncisive (cm)	1.10 ± 0.10
	Width of papilla 217ncisive (cm)	1.10 ± 0.07
	Length of dental pad (cm)	6.22 ± 0.58
	Width of dental pad (cm)	2.70 ± 0.31
	Length of median palatine raphae (cm)	16.38 ± 1.04
BUCCAL FLOOR	Length of rostral prefrenular (cm)	7.62 ± 0.96
	Width of rostral prefrenular at frenulum linguae (cm)	5.56 ± 0.39
	Width of rostral prefrenular behind incisors (cm)	6.08 ± 1.30
	Distance between the frenulum and caruncles (cm)	4.18 ± 0.32
	Length of sublingual caruncles (cm)	1.62 ± 0.17
	Distance between the median sides of the and right caruncles (cm)	1.32 ± 0.07

CONCLUSION AND APPLICATION

The mean (±SEM) weights, lengths, widths and thicknesses of hard palate parts, and buccal floor parts of White Fulani cattle studied have similar biometric patterns though with some variations. The hard palate is the longest portion of the oral cavity. The biometric features of the oral cavity are of great importance in clinical dental sciences. The length, depth, and width of the palate have had considerable importance in orthodontic treatment planning and in the early diagnosis of oral disease.

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Animal Physiology, Reproduction and Health: APH021

HORMONAL RESPONSE OF GROWING RABBITS FED GROUNDNUT, LABLAB AND MORINGA FORAGE MEAL BASED DIETS

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ABSTRACT

A study was carried out to evaluate the hormonal profile of rabbits fed groundnut, moringa and lablab forage meal -based diets to enhance reproductive efficiency. 48 growing crossbred rabbits (New Zealand White X Chinchilla) age between 60 to 70 days old were used, consisting of twenty-four each of male and female rabbits with average initial weight of 1.56 kg. The rabbits were randomly allocated to four treatments made up of a control (concentrate only), groundnut (*Arachis hypogea*), moringa (*Moringa oleifera*) and lablab (*Lablab purpureus*) forage meals incorporated at 10% substitution of the control diet to form complete ration, in a completely randomized design. Progesterone, oestradiol and testosterone concentrations were measured. All data were subjected to analysis of variance while significant differences in means were separated using pairwise-difference. Progesterone concentration of growing rabbits on lablab forage meal diet was slightly higher than groundnut and moringa forage meal diets and the concentrate diet. Oestradiol concentration on the other hand was lower on lablab forage meal diet than groundnut, moringa forage diets and the concentrate. Testosterone concentration was lower in lablab forage meal diet than groundnut, moringa forage diets and the concentrate. It is concluded that groundnut and moringa forages could be used in concentrate diets of growing rabbits to evoke higher oestradiol and testosterone concentration while for progesterone concentration, lablab forage appeared to be better than the other forage meals.

Keywords: Forage meals, groundnut, hormones, lablab, moringa, rabbits

DESCRIPTION OF PROBLEM

Hormones are messengers or molecules that transmit information from cell to cell and from tissue to tissue in animals. These hormones ensure the establishment and maintenance of physiological homeostasis and normal reproductive functions in male and female reproductive systems (1). Testosterone is the most potent naturally secreted androgenic and anabolic hormone in male and female animals (2). In the females, puberty is initiated by the hormone oestrogen bringing about ovum development, ovulation, oestrus behavior and inter-uterine development (3). Progesterone is a pregnancy maintaining hormone which can also indicate sexual maturity in rabbits (4)

Forages are non-conventional feedstuff which serve as cheap sources of fibre and protein for rabbits (5), however they have to be compound with additional feed sources or concentrates for optimal utilization by rabbits. The role of leguminous plants, such as groundnut, lablab and moringa forages, and their extracts in improving nutrition, growth and reproductive functions is currently a focus of interest in animal production. These plants are assumed to contain phytoestrogens. Phytoestrogens are compounds which act similar to 17β-oestradiol. Groundnut, lablab and moringa leaf meals from studies enhanced reproductive function by increasing the secretion or availability of ovarian hormones such as progesterone and oestrogens in rabbits (4) and female rats (6). There is need to further study the influence of these forages on hormonal response of growing rabbits with a view to improve reproductive efficiency in rabbits. Thus, this study was design to evaluate the influence of groundnut, lablab and moringa forage meal diets on progesterone, oestradiol and testosterone profiles of growing rabbits.

MATERIALS AND METHODS

The experiment was conducted at the Rabbitry Unit, Swine and Rabbit Research Programme, National Animal Production Research Institute (NAPRI), Shika, Ahmadu Bello University, Zaria. Shika is located in the Northern Guinea Savannah on latitude 11°8'N and longitude 07°4'E with altitude of about 663.77 mm above sea level (7). Average temperature varies from 14°C during the early dry season (November–January) and 39.3°C during the late dry season (February to April) while the mean relative humidity during dry and wet season is 21% and 72% respectively.

Forty-eight growing crossbred rabbits (New Zealand White X Chinchilla), 60 to 70 day-old, weighing 1.56 kg were used. They consisted of twenty-four each of male and female rabbits. The rabbits were housed individually in metal cages with a dimension of 120 x 60 x 50 cm, raised about 25 cm from the ground. The rabbits were randomly allocated to four treatments in a completely randomized design. The treatments were made up of a control (concentrate only), groundnut (*Arachis hypogea*), moringa (*Moringa oleifera*) and lablab (*Lablab purpureus*) forage meals were incorporated into the control diet (air-dry basis) at 10% substitution of control diet to form complete diets. The diets were offered at 150 g/day and clean water supplied at 8 am in earthen, flat bottom pots. The experiment lasted for 12 weeks after a one-week adjustment period.

Blood samples were collected at the 2nd week of feeding trial and subsequently at two weeks' interval and used for hormonal profiling (oestradiol, progesterone and testosterone). The blood samples were collected from the marginal ear veins of the rabbits, placed into sterile sample bottles containing oxalate fluoride to separate the serum from the blood, which was decanted into labelled plain serum bottles. The serum samples were stored at -20ºC until assayed. The hormonal profile (oestradiol, progesterone and testosterone concentration) was determined by enzyme linked immunosorbent assay (ELISA) technique using the methods described by (8), at the Animal Reproduction Laboratory of NAPRI, Shika. Data collected were subjected to analysis of variance while significant differences in means were separated using pairwise-difference according to (9).

RESULTS AND DISCUSSION

Figure 1 shows progesterone and oestradiol profiles of growing rabbits fed forage meal-based diets. Progesterone concentration of growing rabbits on lablab forage meal diet was slightly higher than groundnut and moringa forage meal diets and the concentrate diet. Contrary to this, (4) reported that groundnut forage meal influenced higher progesterone concentration in male and female rabbits than lablab forage meal diet. Oestradiol concentration (Fig.2) on the other hand was lower on lablab forage meal diet than groundnut, moringa forage diets and the concentrate. Nutritional factors influence hypothalamic-pituitary function and therefore gonadotrophin profiles, directly through effects of nutrients or metabolic hormones, acting on target organs or through changes in sensitivity of these organs to oestradiol, progesterone and other hormonal feedback mechanism (10). The forages might evoke a response in the hypothalamus.

Testosterone concentration was lower in lablab forage meal diet than groundnut, moringa forage diets and the concentrate (Fig. 3). There was no significant ($p>0.05$) difference in serum concentration of testosterone in rabbits fed groundnut and lablab forage meals (4). Groundnuts have been proved to effectively increase oestradiol and testosterone levels in boars (11). Groundnuts have been shown to significantly increase the level of testosterone accompanied with high density lipoprotein-cholesterol in male rats (12) and in broiler breeder roosters (13). Moringa leaf meal significantly increased the proportion of testosterone concentration in rabbit bucks (14) and in male and female rats (6). Decrease in total testosterone level might be caused by defective cholesterol transport (15). The hypothalamus in turn stimulates the anterior pituitary to produce the gonadotrophin hormones released into the blood and thus increase the level testosterone (16). In addition, flavonoids, alkaloids and other phytochemical content in moringa are well known for increasing testosterone hormone concentration (17).

CONCLUSION

It is concluded that groundnut and moringa forages could be used in concentrate diets of growing rabbits to evoke oestradiol and testosterone production while for progesterone production, lablab forage appeared to be better than the other forage meals.

Figure 1: Progesterone concentrations of growing rabbits fed forage meal-based diets

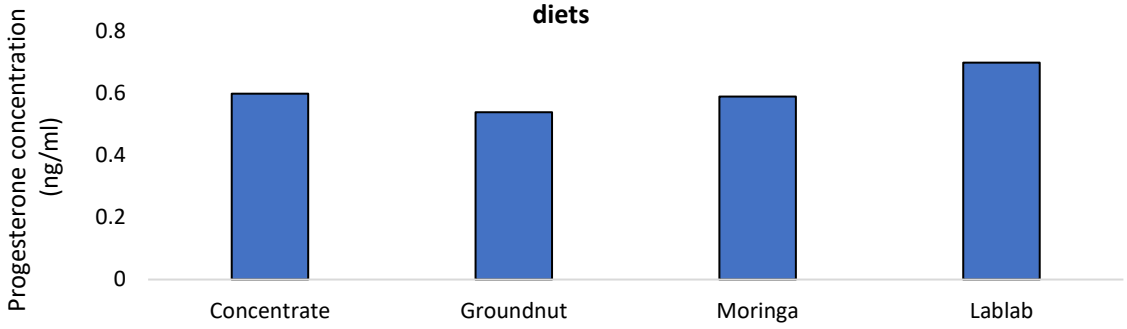


Figure 2: Oestradiol concentrations of growing rabbits fed forage meal-based diets

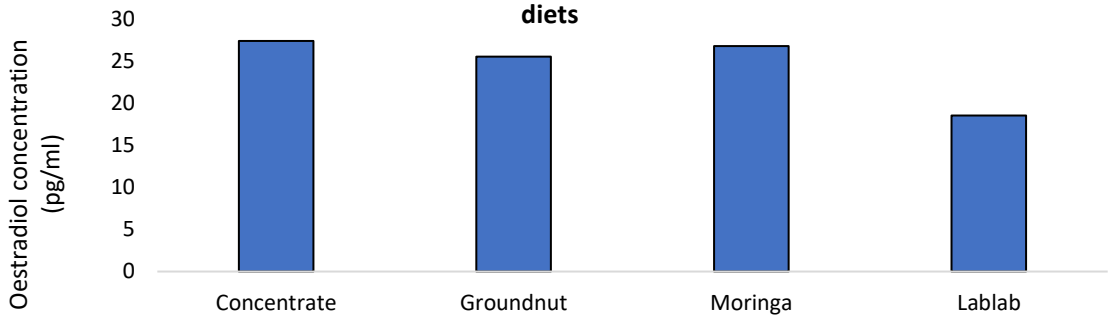
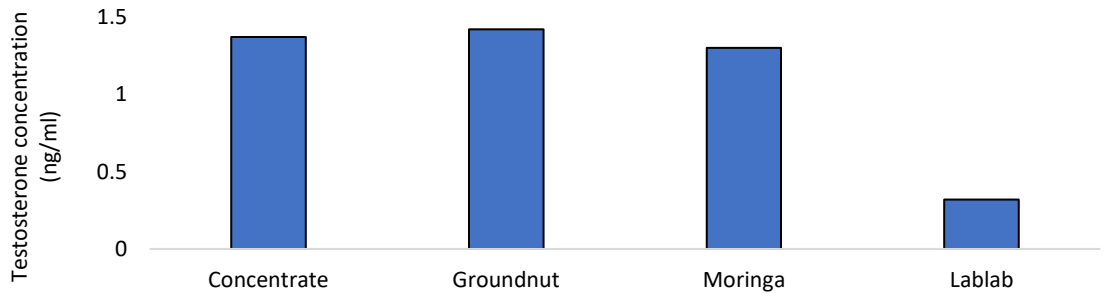


Figure 3: Testosterone concentration of growing rabbits fed forage meal-based diets



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nimal Physiology, Reproduction and Health: APH022

SEMEN QUALITY OF WEST AFRICAN DWARF BUCK SEMEN EXTENDED WITH NORMAL SALINE-WATERMELON FRUIT JUICE AND STORED AT ROOM TEMPERATURE

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ABSTRACT

This study aimed at evaluating the ability of normal saline-watermelon fruit juice to sustain spermatozoa viability at 24-29℃ over a period of time. Semen was collected from 17 WAD bucks aged 1-3 years old with an average body weight of 12.15±1.51kg, pooled and divided into 6 portions, which indicated the treatments. The treatment groups comprised 100% skimmed milk-glucose (T1) which served as negative control,100% normal saline (T2) which served as positive control, 95.00% NS + 5% WMFJ (T3), 90.00 % NS + 10 % WMFJ (T4), 85.00% NS + 15% WMFJ (T5) and 80.00 % NS + 20 % WMFJ (T6) in a Completely Randomized design. The treatments were then assessed for semen characteristics at 2 hours interval at 24-29℃ using standard procedures. Data were analysed using descriptive statistics and ANOVA. Results showed that at 0 hour, progressive motility in T2 (73.33±2.88%) having 0% of water melon juice and 100% of normal saline was significantly (P<0.05) lower compared to T1, T3, T4, T5 ad T6. At 2 hours, progressive motility in T4 (78.33±2.88%) was significantly (P<0.05) higher compared to motility in T1 (10.00±0.00%), T2 (70.00±0.00%) and T6 (68.33±2.88%), but was statistically similar to T3 (75.00±5.00%) and T5 (73.33±2.88%). At 4 hours, progressive motility in T4 was significantly (P<0.05) higher compared to motility in T1, T2, T5 and T6, but was statistically similar to T3. At 6 hours, T1 was significantly (P<0.05) lower than other treatments. However, T2, T3, T4, T5 and T6 were statistically similar. At 8 hours, T4 was significantly (P<0.05) higher than other treatments, but was statistically similar to T3 and at 10 hours, progressive motility was significantly (P<0.05) higher in T4 than other treatments while T1 and T2 recorded the least value. Acrosome integrity showed that at 0, 2, 4, 8 and 10 hours, acrosome integrity across the treatments were similar. At 6 hours, T4 was significantly (P< 0.05) higher than T1 and T2, but was statistically similar to T3, T5 and T6. At 0 hour, spermatozoa livability was significantly (P<0.05) lower in T1 compared to other treatments. At 2, 6, 8 and 10 hours, there were no significant (P>0.05) differences across the treatments. At 4 hours, T1 (89.00±1.88%) was significantly (P<0.05) lower compared to other treatments while T3, T4, T5 and T6 were statistically similar. This suggest that motility, acrosome integrity and livability of sperm cells extended with normal saline-watermelon fruit juice was significantly high at room temperature compared to the skimmed milk-glucose extender. Water melon fruit juice incorporation sustained spermatozoa quality *in vitro* up to 10 hours.

Key-words: Spermatozoa quality, motility, West African Dwarf buck, watermelon fruit juice

DESCRIPTION OF PROBLEM

Production of reactive oxygen species (ROS) is a physiological process that occurs during semen production, collection and storage. When ROS production is in excess, they result in oxidative stress on the seminal plasma that is rich in polyunsaturated fatty acids and this eventually damage the sperm integrity leading to infertility. There is increasing evidence that lipid peroxidation damage to the plasma membrane of spermatozoa plays an important role in the mechanism of male infertility [1]. Conventional extenders are sometimes not readily available for farmers use, most of them lack antioxidant in their composition. Recently antioxidants are being advocated for inclusion in semen extenders due to their ability to lower plasma lipid peroxidation [2], hinder the production of reactive oxygen species (ROS) and neutralise the adverse effect

of free radicals. Watermelon is a natural fruit that contains different compounds (e.g. lycopene, carotenoids, vitamins A, B, C, E, flavonoids and some specific amino acids (arginine, citrulline etc.) that may be responsible for its antioxidant properties. Although water melon contain an array of phytochemicals, most of the attention have been focused on lycopene, the main carotenoid in water melon products which possesses the greatest quenching ability of singlet oxygen among the various carotenoids [3]. It is plausible that deterioration of semen quality could be due to the action of ROS through propagation of the lipid peroxidation cascade during the storage period post-collection in the extended semen. This research aimed at investigating the potentials of watermelon (*Citrullus lanatus*) fruit juice as an exogenous antioxidant source for *in vitro* goat semen preservation.

MATERIALS AND METHOD

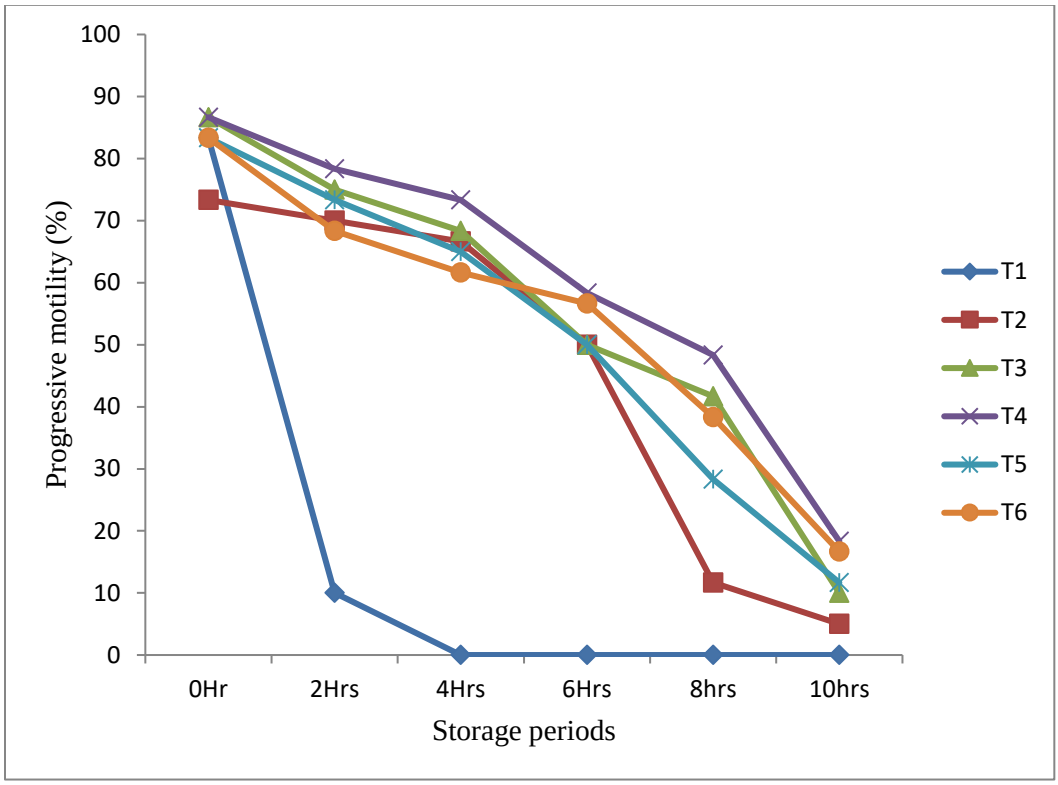
The experiment was conducted at the Small Ruminant Unit of Teaching and Research Farm, University of Ibadan, while the analysis of semen was conducted at the Physiology Laboratory of Department of Animal Science of the same institution. Seventeen adult bucks aged 1-3 years old with an average body weight of 12.15±1.51kg were used for the study. Semen was collected using electro ejaculator according to [4]. The semen was harvested into collection tubes in a warm flask and temperature was maintained at 37°C, pooled and divided into 6 portions, which indicated the treatments in a plain bottle, labeled properly and then the various extenders were added to the plain bottles according to the treatments. The treatments comprised 100% skimmed milk-glucose (T1) which served as negative control,100% normal saline (T2) which served as positive control, 95.00% NS + 5% WMFJ (T3), 90.00 % NS + 10 % WMFJ (T4), 85.00% NS + 15% WMFJ (T5) and 80.00 % NS + 20 % WMFJ (T6) in a completely randomized design. The spermatozoa quality of the semen groups were assessed at zero hour and subsequently at two hours interval until sperm motility dropped below 20%. Sperm motility, percentage livability and acrosome integrity were assessed as described in [5]. Data were subjected to descriptive statistics and one -way analysis of variance procedure of [6] and means were compared using Duncan's multiple range test of the same software.

RESULTS

The progressive sperm motility in WAD goat semen extended with normal saline and -watermelon fruit juice at room temperature is presented in Figure 1. At 0 hour, progressive motility in T2 (73.33±2.88%) having 0% of watermelon juice and 100% of normal saline was significantly ($P<0.05$) lower than other treatments. At 2 hours, progressive motility in T4 (78.33±2.88%) was significantly ($P<0.05$) higher than motility in T1 (10.00±0.00%), T2 (70.00±0.00%) and T6 (68.33±2.88%), but was statistically similar to T3 (75.00±5.00%) and T5 (73.33±2.88%). At 4 hours, progressive motility in T4 was significantly ($P<0.05$) higher than progressive motility in T1, T2, T5 and T6, but was not significantly different from T3. At 6 hours, T1 was significantly ($P<0.05$) lower than other treatments, which were statistically similar ($P>0.05$). At 8 hours, T4 was significantly ($P<0.05$) higher than other treatments, but was statistically similar to T3 and at 10 hours, progressive motility was significantly ($P<0.05$) higher in T4 than other treatments while T1 and T2 recorded the least value. Motility of spermatozoa was highly expressed and best in treatment 4 (10% water melon + 90% normal saline) than other treatments throughout the period of storage.

Spermatozoa acrosome integrity of WAD goat semen extended with normal saline and -watermelon fruit juice and stored at room temperature is shown in Table 1. At 0, 2, 4, 8 and 10 hours, acrosome integrity across the treatments were similar ($P>0.05$). At 6 hours, T4 was significantly ($P< 0.05$) higher than T1 and T2, but was statistically similar to T3, T5 and T6.

Livability of sperm cells in WAD goat semen extended with normal saline and -watermelon fruit juice at room temperature (24-29℃) is shown in Figure 2. At 0 hour, spermatozoa livability was significantly ($P<0.05$) lower in T1 than other treatments. At 2, 6, 8 and 10 hours, there were no significant ($P>0.05$) differences across the treatments. At 4 hours, T1 (89.00±1.88%) was significantly ($P<0.05$) lower than other treatments while T3, T4, T5 and T6 were statistically similar.



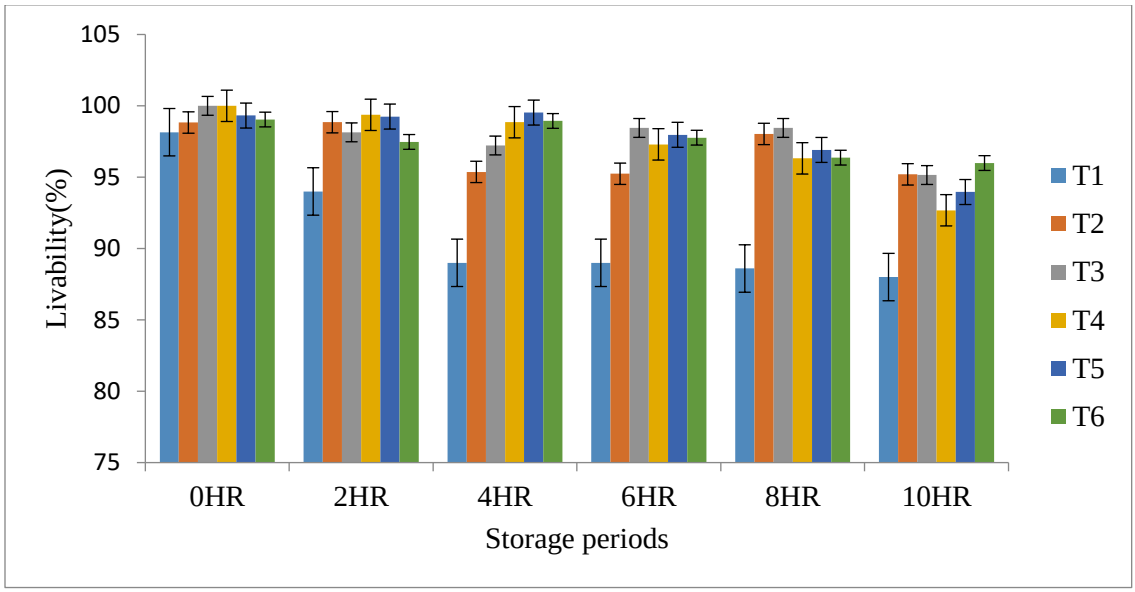
T1: 100% Skimmed milk–glucose, T2: 100% NS + 0 % WMFJ, T3: 95 .00% NS + 5% WMFJ, T4: 90.00 % NS + 10 % WMFJ, T5: 85 .00% NS + 15% WMFJ, T6: 80.00 % NS + 20 % WMFJ

Figure 1. Progressive motility (%) of WAD goat semen extended with normal saline-watermelon fruit juice and stored at room temperature (24 -29℃)

Table 1. Acrosome integrity (%) of WAD goat semen extended with normal saline- watermelon fruit juice at room temperature (24 -29℃)

Hours	T1 100% SMG	T2 100%NS+ 0%WMFJ	T3 95%NS+ 5%WMFJ	T4 90%NS+ 10%WMFJ	T5 85%NS+ 15%WMFJ	T6 80%NS+ 20%WMFJ
0	100.00±0.00	100±0.00	100±0.00	100±0.00	100±0.00	100±0.00
2	99.46±0.92	99.44±0.96	100±0.00	100±0.00	100.00±0.00	100±0.00
4	98.66±2.30	98.55±1.27	100±0.00	100±0.00	99.09±0.83	99.58± 0.72
6	97.67±1.32^{b}	96.43±2.00^{c}	98.48± 0.61^{ab}	99.47±0.91^{a}	98.72±1.11^{ab}	98.26±0.38^{ab}
8	96.93±2.40	98.04±3.39	97.97± 1.93	99.37± 1.09	99.45±0.94	99.43±0.97
10	96.74±2.95	96.84±2.58	96.90±3.03	98.56±1.45	98.66±2.30	99.51±0.83

a,b,c: Means along the same row with different superscripts are significantly (P< 0.05) different
SMG: Skimmed milk-glucose extender, NS: Normal saline, WMFJ: Water melon fruit juice.



T1: 100% Skimmed milk–glucose, T2: 100% NS + 0 % WMFJ, T3: 95 .00% NS + 5% WMFJ, T4: 90.00 % NS + 10 % WMFJ, T5: 85 .00% NS + 15% WMFJ, T6: 80.00 % NS + 20 % WMFJ.

Figure 2. Livability (%) of WAD goat semen extended with normal saline-watermelon fruit juice at room temperature (24 -29℃)

DISCUSSION

Motility was assessed periodically from collection time till it dropped below 20%. At 0 hour, progressive motility of the spermatozoa across the treatments was significantly high, although treatment diluted with 100% of normal saline had lower motility. This could be attributed to some of the nutrients such as beta carotene, vitamins, minerals present in watermelon juice which is absent in the normal saline. The antioxidant property of watermelon juice also influenced motility positively. At 2 hours, progressive motility was significantly higher in T4 diluted with 10% of watermelon juice than other treatments. However, T1 (negative control) had significantly low motility which was far below recommended level for artificial insemination considering motility as a factor [7]. Motility in treatments incorporated with watermelon fruit juice was high. This could be attributed to nutrients supplied by water melon fruit juice since water melon fruit juice has been reported to be rich in nutrients [8]. At 4 hours, T4 incorporated with 10% of water melon fruit juice showed significantly high motility while semen diluted with 100% skimmed milk-glucose had no motility. This could be attributed to certain enzymes in the seminal plasma originating from the bulbourethral gland secretion catalysis the hydrolysation of lecithin and milk triglyceride of the extender releasing sperm-toxic products (lysolecithin and fatty acids) that lead to subsequent spermatozoa deterioration[9] and [10] who reported that milk extenders cannot preserve semen for artificial insemination for more than 24 hours and should be prepared prior to use and preserved for at most 2 days in the refrigerator at 4 – 8℃. Likewise best motility was achieved with extender containing 10% of water melon juice at 8 hours of storage at room temperature. At 6 hours, motility ranged from 50.00 – 58.33% in all treatments except in T1 that had 0% motility. The motility was good and effective for the purpose of artificial insemination. According to [7] spermatozoa motility between 50 and 70% is rated as good motility for artificial insemination. Beyond 6 hours, motility declined gradually to a level that would not be fit for artificial insemination. This could be attributed to gradual depletion of nutrients required for high metabolic demands of sperm transport. Time effect had shown that progressive motility declined with increase in storage time. Water melon incorporation in normal saline had positive effect on motility. This is in agreement with [11] in man who reported that a higher antioxidant intake was associated with a greater motility and sperm numbers. It was observed that water melon incorporation had significant positive effect on motility, livability and acrosome integrity. This corroborates the findings of [12] who observed that lycopene supplementation significantly improved semen quality such as motility, viability in group that received 0.5mL of lycopene via drinking water than the control group. Acrosome integrity showed that at 6 hours, treatment 4 extended with normal saline-watermelon fruit juice at 10% showed significantly higher acrosome integrity

mean value than treatments 1 and 2 without water melon fruit juice (0%). This revealed that the extenders had the capacity of preserving and sustaining the integrity of the acrosome. Livability assessment at 0 hour showed that treatments incorporated with water melon juice and 100% normal saline (T2) had significant higher livability than the negative control extended with 100% skimmed milk-glucose extender. At 4 hours, T1 comprising of 100% skimmed milk-glucose extender was significantly lower than other treatments. This is because watermelon contains a variety of non-enzymatic antioxidants [13], which will influence the antioxidants in the seminal plasma to provide protection to spermatozoa thus causing significant decrease in percentage of acrosome abnormalities.

CONCLUSION

Motility, acrosome integrity and livability of sperm cells extended with normal saline-water melon fruit juice was significantly high at room temperature compared to the skimmed milk-glucose extender. Water melon fruit juice incorporation sustained spermatozoa quality *in vitro* up to 10 hours.

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Animal Physiology, Reproduction and Health: APH023

COMPARATIVE EVALUATION OF ANTIBIOTIC RESIDUE LEVELS IN ABHOR ACRE BROILER CHICKENS FED MORINGA/NEEM LEAF MEAL MIXTURE AS A REPLACEMENT FOR SYNTHETIC ANTIBIOTICS IN IAR&T ADOPTED VILLAGES IN OYO STATE

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ABSTRACT

This study evaluated antibiotic residue levels in meat samples of four hundred (400) Abhor Acre broiler chickens fed Moringa/Neem leaf meal mixture (MNLM) as a replacement to synthetic antibiotics in four (Alabata, Apete Onidoko, Oniyo and Ikija) IAR&T adopted villages. Each location was provided with 100 day-old chicks grouped into two with five replicates containing 10 birds each. One group was fed diet containing synthetic antibiotic oxytetracyline at 500g/1000kg and while birds in the other group were fed MNLM (300g/100kg) diet. At the end of 56days, meat samples (200g) were collected from three (3) birds randomly selected from each replicate. The total antibiotic residue (TAR) levels in the muscle tissue of the meat parts was determined using validated analytical methods. Antibiotic residue was not observed in MNLM (IAR&T technology) (0.00µ/kg) samples compared to synthetic antibiotic (Farmers choice) which had 46.88µ/kg of oxytetracycline residue. The impact of the diets on TAR varied significantly among the locations. Meat samples from birds raised in Oniyo had the least and no TAR (0.00µ/kg of meat sample) while those at Alabata had the highest (41.80µ/kg). Birds fed MNLM in all locations showed no detectable antibiotic residue (0.00 µg/kg) while Farmers Practice in Alabata (50.78 µg/kg) and Apete (53.05 µg/kg) showed significant ($p<0.05$) but moderate antibiotic residues. Ikija (83.66 µg/kg) samples had the highest antibiotic residues while Oniyo samples showed no detectable residue (0.00 µg/kg). It can be concluded from this study that IAR&T Technology (MNLM) ensures a safer meat devoid of antibiotic residues which could benefit consumer health and safety.

Key words: Antibiotics, Moringa, Neem, Broiler, Health

DESCRIPTION OF PROBLEM

The escalating concern over antibiotic resistance and the associated risks to human health has prompted a critical reassessment of antibiotic usage in animal agriculture (2, 4). In particular, the poultry industry has come under scrutiny due to the widespread application of antibiotics as growth promoters and for disease prevention (2). As a result, there has been a growing interest in exploring alternative strategies to maintain poultry health and productivity without relying on synthetic antibiotics (5). Among the alternatives gaining attention are natural feed additives such as Moringa and Neem leaf meal mixture. Moringa (*Moringa oleifera*) and Neem (*Azadirachta indica*) are renowned for their medicinal properties and have been traditionally used in various cultures for their therapeutic effects (6). Both plants contain bioactive compounds known to possess antimicrobial properties, making them potential candidates for replacing synthetic antibiotics in poultry diets. Moringa containing compounds like Isothicynates and pterygospermin and like wise Neem leaf containing azadiractin, Nimbin, nimbidin and Quercetin (3) which possess antibacterial properties, this mixture provides a synergistic effect of multiple bioactive compounds rather than a single major component. A study carried out by Makanjuola *et al*. (1) recommended the inclusion of 300grams each of Moringa and Neem leaf meal mixture in 100kg diet of Broiler chickens as replacement for synthetic antibiotics in feed. The Abhor Acre broiler chicken, a popular breed known for its rapid growth and robustness, serves as an ideal model for investigating the antibiotic residue levels in chicken. This research examined the multi-locational comparative evaluation of the antibiotic residue levels in Abhor Acre broiler chickens fed diets containing Moringa/Neem leaf meal mixture as replacement for synthetic antibiotics in the adopted villages

(Alabata, Apete Onidoko, Oniyo and Ikija) of the Institute of Agricultural Research and Training, Moor Plantation, Ibadan, (I.A.R&T).

MATERIALS AND METHODS

This study was carried out in four of IAR&T's adopted villages (Alabata, Apete Onidoko, Oniyo and Ikija) in Oyo state with each location provided with 100 unsexed day-old Abhor Acre Broiler chicks which were grouped into two treatments groups with five replicates containing 10 birds each. The first group were fed diet containing synthetic antibiotic 'oxytetracyline' and termed **'Farmers choice'** while the second group were fed Moringa/Neem leaf meal mixture termed **'IAR&T Technology'** at an inclusion rate of 300grams each of Moringa and Neem leaf meal mixture per 100kg diet. The birds were randomly divided into the two treatment groups. The birds were housed in a well-ventilated and illuminated open-sided poultry house on deep litter. The chicks were fed *ad libitum* with a formulated starter and finisher diet. The diet contained 3,027 and 3,195.3 kcal/kg metabolic energy and 23 and 20% crude protein respectively and the study lasted for 56 days.

Antibiotic residue level determination

Three (3) matured birds were randomly selected from each replicate and sacrificed upon completion of the study. Meat samples weighing 200g were collected from the breast, thigh and drumstick of each selected bird and labeled. Antibiotic residue levels in the muscle tissue of this meat parts were used to assess the antibiotic residue levels using validated analytical methods (7).

Sample Preparation:

The meat samples were homogenized to ensure uniform distribution of antibiotic residues. The homogenized meat samples for analysis were then weighed using a digital sensitive scale.

Extraction of Antibiotic Residues:

Extraction solution for oxtetracyline was prepared and the solvent extraction done using the method described by Shareef *et al*. (7). The antibiotic residues in the meat samples were then extracted using liquid chromatography-mass spectrometry (LC-MS) technique and the antibiotic residues in the samples were quantified by comparing peak areas or heights of target analytes with those of standard calibration curves. The confirmation of the identity of the antibiotic residues was then carried out through retention time matching (9).

Data Analysis:

The concentrations of antibiotic residues in the chicken meat samples were calculated based on the calibration curves and recovery rates. The levels of antibiotic residues in the two experimental groups were carried out on replicate basis and the data obtained were subjected to Analysis of Variance using Minitab (2002) and where significant ($P<0.05$), means were separated using Duncan Multiple Range test.

RESULTS AND DISCUSSION

The comparative effect of IAR&T technology (Moringa/Neem leaf meal mixture) and Farmers practice (Oxytetracycline) on Total antibiotic residue (TAR) is presented in Table 1. Antibiotic residue was not observed (0.00µ/kg) in the IAR&T technology meat samples compared to the farmers practice which had 46.88µ/kg of Oxytetracycline residue. This result clearly suggests that the low antibiotic residues in the meat using IAR&T Technology is safer for consumers, reducing the risk of antibiotic resistance and antibiotic residues in human food which is quite in tandem with the research of Diaz-Sanchez *et al.* (10) and Mandey *et al*. (11) advocating the use of botanicals as alternative to synthetic antibiotics.

The comparative effect of location (Table 2) was significantly different ($P<0.05$) across the different locations with Oniyo having the least TAR (0.00µ/kg) while Alabata had the highest TAR (41.80µ/kg) suggesting variation in Antibiotic residue across locations. The TAR noticed in the Oniyo adopted village was as a result of the farmers in this village emphasizing that there animals are mainly reared using local herbs for diseases prevention and treatment as synthetic antibiotic are unavailable and inaccessible. The

farmers in Alabata village are aware of synthetic antibiotics, have access to them and use it for disease treatment and prevention hence, the presence of the residue in the chicken meat.

Table 1: Comparative effect of Moringa/Neem Leaf meal or Oxytetracyline on Antibiotic Residue in meat of Broiler chicken

Parameter	IAR&T Technology	Farmers Choice	±SEM	P-Value
Total Antibiotic Residue (µ/kg)	0.00[b]	46.88[a]	21.957	0.000

Means with different superscript a and b across the row are significantly different from each other.

Table 2: Comparative effect of synthetic antibiotic or Moringa/Neem Leaf meal supplemented diet on the antibiotic residue in meat of broiler chicken fed Moringa/Neem Leaf meal in IAR&T adopted villages

Adopted Village	Total Antibiotic Residue (µ/kg)
Alabata	41.80[a]
Apete	26.50[ab]
Ikija	25.39[ab]
Oniyo	0.00[b]
±SEM	29.781

Means with different superscript a and b across the column are significantly different from each other.

Across all locations (Alabata, Apete, Ikija and Oniyo), broiler chickens fed with the Moringa/Neem leaf meal using IAR&T Technology showed no detectable antibiotic residue (0.00 µg/kg). This demonstrates the effectiveness of Moringa/Neem leaf meal in completely eliminating antibiotic residues in broiler meat when following IAR&T Technology. Farmers Practice in Alabata (50.78 µg/kg) and Apete (53.05 µg/kg) showed significant but moderate antibiotic residues. Ikija Farmers Practice (83.66 µg/kg) showed the highest antibiotic residues, indicating possible higher or more frequent use of antibiotics. Oniyo Farmers Practice showed no detectable residue (0.00 µg/kg), which is an outlier compared to other locations using Farmers Practice. This might suggest different management practices or lower/no antibiotic use in Oniyo even under conventional methods. The table clearly indicates that the use of Moringa/Neem leaf meal (IAR&T Technology) is effective in reducing antibiotic residues to zero across all locations compared to Farmers Practice. This results quite validates the reports of Jammoul and El Darra (12) where chicken meats samples contained numerous antibiotic residues across various locations.

Table 3: Interactive effect of location and practice on the total antibiotic residue in meat of broiler chicken in IAR&T adopted villages

Adopted Village	Practice	Total Antibiotic Residue (µ/kg)
Alabata	Farmers Practice	50.78[b]
	IAR&T Technology	0.00[c]
Apete	Farmers Practice	53.05[b]
	IAR&T Technology	0.00[c]
Ikija	Farmers Practice	83.66[a]
	IAR&T Technology	0.00[c]
Oniyo	Farmers Practice	0.00[c]
	IAR&T Technology	0.00[c]
	±SEM	0.679

Means with different superscript a, b and c across the column are significantly different from each other.

CONCLUSION AND RECOMMENDATION

These findings could help farmers comply with regulations regarding antibiotic use in livestock. Also, the growing consumer preference for antibiotic-free meat aligns with the use of the Moringa/Neem leaf meal technology which is in line with the current market trend. It can be concluded from this study that the adoption of IAR&T Technology using Moringa/Neem leaf meal ensures that broiler meat is free from antibiotic residues, which is crucial for consumer health and safety. This technology will help in combating antibiotic resistance, a major public health concern. Reducing the use of antibiotics in poultry production also has positive implications for the environment, as it lowers the risk of antibiotic contamination in soil and water systems.

Adoption of IAR&T Technology: The zero antibiotic residue with IAR&T Technology aligns with regulatory standards and consumer demand for antibiotic-free poultry products. Hence, Farmers are encouraged to adopt the usage of mixtures of Moringa leaf meal (300g/100kg) and Neem leaf meal (300g/100kg) as part of their feeding practices to eliminate antibiotic residues and improve overall poultry health.

Further Research and Extension Services: Continuous research and extension services are needed to support the widespread adoption of these practices and to optimize their implementation in various local contexts.

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Animal Physiology, Reproduction and Health: APH024

EFFECT OF ASCORBIC ACID ON SEMEN AND SPERM QUALITY TRAITS OF RED SOKOTO BUCKS

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ABSTRACT

The experiment was carried out to determine the effect of subcutaneous injections of ascorbic(vitamin C) on the seminal and sperm quality traits of Red Sokoto bucks. A total of nine healthy and fertile adult Red Sokoto bucks were used for this study. They were stabilized for two weeks and randomly allotted into three groups (n= 3) and received 0mg (control group), 20mg and 40mg per kg body weight of vitamin C. Bucks were given feed and water *ad libitum* and routine vaccinations/medications were administered appropriately. The study was carried out during the dry season for the period of 60days from April to May. The ejaculates were evaluated forvolume, sperm concentration, sperm colour, pH, and motility. Data generated were subjected to analysis of variance using PROC. GLM of SAS, version 9.1. Means were separated using Duncan Multiple Range Test. The findings of this study showed that bucks injected with 40mg of vitamin C had the highest ($p<0.05$) semen volume. Bucks injected with 20mg of vitamin C had the highest ($p<0.05$) sperm concentration at 24th and 42nd day of sperm collection. Bucks injected with 20mg of vitamin C had the better ($p<0.05$) semen colour. The result of semen pH showed no significant difference ($p>0.05$) across the period of collection. Bucks injected with 20 mg and 40 mg of vitamin C had the highest ($p<0.05$) sperm motility. It was concluded that Vitamin C was found to influence seminal and sperm quality traits during hot period under tropical condition.

Keywords: Ascorbic acid, Red Sokoto Bucks, Seminal, Sperm, fertile

DESCRIPTION OF THE PROBLEM

Fertility of goat is the basis of reproductive success in goat production [1]. The use of antioxidant agent to improve fertility during environmental stress becomes necessary [2]. Ascorbic acid also known asvitamin C has been reported to increase body resistance to environmental stress by reducing the synthesis and secretion of corticosteroids, thus alleviating the negative effect of stress [3]. Ascorbic acid as an effective scavenger of reactive oxygen species, controls cells and tissues that may be damaged by these reactive oxygen species, and helps to protect these cells from oxidative damage [4]. During hot weather, it was discovered that sperm quality traits reduced which subsequently affected reproductive performance of goats [5]. Therefore, this study seeks to determine the effect of ascorbic acid on sperm and semen quality traits of Red Sokoto goats.

MATERIALS AND METHODS

Study Area: The study was carried out at Teaching and Research Farm, Department of Animal Science, Federal University Dutse, located in the savannah zone with an altitude of 485m and latitude between 11 ºN 13 ºN, of longitude 8 ºE and 10.15 º E [6].

Source of Experimental Animals: Animals were purchased at Shuwarin market,Dutse local government of Jigawa state.

Experimental Animals and Management: Nine healthy and fertile adult Red Sokoto bucks were used for this study. Animals were stabilized for two weeks and were treated against internal and external parasites using Ivotek super® (ivermecting + clorsulon) at a dose of 200µg/kg body weight subcutaneously. Animals

were fed the same kind of feed containing sorghum chaff, rice bran, wheat bran, groundnut haulms, cowpea leaf meal, salt and bone meal. The ration contained (dry matter basis) 2.17Mcal metabolizable energy per kg, 14.0% crude protein, 1.03%calcium and 0.5% phosphorus. Feed and water were given*ad libitum.*

Experimental procedure: The study was carried out during the dry season for the period of 60days from April to May. The bucks were randomly allotted into three groups of 3 animals each and vitamin C was administered subcutaneously as follows; 0 mg Vitamin C (group 1), 20 mg vitamin C (group 2) and 40 mg vitamin C (group 3) per kg live weight. Vitamin C (L-ascorbic acid) was dissolved in double distilled water and filtered through a 25 µm filter before injection. Semen collection was done a day prior to starting ascorbic acid injections, 15 days after the first injection and again at 9-day intervals on 5 occasions [7]. Ascorbic acid injection was done at two weeks interval throughout the duration of the study (60days) from April to May.

Semen collection and evaluation
Semen samples were collected and evaluated at 9-days interval using Lane pulsator electro-ejaculator (Lane Manufacturing Co., Denver, Colorado, USA) [7]. The collected semen sample was evaluated for volume, sperm concentration, sperm colour, pH, and motility.

Statistical analysis
Data generated were subjected to analysis of variance (ANOVA) using PROC. GLM of SAS, version 9.1. Means were separated using Duncan Multiple Range Test [8].

RESULT AND DISCUSSION

Result on semen volume showed that Red Sokoto bucks injected with 40 mg dosage had the highest ($p<0.05$) semen volume. This agrees with the report of [9] who reported that intramuscular injection of 20 mg ascorbic acid per kg live weight for 30 days significantly ($p<0.05$) increased semen volume in ram. On sperm concentration, the result of this finding showed that bucks that received 20 mg vitamin C (Vit C) had significantly ($p<0.05$) higher sperm concentration than those that were not injected with Vit C. This result is similar to the report of [9] who reported that intramuscular injection of 20 mg ascorbic acid per kg live weight for 30 days significantly increased sperm concentration in rams. Bucks that received 20 and 40 mg of ascorbic acid had a significantly ($p<0.05$) better semen colour compared to bucks that were not injected Vit C (0 mg). This finding confirms the work of [10] who reported that the ranges of semen ejaculate colour from light milky to creamy, with majority being milky white, was not season dependent. However, the finding of this study showed that Vit C did not exert any marked influence on semen pH of bucks examined. Bucks that received 40 and 20 mg Vit C had significantly ($p<0.05$) higher sperm motility than the bucks that were not given Vit C. This result agrees with earlier works of [11] who reported that semen motility was significantly higher in samples extended with 1 mM and 2 mM Vit C compared with the control group.

Table 1: Effect of ascorbic acid on semen volume of Red Sokoto bucks

	Ascorbic acid(mg)		
Periods (days)	T_1 (0)	T_2 (20)	T_3 (40)
1	0.35±0.06	0.40±0.12	0.43±0.03
15	0.43±0.15	0.40±.06	0.83±0.45
24	0.27±0.58	0.50±0.44	0.30±0.17
33	0.53 ± 0.17^{b}	0.27 ± 0.12^{b}	1.00 ± 0.21^{a}
42	0.37 ± 0.09^{b}	0.47 ± 0.07^{b}	0.77 ± 0.23^{a}
51	0.23 ± 0.12^{b}	0.30 ± 0.17^{b}	0.47 ± 0.23^{a}
60	0.17 ± 0.33^{b}	0.40 ± 0.00^{b}	0.67 ± 0.20^{a}

^{a,b}Means within the rows with different superscripts are significantly different ($p<0.05$)

Table 2: Effect of ascorbic acid on sperm concentration of Red Sokoto bucks

	Ascorbic acid(mg)

Periods (days)	T_1 (0)	T_2 (20)	T_3 (40)
1	2350.00±75.05	2843.30±45.72	2726.70±52.19
15	1103.30±16.89	1465.30±34.10	1508.70±19.68
24	2206.70±31.03[b]	2803.30[a]±38.01[a]	1513.30±28.72[b]
33	2550.00±25.44	3643.00±28.39	4197.00±36.09
42	2003.30±48.07[b]	2793.30±17.68[a]	1766.70±20.53[c]
51	2243.30±34.10	2610.00±41.67	2153.30±26.10
60	1540.00±39.28	2623.30±77.37	2136.70±48.77

[a,b,c]*Means within the rows with different superscripts are significantly different (p<0.05)*

Table 3: Effect of ascorbic acid on semen colour of Red Sokoto bucks

	Ascorbic acid(mg)		
Periods (days)	T_1 (0)	T_2 (20)	T_3 (40)
1	3.27±0.31	3.33±0.30	3.33±0.30
15	3.16±0.67[b]	4.00±0.26[a]	3.33±0.43[b]
24	3.00±0.00[b]	3.33±0.57[a]	2.67±0.54[b]
33	3.67±0.33	4.00±0.33	3.67±0.46
42	3.00±0.24	3.33±0.24	3.00±0.24
51	3.00±0.22[b]	3.67±0.00[b]	4.00±0.22[a]
60	3.00±0.00	3.00±0.22	3.33±0.22

[a ,b,]*Means along the rows with different superscripts are significantly different (p<0.05)*

Table 4: Effect of ascorbic acid on semen pH of Red Sokoto bucks

	Ascorbic acid(mg)		
Periods (days)	T_1 (0)	T_2 (20)	T_3 (40)
1	7.67±0.33	7.67±0.33	8.00±0.00
15	8.00±2.67	8.00±0.00	8.33±0.33
24	8.00±0.00	8.33±0.57	8.33±0.57
33	7.67±0.33	8.00±0.58	8.00±0.00
42	7.67±0.33	8.00±0.00	8.67±0.33
51	8.00±0.00	8.00±0.00	8.33±0.33
60	8.00±0.00	8.00±0.00	8.00±0.33

Table 5: Effect of ascorbic acid on sperm motility of Red Sokoto bucks

	Ascorbic acid(mg)		
Periods (days)	T_1 (0)	T_2 (20)	T_3 (40)
1	66.67±2.13	73.33±8.83	76.67±6.01
15	75.00±5.17	66.67±3.33	60.00±2.32
24	70.00±5.00	65.33±5.77	66.67±5.77
33	66.67±3.33[b]	76.67±3.33[a]	71.67±4.41[b]
42	70.00±7.64	75.00±2.89	71.67±4.41
51	47.33±8.42	53.33±8.67	48.33±8.67
60	63.33±4.41[a]	61.67±8.82[b]	75.00±10.41[a]

[a,b]*Means along the rows with different superscripts are significantly different (p<0.05)*

CONCLUSION

It can be concluded from the findings of this study that Vitamin C plays an important role in reproduction competence of Red Sokoto bucks. Semen volume, sperm concentration, sperm colour and sperm motility

were significantly influenced by subcutaneous injection of ascorbic acid, as such administering ascorbic acid (vitamin C)resulted in significant positive effect on the reproductive performance of Red Sokoto bucks.

Applications

Up to 40 mg of ascorbic acid could be used to improve the semen and sperm quality traits of Red Sokoto bucks for better reproductive performance and competence.

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Animal Physiology, Reproduction and Health: APH025

FOLLICLE STIMULATING HORMONE SECRETION STATUS IN LAYING HENS FED COCOYAM (*Xanthosoma sagittifolium*) BASED DIETS

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ABSTRACT

The study evaluated the effect of inclusion levels of cocoyam-based diets on follicle stimulating hormone (FSH) concentration over time in laying hens. One hundred and sixty (160) day old chicks (Shika Brown) were allotted to seven dietary treatments (n=20 birds) in a factorial arrangement 2×3+1; 2 factors (raw and boiled cocoyam), 3 levels (25%, 50% and 75%) and 1 control 0% in a completely randomized design, 80 chicks for raw sun dried (RS) cocoyam and 80 chicks for boiled sun dried (BS) cocoyam. The rate of cocoyam inclusion comprises 4 diets from RS and another 4 from BS cocoyam; each replaced maize at 0%, 25%, 50%, and 75% levels. During the 12 months experimental period, the birds were given feed and water *ad libitum* and routine vaccinations/medications were administered appropriately. Data collected were subjected to analysis of variance and significant differences among treatments means were compared using least significant difference (LSD). The result of the experiment on FSH concentration showed no significant difference ($p>0.05$) on processing and levels between the treatment across the period, except with processing at week 40, where birds fed boiled cocoyam were found to be similar ($p>0.05$), with the control higher ($p<0.05$) than RS cocoyam. Strong interaction was found at 44 weeks of age, highest value recorded at 75% level BS cocoyam. It was concluded that cocoyam processing had biological significance on FSH concentration in laying hens especially with birds on BS cocoyam.

Keywords: Cocoyam, Follicle Stimulating Hormone, Shika Brown, Raw sundried, boiled sundried

DESCRIPTION OF THE PROBLEM

The poultry industries in Nigeria have been plagued by a variety of problems which includes the search for feed ingredients that are not competitive by man [1]. The increasing cost of feed resources or rather ingredients in livestock production have been identified as a serious impediment to meeting the demand for animal protein particularly in developing countries [2]. Poultry production relies mainly on maize as the main energy source, but maize suffers intense competition as food for humans resulting in higher demand than supply, higher cost and thus lower profit margin for poultry producers [3].In order to ameliorate this problem, alternative sources of energy (eg cocoyam) that are less in demand with relatively lower cost must be exploited [4].The main endocrine factors that regulate egg-laying are gonadotropin-releasing hormone (GnRH), prolactin (PRL), follicle-stimulating hormone (FSH) and luteinizing hormone (LH) [5]. There is limited reference work in the utilization and inclusion of tannia cocoyam as an alternative energy source in layer production. Therefore, the objective of this study was to evaluate FSH secretion status overtime in laying hens fed cocoyam as a dietary substitute for maize supplemented with selenium.

MATERIALS AND METHODS

Study area: The study was carried out at the Poultry Research Program Section of the National Animal Production Research Institute, Shika, Zaria Nigeria.

Experimental animals and management: A total of one hundred and sixty (160) day-old layer chicks (Shika Brown) were used in this study. Animals were procured from hatchery section at artificial insemination unit of National Animal Production Research Institute, Shika (NAPRI), Zaria. The birds were raised on litter

(wood shavings) of good absorbent quality. Birds were brooded for the period of two weeks at mean temperature of 35ºC.

Procurement and processing of cocoyam (Xanthosoma sagittifolium): Cocoyam (*Xanthosoma sagittifolium*) was purchased at Dal market, Sumaila local government, Kano state. The cocoyam was clean from sand and external fibers manually using hand followed by chopping using knife. The chopped cocoyams were subjected to two different processing methods as a means of improving its nutritive value i.e raw & sundried (RS) and boiled & sundried (BS). The method of [6] was used in preparing the sundried cocoyam meal. Cleaned cocoyam were sliced and spread on an even surface to sundry. Sun drying was done for five consecutive days until crisp textured. Chopped cocoyam was immersed in boiling water (75 liter) at 100ºC and allowed to boil continuously for thirty minutes, cooled, drained and dehydrated. This method was previously described by [7].

Experimental diets and design: A total of one hundred and sixty day-old layer chicks were sourced from incubation section at artificial insemination unit of National Animal Production Research Institute, Shika, Zaria and allocated into eight dietary treatments of twenty (20) birds per treatment in two replicates in a completely randomized design, 80 for raw cocoyam and 80 for boiled cocoyam. Eight experimental diets were formulated, comprising 4 diets from raw sundried and another 4 from boiled sundried form, each replacing maize at 0%, 25%, 50%, and 75%as treatment 1 (T_1), treatment 2 (T_2), treatment 3 (T_3) and treatment 4 (T_4) respectively. The experiment last for the period of 12 months.

Follicle Stimulating Hormone Concentration Measurement

At laying period, the blood samples for hormone analysis were collected from the wing veins of two birds of similar weights from each replicate into sterilized tubes and were placed in a flask with ice pack on monthly basis for the period of 4 months, and the samples were later analyzed. Concentrations of Follicle-stimulating hormone (FSH) were measured with medical diagnosis Radioimmunoassay (RIA) kit. The samples were analyzed according to the protocols supplied by the kit provider. All samples were assayed in duplicate. The data generated were used to determine the hormonal profile and compared between the control and other treatments treated with varying levels of cocoyam [8].

Statistical analysis: The data were analyzed by 2×3+1 factorial in completely randomized design (CRD) by a general linear model (GLM) procedure in SAS (2009) software 9.4 Version (SAS Institute Inc., Cary, NC, USA). Means were compared using least significant difference at 5% level of significance.

RESULTS AND DISCUSSION

Effect of processing methods and levels of cocoyam (*Xanthosoma sagittifolium*) based diets on FSH concentration (IU/L) in laying hens at different stages of lay.

The effect of processing was found to be significant ($p<0.05$) at 40 weeks of age with boiling being similar ($p>0.05$) to the control. However, no significant difference was observed with levels (0%, 25%, 50% and 75%) across the period of experiment. Figure 1 show increase in FSH concentration, then decrease at 50% and then further increase at 75%; nonetheless, all are within the recommended range. It's important to note that there is very little literature on the use of cocoyam in laying chickens.

Interaction effect of cocoyam (*Xanthosoma sagittifolium*) processing methods and levels on FSH concentration (IU/L) of laying hens

The interaction of processing methods used was significant ($p<0.05$) on follicle stimulating hormone at week 40. Strong interaction was observed at week 44 withbirds fed diet containing 75% levels of boiled cocoyam having highest ($p<0.05$) value however, similar ($p>0.05$) with 25% level BS and 50% RS cocoyam for follicle stimulating hormone concentration. Highest values also recorded with boiled cocoyam indicate that it was better means of processing cocoyam in reducing anti-nutrient factors than sun drying alone.

Table 1: Ingredients composition of experimental diets (layer diet)

Ingredients	Inclusion levels (%)			
	0	25	50	75
Cocoyam	0.00	12.50	25.00	37.50
Maize	50.00	37.50	25.00	12.50
Fish meal	5.00	5.00	5.00	5.00
Soybean meal	22.00	22.00	22.00	22.00
De-oiled rice bran	11.20	10.70	10.20	9.70
Bone meal	3.00	3.00	3.00	3.00
Limestone	7.00	7.00	7.00	7.00
Salt	0.30	0.30	0.30	0.30
Methionine	0.25	0.25	0.25	0.25
Vit. Min. premix	0.25	0.25	0.25	0.25
Palm oil	1.00	1.50	2.00	2.50
Total	100	100	100	100
Calculated Analysis				
CP %	16.63	16.40	16.17	15.94
Energy kcal/kg	2608.27	2617.31	2626.35	2635.40
Lysine %	1.04	1.04	1.05	1.05
Methionine %	0.58	0.57	0.57	0.56
Calcium %	3.88	3.85	3.85	3.85
Phosphorus %	0.99	0.95	0.91	0.87
Selenium mg/kg	0.13	0.12	0.11	0.09

CP= crude protein; Vit. Min. premix= vitamins minerals premix contains vitamin A 14,000,000 I.U, vitamin D_3 3,500,000 I.U, vitamin E 20,000 I.U, vitamin K 2,400 mg, vitamin B_1 1,800 mg, vitamin B_2 5,000 mg, vitamin B_6 1,800 mg, vitamin B_{12} 12 mg, niacin 18,400 mg, panth acid 6,000 mg, folic acid 700, biotin 50 mg, choline chloride 240,000 mg, manganese 96,000 mg, zinc 60,000 mg, iron 40,000 mg, copper 8,000 mg, iodine 1,400 mg, selenium 240 mg, cobalt 250 mg and antioxidant 125mg; mg/kg: milligram/kilogram.
Selenium supplemented at 0.5mgSe/kg diet

Table 2: Effect of processing methods and levels of cocoyam (*Xanthosoma sagittifolium*) based diet on FSH concentration (IU/L) in laying hens at different stage of lay.

	Processing					Level of cocoyam (%)					
Age (wk)	Control	raw	Boiled	SEM	Pval	0	25	50	75	SEM	Pval
36	19.48	18.82	19.25	0.323	0.367	19.18	18.23	18.23	19.15	0.326	0.440
40	19.68^{a}	17.70^{b}	19.23^{a}	0.259	0.020	19.28	18.43	19.23	18.75	0.326	0.439
44	18.80	18.87	19.13	0.240	0.837	18.80	19.08	19.68	19.25	0.245	0.837
52	18.25	19.17	19.20	0.216	0.212	18.25	19.00	18.85	19.70	0.205	0.153

SEM=standard error of mean; P val=probability value; IU/L=international unit /liter; wk=week

Table 3: Interaction effect of cocoyam (*Xanthosoma sagittifolium*) processing methods and levels on FSH concentration (IU/L) in laying hens

Processing	Raw cocoyam				Boiled cocoyam				
Treatment	Control	25	50	75	25	50	75	SEM	P value
36 weeks	19.48	18.75	18.55	19.15	17.70	17.90	19.15	0.362	0.785
40 weeks	19.68	17.50	17.70	17.90	19.35	18.75	19.60	0.300	0.303
44 weeks	18.80^{b}	18.40^{b}	19.70^{a}	18.50^{b}	19.75^{a}	17.65^{c}	20.00^{a}	0.150	0.027
52 weeks	18.25	19.10	18.70	19.70	18.90	19.00	19.70	0.235	0.576

^{a,b,c}Means within the rows with different superscripts are significantly different ($p<0.05$)
SEM=standard error of mean; IU/L=international unit /liter; P val=probability value

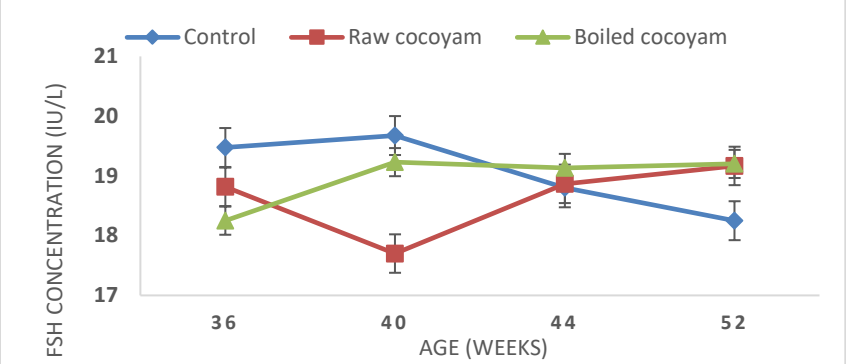

Figure 1: Effect of processing methods and levels of cocoyam (*Xanthosoma sagittifolium*) based diet on FSH concentration (IU/L) in laying hens.

CONCLUSION

Inclusion of RS cocoyam and BS cocoyam had biological significance on follicle hormone concentration in laying chickens at40 to 44 weeks of age.

Applications

Poultry farmers should use boiling as means of cocoyam processing with 75% level of inclusion for higher FSH concentration and better egg production.

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Animal Physiology, Reproduction and Health: APH026

INFLUENCE OF *VERNONIA AMYGDALINA* (BITTER LEAF) EXTRACT AS SUBSTITUTE FOR COCCIDIOSTAT ON BROILER CHICKENS

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ABSTRACT

One hundred and eighty a-day old Arbor acre broiler chicken were used to investigate the effectiveness of extracts of bitter leaf (*Vernoniaamygdalina)* in the treatment of coccidiosis in broiler chicken. The broilers were brooded following the standard procedure before being infected with coccidiosis. The birds were then allotted into three treatment levels with each treatment having sixty chickens with three replicates of twenty birds each. The treatment is made up of control (T1) (without any medication administration), T2 withEmbazin forte (synthetic coccidiostat) and T3 with aqueous bitter leaf extract. During the four weeks trials, same commercial feed and cool clean water were served liberally to the birds. Recommended medications were complied with except for coccidiostat. Data were collected on the phytochemical qualitative and quantitative content of bitter leaf as well as the growth performance of the broiler chickens. The result of the investigation reveals a large quantity of tannin, alkaloids, saponin and flavonoids (0.432, 0.435, 0.553 and 0.463mg/dl) respectively in the bitter leaf extract. The phenol, phytates and oxalates were qualitatively mild with quantities ranging from 0.288-0.355mg/dl. The cyanide, steroids and terpenoids were negligible qualitatively with quantitative range of 0.136-0.212mg/dl. There was no significant difference ($p \leq 0.05$) in daily weight gain, final weight, and feed conversion ratio of the chickens across the treatment means. No mortality was recorded. The experiment concluded that bitter leaf extract can successfully be used in place of synthetic anti-coccidiosis in broiler chicken without any deleterious effect.

Keywords: Bitter leaf, Broiler chicken, Oocyst count, liver, terpenoids

INTRODUCTION

Coccidiosis constitutes a major challenge to poultry production especially in the tropics and it is responsible for about 20% loss globally (1). Not only is this protozoan-caused disease capable of reducing chicken growth and production but often can lead to a colossal loss through a high percentage of mortality (2) especially in intensively reared poultry. The disease is characterized by bloody diarrhea, low feed intake, poor absorption of nutrients from the feed, dehydration, blood loss and mortality (3). Efforts at combating this health challenges in poultry using antimicrobial chemotherapies have yielded a little result (4) as often when the disease is cured, a resultant residual effect of the drugs is at times left on the birds which could result into the initiation of another effect on the humans on consumption of such chicken (5). Again, all the bio-security measures employed as an alternative have only reduce the spread of the disease but could not totally eradicate it. It has therefore become imperative for technology to evolve a less technical, cheaper, and seemingly organic method(s) targeting at treating infected chicken without any adverse effect on the livestock and the consumer (6). The use of plant part and plant's extracts in livestock medication has been widely elucidated (7, 8). Roots, bark, and leaves of most herb plants has been isolated to contain phytochemicals that is capable of being used to suppress disease causative microorganisms, as curative to some known diseases and could also act as growth promoters in many livestock (9, 10, 11). Bitter leaf (*Vernonia amygdalina*) has been well documented to possess plant extracts and antioxidants of note that is

used to treat cancer, malaria, diarrhea, and other diseases (12). It is also employed in livestock production (13). It is employed in the management of diabetes and hypertension through its inhibition of the alpha-glucosidase and angiotensin-1-converting enzyme (ACE) and its antioxidant properties (14). It derived its name from it expressed bitter taste and eaten as a vegetable in most African homes. Its content of low phytate, oxalate and phenol has made it safe for human consumption (15). It is equally noted for its antibiotic growth promoting properties (16). Therefore, this research work investigated the effectiveness of using the leaf extracts of bitter leaf in the treatment of Coccidiosis in broiler chickens.

MATERIALS AND METHODS

Study Area
This experiment was carried out at the Teaching and Research Farm of the School of Agriculture, Yaba College of Technology, Odoragunshin, Epe. Longitude 3º 58" 56' E and Latitude 9º 38" 36' which lies on km 16, along Epe-Ijebu road, Epe, Lagos. (17).

Preparation, cleaning, and disinfection of the poultry pen
The pen used for brooding of the chicks was properly washed and disinfected. Torn nets were repaired, and the sides were covered with clean tarpaulin. Drinkers and feeders were purchased and cleaned; heating equipment were installed strategically in the pen. 10kg of fresh young bitter leaf leaves were harvested from Odoragunshin, chopped, and squeezed of its leaf extract using 17 litres of water. Small quantity of the extract was sent to the laboratory for the phytochemical constituent analysis and the 9.3 litres of the aqueous extract gotten was refrigerated at 4^0C until usage.

Purchase and arrival of chicks.
180 pieces of one-day old Arbor acres plus broiler chicks were purchased from Fidan farms Ibadan in Oyo state. On arrival of the chicks, clean feed and water were provided and heating equipment such as coal pot and stove were used as a source of heat. Initial weight of the birds was taken with the use of a sensitive weighing scale before they were transferred into a well disinfected brooding house. The chicks were fed with branded broiler starter feed and were constantly monitored. Vaccines and medication were administered as at when due except the administration of coccidiostat.

Infection of chicks with coccidiosis
At two weeks of age, infected litter sample were collected from a farm with confirmed coccidiosis outbreak and introduces into the pen of each replicate as bedding which lasted for a week and later packed when the birds started manifesting signs and symptoms of coccidiosis.

Allotment of experimental birds
60 birds were designated into each of the three treatments, each treatment had 3 replicates with 20 birds per replicate. The control (T_1) birds were not offered any coccidiostat medication Treatment two (T_2) birds were given Embazin forte while Treatment three (T_3) chicks were exposed to bitter leaf extract.

Treatment of birds
Treatment was carried out for 3 days with two-day space interval after the first 3 days before the continuation of treatment the following three days according to the instructions of the synthetic coccidiostat manufacturer. During each day of treatment, 9.0 litres of extract from bitter leaf was evenly shared into 3 litres each per replicate of the birds on T_3 while same quantities of clean water or with 10g Embazin forte were offered to chicks on T_1 and T_2 respectively for the six days of the treatment.

Collection of data
Performance characteristics: The initial body weight gain was recorded on arrival and subsequent body weight gain was recorded at the end of every week for the total duration of the experiment. Final weights were taken at the end of the experiment.
Statistical Analysis

All data generated from the parameters were subjected to one-way analysis of variance at 5% level of significant while the difference was compared using Duncan's multiple range test (18, 19).

RESULTS AND DISCUSSION

Table 1: Proximate composition of Broiler starter used for the experiment.

PARAMETER	STARTER
Crude protein	22.00
Fat/oil	6.00
Crude fibre	5.00
Available phosphorus	0.40
Lysine	1.20
Methionine	0.36
Salt	0.36
Metabolizable energy(kcal)	2900.00

Source: Top feed Poultry feed manufacturers

Table 2: Phytochemical constituents of *Vernonia amygdalina (Bitter leaf)*

PARAMETER	QUALITATIVE	QUANTITAVEMEAN (mg/dl)
Tannin	+++	0.43
Phenol	++	0.33
Alkaloid	+++	0.44
Saponin	+++	0.55
Flavonoid	+++	0.46
Terpenes	+	0.21
Steroid	+	0.18
Phytate	++	0.36
Oxalate	++	0.29
Cyanide	+	0.14

+ =present in small quantity, ++ = present in moderate quantity, +++ = present in large quantity

Table 3: Performance characteristics of broiler chickens offered with Embazin forte and aqueous extract of bitter leaf as anti-coccidiostat. (0-4 weeks)

PARAMETERS	T1 (Control)	T2 (Embazinforte)	T3 Bitter leaf extract	SEM	P-value
Initial weight (g)	40.00	40.00	40.00	0.00	-
Final weight (g)	480.00^{b}	570.66^{a}	566.66^{a}	20.88	<.0001
Weight gained (g)	440.00^{c}	530.66^{a}	526.66^{a}	20.88	<.0001
Daily feed intake (g)	36.73	36.70	36.07	1.93	<.0001
Total feed intake (g)	1028.53^{a}	1027.60^{a}	1009.86^{b}	15.13	<.0001
Daily weight gain (g)	15.71^{c}	18.95^{a}	18.81^{a}	18.76	<.0001
Feed conversion ratio	2.34^{a}	1.94^{b}	1.92^{c}	0.05	<.0001

Table 3 shows the performance characteristics of broilers (0-4 weeks) offered with broiler starter mash and different treatment means. It is observed that all parameters measured were significantly ($p>0.05$) different across the treatment means except daily feed intake. However, least weight gain was on the untreated broiler chickens which also had the highest feed intake. Meanwhile, the best FCR observed in chickens offered with bitter leaf extract was best and it is in tandem with the findings of Oleforuh-Okoleh (13) when he gave Marshal broiler chickens water containing 50g dried bitter leaf extract in 75ml of drinking water. He reported a gradual reduction in the microbial count of the cultured stool of the chicken from the those offered bitter

leaf extract than those on synthetic coccidiostat and much higher in its control. His report was corroborated by that of Obasi (19) when Marshal white broilers finishers were offered scent and neem leaf extracts as anti-microbial feed additives

Recommendation

This experiment concluded that the use of extract of bitter leaf is more effective, cheap and safe for the treatment of coccidiosis in broiler chickens and it is hereby recommended.

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Animal Physiology, Reproduction and Health: APH027

ANTIBACTERIAL EFFECTS OF NEEM (*Azadirachta Indica* A.Juss) LEAF EXTRACTS ON THE QUALITY AND SPERMATOZOA FERTILIZING POTENTIAL [MB1]OF EXTENDED BOAR SEMEN

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ABSTRACT

The addition of antibiotics to an extender is very important during preservation because it prevents rapid bacteria multiplication, which can reduce spermatozoa concentration and quality. Antibacterial resistance is however a major constraint to the effective use of conventional synthetic antibiotics. The antibacterial potentials of Neem (*Azadirachta indica)* leaf extracts have been documented. Fresh Neem leaves air dried, then oven dried (60°C) and milled into finer particles. Three Samples (200g/sample) were weighed into three different reflux apparatus set-up and extracted with absolute ethanol (70°C). Collected semen samples were allotted to treatments (T1-Beltsville Thawing solution + Penicillin / Streptomycin, T2-Beltsville Thawing solution without Penicillin+ Streptomycin, T3-Beltsville Thawing solution without Penicillin/ Streptomycin+50µ/mL Ethanoloc Neem lead extract (ENLE), 4-Beltsville Thawing solution without Penicillin/ Streptomycin + 100 µ/mL ENLE and T5- Beltsville Thawing solution without Penicillin/ Streptomycin + 150 µ/mL ENLE, in a completely randomised design. The treated samples were refrigerated (17°C) for 0, 12, and 24 hours. Semen quality assessment parameters evaluated were liveability (%), Normal Spermatozoa (%), Acrosome Integrity (%), and Bacterial load were evaluated to determine the antimicrobial effects of ENLE and spermatozoa fertilizing potential of ENLE. Results indicated that microbial load in extended semen is reduced up to 150µL inclusion at 0, 12, 24 hours were not significantly ($p>0.05$) different. However, all mean values were within the accepted range. The ENLE inclusion at 100 µ/mL significantly gave better ($p<0.05$) mean values for liveability, normal spermatozoa, acrosome integrity, and bacteria load compared to the control. Ethanolic neem leaf extract demonstrated antibacterial potentials at 100 µL concentration, as evidenced by the observed significant reduction in microbial load.

Keywords:

INTRODUCTION

Developing countries, such as Nigeria, grapple with the issue of malnutrition, particularly concerning daily protein intake. Agricultural experts and nutritionists have identified the development of the swine industry as the most effective solution to this problem. The optimal approach to developing the swine industry is to adopt artificial insemination (AI). Artificial insemination presents an alternative to natural mating and is globally recognized as a reproductive technique to enhance animal protein production. It involves the introduction of semen into the cervix or uterine cavity to achieve conception or pregnancy via in vivo fertilization. In swine production, AI stands out for its ability to transfer the genetic potential of superior boars to numerous sows, thereby driving genetic advancements. It also extends fertility during unfavourable periods or adverse weather conditions, supports cycle-based production and aids in more efficient breeding programs (4). Successful swine fertility programs often benefit from the use of extended cooled semen in comparison to natural reproduction. Moreover, Artificial insemination (AI) reduces the risk of transmitting diseases (8), enabling the integration of superior genes into sow herds and resulting in increased profitability per boar ejaculate.

To address the issue of the high cost of artificial insemination and to mitigate the negative consequences of antibiotic use, scientists have been exploring the possibility of replacing antibiotics with natural organic sources, such as honey, watermelon, scent leaves, aloe vera, Neem leaf, and bitter leaf. (2), reported that the

methanolic extract of Musa paradisiaca root showed anticoccidial activity in chickens, whereas (1) discovered that the acetone extract and fractions of Vernonia amygdalina (bitter leaf) exhibited anthelminthic activity against Haemonchus contortus eggs and larvae in small ruminants. Akuamma plant (*Pricalima nitida*) was also discovered to inhibit growth of *Escherichia.coli* and *Staphylococcus aureus*, with high inhibition observed in E. coli (9). (11) reported that Neem leaves exhibited strong antimicrobial activity against bacteria and fungi at all concentrations. Furthermore, Neem leaf extract has shown a strong antibacterial effect against multidrug-resistant pathogenic bacteria of swine (5).

MATERIALS AND METHODS

Location of Experiment

The study was carried out at the Swine Unit of the Teaching and Research Farm and Animal Physiology Laboratories of the Department of Animal Science, University of Ibadan, Nigeria (7° 20'N, 3° 50'E; 200 - 300 above sea level).

Preparation and Extraction of Neem Leaves with Ethanol

The extraction process was carried out using the Soxhlet extraction method. Collected Neem leaves were oven-dried and ground into finer particles. Three samples (250 g each) of the grounded neem leaves were weighed into three different reflux apparatus set-up and were extracted using 50 mL each of ethanol. The extraction process was carried out for 5 hours until the extraction was completed (the refluxing solvent became clear). Solvent residues from the extracts collected were further reduced using a rotary evaporator, centrifuged, and sieved to obtain clear neem leaf extracts. The neem leaf extracts were recovered and reconstituted using dimethyl sulfoxide (DMSO).

Semen Collection

Semen was collected from a mature boar with proven fertilizing ability and semen quality history for the study. The boar semen was collected into a semen collection cup; lined with nylon and covered with a disposable milk filter. The technique used was the gloved-hand technique.

Experimental Treatment and Design

Aliquot portions of diluted semen were allotted to five treatments with three replicates (n=15) per treatment in a completely randomized design.

Evaluations of semen quality and spermatozoa fertilising potential were carried out at time intervals of 0, 12, and 24 hours.

Experimental Treatment Layout

Treatment 1: Semen + BTS[a]
Treatment 2: Semen + BTS[b]
Treatment 3: Semen + BTS[b] + 50 µg/mL ENLE
Treatment 4: Semen + BTS[b] + 100 µg/mL ENLE
Treatment 5: Semen + BTS[b] + 150 µg/mL ENLE

Note: ENLE = Ethanolic Neem Leaf Extract, BTS = Beltsville Thawing Solution, a = BTS with Penicillin and Streptomycin, b = BTS without penicillin and streptomycin

Semen Quality Evaluation

The collected semen was immediately assesed for mass activity and progressive motility to verify its suitability for use, then aliquot portions were alloted to treatments as descibed above. The treated semen samples were immediately refrigerated (17 °C) and the quality of spermatozoa evaluated at 0, 12 and 24 hours.

Bacteria Load – The bacterial load was determined, as described by pig(10) and (6), and expressed as CFU/mL (3).

Statistical Analyses

Means from all the data collected were analysed using the one-way analysis of variance (ANOVA) for completely randomized design using SAS (2011), and means were separated usingTukey HSD test of the same software.

RESULTS

Effects of ENLE on Microbial Load in Extended Boar Semen Quality

Figures 1 to 3 show bacterial load count of extended boar semen with different concentrations of Neem extract, evaluated at 0hr, 12 hrs, and 24 hrs of semen collection. It was observed that mean values in T2 (negative control) which contains no antibiotics show the highest largest level of microbial load. However, a gradual reduction is evident in Treatment 1 (positive control group), which is similar to Treatment 3 and Treatment 4 . Treatment 5 with 150 µL inclusion of ethanolic Neem extract shows the lowest microbial load which is a promising observation. This same trend has been noticed in storage periods of 12 and 24 hrs) This is an indication that ENLE has the ability to hinder microbial growth in stored extended semen.

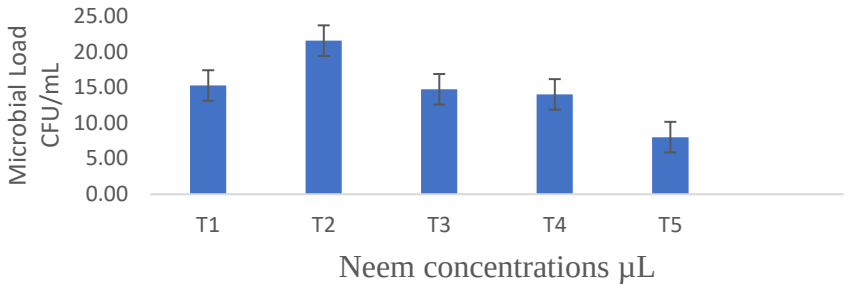

Figure 1: Effects of ENLE on Microbial Load in Extended Boar Semen Quality at 0 Hour

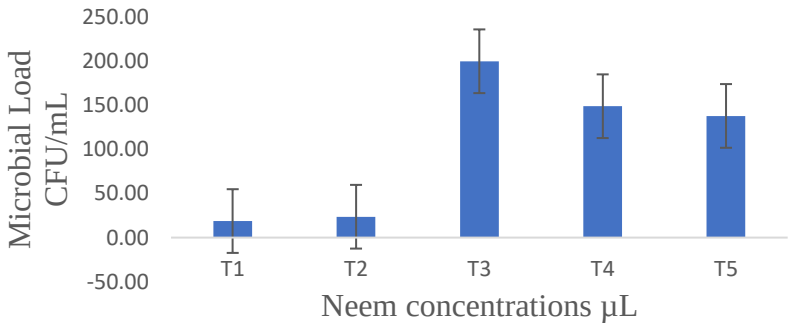

Figure 2: Effects of ENLE on Microbial Load in Extended Boar Semen Quality at 12 Hours

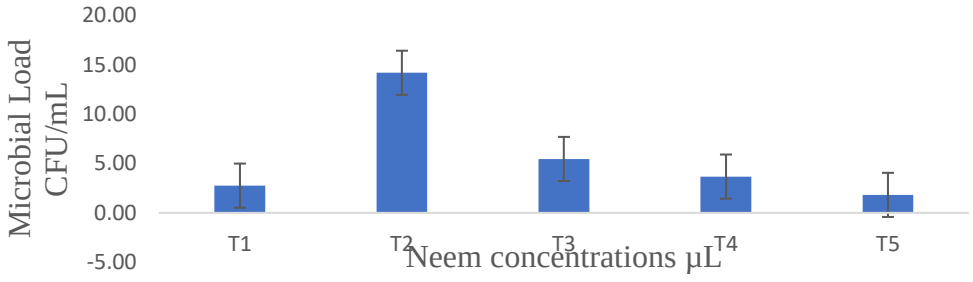

Figure 3: Effects of ENLE on Microbial Load in Extended Boar Semen Quality at 24 Hours

Effects of ENLE on the Quality of Extended Boar Semen

Table 1 shows the mean value of liveability, normal spermatozoa, and acrosome integrity obtained from boar semen treated with ENLE at 0, 12 and 24 hours. It was observed that there were significant differences ($P<0.05$) in the variables evaluated across treatments except acrosome integrity at 0 hour.

Table 1: Effects of ENLE on the Quality of Extended Boar Semen

Parameters (%)	T1	T2	T3	T4	T5	SEM
0 Hour						
Liveability	97.67^{a}	94.33^{bc}	96.33^{ab}	95.00^{bc}	93.67^{c}	0.42
Normal Spermatozoa	93.00^{a}	93.67^{a}	93.67^{a}	91.67^{ab}	89.00^{b}	0.52
Acrosome integrity	92.00	90.67	92.33	92.00	89.67	0.37
12 Hours						
Liveability	96.00^{a}	87.00^{b}	94.33^{a}	92.33^{ab}	92.00^{ab}	1.53
Normal Spermatozoa	91.33^{a}	84.00^{b}	93.33^{a}	93.33^{a}	84.67^{b}	1.13
Acrosome integrity	90.67^{ab}	88.00^{b}	94.67^{a}	93.00^{ab}	87.33^{b}	0.90
24 Hours						
Liveability	95.00^{a}	84.67^{b}	90.67^{a}	91.00^{a}	91.33^{a}	0.96
Normal Spermatozoa	90.67^{ab}	80.00^{c}	92.00^{a}	92.00^{a}	84.00^{bc}	1.41
Acrosome integrity	86.67^{abc}	85.00^{bc}	93.33^{a}	91.67^{ab}	81.33^{a}	1.30

Similar ($P>0.05$) liveability and acrosome integrity mean values were obtained at T1, T3 and T4, which were significantly higher ($P<0.05$) than that of T2 (negative control), and T5 at 12 hours. A similar trend was observed at 24 hours.

DISCUSSION

The bacterial load count upsurge obtained immediately after the extended boar semen was treated with ENLE at 0 hour and the reductions at 24 hours revealed a great potential in reducing the growth of microbes up to 150 µg/mL. The reductions were even more than the positive control. This agrees with (7) research who reported that Leaf and fruit methanolic extracts of *Azadirachta indica* exhibit antibacterial activity on rat's semen. Tthe proportions of ENLE gave a good percentage of acrosome integrity. The differences in mean values for liveability, normal spermatozoa and acrosome integrity of ENLE treated extended boar semen samples is an indication of its potential as an antibacterial agent in porcine semen extension.

CONCLUSION

This study presents a promising initial exploration of ENLE as a potential alternative to antibiotics in boar semen extenders. The observed improvements in sperm livability suggest its potential for maintaining semen quality.

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Animal Physiology, Reproduction and Health: APH028

HISTOLOGY OF THE DIGESTIVE TRACT OF *Archachatina marginata* FED DIET CONTAINING DIFFERENT LEVELS OF COMMON SALT

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ABSTRACT

The study was carried out to investigate the histological alteration of the digestive tract of giant African land snail (*Archachatina maginata*) fed concentrates diet with different levels of common salt under two rearing environment for eight weeks. The salt treatment levels were 0.00 % (control), 0.25 %, 0.35 % and 0.45 %. A total of 192 snails were used for each rearing environment (outdoor and indoor). Snails were then selected based on sizes and randomly allocated to the four (4) experimental treatments in a completely randomised design of four (4) snails each in three replications. All data obtained were subjected to the analysis of variance (ANOVA) and means separated by Duncan's multiple range test where significant differences existed. The results revealed that the photomicrograph of the histological dynamics of the organs of the digestive tract stained with hematoxylin and eosin (H&E) for snails that consumed 0.25 % to 0.045 % salt in their diet showed atrophy, sloughing, inflammation and enlargement of the tissue structure. Since there were histo-morphometric alterations at the various level of salt inclusion of 0.25 %, 0.35 % and 0.45 %. Based on the results, it can be concluded that salt inclusion up to 0.45 % in the diet of snail have an adverse effect on the digestive system. And there is no significant different between the two rearing system (outdoor rearing and indoor rearing).

Keywords: Salt, Digestive Tracts, *Archachatina marginata*, Histological, Hematoxylin and Eosin

DESCRIPTION OF PROBLEM

Salt is unique in that animals have a much greater appetite for the minerals (sodium and chloride) in salt than for other minerals and most plants which are the major food for snails, provide insufficient sodium and may lack adequate chloride content. Therefore, there is need for salt supplementation or inclusion in animal diet since it is a critical part of nutritionally balanced diet for animals. Despites the general knowledge on the importance of salts in both humans and animals body, some authors and farmers still believed that salt should not be included in the diet of snail because it could have an adverse effect on them. (5) stated that formulated feeds, household waste like plantain, yam, peels of fruits and left over food like cooked rice, fufu and eko should be introduced as food for snails but household waste containing salt should not be included. Also, (3) pointed out the need to avoid salt in snail feed since it possibly coagulates the slimy salivary systems and deadens the foot or flesh of the snail resulting to instant death. But it has been reported that snails consume household wastes (contain salt) which were converted and utilized for their growth and egg production (2). In addition, researches have been conducted using layer marsh in feeding the snails (1; 6). These diets are known to contain a salt level of 0.35% in the feed and no adverse effect on the snail was reported. However, work done on salt inclusion in snail diet up to 0.45 % and its effects on its biophysical parameter, haemocyte count and haemolymph biochemistry of *Archachatina marginata* shows no adverse effect on the snail. But there is need to ascertain the response of the gut histo-morphological makeup of the digestive tract of *Archachatina marginata* to a compounded diet with varied inclusion level of salt up to 0.45 %.

MATERIALS AND METHODS

Experimental site: The experiment was carried out at the snailary unit of the University of Benin Teaching and Research Farm, Benin City, Edo State, Nigeria. The farm is located within the tropical rain forest vegetation zone of Southern Nigeria between longitude 50˚E and 60˚42ˈE and latitude 5˚45' and 7˚34ˈN of the equator (NR, 2013). On the North Edo is bounded by Kogi State, to the East is Anambra State, South by Delta and West by Ondo State. The average annual temperature is 25.7^{0}c and 2679 mm of precipitation falls annually.

Experimental Laboratory: The histological procedures were carried out at the Histopathology Laboratory of University of Benin Teaching Hospital, Benin City and the microscopic examination was done at the Department of Animal Science Laboratory, Faculty of Agriculture, University of Benin, Benin City.

Experimental procedure: The cage measuring length 90 cm and breath 90cm with depth of 54 cm and basket of 40 cm × 25 cm × 20 cm were filled with sun-dried humus soil up to 5 cm and moistened with about 300 mL of water. Cages were used for the outdoor and basket in the indoor, and were assigned shallow feeders and drinkers for feed and water. The weights of the snails were taken upon initial selection using an electronics weighing scale after which the average weight was randomly allocated to the treatments. Following after, a compounded diet with treatment 0.00% salt level (T1), 0.25% salt level (T2), 0.35% salt level (T3), 0.45% salt level (T4) were formulated in 10 kg each to prevent deterioration and was fed *ad libitum* and water was provided on regular basis. The control diet of 0.00 % salt level was fed to all the snails *ad libitum* for two weeks for acclimatization.

Tissue collection and dissection procedures: Snail shell was cleaned thoroughly to remove the adhering water and dissection was done according to the procedures outlined by (7).

Microscopic Examination: The slides were examined with motic light microscope using a low power magnification (X4). The examined slides were photomicrograph using motic image plus 2.0 and were presented.

Histological Features observed: Inflammation and thickness, Cellular alterations and other general tissue composition and Calcium accumulation and or depletion

RESULTS

Gut histological dynamics stained with Hematoxylin and Eosin (H&E) viewed at X4 magnification of *Archachatina marginata* at vary salt inclusion level.

The study investigated the effect of salt in digestive tract of snail for crop, esophagus, stomach, intestine and hepatopancrease. The histological alterations are presented by photomicrograph in figures 1.1 to 1.5, Me=muscularis external, LU=lumen, Sb=submucosa, Ep=simple columnar epithelia, Se=serosa, 0.00% (out) = zero salt inclusion, 0.25% (out) = 0.25% salt inclusion, 0.35% (out) = 0.35% salt inclusion, 0.45% (out) = 0.45%, 0.00% (in) = zero salt inclusion, 0.25% (in) = 0.25 % salt inclusion, 0.35% (in) = 0.35% salt inclusion, 0.45% (in) = 0.45% salt inclusion.

Crop: Figure 1.1 shows the transverse section of crop photomicrograph of the *A. marginata* under the outdoor (out) and indoor (in) rearing environment.

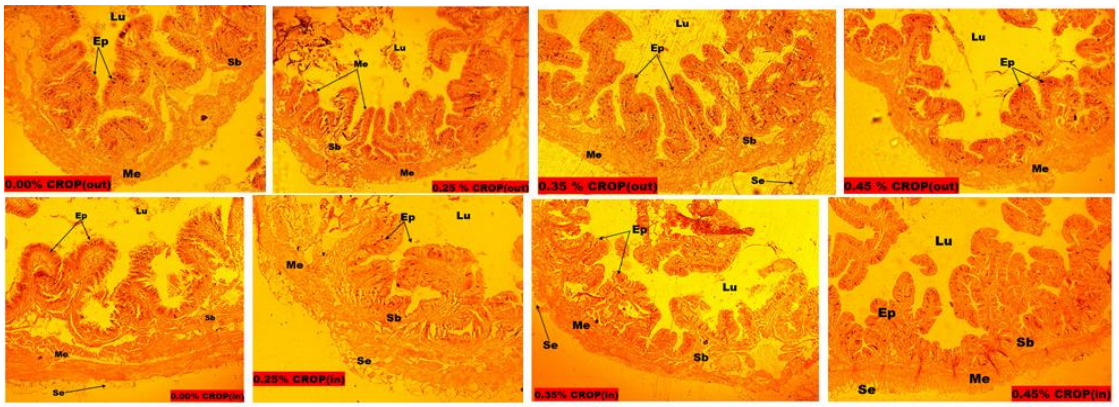

Figure 1.1: *Histomorphological photomicrograph of the crop of A. marginata under the outdoor (out) and indoor (in) rearing environment at varied level of salt inclusion*

Oesophagus: Figure 1.2: The Photomicrograph of the oesophagus outdoor (out) rearing shows no visible alteration across the varied level of salt inclusion of 0.00 %, 0.25 %, 0.35 % and 0.45 %. While the photomicrograph of oesophagus indoor (in) rearing shows an enlarged submucosa (Sb) at 0.45 %, which is not observed for 0.00 %, 0.025 % and 0.035 % salt inclusion level.

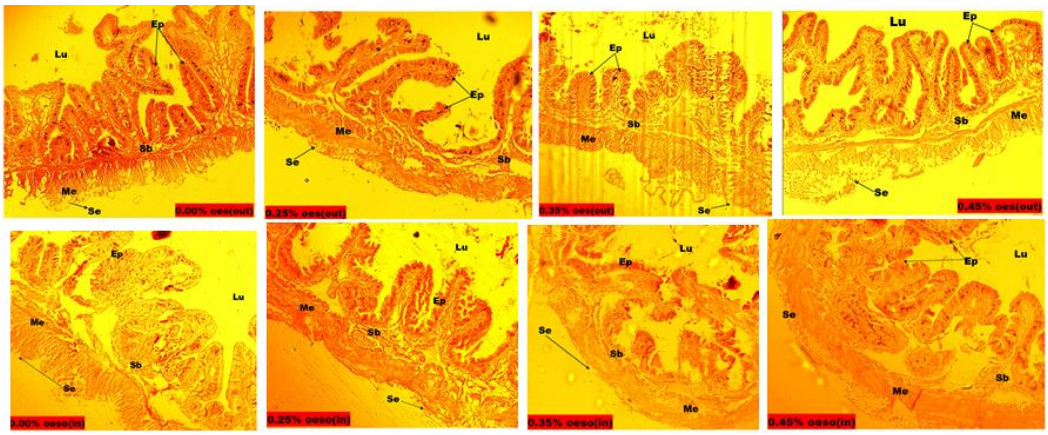

Figure 1.2: *Histomorphological photomicrograph of the oesophagus of A. marginata under the outdoor (out) and indoor (in) rearing environment at varied level of salt inclusion*

Stomach: Figure 1.3 shows the transverse photomicrograph histological dynamics of the stomach stained with H&E under the outdoor rearing environment with varied salt inclusion level 0.00 %, 0.25 %, 0.35 % and 0.45 %. The gastric pits (Pt), submucosa (Sb) and muscularis externa (M) are well seen at varied salt inclusion levels.

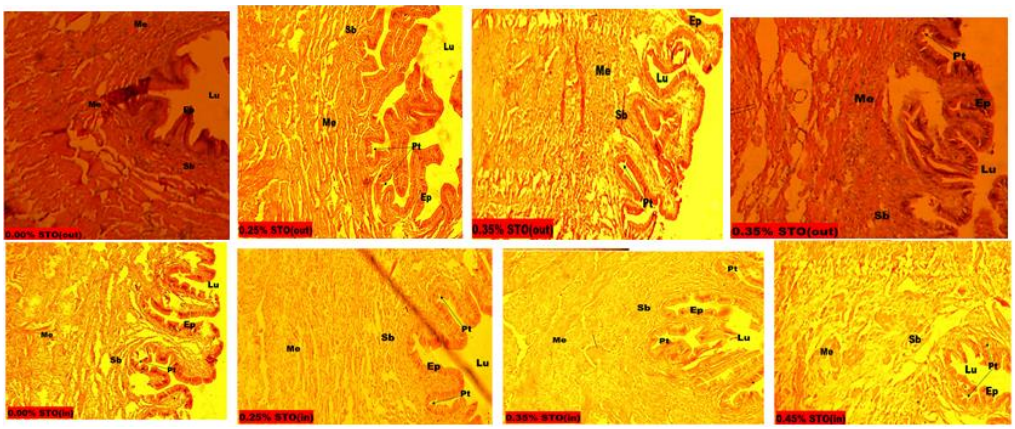

Figure 1.3: *Histomorphological photomicrograph of the stomach of A. marginata under the outdoor (out) and indoor (in) rearing environment at varied level of salt inclusion*

Intestine: The histological dynamics of the intestines shows that there is variation of the tissue integrity in snails fed 0.00 %, 0.25 %, 0.35 % and 0.45 % of salt inclusion. An alteration of the tissue was seen in snails fed with 0.45 % INT (out) of salt inclusion showing an inflammation of the submucosa. However, there were slaughing of the muscularis externa in snails fed with 0.25 %(out) and 0.35 % (out) of salt inclusion, while a corresponding inflammation was seen in snails fed 0.45 % of salt inclusion level.

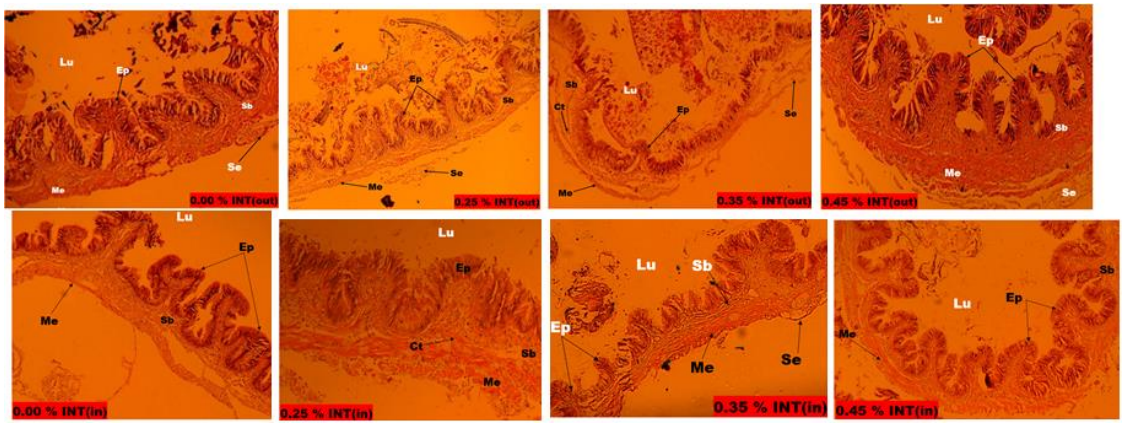

Figure 1.4: *Histomorphological photomicrograph of the intestine of A. marginata under the outdoor (out) and indoor (in) rearing environment at varied level of salt inclusion*

Hepatopancreas

Figure 1.5 shows the transverse section photomicrograph of the hepatopancreas histology stained with H&E under the outdoor (out) and indoor (in) rearing environment with varied salt inclusion levels of 0.00 %, 0.25 %, 0.35 % and 0.45 %. The photomicrograph of the hepatopancrease shows reduced epithelia tubules and cells loss at 0.25 %, 0.35 % and 0.45 % salt inclution levels, which did not occur at 0.00 %. The lumen of the acini, the vacuoles and the nuclei were well visible across the varied salt inclusion levels.

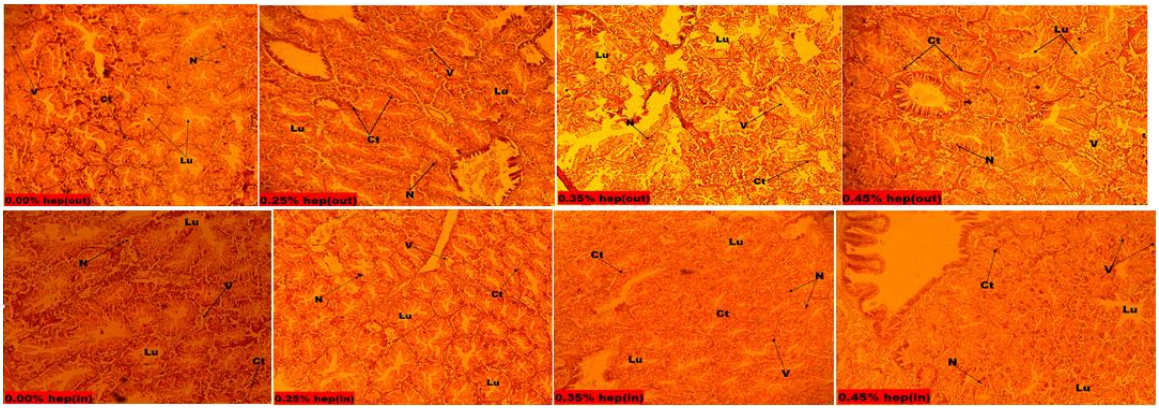

Figure 1.5: *Histomorphological photomicrograph of the hepatopancreas of A. marginata under the outdoor (out) and indoor (in) rearing environment at varied level of salt inclusion*

DISCUSSION

The photomicrograph of the crop shows decrease in the muscularis externa (Me) structure at 0.25%, 0.35% and 0.45% salt inclusion levels, which was observed for both indoor and outdoor rearing may be attributed to the possibility of tissue atrophy and sloughing. The photomicrograph of oesophagus also shows an enlarged or inflammed submucosa (Sb) at 0.45%, which is not observed for 0.00%, 0.025% and 0.035% salt inclusion levels may be attributed to the salt present in the diet. (10) stated that animal studies decleared that high salt diet was regarded to have an adverse effect on gut health, by causing aggrevation of tissue inflammation and autoimmune diseases. Also, there were variation of tissue integrity in the histological dynamics of the intestines. It shows inflammation of the submucosa at 0.45 % of salt inclusion for both out door and indoor rearing and slaughing of the muscularis externa at 0.25 % and 0.35 % of salt inclusion level for indoor rearing. It has been reported that high-sodium diets promote local and systemic tissue inflammation and impair intestinal anatomy compared with low sodium intake in both human and animal studies (8). The photomicrograph of the hepatopancrease shows reduction of the epithelia tubules and the loss of some cells at 0.25%, 0.35% and 0.45% salt inclution level. This may be as a result of feed ingested. High salt diet may cause epithelial proliferation, apoptosis, and altered cellular types (9).

CONCLUSION AND APLICATION

Investigation of histological changes in the gastrointestinal tract of *Archachatina marginata* examined, showed histo-morphometric alterations at the various level of salt inclusion (0.00 %, 0.25 %, 0.35 % and 0.45 %). Based on the results, it can be concluded that salt inclusion from 0.35 % to 0.45 % in the diet of snail reared in either indoor or outdoor system, have an adverse effect on the digestive system while 0.00 % to 0.25 % table salt in the concentrate fed to snails can be tolerated in the digestive tract for both rearing environment.

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Animal Physiology, Reproduction and Health: APH029

EFFECT OF EGG STORAGE DURATION AND ORIENTATION ON HATCHABILITY AND CHICK WEIGHT IN ISA BROWN CHICKENS

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ABSTRACT

Hatchable eggs are conventionally-stored with broad end up in cold room before incubation. This study investigated the effect of storage duration and orientation on egg hatchability and chick weight in ISA brown chickens. Eggs (n=180) were either stored horizontally (HOR), in narrow end up (NEU) or broad end up (BEU) orientation for 5 or 8 days before setting in incubator. Hatchability of set (HSE) and fertile eggs (HFE) were significantly ($p<0.001$) influenced by storage duration. Eggs stored for 5 d (72.6 and 75.6%) had the highest HSE and HFE than those for 8 d (39.7 and 43.7%). No significant ($p>0.05$) effect of storage duration was observed in chick weight. No significant ($p>0.05$) effect of orientation was observed on chick weight however, HSE and HFE were significantly ($p<0.001$) influenced by the storage orientation. HOR eggs had the higher HSE and HFE (64.5 and 65.3%) than those stored in NEU orientation (54.8 and 59.4%). Both had higher values than eggs stored in BEU (49.8 and 54.1%) position. Horizontal storage is the natural position of eggs in brooding. Interaction between storage duration and orientation showed that for longer period of egg storage (8 days), NEU gave better hatchability rather that BEU that was superior at 5-d storage. It may be necessary to change the conventional orientation of egg storage to NEU from the accepted BEU orientation in chicken egg storage that are stored for longer period.

Key words: Isa brown chicken, Storage duration, Incubation orientation.

DESCRIPTION OF PROBLEM

In commercial poultry production, maximizing hatchability and chick quality is crucial for profitability and meeting market demands. Eggs are often stored before incubation to align hatching schedules and manage production. The successful incubation of eggs is vital in poultry production as it directly affects hatchability rates and the quality of hatched chicks. Storage duration and egg orientation are two key factors influencing these outcomes. Research shows that longer storage periods can lead to decreased hatchability rates and lower chick weights [1].[1] found that prolonged storage negatively impacted hatchability and resulted in lighter chicks. It was observed that storage durations beyond 7 days reduced both hatchability and chick weight [2]. Additionally, storage conditions, including temperature and humidity, play a significant role in maintaining egg quality and influencing hatchability. Egg orientation is another important factor affecting hatchability and chick quality. The way eggs are positioned can influence gas exchange and nutrient absorption, which are crucial for embryo development. Studies have shown that improper egg orientation can lead to decreased hatchability and poor chick quality [1]. Other authors observed that incorrect positioning or infrequent turning of eggs led to reduced hatchability rates and lower chick weights [3]. Therefore, there is need to investigate the effect of storage duration and orientation on hatchability and chick weight in ISA brown chicken. Hence, the need for the present study.

MATERIALS AND METHODS

Experimental site

The experiment was carried out at two locations: Alanko Farm, Oshiele, Odeda Abeokuta and the hatchery unit of the Obasanjo Farms Ltd, Owiwi branch, Obada Oko, Lagos-Abeokuta Expressway, Abeokuta Ogun

State Nigeria. The location falls within the rainforest of south-western Nigeria with a mean temperature between 27 – 28°C and annual rainfall of1,217.27mm [4].

Experimental animals and management

A flock of hens aged 50 weeks old were used for this research. The birds were intensively-managed within battery cages. Regular cleaning and disinfection of the pens was conducted. Biosecurity measures were enforced within the pens, with restricted access for visitors to minimize the risk of disease outbreaks. The birds were fed *ad libitum with* regular provision of water. Artificial insemination was carried out twice weekly in the flock to ensure good fertility rate.

Egg collection, storage and incubation

Fertile eggs from birds were collected, labelled, and stored in either of three (3) positions: horizontal (HOR), narrow end up (NEU), and broad end up (BEU). Labelled eggs were transferred for storage in egg tray and stored under 16±1.5ºC and 75±1.5ºC relative humidity conditions [Ref?]. Eggs were stored for either 5 or 8 days. All the eggs were set at the same time in a 2-stage incubator (N.V. Petersime® EV1/EN2 Incubator, *Belgium*) after the storage period, and transferred into hatcher under uniform conditions of 29.5 and 37.5°C wet-bulb and dry-bulb temperature on day 18 of incubation.

Data Collection

At candling, percentage fertility was determined as the ratio of fertile to set eggs in percentage. Hatchability of set and fertile eggs were calculated as the ratio of the hatched to set eggs and fertile eggs respectively for each treatment group. Chicks were weighed after hatched

Statistical Analysis

Data collected were analysed using two-way analysis of variance (ANOVA) using Minitab Statistical Software at $p<0.05$ probability level while significant means was compared using Tukey test

RESULTS AND DISCUSSION

Table 1 shows the effect of storage duration on egg hatchability and chick weight in ISA brown chicken. Percentage hatchability of set eggs (HSE) and of fertile eggs (HFE) were significantly ($p<0.001$) affected by egg storage duration. However, the chick weight(g) was not significantly ($p>0.05$) affected by egg storage duration. Storage of eggs for 5 days resulted in a higher hatchability of set and fertile eggs than the storage for 8 days. Effect of storage orientation on egg hatchability and chick weight in ISA brown chicken is shown in Table 2. The HSE and HFE were significantly ($p<0.001$) affected by egg storage orientation. On the other hand, chick weight was not significantly ($p>0.05$) affected by the egg storage orientation. Egg stored in a horizontal position exhibited higher hatchability of set and fertile eggs than the eggs stored in a broad and narrow position. Hatchability of set and fertile eggs were higher in narrow end up (NEU) position than in (BEU) broad end up position.

Table 1: Effect of storage duration on egg hatchability and chick weight in ISA brown chicken

Parameter	Storage duration (days)		SEM	P-value
	5	8		
Hatchability of set eggs (%)	72.6[a]	39.7[b]	0.03	0.000
Hatchability of fertile eggs (%)	75.6[a]	43.7[b]	0.02	0.000
Chick weight (g)	35.7	34.2	0.78	0.185

[a,b] *Means within the same row having different superscripts differ significantly*

Table 2: Effect of storage orientation on egg hatchability and chick weight in ISA brown chicken is as shown in Table 2

Parameter	Storage orientation			SEM	P-value
	BEU	HOR	NEU		
Hatchability of set eggs (%)	49.8[c]	64.5[a]	54.3[b]	0.05	0.000
Hatchability of fertile eggs (%)	54.1[c]	65.3[a]	59.4[b]	0.03	0.000
Chick weight (g)	34.5	34.4	35.9	1.06	0.493

[a,b,c]*Means within the same row having different superscripts differ significantly*

Interactive effect of storage duration and storage orientation on egg hatchability and chick weight in ISA brown chicken is shown in Table 3. The HSE and HFE were significantly ($p<0.001$) affected by the egg storage duration and egg storage orientation. However, chick weight was not significantly ($p>0.05$) affected by the egg storage duration and orientation. Eggs that were stored for 5 days in a horizontal position recorded the highest HSE and HFE than eggs stored for 5 days in a broad and narrow position. Hatchability of set and fertile eggs were elevated in egg stored for 5 days in a broad end up (BEU) position than narrow end up (NEU) position. Additionally, the hatchability of set and fertile eggs that have been stored for 8 days in a narrow position turned out to be higher than eggs stored for 8 days in a broad and narrow position.

Table 3: Interactive effect of storage duration and orientation on egg hatchability and chick weight in ISA brown chickens

Storage duration	Storage orientation	Hatchability of set eggs (%)	Hatchability of fertile eggs (%)	Chick weight (g)
5	BEU	68.8[b]	73.3[b]	35.9
	HOR	86.7[a]	86.7[a]	34.6
	NEU	62.5[c]	66.7[c]	36.6
8	BEU	30.8[f]	34.8[f]	33.1
	HOR	42.3[e]	44.0[e]	34.2
	NEU	46.2[d]	52.2[d]	35.1
SEM		0.06	0.04	1.37
P-value		0.000	0.000	0.696

[a,b,c,d,e,f]*Means within the same column having different superscripts differ significantly*

In the present study, it was revealed that the storage of eggs for 5 days had a higher hatchability percentage. This is in agreement with the findings of [5], that decline in egg hatchability commences after 5 days in storage. A lower hatchability was recorded in the eggs stored for 8 days, this is similar to the previous report which showed that storing chicken eggs for more than 8 days exhibited higher dead in germ and had lower hatchability [6]. Though the authors used FUNAAB-alpha chicken eggs, similar response is obtainable in ISA brown chicken eggs [7].Authors had confirmed that hatchability is lowered by extended storage of chicken eggs [8, 9], especially in older breeder hens [9].

It was discovered in this study that storing of eggs in a horizontal position gave an outcome of a higher hatchability than those stored in a BEU and NEU positions, which is in opposition to the findings of [10].The author stated that the position of eggs during storage does affect hatchability. However, the comparison was done between broad end up and narrow end up orientation, and not with horizontal positioning. [11] in line with the present findings, reported that NEU orientation resulted in higher hatchability and heavier chicks compared to the normal position (BEU) in eggs stored for 7 and 14 days periods. Similarly, [12] reported the better hatchability in eggs stored with pointed end up over those in pointed end down orientation. The reason for these differences may be attributed to the age of breeder hens and the storage condition. In previous study, eggs from younger breeder hens stored for 7 days exhibited lower hatchability in NEU group than BEU group. These may be species-specific as eggs stored with broader end up hatched better and faster in Japanese quails [13].

In conclusion, it was discovered that egg stored horizontally gave the best hatchability. Horizontal storage is the position of eggs in brooding employed by hens naturally. Interaction between storage duration and orientation showed that for longer period of egg storage (8 days), NEU gave better hatchability rather that BEU that was superior at 5-d storage. Commercially, it may be necessary to change the conventional orientation of egg storage to NEU from the conventionally-accepted BEU orientation in chicken egg storage as it gave a better egg hatchability than in BEU storage orientation when eggs are stored for a longer period.

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Animal Physiology, Reproduction and Health: APH030

ANTI-OXIDATIVE EFFECTS OF NATURAL HONEY ON QUALITY OF EXTENDED BOAR SEMEN

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ABSTRACT

The ability of spermatozoa to fertilize is crucial for the successful use of artificial insemination. Reactive oxygen species (ROS) can adversely affect boar spermatozoa which declines the quality and fertilizing ability. This study investigated the effects of Natural Honey (NH) as an anti-oxidative agent on quality and spermatozoa fertilizing potential in an extended boar semen. Semen was collected and divided into 15 sample bottles containing five treatments with three replicates each using a completely randomized design. T1 served as the control; Beltsville Thawing Solution (BTS[a]) + penicillin and streptomycin with 0% NH, T2 contained BTS[b] without penicillin and streptomycin with 0% NH, while other treatments T3 to T5 contained BTS[b] without penicillin and streptomycin but supplemented with NH at different concentrations of 1.0, 1.5, and 2.0% respectively and were evaluated at 0, 12 and 24 hours for pH, liveability (%), normal spermatozoa (%), and lipid peroxidation. Data were analysed using one-way ANOVA and means separated using the Tukey HSD test. The results indicated that treated semen samples gave a better liveability (98.00%) than control up to 24 hours. At 24 hours, treated samples show no significant differences in mean values for pH (7.09 -7.72) among treatments through the extension time. However, all the values were within the accepted range for semen quality. The findings of this study indicate that inclusion of 1.0% natural honey into boar semen extender is effective and yields results comparable to those obtained with conventional extenders used in the control group.

Keywords: Natural honey, anti-oxidative, semen quality, Reactive oxygen species

DESCRIPTION OF PROBLEM

Pig industry is a crucial part of livestock in agricultural industry as a whole. In Nigeria, their production plays a prominent role in ensuring food security, creating jobs, and ending poverty (Nwanta *et al.*, 2011). They have numerous advantages over other farm animals due to their early maturity and short reproductive cycles (Pierozan *et al.*, 2016).

The utilization of artificial insemination in pigs has grown remarkably, worldwide due to the short-, medium-, and long-term benefits that it provides. These benefits include advancements in genetic improvement, continuous evaluation of sperm quality to ensure fertilization success, and optimization of the control of reproductive performance of the animal production unit (Alejandro *et al.*, 2019). More than 90 % of the sows in Western European countries have been produced using artificial insemination for over 20 years (Vyt *et al.*, 2007). Boars present on the farm provide the semen, providing a range of genetic lines and breeds and the ability to supply doses of ready-to-use semen that are consistent and of high quality. It is necessary to consider both hereditary and environmental factors that can affect the semen quality and ji output to maximize productivity from each boar.

In recent times, much attention has been on creating semen extenders that can preserve the quality of semen while it is being stored before insemination. Artificial insemination requires fresh or properly stored semen. As a result, to protect its quality, semen needs to be kept in ideal conditions (Hernández-Avilés *et al.*, 2020). Semen extenders are used for semen preservation for fertilization to occur. Additionally, it limit cryogenic

damage, control bacterial transmission and contamination, regulate the pH of the medium, and maintain and preserve sperm metabolic functions (Malik *et al.*, 2018).

Similarly, semen extenders must be able to maintain a pH between 6.8 and 7, supply energy, antioxidants to lessen oxidative stress, antibiotics to stop contamination, and anti-freezing shock (Tareq *et al.*, 2012). Numerous commercially available extenders can be generally categorized as either long-term (more than 5 days) semen preservation or short-term (1 to 3 days) semen preservation (Gadea, 2005).

According to studies, spermatozoa with short-term extenders exhibit decreased motility and a higher percentage of normal morphology on day two of storage, along with an increase in DNA disintegration. (Fischer *et al.*, 2014). This renders the spermatozoa unsuitable for insemination because it creates reactive oxygen species (ROS), which act as an intermediary in mitochondrial metabolic pathways, resulting in oxidative stress and decreased fertility. Spermatozoa motility, morphologically normal spermatozoa, and live percentage are considered when evaluating semen extender suitability (Fischer *et al.*, 2014). These make it possible to estimate how long spermatozoa will be stored and fertilized after AI (Blesbois *et al.*, 2008). The addition of antioxidants to extender can lessen the oxidative damage done to semen, by scavenging dangerous chemicals.

Honey is a popular source of antioxidants due to the significant growth in demand for antioxidants in a variety of applications. It is a naturally occurring material made by honeybees (*Apis mellifera*) from sweet, flavourful, and viscous nectar of flowers. It has been utilized as food and medicine from the beginning of time.

Hussein *et al.*, (2011) reported that honey's high antioxidant-reducing activity and ability to break down free radicals are closely associated with its phenolic content. In addition to glucose, honey contains proteins, minerals, and chemicals that act as antioxidants. Honey's botanical origins are linked to the existence of diverse minor components and antioxidant action (Escuredo *et al.*, 2013). It is rich in carotenoids, polyphenols, and vitamins among other antioxidant and antimicrobial substances (O'Sullivan *et al.*, 2013).

MATERIALS AND METHODS

Experimental Location

The research was done at the Piggery unit of Teaching and Research Farm and Animal Physiology Laboratories, Department of Animal Science, University of Ibadan, Nigeria (7° 20'N, 3° 50'E; 200 - 300 above sea level). Semen collection was carried out at the Piggery Unit of Teaching and Research Farm, University of Ibadan, and the semen analyses were done at the Animal Physiology and Bioclimatology Laboratories of the Department of Animal Science of the same institution.

Management of Selected Boar

The experimental animal (healthy adult boar (*Sus scrofa*) of proven fertility was selected for the study. The animal was housed in a controlled environment with proper ventilation, temperature, and lighting conditions. A balanced diet and clean water were provided to ensure optimal health and reproductive performance throughout the experimental period.

Preparation of Extracts

The natural honey was purchased from Teaching and Research Farm, University of Ibadan, Nigeria (7° 20'N, 3° 50'E; 200 - 300 above sea level). It was stored for further use. The honey solution was put into four test tubes containing 4.0 mL per tube. 10% (v/v) graded concentration of honey supplement was obtained by constituting 10 mL of the natural honey in 100 mL distilled water mixed together in a 100 mL Volumetric flask.

Preparation of Semen Extender

The semen extender (Beltsville Thawing Solution) was prepared (Johnson, 2000) before the semen collection from the boar. BTS[a] was prepared by mixing glucose, sodium citrate, potassium chloride,
Ethylenediamene tetraacetic acid (EDTA) sodium bicarbonate, penicillin, and streptomycin in different proportions into 100 ml of distilled water. While BTS[b] was also prepared with same proportions but does not contain penicillin and streptomycin.

Experimental Treatment and Design

The semen was allotted into five treatments, each with three replicates using completely randomized design.

Treatment description

Treatment 1: BTS[a] + 0% Honey
Treatment 2: BTS[b] + 0% Honey
Treatment 3: BTS[b] + 1.0% Honey
Treatment 4: BTS[b] + 1.5% Honey
Treatment 5: BTS[b] + 2.0% Honey

Note: BTS = Beltsville Thawing Solution, BTS[a] = BTS with Penicillin and Streptomycin, BTS[b] = BTS without penicillin and streptomycin

Semen Collection

The semen was collected from the boar using the hand glove technique. Once the boar mounts and begins to thrust, the penis grasped firmly in a gloved hand perpendicular to its body and pressure was applied to to the penis tip. This grip was sustained until the boar finished ejaculating. Semen was collected into a boar semen collection cup lined with a disposable plastic bag which helps to separate the gel-fraction from the sperm-rich fraction.

Statistical Analyses

Means from all the data collected were analysed using the one-way analysis of variance (ANOVA) for completely randomized design using SAS (2011), and means were separated using Tukey HSD test of the same software.

RESULTS

Results shown in Table 1 indicates significant differences in mean values for all parameters irrespective of time, except for pH and normal spermatozoa at 0hr. Similar (P>0.05) mean values were observed for mean values of natural honey treated extended boar semen samples up to 2 % for liveability and normal spermatozoa. Also, significant reduction in lipid peroxidation was observed for treated samples at 12 and 24 hours.

DISCUSSION

The quest for improved extenders has led researchers to explore natural antioxidants like honey. Honey is acidic and its composition varies based on geographical and botanical origins (Azeredo *et al*., 2003). It is rich in energy substrate (mainly monosaccharides and small number of disaccharide) and several natural bioactive components such as phenolics, glycoproteins with high-mannose N-glycans, flavoids, and peptides with complex mechanism of action responsible for its antioxidants (Viuda-Martos *et al.,* 2008).
Honey has a wide variety of proven antioxidants components including phenolics, peptides, vitamin c, enzymes (especially glucose oxidase and catalase), and zinc (Manyi-Loj *et al*., 2011).
The significant reduction in the lipid perodixation value for treated samples at 12 and 24 hours could be as a result of the anti-oxidative properties of honey and aligns with the previous research by Trimeche *et al*., (1999) who reported the protective ability of proline and glutamine against reactive oxygen specie. Reactive oxygen specie (ROS) induce lipid peroxidation which causes damage to sperm plasma membranes. Potent antioxidants can mitigate the production of such ROS, and honey is generally a very potent natural

antioxidants (Nicewicz *et al.*,2021). The increased liveability indicates that honey may be effective in maintaining sperm viability, potentially reducing the oxidative stress and preserves the integrity of the sperm membrane. The mean values for the normal spermatozoa aligns with the research of Shipley *et al.,* (1999) who reported that percentage normal spermatozoa should be at least 70%.

Table 1: Effects of Natural Honey on Quality of Extended Boar Semen at 0, 12 and 24 Hours

Parameters	T1	T2	T3	T4	T5	SEM
0 Hour						
pH	7.09	7.02	7.16	7.17	7.17	0.09
Liveability (%)	97.67^{a}	94.33^{c}	98.00^{a}	96.67^{ab}	95.33^{bc}	0.41
Normal Spermatozoa (%)	93.00	93.67	95.00	93.00	92.00	0.37
Lipid Peroxidation (mm MDA/l0^{-4})	0.14^{b}	0.19^{a}	0.15^{b}	0.11^{c}	0.10^{c}	0.01
12 Hours						
pH	7.23	7.37	7.47	7.72	7.50	0.16
Liveability (%)	96.00^{a}	87.00^{b}	96.33^{a}	94.33^{a}	94.67^{a}	1.02
Normal Spermatozoa (%)	91.33^{ab}	84.00^{c}	94.33^{a}	91.00^{b}	91.00^{b}	0.94
Lipid Peroxidation (mm MDA/l0^{-4})	0.18^{b}	0.05^{c}	0.24^{a}	0.16^{b}	0.19^{b}	
24 Hours						
pH	7.33	7.37	7.49	7.41	7.19	0.22
Liveability (%)	95.00^{a}	84.67^{c}	93.33^{ab}	90.00^{b}	92.00^{ab}	1.03
Normal Spermatozoa (%)	90.67^{a}	80.00^{b}	93.33^{a}	89.67^{a}	90.00^{a}	1.29
Lipid Peroxidation (mm MDA/l0^{-4})	0.17^{a}	0.03^{d}	0.05^{c}	0.08^{b}	0.08^{b}	0.01

a,b,c= means on the same row with different superscripts are significantly different,
SEM = Standard error of the mean.

CONCLUSION

The findings of this study indicate that inclusion of 1.0% natural honey into boar semen extender is effective and yields results comparable to those obtained with conventional extenders used in the control group.

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Animal Physiology, Reproduction and Health: APH031

CYTOPROTECTIVE AND ANTIOXIDATIVE EFFECTS OF NEEM (*Azadirachta indica* A. Juss) LEAF EXTRACTS ON THE QUALITY AND FERTILIZING POTENTIAL OF EXTENDED BOAR SEMEN

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ABSTRACT

Oxidative stress is a major contributor to reduced semen quality, leading to decreased fertility rates (1,2). Neem (*Azadirachta indica* A. Juss) leaf extract has been shown to have anti-oxidative properties that may have a positive impact on sperm quality and fertility (5,10). This study investigated the cytoprotective and anti-oxidative effects of neem leaf extract on the quality of extended boar semen. The ENLE was added to boar semen at different concentrations of five experimental treatments (T1: Semen + BTS^{a}, T2: Semen + BTS^{b}, T3: Semen + BTS^{b} + 50µ/mL ENLE, T4: Semen + BTS^{b} + 100µ/mL ENLE, T5: Semen + BTS^{b} + 150µ/mL ENLE, with three replicates arranged in a completely randomized design. The treated samples were evaluated on liveability, normal spermatozoa, acrosome integrity, pH, and lipid peroxidation. The results showed that ENLE significantly improved spermatozoa liveability, and normal spermatozoa, while reducing lipid peroxidation and maintaining optimal pH levels. In this investigation, the optimal concentration of ethanolic neem leaf extract included in extended boar semen appeared to be 50 µg/mL at 24 hours.

Keywords: Neem, Extract, Semen, Oxidative Stress.

INTRODUCTION

Boar semen is widely used in artificial insemination (AI) programs in the swine industry (15,16). Still, its quality and fertilizing potential can be affected by various factors, including oxidative stress and lipid peroxidation (4). Synthetic antioxidants are commonly used to mitigate oxidative stress, but natural alternatives are sought to reduce costs and potential toxic effects.

Neem (Azadirachta indica A. Juss) leaf extract has emerged as a promising natural antioxidant that may enhance sperm quality and fertility. Rich in bio-active compounds like flavonoids, phenolic compounds, tannins, and triterpenoids, (14). Neem leaf extract has been traditionally used in Indian medicine for its therapeutic properties (3). Recent studies have demonstrated its potential to mitigate oxidative stress in testicular tissues and improve sperm quality (7).

This research aims to investigate the effects of Ethanolic Neem Leaf Extract (ENLE) on the quality and fertilizing potential of extended boar semen, to improve reproductive outcomes in boar breeding programs. The significance of this study lies in its potential to address the prevalent issue of oxidative damage in extended boar semen, which results in diminished sperm quality and decreased fertility rates. By exploring the anti-oxidative and cytoprotective effects of ENLE, this research seeks to maintain/preserve the sperm, thereby improving the overall quality and fertilizing potential of extended spermatozoa, leading to enhanced reproductive success in the swine industry.

MATERIALS AND METHODS

The experiment was carried out at the Swine Unit of the Teaching and Research Farm. All analysis were carried out at the Animal Physiology Laboratories of the Department of Animal Science, University of Ibadan, Nigeria. Fresh neem leaves were collected at the same location, washed, air-dried, oven-dried, and ground into fine particles. Soxhlet extraction method was used to extract the Neem leaves with ethanol, this is how Ethanolic Neem Leaf Extract (ENLE) was obtained. The extracts were then reconstituted using dimethyl sulfoxide (DMSO) as a solvent, as some bioactive compounds in Neem remain more stable in DMSO and stored at -1 ℃. A Beltsville Thawing Solution (BTS) extender was also prepared in two different formulations BTS^a and BTS^b · BTS^a was prepared by mixing glucose, sodium citrate, potassium chloride, EDTA, sodium bicarbonate, penicillin, and streptomycin in specific proportions into 100ml of distilled water. In contrast, BTS^b was prepared without penicillin and streptomycin, using only the remaining ingredients in the same proportions as BTS^a. It was kept refrigerated (8 ℃) until when needed.

Semen was collected from a healthy, intact, and proven Large White boar using the hand-gloved technique and evaluated for spermatozoa quality and fertilizing potential, at 0, 12, and 24 hours.

The parameters assessed were pH, liveability (%), normal spermatozoa (%), and lipid peroxidation (mm MDA/$l0^{-4}$). Observed data were subjected to statistical analysis using one-way analysis of variance (ANOVA) at P<.05 (17).

Experimental Treatments and Design:
Equal portions of diluted semen were allotted to five treatments of three replicates per treatment (n=15), in a completely randomized design. The Azadirachta indica A.Juss extract inclusion rate was:
T1: 0 µ/mL of ENLE + BTSa
T2: 0 µ/mL of ENLE + BTSb
T3: 50 µ/mL of ENLE + BTSb
T4: 100 µ/mL of ENLE + BTSb
T5: 150 µ/mL of ENLE + BTSb

Note: ENLE = Ethanolic Neem Leaf Extract, BTS = Beltsville Thawing Solution,
a =BTS with Penicillin and Streptomycin, b = BTS without penicillin and streptomycin

RESULTS

Results shown in Table 1 indicated significant differences in mean values for all parameters irrespective of time. Similar (P>0.05) mean values were observed for mean values of treated ENLE extended boar semen samples up to 100 µ/mL and positive control, for liveability and normal spermatozoa. Also, a significant reduction in lipid peroxidation was observed at 50 and 100 µg/mL ENLE treated samples at 12 and 24 hours.

DISCUSSION

The findings of this study suggest that ENLE have the potential as a natural additive in boar semen extenders to improve spermatozoa quality. The ENLE treated extended semen samples also indicated some form of cytoprotection. The cytoprotective and anti-oxidative effects of ENLE may be attributed to its high content of flavonoids and terpenoids, which have been shown to have antioxidant properties. This agrees with (8) and (12) who opined that neem plants exhibit antioxidant activity by inactivating lipid free radicals or preventing the decomposition of hydroperoxides into free radicals. Phenolic compounds are considered to be the most important antioxidant components of herbs and other plant materials and a good correlation between the concentration of plant phenolic and total antioxidant capacities has been reported (6,13).

Table 1: Effects of Neem Leaf Extracts on the Quality of Extended Boar Semen at 0, 12 and 24 Hours

Parameters (%)	T1	T2	T3	T4	T5	SEM
0 Hour						
pH	7.10^{a}	7.12^{a}	6.82^{a}	6.32^{b}	6.06^{b}	0.16
Liveability (%)	97.67^{a}	94.33^{bc}	96.33^{ab}	95.00^{bc}	93.67^{c}	0.42
Normal Spermatozoa (%)	93.00^{a}	93.67^{a}	93.67^{a}	91.67^{ab}	89.00^{b}	0.52
Lipid peroxidation (mm MDA/l0^{-4})	0.03^{e}	0.28^{b}	0.31^{a}	0.09^{d}	0.13^{c}	0.01
12 Hours						
pH	7.23^{a}	7.40^{a}	6.91^{b}	6.54^{c}	6.29^{c}	0.11
Liveability (%)	96.00^{a}	87.00^{b}	94.33^{a}	92.33^{ab}	92.00^{ab}	1.53
Normal Spermatozoa (%)	91.33^{a}	84.00^{b}	93.33^{a}	93.33^{a}	84.67^{b}	1.13
Lipid peroxidation (mm MDA/l0^{-4})	0.38^{a}	0.19^{c}	0.13^{c}	0.24^{b}	0.28^{b}	0.01
24 Hours						
pH	7.09^{ab}	7.23^{a}	6.94^{ab}	6.68^{bc}	6.36^{c}	
Liveability (%)	95.00^{a}	84.67^{b}	90.67^{a}	91.00^{a}	91.33^{a}	0.96
Normal Spermatozoa (%)	90.67^{ab}	80.00^{c}	92.00^{a}	92.00^{a}	84.00^{bc}	1.41
Lipid peroxidation (mm MDA/l0^{-4})	0.14^{b}	0.08^{d}	0.11^{c}	0.16^{b}	0.26^{a}	0.01

abc = means on the same row with different superscripts are significantly different, SEM = Standard error of mean.

CONCLUSION

The optimal concentration of ethanolic neem leaf extract inclusion in extended boar semen, in this investigation appeared to be 50 µg/mL. The use of ENLE as an antioxidant in boar semen extenders can be explored as an alternative to conventional antioxidants, which may have negative effects on sperm quality and fertility.

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Animal Physiology, Reproduction and Health: APH032

ANTIBACTERIAL EFFECTS OF NATURAL HONEY ON THE QUALITY OF EXTENDED PORCINE SEMEN

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ABSTRACT

Reproductive efficiency has improved greatly through Artificial insemination (AI). Despite advancements in porcine semen extension, challenges such as bacterial contamination and reduced sperm quality persisted, potentially hindering fertility and reproductive outcomes. The traditional reliance on synthetic antibiotics in semen extenders raised concerns about antimicrobial resistance and adverse effects, prompting a search for safer, natural alternatives. Natural honey, deeply ingrained in traditional medicine, is a promising antibacterial agent. This study explored its potential to enhance the quality and fertilizing potential of extended boar semen. Semen was collected using the gloved hand method to deflect penile intrusion during ejaculation. Aliquot portions of ejaculates were placed in sample bottles with 3 mL Beltsville Thawing solution (BTS) to make five (5) experimental treatments (T1: Semen + BTSa, T2: Semen + BTSb, T3: Semen + BTSb + 1.0% Honey Extract, T4: Semen + BTSb + 1.5% Honey Extract, T5: Semen + BTSb + 2.0% Honey Extract) with three replicates arranged in a completely randomized experimental design (CRD). Livability, normal spermatozoa, acrosome integrity, and microbial load were variables assessed at 0, 12, and 24 hours.Results showed that Treatment 3, comparable to T1, exhibited the highest ($p<0.05$) level of livability at 98.00%, signifying the optimal overall environment for cell viability maintenance. A comparable decrease in microbial load was observed with an increasing level of honey inclusion, indicating antimicrobial effects in extended semen, at 12 hours.Findings in this study suggested an optimal inclusion of natural honey as antimicrobial component in boar semen extender of 1.0%, comparable to the use of conventional extenders used in the control in this study.

Keywords:

INTRODUCTION

The swine industry is a vital contributor to global food security, and artificial insemination (AI) plays a crucial role in its efficiency. However, extended porcine semen faces significant challenges, including bacterial contamination and compromised sperm quality, which can negatively impact fertility and reproductive success. Traditionally, antibiotics have been used in semen extenders to combat bacterial growth but concerns about antibiotic resistance and potential side effects have driven the search for safer and more natural alternatives.

Natural honey has emerged as a promising candidate due to its well-documented antibacterial properties. Honey's diverse composition, including sugars, phenolic acids, flavonoids, and enzymes, contributes to its broad-spectrum antimicrobial activity against various bacteria commonly found in semen (5). Studies have demonstrated honey's effectiveness in inhibiting the growth of *Escherichia coli, Staphylococcus aureus, and Pseudomonas aeruginosa*, all of which can negatively impact semen quality and fertility (5).

The u'e of synthetic antimicrobials have been reported to exhibit anti-microbial resistance (AMR) and this has led to the shift in focus to the use of natural antimicrobials (6). The principal objective of this study is to insight into the maximization and enhancement of semen quality and fertilizing potentials using natural honey as a principal component in the production of healthy and comparatively productive offspring artificially in commercial swine industry.

MATERIALS AND METHODS

Experimental Location

The research was carried out at the Piggery unit of the Teaching and Research Farm and Animal Physiology Laboratory, Department of Animal Science, University of Ibadan, Ibadan. Semen collection was done at the Porcine Unit of the Teaching and Research Farm, University of Ibadan (7° 20'N, 3° 50'E; 200 - 300 above sea level), while the analyses of semen was carried out at the Animal Physiology and Bioclimatology Laboratories of the Department of Animal Science of the same institution.

Preparation of Extracts

The natural honey was purchased from Teaching and Research Farm, University of Ibadan, Nigeria (7° 20'N, 3° 50'E; 200 - 300 above sea level). It was stored for further use. The honey solution was put into four test tubes containing 4.0 mL per tube. 10% (v/v) graded concentration of honey supplement was obtained by constituting 10 mL of the natural honey in 100 mL distilled water mixed together in a 100 mL Volumetric flask.

Preparation of Semen Extender

Prior to semen collection from the boar, Beltsville Thawing Solutions (BTS) extender were prepared with 'a' containing synthetic antibiotics and 'b' without. The collected ejaculate was mixed thoroughly but gently in a swirling motion with the extender (in a ratio of 1:3) at a differential temperature of not more than 1 °C using a thermo regulated refrigerator.

Experimental Treatment and Design

Aliquot portions of diluted semen were allotted to three (5) treatments with four (3) replicates (n=15) per treatment in a completely randomized design (CRD).
Evaluations of semen quality and spermatozoa fertilising potential was carried out at time intervals of 0, 12, and 24 hours.

Treatment Description

Treatment 1: Semen + BTS^a
Treatment 2: Semen + BTS^b
Treatment 3: Semen + BTS^b + 1.0% Honey Extract
Treatment 4: Semen + BTS^b + 1.5% Honey Extract
Treatment 5: Semen + BTS^b + 2.0% Honey Extract

Statistical Analyses

Means from all data collected during study were analysed using one-way analysis of variance (ANOVA) for completely randomized design using SAS (2011) and means were separated using Tukey HSD procedure of the same programme.

RESULTS

Table 1 sheds light on the dynamic influence of honey on semen quality parameters after extension. All parameters (liveability, normal spermatozoa, and acrosome integrity) exhibited significant differences ($P<0.05$) across treatments. While T1, T3, T4 and T5 displayed similar liveability mean values and T2 show the lowest value. Also, the inclusion of natural honey in extended boar semen demonstrated a significant positive effect ($P<0.05$) on spermatozoa liveability compared to the control groups (T1 and T2). This trend was also observed for microbial load.

Table 1: Effects of Natural Honey on the Quality of Extended Boar Semen at 0, 12 and 24 Hours

Parameters (%)	T1	T2	T3	T4	T5	SEM
0 Hour						
Liveability	97.67^{a}	94.33^{c}	98.00^{a}	96.67^{ab}	95.33^{bc}	0.41
Normal Spermatozoa	93.00	93.67	95.00	93.00	92.00	0.37
Acrosome integrity	92.00	90.67	93.33	93.33	94.00	0.45
12 Hours						
Liveability	96.00 ^{a}	87.00^{b}	96.33 ^{a}	94.33^{a}	94.67 ^{a}	1.02
Normal Spermatozoa	90.67^{a}	80.00^{b}	93.33^{a}	89.67^{a}	90.00 ^{a}	1.29
Acrosome integrity	86.67^{bc}	85.00^{c}	93.33^{a}	92.67^{a}	91.33^{ab}	1.02
24 Hours						
Liveability	95.00 ^{a}	84.67^{c}	93.33^{ab}	90.00^{b}	92.00^{ab}	1.03
Normal Spermatozoa	90.67^{a}	80.00^{b}	93.33^{a}	89.67^{a}	90.00 ^{a}	1.29
Acrosome integrity	86.67^{bc}	85.00^{c}	93.33^{a}	92.67^{a}	91.33^{ab}	1.02

abc = means on the same row with different superscripts are significantly different, SEM = Standard error of the mean.

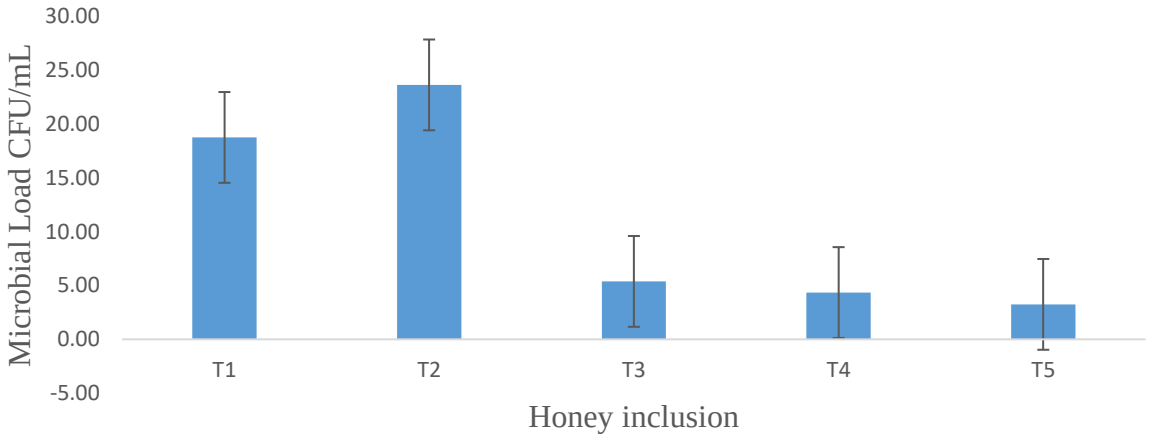

Figure 1: Antimicrobial effects of Natural Honey in Extended Boar Semen at 12 Hours

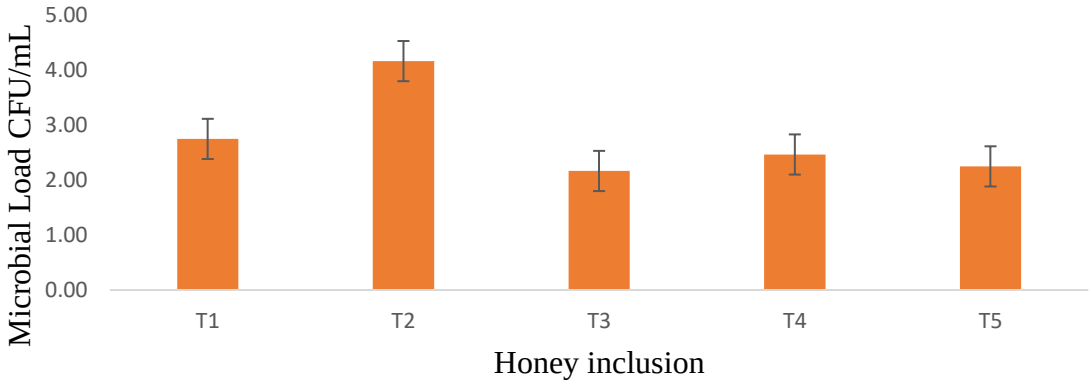

Figure 2: Antimicrobial effects of Natural Honey in Extended Boar Semen at 24 Hours

Discussion

The observed results for spermatozoa quality parameters assessed in this study reinforce the initial observation of honey's potential to enhance sperm survival. Honey is abundant in energy substrates, primarily monosaccharides with small amounts of disaccharides. It contains various natural bio-active compounds such as phenolics, glycoproteins, flavonoids, high-mannose N-glycans and peptides. These components operate through complex mechanisms, contributing to its antoxidative, antiparasitic, anti-microbial and anti-inflammatory properties (3).

The antimicrobial properties of honey are associated with hydrogen peroxide (H_2O_2), which is generated by glucose oxidase, particularly when honey is diluted. Hydrogen peroxide exhibits antibacterial activity without causing tissue damage (2). However, certain honeys maintain their anti-microbial effectiveness even in presence of catalase known as "non-peroxidase honeys" (4). This characteristic is particularly significant in the context of topical anti-microbial applications (5).

The reductions of antibacterial load observed in natural honey treated extended boar semen samples align with previous research by (4) who reported honey's antibacterial properties against various microorganisms commonly found in boar semen. The improved liveability suggests that honey may effectively combat bacterial growth, potentially creating a more favourable environment for spermatozoa survival.

CONCLUSION

Findings in this study suggested an optimal inclusion of natural honey in boar semen extender of 1.0%, comparable to the use of conventional extenders used in the control in this study.

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Animal Physiology, Reproduction and Health: APH033

IMPLICATIONS OF LIGHT INTENSITIES ON INTERNAL QUALITY AND LIPID PEROXIDATION OF EGGS FROM HENS AT EARLY LAYING PHASE.

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ABSTRACT

Implication of varying light intensities on internal qualities and lipid peroxidation of eggs collected from laying hens were examined in this study. ISA Brown chicks (n=120) aged 18 weeks were randomly allotted to four treatments; each treatment were replicated five times with six birds per replicate. The hens were raised in a three-tier cage system, The birds were allotted to four levels of light intensities (0, 9, 13.5 and 18lux) of blue colour in a completely randomized design. At age 26 weeks, three randomly selected eggs from the pullets (n=12) were assessed for the internal quality attributes. Results showed that the egg weight, albumen weight, albumen height, yolk weight, yolk height, yolk width and Haugh unit of eggs exposed were not significantly affected by the treatments ($p>0.05$). However, the thiobarbituric acid reactive substances (mg/g), of eggs in T3 (0.029) was significantly higher ($p<0.05$) than T2 (0.023) and also significantly higher ($p>0.05$) than T4 (0.018) and T2 (0.016). Therefore, most internal qualities indices were not affected by the treatments except the thiobarbituric acid reactive substances (TBARS) which seemed to be negatively enhanced by much more intensive blue lighting.

Keywords: Laying hens, Haugh unit, Internal egg qualities, ISA Brown, Thiobarbituric acid reactive substances.

DESCRIPTION OF PROBLEM

Light is a crucial environmental factor influencing the production, welfare and behaviour of laying hens (1, 2, 3). Artificial illumination should be applied to laying hens to achieve the expected production level in poultry houses with or without windows. In this respect, different lighting programs have been developed (4, 5).

Light has five basic characteristics: source, intensity, duration, uniformity, and wavelength (light colour) (6). Research on poultry lighting dates back to the early 1930s, since then, extensive research has led to a broad understanding of lighting effects on poultry (7). Recently, more energy efficient, durable, affordable, and dimmable light emitting diode (LED) lights are increasingly finding applications in poultry production. Light is a crucial environmental factor that affects bird behavior, development, production performance, health, and wellbeing (8, 9). Quality of light used in illumination is defined as light intensity and spectrum quality (11). Light intensity is suggested to provide a suitable environment for management rather than meeting the physiological requirements of hens (4). In addition, white light with intensity in the range of 0.9 and 1.7lx is required for the stimulation of photoperiodic mechanisms (8). The spectrum of light is known to influence egg quality. (9) indicated that incandescent bulbs increased egg weight as compared to red LEDs and egg quality was influenced by different colours of LED light. After incandescent bulbs, fluorescent lamps and mini fluorescent lamps, the use of LEDs has grown in poultry production in countries like Germany, the Netherlands, Austria and England due to their durability, low cost and high energy efficiency. LEDs in green colours are preferred source of lighting in Switzerland. Red LEDs improve sexual maturation and provide a calming effect in hens (10). A comprehensive review was made on the evidence available on

the light intensity required for the performance of pullets and laying hens (8). It was also stated that a light intensity of about 5 lux is adequate for laying hens but recommend that light intensity for laying hens are selected on the basis of the working conditions of the staff as well as ensuring adequate inspection of the flock, rather than because of the physiological needs of the birds (12), Other reports on the importance of lighting intensity have been focused on performance of pullets (8, 11, 12). There is the therefore the need for documentation on the different lighting intensity on the internal quality attributes of eggs from laying pullets at the early laying phase which is the objective of the present research or endeavour.

MATERIALS AND METHOD

This experiment was conducted at the Poultry Unit, Teaching and Research Farm, University of Ibadan, Ibadan, Nigeria. The study area lies between latitude 7° 23' 28.19" N and Longitude: 3° 54' 59.99" E (23).

Data Collection

Eggs from birds (n=120) exposed to blue colour of light in four levels of light intensities (0, 9, 13.5 and 18 lux) were examined in this study. Each treatment group was in triplicate of one egg per replicate making twelve eggs for the storage day. Eggs attributes were determined after 24 hours of collection.

Measurement of Internal Characteristics

The Internal qualities determined were albumen weight(g), albumen height(mm), yolk height(mm), yolk weight(g) and yolk width(mm). Each egg was broken on a flat petri dish. The yolk was carefully separated from the albumen, it's height and width were measured using Vernier caliper, and its weight was measured using campy electronic digital scale. The albumen height was also determined using Vernier caliper. The albumen weight was determined by the difference in egg weight and the combined weight of yolk and dry shell. Egg weight- (Yolk weight +dry shell weight). The Haugh unit (HU) was calculated using the formula;
$HU=100 \log (H+7.6-1.7W^{0.37})$
H=observed albumen height in mm and W=observed weight of the egg in grams.

Statistical analyses

Data were subjected to descriptive statistics and analysis of variance using Statistical Package for Social Sciences (SPSS) version 26.0(IBM Corp., Armonk, NY, USA). Means were separated by Duncan's multiple range test option of the same software at α0.05.

RESULTS

Effects of varying light intensities on the internal qualities of eggs sample.
The effects of light intensities on the internal qualities of eggs sample at day one of storage are presented in table1, there was no significant differences ($p>0.05$) in the Egg weight, Albumen weight, Albumen height, Yolk height, Yolk weight, Yolk width and Haugh Unit across all the treatments. Thus, the three levels of the lighting intensities (9lux, 13.5 lux and 18 lux) did not perform relatively best to the control.

Table 1; Internal quality of eggs from laying hens exposed to different light intensity at early laying phase.

Parameters	T1	T2	T3	T4	SEM
Egg Weight	56.00	54.00	53.00	54.67	1.61
Albumen Weight	33.67	32.67	32.00	33.33	1.11
Albumen Height	10.00	11.67	11.00	11.33	0.49
Yolk Weight	12.67	13.67	11.67	12.67	0.39
Yolk Height	1.03	1.17	1.13	1.07	0.03
Yolk diameter	33.67	32.67	32.00	33.33	0.03
Haugh Unit	98.59	107.19	105.01	105.93	2.12

[a,b,c,d] Means with different superscripts on the same column are significantly different($p<0.05$)
Lipid peroxidation of laying hens exposed to different light intensity at early laying phase.

The effect of light intensity on the lipid peroxidation profile of laying hens is shown in table 2. The thiobarbituric acid reactive substances were significant($p<0.05$) across all the treatments. Hens on T3 (0.029) and T2 (0.023) had higher value respectively, while Hens on T4 (0.016) and T1 (0.018) were almost similar in value. Thus, Hens from T1 performed relatively best others, according to (13) who states that the lower the thiobarbituric acid reactive substances (TBARS) value, the safer the egg is for consumption.

Table 2: Lipid peroxidation of laying hens exposed to different light intensity at early laying phase**.**

Parameter	T1	T2	T3	T4	SEM
TBARS	0.016^{c}	0.023^{b}	0.029^{a}	0.018^{d}	0.002

^{a,b,c,d} Mean with different superscripts on the same column are significantly different ($p<0.05$). (TBARS) Thiobarbituric acid reactive substances

CONCLUSION

Most internal qualities indices were not affected by the treatments except the thiobarbituric acid reactive substances (TBARS) which seemed to be negatively enhanced by much more intensive blue lighting. Thus, light intensity is rather suitable for environmental management.

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Animal Physiology, Reproduction and Health: APH034

EVALUATION OF UDDER TRAITS AND THEIR CORRELATIONS WITH SOMATIC CELL COUNT IN DAIRY CATTLE

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ABSTRACT

The aim of this study was to investigate the quality of milk for the different breeds (Bunaji, Wadara and Crossbred) and the association between udder and teat traits in relation to somatic cell count at the dairy research centre. Udder and teat traits assessed include udder depth (UD), fore teat length (FTL), rear teat length (RTL), fore teat diameter (FTD), rear teat diameter (RTD), and teat distance from the ground (TDG). Milk samples were collected from 37 cows (15 Bunaji, 12Wadara and 10 Crossbred) over a period of 16 weeks with a week interval. Mean, standard deviation (SD) and coefficient of variation (CV) for udder and teat traits ($P< 0.01$) showed significant differences ($P<0.01$) were observed in UD (mean 22.117, SD 2.266, CV 23.96%) and RTL ($P<0.05$; mean 4.598, SD 0.638, CV 26.71%). No significant differences in SCC were found among the three breeds ($P>0.05$). Negative correlations were identified between SCC and UD (-0.071), RTL (-0.157), FTD (-0.100), and RTD (-0.030). Positive correlations were found between SCC and FTL (+0.203) and TDG (+0.050). In conclusion, considerable variations were observed for some udder and teat traits measured among the three breeds of cattle and the negative correlations between udder, and teat traits and SCC suggest that these characteristics may have a mitigating effect on SCC levels.

Keywords: Somatic cell count; bulk tank somatic cell count, udder traits, teat traits.

DESCRIPTION OF PROBLEM

Somatic cell count is used to assess fresh milk quality and safety (1). Some of these udder and teat characters are heritable (2). The inclusion of the desirable characters of udder and teats which would encourage negative selection against mastitis in breeding programmes and in turn reduce the incidence of mastitis in future population is highly essential (3). The number of epithelial cells and leucocytes (somatic cells) normally found in milk, increase in case of mammary infection (mastitis). As Somatic Cell Count (SCC) increases, milk yield and the fat and protein content of milk decrease (4). Furthermore, the shelf-life of milk and milk products shortens (5). Costs of medication and veterinary services for mastitis treatment reduce the profitability of holdings (6). Thus, the udder and the conformation traits could be used to improve udder health (7). Udder and teat conformation traits were reported to have a relationship with somatic cell count (8) and mastitis resistance (9). This study was therefore carried out to evaluate the relationship between udder and teat characteristics with Somatic Cell Count (SCC) from Bunaji, Wadara and Crossbred cows.

MATERIALS AND METHODS

This study was carried out at Abubakar Tafawa Balewa University Dairy Research and Development Centre Gubi, Bauchi State, Nigeria. Bauchi State is located in the Northern Guinea Savannah Agro-ecological Zone of Nigeria, at approximately 10°17'N, 9°49'E and 690.3m above sea level.

Experimental Animals

Dairy cattle in the farm; comprised15 Bunaji, 12 Wadara and 10 Crossbred i.e 37 cows. They were managed under semi-intensive system. This means the cows had access to unrestricted free –grazing in addition to supplementary feeds (crop residue, concentrate and hay). The concentrates were supplied in the morning between 7:30 to 8:00 am while the crop residue and hay were given in the evening between 5:30 to 6:00pm.

Data collection

Somatic cell count

Milk samples (5 ml) were collected from cows during morning milking (6-7 am) on specific dates between February 23rd and May 18th. Samples were stored at 4°C in ice pack containers and transported to the National Veterinary Research Institute NVRI, Vom, in Plateau State for analysis. The surface viable count technique was use as described by (11). Serial dilution was performed using six tubes containing 9 ml of sterile distilled water. From each dilution, 20 µL was inoculated onto dried blood agar plates, which were then incubated for 18-24 hours. Colony-Forming Units (CFU) per ml was determined by counting colonies from sectors with the highest number of discrete colonies. The calculation used was: CFU/ml = Average number of colonies for a dilution x 50 x dilution factor

Udder and teat traits

Udder depth was measured as the distance from the lowest part of the udder floor to the hock or distance between rear attachments, was taken by using flexible tape .**Teat length** was measured from the upper part of the teat, where it hangs perpendicularly from the quarter to the tip, was taken by using flexible tape.**Rear teat length** was measured from the upper part of the teat, where it hangs perpendicularly from the quarter to the tip, was taken by using flexible tape. **Teat diameter** was measured at the mid- point length by Vernier Caliper to the nearest 0.01 cm. **Teat distance from the ground** was measured as the distance of teat tip from ground by using flexible tape. All measurements are in centimeters (cm) (11, 12) and (13)

Data analysis

The quantitative data collected were analysed by means of General Linear Model (GLM) and coefficient of correlation using SPSS version 26.0.

RESULTS AND DISCUSSION

Difference in somatic cell count between Bunaji, Wadara and Crossbred

The difference in somatic cell count (SCC) between Bunaji, Wadara and Crossbred is shown in Table 1. The effect of breed was not Significant (P>0.05) Bunaji with mean values of 679902 cells/mL of milk Wadara 188442 cells/mL of milk and Crossbred 132715 cells/mL of milk. The mean total of the SCC values for the three breeds 333686.483 cells/mL of milk as bulk tank somatic cell count (BTSCC) is healthy and consumable as reported by (1).

Comparison of udder and teat traits between Bunaji, Wadara and Crossbred

Mean standard deviation and coefficient of variation for udder and teat traits measurements are presented on Table 2 showed Breeds had significant difference (P< 0.05) in udder depth and rear teat length among Bunaji, Crossbred, and Wadara cattle. Notably, all breeds demonstrated greater udder depths compared to previous reports by (14, 15) with Wadara having the highest values. Rear teat length in Bunaji was found to be larger than reported by (16), while Crossbred and Wadara measurements were consistent with earlier findings by (13, 16) These results highlight the importance of breed-specific considerations in dairy cattle management and breeding programs. The observed differences in udder and teat characteristics may have implications for milking efficiency, udder health, and overall productivity. Further research is warranted to explore the genetic and environmental factors contributing to these variations and their potential impact on dairy production systems.

Correlations of udder and teat traits with somatic cell count

Table 3 present correlations of udder and teat measurement traits with somatic cell count. The data from the table showed that correlation coefficient of udder depth (-0.071) with somatic cell count was negative and not significant which was contradictory with the result of (17) and (13). Teat distance from the ground showed positive correlation coefficient with somatic cell count (+ 0.050) but not significant which disagree with the result reported by (17) and (13). Fore teat length showed positive correlation coefficient with somatic cell count (+ 0.203) which is similar to report by (17) and (13). Rear teat length showed negative

correlation coefficient with somatic cell count (-0.157) not significant which disagree with the result reported by (17) and (13). Fore teat diameter showed negative and no significant correlation coefficient with somatic cell count (-0.100) which is not in consonant with the result reported by (18). Rear teat diameter showed negative and no significant correlation coefficient with somatic cell count (-0.030) which is at variance with the result reported by (18). Potential explanations for these differences could include variations in breed characteristics, environmental factors, management practices, or sample size limitations.

Table 1: Mean ± standard deviation and coefficient of variation for somatic cell count

Parameter	Overall	Bunaji	Wadara	Crossed	Mean±SD	CV%	p-value
Observation	37	15	12	10			
SCCx10^3/ml		679902	188442	132715	333686.483±1169174^{NS}	4.9	0.425

Standard deviation=SD, Coefficient of variation =CV, No Significant different = NS, Somatic cell count = SCC. (P>0.05)

Table 2: Mean ± standard deviation and coefficient of variation for udder and teat traits

Parameter	Overall	Bunaji	Wadara	Crossed	Mean±SD	CV%	p-value
Observation	37	15	12	10			
Udder depth		22.000^{ab}	23.750^{a}	20.600^{b}	22.117±2.266	23.96	0.010
Front teat length		5.667	5.250	5.050	5.322±0.695^{NS}	13.27	0.089
Rear teat length		5.100^{a}	4.383^{b}	4.310^{b}	4.598±0.638	26.71	0.005
Front teat diameter		1.800	1.833	1.870	1.834±0.363^{NS}	0.94	0.852
Rear teat diameter		1.380	1.267	1.150	1.266±0.321^{NS}	9.63	0.179
Teat distance from the ground		62.067	65.167	63.600	63.611±3.240^{NS}	15.25	0.060

^{ab} Means with difference subscripts are significantly different, SD= standard deviation, CV= coefficient of variation, NS= No significant difference, (P< 0.05).

Table 3: Correlations of udder and teat measurement traits with somatic cell count

Traits	Somatic cell count
Udder depth	-0.071
Front teat length	+0.203
Rear teat length	-0.157
Fore teat diameter	-0.100
Rear teat diameter	-0.030
Teat distance from the ground	+0.050

(P>0.05)

CONCLUSIONS

The findings from this study had shown that the Bulk Tank Somatic Cell Count (BTSCC) is within the normal range. The negative correlations suggests that these characteristics may have a mitigating effect on SCC level. There were considerable variations in udder depth and rear teat length which indicated some genetic distinctions between the three breeds.

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Animal Physiology, Reproduction and Health: APH035

LIPID PROFILE OF EGG FROM HENS EXPOSED TO VARYING LIGHTING COLOUR AND INTENSITY AT THE EARLY LAYING PHASE

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ABSTRACT

The impact of varying lighting colour and intensity on lipid profile of eggs at the early laying phase was assessed in this study. Isa-Brown pullets (n=300) weighing 1.5±2kg at week-16, were randomly allotted to four lighting colours (White, Blue, Red and Green) and three intensities (10, 15, 20), each treatment replicated five times in a completely randomised design. The hens were exposed to additional photoperiod of four hours per day beyond the daylight duration. At week 30 hen-age, eggs were sampled, weighed, labelled and analysed for lipid profile. Total phospholipid (%) was not significantly affected ($p>0.05$) by the lighting colours and intensity. Triglyceride (mg/dL) was significantly higher ($p<0.05$) in eggs from hens exposed to white and control than blue, red and green. Also, linoleic and linolenic fatty acid compositions (%) of eggs from blue, red, and green were significantly higher ($p<0.05$) than control and white. Hens exposed to different lighting intensities produced eggs with similar Total phospholipid compositions. Laying chickens on intensities of 0 and 15 had higher ($p<0.05$) egg Triglyceride contents than 20 and 10. Also, egg linoleic acid contents from layers on 10, 15 and 20 were higher than those on 0. Red performed best in all parameters examined relative to others. The response of hens to varying lighting colours and intensities indicated that the light that will be used in poultry production during laying phase of chicken should be monitored. In conclusively, hens exposed to blue, red, green lighting colours and 10 and 15 intensities produced better egg lipid profile.

Key words: Laying Hens, Light colour, Light intensity and photoperiod, Lipid profile

INTRODUCTION

Environmental manipulation is an effective means to improve poultry production and welfare (11, 12). Among those environmental factors, light plays a vital role in affecting chicken production (16). Light has five basic characteristics: source, intensity, duration, uniformity, and wavelength (light colour) (7). Eggs are animal protein sources that contain essential nutrients in the form of selenium, B vitamins, provitamin A, amino acids, folic acid, and fatty acids (13). Egg production is influenced by climate, feed, and the health of the laying hens.

Light is a crucial environmental factor influencing the production, welfare and behavior of laying hens (9, 8). With a ban on traditional incandescent bulbs, the poultry industry is undergoing a shift to alternative lighting sources, such as light-emitting diode (LED) bulbs and compact fluorescent lamps (CFL), which are luminous efficient and have long lifespans. Facets involved in light management of chickens include photoperiod, intensity, and wavelength (monochromatic light colour) (10). Growth rate and feed efficiency during the pullet phase as well as reproductive status during the laying phase are two of the main parameters underlying the performance of commercial laying hens; each of these can be influenced by artificial lighting.

Light spectrum is the combination of different wavelengths of electromagnetic radiation produced by a lighting source(3). There is increasing attention in the literature with respect to LED spectrum reflecting the lighting quality as part of lighting programs (14). It is shown that the different monochromatic light or different colour temperature exert variable effects for the production efficiency (3, 15, 17). The spectrum of

light is known to influence egg quality. A study indicated that incandescent bulbs increased egg weight as compared to red LEDs and egg quality was influenced by different colours of LED light (5). After incandescent bulbs, fluorescent lamps and mini fluorescent lamps, the use of LEDs has grown in poultry production in countries like Germany, the Netherlands, Austria and England due to their durability, low cost and high energy efficiency. LEDs in green colour are a preferred source of lighting in Switzerland. Red LEDs improve sexual maturation and provide a calming effect in hens (6).

Research on poultry lighting dates to the early 1930s. Since then, extensive research has led to a broad understanding of lighting's effects on poultry. (5) investigated the effect of different coloured LED lights on egg quality and found that hens under red light laid smaller eggs at earlier periods than those under blue or green lights; egg length in blue light was shorter than in other colored lights; shell strength in green light was greater than those in white and blue lights. (4) compared the effect of different colored LED lights vs. incandescent lights on laying hens, and the results showed no influence of the LED vs. incandescent lights on the internal egg quality. These effects of lighting colours and intensities on quality of eggs from laying hens were all observed in humid environment (region). Therefore, this experiment observed the effect and interaction of varying lighting colours and intensities on lipid profile of egg from laying hens at early laying phase in tropical region.

MATERIALS AND METHOD

Experimental Site

The Study was carried out at the Teaching and Research Farm, University of Ibadan, Ibadan, Oyo State, Nigeria. The study area lies between the longitude 7º27.05 N and 3º53.74 of the Greenwich Meridian East, at an altitude of 200m above sea level. The average temperature of the location was 23ºC-42ºC, while the humidity was 60%-80% (SMUI, 2018). Feed preparation was carried out at the Central Nutrition Laboratory, Department of Animal Science.

Experimental Birds

Isa-Brown pullets (n=300) weighing 1.5±2kg at week-16, were randomly allotted to four lighting colours (White, Blue, Red and Green) with three intensities (10, 15, 20) which were replicated five times in a Completely Randomised Design. The hens were exposed to additional photoperiod of four hours per day beyond the daylight duration. At week 30 hen-age, eggs were sampled, weighed, labelled and analysed for lipid profile

Data Collection

The lipid profile was determined by standard procedures (1).
The % of each Fatty Acid is obtained using the formula:

$$\%\text{Fatty Acid} = \frac{\text{Absorbance of sample x Gradient Factor of a Specific Fatty Acid x DF}}{\text{Wt. of Sample x 10000}}$$

Where DF = Dilution Factor.

Chemical and Statistical Analysis

Samples were analysed chemically according to the official methods of analysis described by the Association of Official Analytical Chemist (2). All analysis were carried out in duplicate. Analysis of variance (ANOVA) and descriptive statistics were used to analyse data obtained on lipid profile. Means across groups were separated with the aid of Duncan Multiple Range Tests. Results were expressed as mean ± standard deviation, while the level of significance was at $p \leq 0.05$. All statistical analysis were performed using the Statistical Package for Social Sciences (SPSS) version 26.0 (IBM Corp., Armonk, NY, USA).

RESULTS AND DISCUSSION

Lipid Profile of Egg from Laying Hen exposed to varying lighting colour at early Laying Phase.

The lipid profile of egg from laying hen exposed to varying lighting colour at early laying phase are presented in Table 1. There were no significant effect (P>0.05) in total phospholipid parameters examined while Triglyceride, Linoleic acid, Linolenic acid and Arachidonic acid parameters were significantly (P<0.05) affected. Triglyceride had significantly (p<0.05) higher value for hens on white (54.65) and control (41.84) than blue (38.05), red (37.24) and green (32.90). The effect of lighting colour on total phospholipid content examined was not significantly affected (P>0.05) in all treatments. Also, linoleic acid for hens on blue (2.60), red (2.55), and green (2.57) were highly affected significantly (p<0.05) than for hens on control (0.89), and white (0.00). The effect of lighting colour on linolenic acid for hens on control (0.00), white (0.00), blue (0.40) and green (0.40) were significantly similar (p<0.05). The Arachidonic acid was significantly affected (p<0.05) in blue (0.20) than in the other treatments while control (0.00) and white (0.00) were similar. Thus, blue and red performed best relative to control, white and green colour.

Table 1: Lipid Profile of Egg from Laying Hen exposed to different lighting colour at early laying phase.

Parameters/Treatments	Control	WHITE	BLUE	RED	GREEN	SEM
Triglyceride (mg/dl)	41.840[b]	54.650[a]	38.053[c]	37.243[d]	32.930	1.982
Total Phospholipid (%)	2.433	2.630	2.350	2.330	12.513	2.036
Linoleic Acid (%)	0.890[b]	0.000[b]	2.603[a]	2.553[a]	2.570[a]	0.326
Linolenic Acid (%)	0.000[b]	0.000[b]	0.040[a]	0.050[a]	0.040[a]	0.006
Arachidonic Acid (%)	0.000[c]	0.000[c]	0.200[a]	0.190[ab]	0.170[b]	0.024

[a, b, c, d:] *Means on the same row with different superscripts differ significantly (P>0.05). SEM: Standard Error of Mean.*

Lipid Profile of Egg from Laying Hen exposed to varying lighting intensity at early laying phase.

The lipid profile of egg from laying hen exposed to varying lighting intensity at early laying phase are presented in Table 2. The result at the laying phase of this study indicated that light is a factor that could be used to improve the performance and egg lipid profile of layer chickens. The result is in agreement with (6) who reported improvement in egg production and egg quality when different intensity of light was introduced to layer chickens during laying phase. In Table 2, the total phospholipid parameters examined were not significantly affected (P>0.05) in all treatments. Hens on control and 15 had higher significant (p<0.05) value of triglyceride (41.84) and (40.23) respectively than 20 (35.07) and 10 (32.93). Also, linoleic acid was significantly affected in 10 (2.570), 15 (2.61), and 20 (2.55) than in control (0.89). Linolenic acid in hens on control (0.00) is lower significantly (p<0.05) while hens on 15 (0.50) and 10 (0.40) had significantly higher value (p<0.05). The Arachidonic acid was highly affected significantly (p<0.05) in 15 (0.21) than in other treatments. Thus, 15 watts performed best relative to control, 10 and 20 Watts.

Table 2: Lipid Profile of Egg from Laying Hen exposed to varying lighting intensity at early laying phase.

Parameters/Treatments	Control	10Watts	15Watts	20Watts	SEM
Triglyceride (mg/dl)	41.840[a]	32.930[d]	40.227[b]	35.073[c]	1.098
Total Phospholipid (%)	2.433	12.513	2.370	2.273	2.550
Linoleic Acid (%)	0.890[b]	2.570[a]	2.610[a]	2.547[a]	0.291
Linolenic Acid (%)	0.000[c]	0.040[a]	0.050[a]	0.020[b]	0.006
Arachidonic Acid (%)	0.000[c]	0.170[b]	0.210[a]	0.150[b]	0.024

[a, b, c, d:] *Means on the same row with different superscripts differ significantly (P>0.05).SEM: Standard Error of Mean.*

Conclusion and Recommendation

Hens on Blue and Red colour performed outstandingly well than other light colours and control. These findings suggests that a combination of 10Watts of white, 20Watts of red and 20Watts of blue light might promote egg production and egg quality in layer chickens. Further studies can be conducted for in-depth

analysis on light colour and intensity on laying hens, in order to establish why the colours and its intensity led to better performance on lipid profile.

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Animal Physiology, Reproduction and Health: APH036

THE EFFECT OF RED PALM OIL ON PERFORMANCE IN WISTAR RATS

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ABSTRACT

Palm oil is a widely consumed vegetable oil in the tropics, renowned for its unique fatty acid composition and nutritional content. Recent studies have suggested its potential cardioprotective effects attributed to its distinct fatty acid composition and antioxidant content. The study assessed the effect of varying dietary inclusion levels of Red Palm Oil (RPO) on the performance in Wistar rats. Forty-eight Wistar rats aged 90 days were randomly divided into four groups (n=12 each), and were fed either the control diet (group 1) containing standard rat chow 0% RPO, or any of the three experimental diets containing graded levels of RPO at 20%, 30%, and 40% for groups, 2, 3 and 4 respectively for 42 days. During the feeding trial, body weight, daily weight gain, daily feed intake, and feed conversion ratio were monitored. The result indicates inclusion of varying levels of red palm oil in Wistar rat diets increased daily weight and weight gain ($p<0.05$) in males when compared to females. However, the daily feed intake, feed intake, feed efficiency and feed conversion ratio ($p>0.05$) were not affected among genders and treatments. The study concludes that daily intake of red palm oil in diets below 400mg/kg inclusion does not alter the physiological responses of Wistar rats. Therefore, we recommend the consumption of red palm oil with less than or not more than 400 mg/kg in daily intake, as it has no adverse effects on the performance.

Key words: Red palm oil, Wistar rat, Weight gain, Feed intake, Diet, Performance.

DESCRIPTION OF PROBLEM

Red palm oil (RPO; *Elaeis guineensis*) is produced from the mesocarp of palm oil fruit. There are two distinct oils produced from palm oil fruit - RPO and palm kernel oil. RPO and palm kernel oil have the same botanical origin, but differ significantly in their fatty acid (FA) composition. RPO was first discovered in Nigeria, West Africa as an edible vegetable oil; and is also grown in Asia, North and South America as the largest exporter of RPO is Malaysia. RPO is mostly consumed in the whole world as vegetable oil and the global statistics has shown that 38% of the world's vegetable-oil output is produced from RPO (7). Interestingly, RPO is used primarily to replace animal fats and hydrogenated fats in the food industry.
RPO obtained from palm oil fruit is red in colour due to its richness in phytonutrients, carotenes, vitamin E and high amounts of fat-soluble antioxidants (carotenoids, tocopherols, tocotrienols, phytosterols, phospholipids, glycolipids) with superior oxidative stability (9, 8). The biological properties of RPO provide synergistic protection against oxidation of unsaturated triacylglycerols (4). Within the group of edible fats, RPO has been known to improve palatability, release flavors and aromas of meals and contribute to the feeling of satiety (5). Literature has shown that addition of fat to diets improve the absorption of fat-soluble vitamins, diminish the pulverulence and increase the efficiency of the consumed energy (lower caloric increment).

The nutritional, health, and industrial benefits of RPO are well documented as the most widely produced edible vegetable oil in the world. For health and industrial issues, palm oil as a cooking oil is considered controversial because of the link between dietary fat and cardiovascular diseases (6). RPO continues to be a major dietary fat in the rations of many populations around the world and is the most misunderstood dietary fats. The study tested the hypothesis that daily consumption of RPO in diet would adversely affect the

performance of Wistar rats. Therefore, the study investigated the effect of RPO inclusion on the performance of Wistar rats.

MATERIALS AND METHODS

The study location and Ethical approval

The institutional research and ethics committee of Alvan Ikoku Federal University of Education, Owerri, Imo State, Nigeria approved the study and its experimental protocols complied with the standard iidelines of Institution Animal Scientific procedures.

Experimental animals and housing

The Wistar rats were housed in stainless steel, wire-bottom cages. The Wistar rats (n=48), aged 90 days and body weight of 149 ± 1.0g bought from Covenant Farm, Gbolasire area, Iwo Road, Ibadan, Oyo State were used for the study. They were housed individually in 14 (length) x 14 (width) x 15 (height) cm metabolic cages, with room temperature of 27 ± 2°C. A light: dark cycle of 13 h:11 h. All the animals were acclimated for one week in the animal house before the 6-week feeding trial with free access to feed and water. The experimental animals were maintained under a standardised pathogen-free animal house conditions and observed daily throughout the feeding trials.

Animal feed and RPO preparation

The conventional isocaloric rat diet prepared by Top Feed mills, Sapele, Delta State, Nigeria on dry matter basis was used for the study. The red palm oil was purchased from local factory in Owerri, Imo state. The experimental diets were prepared by mixing varied levels of RPO (0, 200, 300, 400mg/kg) into the basal diet. The RPO was manually mixed with the animal diet (basal) and left at room temperature overnight before the commencement of feeding trial. Forty-eight Wistar rats were randomly assigned to 4 dietary treatments of 12 animals per group comprising 0, 200, 300 & 400mg/kg, graded levels RPO for treatments 1 (control), 2, 3 and 4 respectively. The animals were fed the treatment diets for 6 weeks. For each animal feed (15g) was weighed in and the residual feed was weighed out the following morning and recorded daily.

Growth index

The growth of Wistar rats is monitored and measured daily and weekly. Weight gain, daily weight gain (DWG), feed intake, daily feed intake (DFI), feed conversion ratio (FCR) and feed efficiency of individual Wistar rats were measured and recorded. FCR is calculated by dividing DFI by DWG. No mortality or any signs of disease were reported in any feeding group during the feeding period.

Data analysis

For the experiment, experimental data values are presented as mean ± SEM (standard error mean) or pooled SEM and $p<0.05$ was declared significant. For each measured parameter, the data was blocked by replicates nested within and weeks of experiment. For performance indices, a 2 × 4 factorial design was used with genders and dietary treatments used as factors. The main effects and their interaction were included using GenStat 18th Edition (Hemel Hempstead, United Kingdom). A Student's Newman Keuls multiple comparisons test was used to determine the difference between varying levels of RPO inclusion.

RESULT AND DISCUSSION

Growth of Wistar rats fed different levels of red palm oil (RPO) inclusion is expressed in Figure 1. Adding varying levels of RPO to the diet of Wistar rats increased ($p<0.05$) weight gain and daily weight gain in male rats compared to female rats (Figure 1). However, daily feed intake (DFI), feed intake (FI), feed efficiency (FE) and feed conversion ratio (FCR) ($p>0.05$) were not affected by gender and treatment. Additionally, there was treatment by gender interaction effect ($p<0.05$) on daily weight gain, weight gain and feed conversion ratio. This revealed that daily weight gain, weight gain and feed conversion ratio of males were improved across treatment. In our study, we tested whether daily red palm oil (RPO) consumption in ration of Wistar rats will alter the physiological responses. Growing Wistar rats fed different

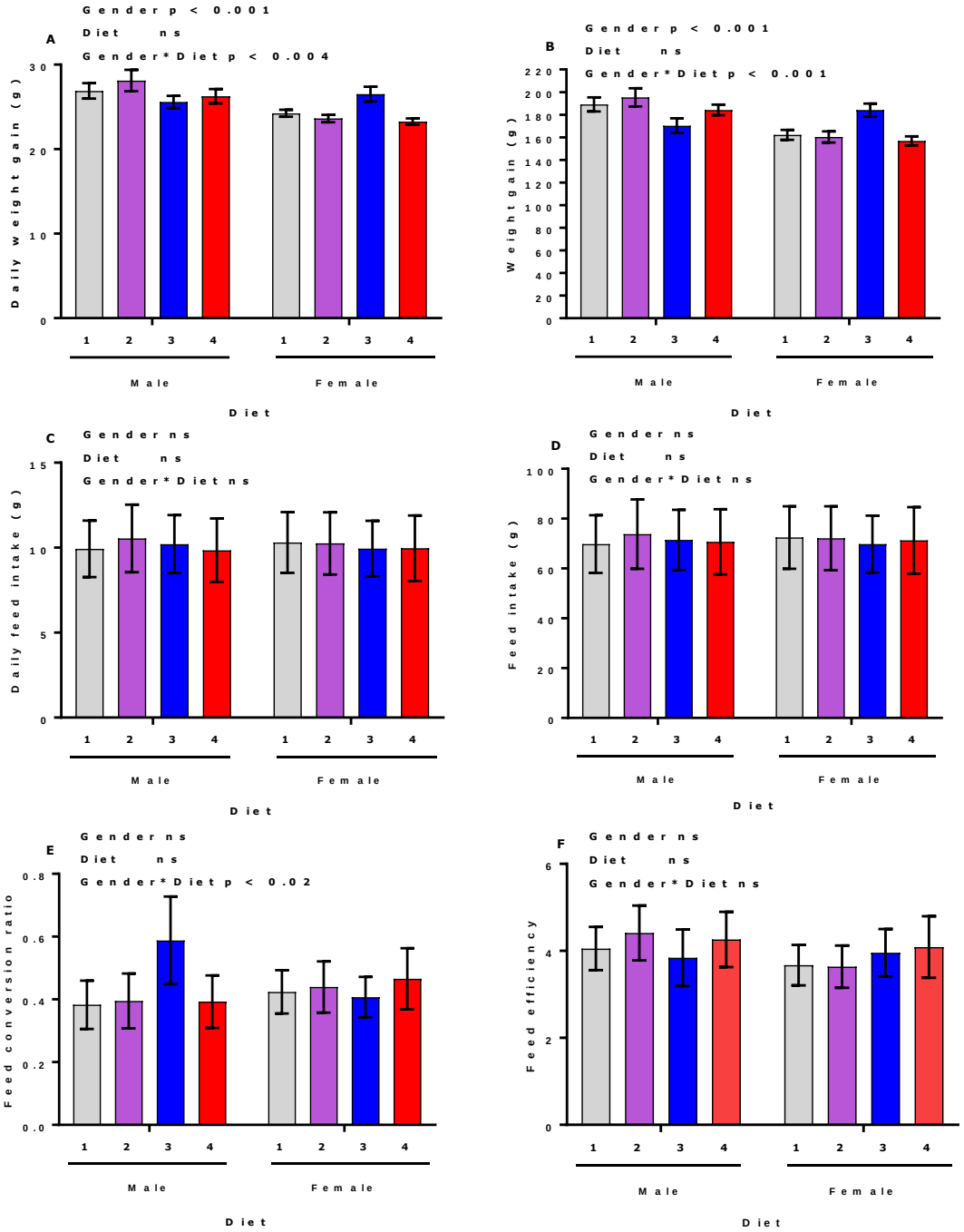

Figure 1: Effect of red palm oil inclusion on performance of Wistar rats. Varying levels of red palm oil were added at 0, 200, 300, 400mg/kg in animal feeds of both genders (males and females). The effect of treatment shown on (a) Daily weight gain (g), (b) Weight gain (g), (c) Daily feed intake (g), (d) Feed intake (g), (e) Feed conversion ratio, (f) feed efficiency. The data are mean ± SEM (standard of means) n = 12/treatment, both genders.

levels of RPO affected daily weight gain and body weight in males compared with females. Weight gain and daily weight gain in the male rats in the study suggest that RPO has growth-promoting properties. This

finding may be related to an energy-efficient diet. Additionally, there was treatment by gender interaction on daily weight gain, weight gain and feed conversion ratio. Results of the study revealed that males showed greater improvements in daily weight gain, weight gain and feed conversion ratio during treatment than females. These results might indicate that male Wistar rats grow faster than female Wistar rats. Feed conversion ratio in our study demonstrated that the addition of RPO in the animals' ration have positive effect on feed consumption, feed utilization and feed efficiency in males more than in females. Moreover, our results confirm the work of other studies indicating increased body weight gain in male Wistar rats fed 4 ml and 2 ml RPO compared to control (2). Inclusion of RPO in Wistar rat diet has different effects on the health of the rats. Some studies have shown that RPO may have an encouraging effect on vitamin A, while others have shown that it has no negative effects on fertility (10). Some studies have shown that palm oil or olive oil co-administration caused a reduction in the rats' body weight fed on high cholesterol diet. Reduction in body weight in those groups, high cholesterol diet-olive oil and high cholesterol diet-palm oil was not affected from either control or high cholesterol diet-fed rats (1). The specific effects of varying levels of RPO in Wistar rat diets on feed intake, body weight and feed efficiency among genders was difficult to point out by treatment by gender interaction. However, some studies have shown that factors such as age, genetic background and nutrition/dietary composition affect differently in male and female rats (12, 11, 3, 13). Therefore, it is possible that the treatment by gender effect observed in the study may be possible to these factors. The effects of RPO on Wistar rat health appear to be complex and multifaceted, and more research is needed to understand the effect of RPO and other nutrients on physiological changes on male and female rats.

CONCLUSION AND APPLICATION

The study concludes that daily intake of red palm oil in diets below 400mg/kg inclusion does not alter the physiological responses of Wistar rats. Therefore, we recommend the consumption of red palm oil with less than or not more than 400 mg/kg in daily intake, as it has no adverse effects on the performance.

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Animal Physiology, Reproduction and Health: APH037

ADMINISTERATION OF DIFFERENT DOSES OF AFRICAN NUTMEG (*Monodora myristica*) ORALLY ON THE GUT MICROBIOTA OF BROILER FINISHER CHICKENS

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ABSTRACT

This study was conducted to determine the effects of aqueous extracts of African Nutmeg seed (*Monodora myristica*) on antimicrobial activity of broiler finishers. A hundred and twenty Agrited Broiler finisher Chickens were used in a Completely Randomized experimental design that lasted for 28 days. The birds were randomly placed into four treatments consisting of 30 birds in each treatment group, there were 3 replicates per treatment with 10 birds per replicate. The birds in all the treatment groups were fed ad-libitum with standard diet and aqueous extracts of *Monodora myristica* were added to the water at different inclusion levels. The treatments comprised T_1 (0ml/L), T_2 (5ml/L), T_3 (10m/L) and T_4 (15ml/L). At the end of the experiment, faecal samples were collected from the hind gut (epigaster). Data collected on microbial analysis were subjected to Analysis of Variance (ANOVA). The microbial analysis indicated that the Total Coliform Count (TCC) and Total heterotrophic bacteria (THB) decreased significantly ($P<0.05$) with increased inclusion of aqueous extracts of *Monodora myristica* seed. The results further indicated that organisms like Salmonella, *E. coli*, Proteus and Bacillus species decreased in numbers of colonies with increased aqueous extract of *Monodora myristica* seed. Total Coliform Count was significantly reduced in the treated groups when compared to the control group. The Total heterotrophic bacteria (THB) was also reduced in the treatments when compared to the control group. These results indicate the potential of *Monodora myristica* to serve as an alternative to synthetic antibiotics.

Keywords: ANOVA, Broiler Chickens, Gut microbiota, Hind gut, *Monodora myristica*,

DESCRIPTION OF PROBLEM

Antibiotics, either natural or of synthetic origin, are used to prevent proliferation and destroy bacteria. They are used routinely to treat and prevent infection in animals and humans. Synthetic antibiotics have played a contributory role since their discovery, impacting in no small measure to the economic effectiveness of poultry production as feed supplement, growth promoter, treatment of infection and prevention of diseases, reduce mortality and morbidity in animals leading to improvement in production of farm animals [1].
However, the massive use of these antibiotics, according to [2] & [3] has led to the growing issue of antibiotic resistance and the presence of antibiotic residue in feed, putting human and animal health in jeopardy. Also, its use leaves behind some major unintended effects pathogenic and non-pathogenic organism strains that spread from animals through the food chain to people and into the environment resulting in the ban on antibiotic use in farm animals [4]. Additionally, [5] reported that synthetic antibiotics have been shown to have side effects that are more difficult sometimes to treat than the diseases they are meant to cure.

In spite of the huge success of synthetic substances (antibiotics), plants provide more than 25% of the prescribed medications [6]. Discovering the healing power in plants is an ancient phenomenon as plants have been a resource of remedies for man diseases since antiquity. [7], documented that resistance of microorganism to conventional antibiotics, its quick development has caused grave anxiety in the fight against disease. Numerous studies have been conducted in an effort to identify potential solutions to overcoming these issues. In order to reduce these adverse effects of synthetic antibiotics on livestock as well as human, using natural products like phytobiotics (botanicals) that will serve as alternative to antibiotics or complementary antibiotics against the diseases is therefore of great importance [8].

According to [9], medicinal plants had been an essential part of the conventional health care system, which was possibly the oldest and most diverse of all therapeutic systems. [10] documented that the foundation of traditional systems of healing has been provided by natural materials (plants, herbs) from the beginning of time. Natural products played an important role in modern drug development, especially for antibacterial and antitumor agents. Plants are important sources of novel pharmacologically active compounds from which many drugs are derived, directly or indirectly. Medicinally, plants make up a large percentage of both traditional and modern medicine, they provide the primary healthcare for about 30% of the rural population [11].

The bioactive compounds found in medicinal plants, such as tannins, alkaloids, terpenoids, steroids, and flavonoids, have defined biologically effects [12]. These compounds contained in the plants are phytochemicals. Phytochemicals are also termed botanicals; they are usually naturally less toxic and residue free plant-derived substances that are added and used as feed for livestock production [13]. Among numerous medicinal plants that have been identified as alternatives by researchers is *Monodora myristica* plant.

MATERIALS AND METHODS

Experimental Site

This study was conducted at the poultry unit of the Rivers State University's Teaching and Research Farms in Nkpolu-Oroworukwo, Port Harcourt. The test site is located in Nigeria's tropical rainforest, agro-ecological zone, with average monthly rainfall, temperature, and relative humidity readings of 200.45mm, 22.54-31.03°C, and 69.08-112.47%, respectively [14].

Preparation of *Monodora myristica* Seed extracts

Monodora myristica seeds were sourced from Mile Three market in Port Harcourt Local Government Area of Rivers state. The seeds sample were toasted over fire, de-hulled by cracking and milled. 150grams (150g) of the milled *Monodora myristica* was added to four litres of boiled water at 100°C. After this, the mixture was stirred and allowed to cool. The extract was sieved through a muslin cloth into bottles and stored in a refrigerator to prevent spoilage.

Experimental Birds and Management

A total 120 unsexed-day-old broiler chickens were used for this research. The day-old chicks were purchased from Agrited, Nigeria Ltd, Ibadan, Oyo state, Nigeria. These birds were brooded for four weeks and during this period, all management and vaccination routine were adhered to.

Experimental Design and Treatment

At the end of the Starter phase, 120 birds were selected on weight equalization basis and allocated to four groups in a Completely Randomized Design (CRD). Each of the group was divided into 3 replicates of 10 birds. The initial body weight was taken and at the end of four weeks prior to administering the treatment. The birds were housed in floor pens and fed on commercial diet (finisher diet) for the duration of the research which lasted for 28days. The experimental groups comprised T_1 (0ml of extract/ litre of water) representing the control, T_2 (5ml of extract/litre of water), T_3 (10ml of extract/litre of water), T_4 (15ml of extract/litre of water). On the last day of the experiment, two birds per replicate were selected randomly, the birds were starved of feed for twelve hours, slaughtered and faecal samples collected for microbial analysis.

Microbial Analysis

The faecal samples were placed in a sample bottle for microbial analysis, so as to ascertain the type and number of bacteria present in the faeces with the use of special media such as MacConkey Agar, Eosin-Methylene Blue Agar (EMB), Nutrient Agar and *Salmonella/Shigella* Agar media.

Procedures for Carrying Out Microbial Analysis

Inoculation was done using 10-fold serial dilution method. Multi-purpose and selective media were used for isolation. Macroscopic and chemical method was used for microbial identification [15].

Experimental Design and Data Analysis

The data collected were subjected to a one-way analysis of variance (ANOVA). Significant differences ($P<0.05$) in treatment means were separated using Duncan Multiple Range Test. The statistical analysis was done using SPSS version 18 [16].

RESULTS AND DISCUSSION

The microbial parameters of broiler birds administered *Monodora myristica* seed extracts are presented in **Table 1**. The microbial parameter measured were Total Heterotrophic Bacteria (THB) and Total Coliform Count (TCC). No Significant difference ($P>0.05$) due to treatment effects existed in the TCC (Total Coliform Count) in frequency of occurrence and number of colony isolated. With regards to THB, the best result was obtained in T_4 having the lowest value, while T_1 (Control) had the highest THB value. For Total Coliform Count (TCC), the best result was obtained in T_2 having the least value while T_1 had the highest TCC value. The result indicated that similar organisms were identified across the groups, although they vary in number of colonies and in the frequency of occurrence. The organism identified were *Salmonella* spp, *E. Coli* spp, *Proteus* spp, *Bacillus cerus, Pseudomonas* spp, *Shigella* spp, *Staphylococcus, Streptococcus faecalis* and *Citrobacter* spp.

Table 1. Effect of *Monodora myristica* Seed Extract on Microbial Organism Parameters of Finisher Broiler Birds

Treatments	THB	TCC	Parameters Organism Identified	Frequencies of Occurrence	Number of Colonies
T_1 (0ml/L, Control)	208.67±14.667	145.33±9.333	*Salmonella Spp., E. Coli*	86, 150	36, 64
			Proteus Spp.	102, 90	53, 47
			Bacillus Cercus	124, 60	67, 33
T_2 (5ml/L)	148.00±19.732	78.33±8.110	*Pseudomonas Spp., Proteus Spp.*	120, 60	66, 34
			E. Coli Spp., Shigella	100, 52	65, 35
			Salmonella Spp.	72, 40	64, 36
T_3 (10ml/L)	151.33±28.990	92.00±12.858	*Staphylococcus Staphlococcus Spp., E. Coli Spp.*	48, 100	33, 67
			Shigella Spp., Salmonella Spp.	44, 60	42, 58
			Streptococcus faeicalis, E. Coli. Spp.	84, 120	41, 59
T_4 (15ml/L)	146.67±36.830	82.00 ± 7.572	*Pseudomonas Spp, Citrobacter Spp*	80, 140	36, 64
			Salmonella Spp, E. Coli	84, 120	81, 19
			Shigella Spp, Proteus Spp	56, 60	48, 52

Mean values within row without superscripts are not of statistical significance (P>0.05).

Table 2 presents the result of *Monodora myristica* seed extracts on the faecal bacterial load of the broiler chickens. For THB, T_1 (Control) had the highest value but not significantly different ($P>0.05$) when compared with others and the least value was observed in T_4. The results show that T_1 for (TCC) had a significantly ($P<0.05$) higher TCC than Treatments 2, 3, and 4

Table 2. Effects of *Monodora myristica* seed extracts on the faecal bacterial load

	Treatments			
Parameters	**T_1 (0ml/L, Control)**	**T_2 (5ml/L)**	**T_3 (10ml/L)**	**T_4 (15ml/L)**
THB	208.67±14.667	148.00±19.732	151.33±28.990	146.67±36.830
TCC	145.33±9.333[a]	78.33±8.110[b]	92.00±12.858[b]	82.00±7.572[b]

a,b,c values within each row with different superscript differs significantly (P<0.05)

Key: THB = Total Heterotrophic Bacteria
TCC = Total Coliform Count

Antimicrobial substance aid in the growth and spread of micro-organism [17]. These substances are usually used in treating microbial diseases in either animal or plant sources. The present study shows that the inclusion of *Monodora myristica* seed extracts reduced the bacteria load among the treatment groups. Total heterotrophic bacteria and total coliform count decreased gradually with increased *Monodora myristica* seed extract. The present study is in consonant with the report of [18] which stated that extract of *Monodora myristica* was effective against *staphylococcus cureus, E. coli, L. pneumonia and Salomonella typi* as the concentration increased. It also proves the antimicrobial properties of African nutmeg as assumed by traditional knowledge. [19] also documented that there were significant differences (P<0.05) in the microbial population of the gastro-intestinal tract of broiler with an increasing concentration of *Monodora myristica*.

CONCLUSION

The study investigated the implications of aqueous extract of *Monodora myristica* seed on the faecal microbial load of broiler chickens. The results obtained showed no significant differences on the Total heterotrophic bacteria (THB). The antimicrobial effects of *M. myristica* was exhibited in its action against Total Coliform Count (TCC). Its inclusion at all levels reduced TCC thereby demonstrating its antimicrobial potentials that comes handy as alternative for synthetic antibiotics. This will serve as a useful information to animal nutritionists.

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Animal Physiology, Reproduction and Health: APH038

TESTICULAR AND EPIDIDYMAL CHARACTERISTICS OF RABBIT BUCKS FED DIETS CONTAINING ROSELLE LEAF MEAL SUPPLEMENTED WITH SELENIUM IN THE TROPICAL ENVIRONMENT

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ABSTRACT

Feeding leaf meal in rabbit production is not only explored for subsidizing feed cost but for some other benefits which includes its phytochemicals such as antioxidants. This study evaluates the effect of Roselle leaf meal (RLM) supplemented with Selenium (SE) on testicular and epididymal characteristics of rabbit bucks. Twenty-four New Zealand white (NZW) rabbit bucks, four to five months old with an average weight of 2374.38g were used. They were randomly assigned to four experimental treatment groups as T1 (0%) control, T2 (20%), T3 (40%) and T4 (60%) Roselle leaf meal (RLM) supplemented with Selenium (SE) at 0.3mg/kg. Each treatment groups contained six rabbit replicated six times with one rabbit per replicate in a completely randomised design. The result of the experiment indicated that average temperature humidity index recorded in June and September were 26.00 and 27.00 respectively during afternoon period; not above the thermo-neutral zone of rabbit. Gonadal and extra gonadal sperm cells (Paired testis weight, caudal left, extra gonadal sperm reserve) decreases above 40% inclusion levels. It was concluded from the result of the study that rabbit bucks can perform better up to 40% inclusion level of Roselle leaf meal (RLM) supplemented with selenium (SE) without any detrimental effect on reproductive performance.

Keywords: Testicular, Roselle leaf, Selenium, Anti-nutritional factor.

INTRODUCTION

Responses to stress in livestock involve behavioral, metabolic and physiological changes at multiple levels of vertebrate organization from subcellular to the whole animal [1] as hypothalamic-pituitary adrenal axis is responsible for releasing cortisol, most commonly known as the stress hormone. Rabbits are considered as a novel production animal, hence its potential and important contribution to future animal protein supply to human should not be underestimated [2] whereas the climatic factors become their constrains in developing countries [3]. Males that are unable to balance pro-oxidants and antioxidants may thus suffer infertility. Selenium is an essential element for spermatogenesis; it can protect the biological membranes from lipid peroxidation during spermatogenesis [4]. The use of unconventional sources of antioxidant agents particularly from plant materials is another potential avenue to improve fertility [5]. *Hibiscus sabdariffa* (Roselle) leaf contains high amounts of protein, dietary fiber and minerals, antioxidative and hepatoprotective properties [5]. There is however, a paucity of information in the effectiveness of *Hibiscus sabdariffa* (Roselle) as an antioxidant supplement in rabbit reproduction.

MATERIALS AND METHODS

Experimental site and location

The experiment was conducted at the Rabbitry unit of the Department of Animal Science Research and Teaching Farm, Faculty of Agriculture, Ahmadu Bello University, Samaru-Zaria. The area is located in the Northern Guinea Savannah of Nigeria at latitude 11^{o} 09’ 06’’ and longitude 7^{0} 38’ 35’’ [6].

Experimental animals and management

New Zealand White rabbit bucks were sourced from National Veterinary Research Institute, NVRI, Vom and housed individually in a conventional rabbit cages with floor dimension of 1.2m x 0.8m, each equipped with feeder and drinker in a naturally well-ventilated building. All management practices were strictly observed. The duration of the experiment was three months.

Experimental diets and design

Roselle leaves were harvested fresh, air dried, crushed and stored in a polythene bag at room temperature for further use and analysis. Four iso-nitrogenous and iso-caloric diets containing 16% CP and 2600KcalME/Kg were formulated using Roselle leaf meal incorporated at 0, 20, 40 and 60% to meet the recommended nutrient requirement for this class of rabbits [7] (Table 2). The rabbits were individually weighed and randomly assigned into four treatment groups as T1 (0%) control, T2 (20%), T3 (40%) and T4 (60%) RLM supplemented with SE at 0.3mg/kg. Each treatment groups contained six rabbit replicated six times with one rabbit per replicate in a completely randomised design. Feed and water were offered *ad libitum*.

Table 1: Levels of Anti-nutritional content of Roselle Leaf Meal

Anti-nutritional content	Concentration mg g-1
Saponin	52.90
Alkaloids	21.44
Tannins	34.72
Trypsin	16.83
Oxalates	34.92
Phytates	48.10

Table 2: Calculated Nutrients in the Experimental Diets with the varied levels of Roselle Leaf Meal

Ingredients(%)	T1(0%RLM)	T2(20%RLM)	T3(40%RLM)	T4(60%RLM)
ME(Kcal/kg)	2678	2656	2642	2633
CP (%)	16.00	16.46	16.51	16.55
CF (%)	11.31	12.26	12.39	12.98

RLM - Roselle leaf meal, ME- Metabolizable energy, CP- Crude protein, CF- Crude Fibre[MB19][B20][B21][B22]

Anti-nutritional analysis

The presence of anti-nutritional factors, Saponin was determined according to [8], Alkaloids according to [9], Tanin and Oxalates according to [10], Trypsin inhibitor according to [11] and Phytate according to [12].

Meteorological data

The ambient temperature and the relative humidity of the pen was recorded in the morning and afternoon period (8:00am and 2:00pm) with the aid of a digital temperature- humidity clock for the experimental period of three months. Temperature humidity index (THI) was computed using the equation THI = t - {(0.31- 0.31 (RH/100) (t – 14.4)} described by [13].

Gonadal and Extra Gonadal Sperm Reserves of Rabbit Bucks

Three male rabbits were randomly selected from each treatment and sacrificed at the end of the study. The testes and epididymis were weighed individually and further epididymis divided into caput, corpus and caudal segments. The sperm reserves were determined using methods described by [14]. Gonadal sperm reserves = concentration per gram testis x total weight of testis ($x10^6$). Concentration per gram = number of sperm cells x volume used/weight of sample. Volume was measured by water displacement according to Archimedes principles. Extra-gonadal sperm reserve = Total sperm reserve per caput, corpus and caudal epididymis.

Statistical analysis

Data obtained from the experiments were subjected to analysis of variance, using the General Liner Model Procedure of [15]. Significant differences among treatment means were separated using the pair wise difference (Pdiff) in the SAS package. Values of P < 0.05 were considered significant.

RESULT AND DISCUSSION

Table 3: Temperature Humidity Index in the Morning and Afternoon during the Study

Period Months	Morning Temp (^{0}C)	RH (%)	THI	Afternoon Temp (^{0}C)	RH (%)	THI
June	25.80	80.10	24.88	27.02	72.19	26.00^a
July	24.84	84.11	23.86	26.56	76.13	24.91^b
August	24.22	84.86	23.24	26.30	76.98	24.36^b
Sept	27.24	81.16	26.02	28.20	74.35	27.00^a
P value	0.12	0.07	0.18	0.14	0.08	0.04
SEM	1.71	2.41	2.15	1.11	2.52	0.54

ab Means with different superscript within rows differed significantly (P<0.05), Temp=Temperature, RH = Relative humidity, THI = Temperature humidity index, SEM = Standard error of means, Sept = September

Temperature humidity index during the study period[MB23]

Table 3 show the THI value of 26.00 and 27.00 obtained in June and September respectively during afternoon period indicate that rabbit were not exposed to heat stress. [16] Reported temperature humidity index in rabbit average 27.3 absence of heat stress in northern Nigeria. This suggests that northern Nigeria have higher THI than southern Nigeria. This could be attributed to the study area's temperature distribution; Ibadan is within moderately hot area (24-27^{o}C mean annual temperature), while Zaria is within hottest area (over 27^{0}C mean annual temperature) [17].

Effect of roselle leaf meal supplemented with selenium on gonadal and extra-gonadal sperm reserve of rabbit buck

Effect of roselle leaf meal supplemented with selenium on gonadal and extra-gonadal sperm reserve of rabbit bucks is presented in Table 13. Significant (P<0.05) increased in TSR (pair testis) and ESR (caudal left) at 20 and 40% RLM supplemented with selenium indicate the beneficial effect of the test diets in both spermatozoa and the testes. Consequently above 40% inclusion level sperm reserve decreases. [18] Stated that lower inclusion level [MB24]of moringa oleifera leaf meal had a beneficial effect on the rabbit productive and reproductive performance but negative impact was detected by feeding with higher inclusion level due to an elevated levels of anti-nutrient content of the diet. [19] Reported the presence of phytate, tannin, saponin, alkaloids and trypsin in the roselle seed and leaf. Significant (P<0.05) increase in EGSR follow similar trends which was directly related to the mechanism that result in high testicular sperm reserve up to 40% inclusion level and translated to the EGSR. [MB25]

Table 4: Effect of Roselle Leaf Meal Supplemented with Selenium on Gonadal and Extra-Gonadal Sperm Reserve of Rabbit Bucks

	Roselle leaf meal levels					
Parameters	**0**	**20**	**40**	**60**	**P value**	**SEM**
TSR (x10^6/ml)						
Paired Testis	26.13^b	32.11^a	30.68^{ab}	25.11^b	0.04	2.36
ESR (x10^6/ml)						
Caudal Left	36.16^b	36.18^b	39.21^a	33.15^c	0.02	1.47
Right	21.11	23.11	25.15	21.43	3.21	2.11
EGSR (x10^6/ml)	89.84^b	102.82^a	109.21^a	89.13^b	0.05	3.36

^{abc}Means with different superscript within rows differed significantly (P<0.05), SEM = Standard Error of Mean; TSR=Testicular Sperm Reserve (x10^6/ml); ESR=Epididymal Sperm Reserve (x10^6/ml); EGSR=Extra Gonadal Sperm Reserve (x10^6/ml)

CONCLUSION AND RECOMMENDATIONS

Inclusion of RLM supplemented with selenium SE (0.3mg/kgDM) in the diets of rabbit bucks improved reproductive performance. Above 40% levels of inclusion will be detrimental due to the increase in anti-nutritive factors in the diets. Therefore, 40% inclusion level is recommended for rabbit production in the tropical environment.

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Animal Products and ProcessingTechnology: APP001

ASSESSMENT OF AFLATOXIN (*Aspergillus flavus*) CONTAMINATION IN SOME BRANDS OF COMMERCIAL POULTRY FEEDS SOLD IN SOUTHERN ECOLOGICAL ZONE OF NASARAWA STATE, NIGERIA.

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ABSTRACT

The research was carried out from April, 2023 – March, 2024 at Nasarawa South Ecological Zone of Nasarawa state to assess aflatoxin contamination in some brands of poultry feeds. These comprised of five (5) LGA namely: Lafia, Obi, Doma, Keana and Awe. 120 samples (10g each) of samples A, B, C, D, E and F poultry feeds were collected in polythene bags from each of the five LGAs totaling 600 samples for the study. The samples collected were pre-processed to ensure homogeneity and removal of extraneous materials and stored under appropriate conditions to maintain sample integrity. The samples were analyzed using validated analytical methods (Enzyme-Linked Immunosorbent Assay (ELISA)) to detect the occurrence and frequency of the total *Aspergillus flavus* level in all feed samples collected. Bar charts and pie chart were used to represent the frequency of *Aspergillus flavus* in the feed samples. There was 90% occurrence of *Aspergillus flavus* in the feed samples ranging between 43 to 99ppb. The highest frequency (96%) of the feed samples collected from Awe LGA was contaminated with *Aspergillus flavus* followed by Keana (92%), Obi (79%), Doma (68%) and Lafia (43%). Out of the total 600 feed samples collected, 96% (*n*= 578) were found positive, while 4% (*n*= 22) were negative for *Aspergillus flavus*. High contamination of *Aspergillus flavus* in most of the poultry feeds were recorded, hence further investigations are needed to address the causes as well as the need for preventive strategies of Aflatoxins contamination in poultry feeds in Nasarawa State.

Keywords: *Aspergillus flavus*, commercial poultry feeds, frequency and occurrence

DESCRIPTION OF PROBLEM

Nowadays, commercial poultry feeds in Nigeria are often associated with deterioration and contamination due to storage conditions and other activities in the distribution chain from the feed millers, distributors, wholesalers, retailers and farmers (3).

The occurrence of Aflatoxins in grains and cereals based poultry feeds is well established in Nigeria with varying degree of influence resulting from agricultural and agronomic practices. There are infestations of the fungi during pre-harvest, storage, and/or processing periods (4).
Aflatoxins have demonstrated potent carcinogenic effect in susceptible animals and their acute toxicological effects in humans. It can lead to growth retardation. There is likely impaired immune function, reduction in egg production, increased susceptibility to diseases, and economic losses for poultry producers (5).

Aspergillus flavus is a soil fungal species that have been recognized as a major contaminant of different grains utilized for poultry diets.They grow rapidly under high moisture condition and produce biological active hepatotoxic aflatoxin (5). Certain grains such as maize, cereals like rice, wheat, cotton seed, groundnut and many feed stuffs are contaminated by these fungal species.
Therefore, assessing *Aspergillus flavus* contamination in poultry feed is crucial to minimize the adverse effects and ensure the production of safe and healthy poultry products. The objective of this research work

is to assess the presence of *Aspergillus flavus* contamination in some brands of commercial poultry feed sold in Nasarawa state southern ecological zone of Nasarawa state.

MATERIALS AND METHODS

Experimental Site

The research was carried out at Nasarawa South Ecological zone which comprises five (5) Local Government Areas namely: Lafia, Obi, Doma, Keana and Awe. Nasarawa State is bounded in the North by Kaduna State, in the West by the Abuja Federal Capital Territory, in the South by Kogi and Benue States and in the East by Taraba and Plateau States. It has a central location in the Middle Belt region of Nigeria and lies between latitude 7° 45' and 9° 25' N of the equator and between longitude 7° and 9° 37' E of the Greenwich meridian. The state has a total area of 27,117 km^2 (10,470 sq. mi) and a population of about 1,826,883, according to the 2006 population census. Nasarawa state has 13 local government areas (9).

Sample Size/Sample Collection

120 samples (10g per sample) of poultry feeds were collected in polythene bags from each of Lafia, Obi, Doma, Keana and Awe local government areas respectively totaling 600 samples for the research. The sample feeds were collected from various distributors, wholesalers, and retailers feed stores within the Southern ecological zone of the state. Samples were selected based on different brand of feeds (A, B, C, D, E and F feeds) of starter, grower, and finisher feed.

Sample Preparation

The 10g per sample was collected and stored separately in an airtight polyethene bag as reported and labelled (4). The samples were taken to the Research Laboratory of Ahmadu Bello University, Zaria for pre-processing in other to ensure homogeneity and removal of extraneous materials. After pre-processing, the samples were stored under appropriate conditions to maintain sample integrity (6).

Isolation and Identification of *A. flavus* from poultry feeds

The collected samples were crushed using a sterile mortar and pestle and approximately about 0.2 – 0.5gm of crushed sample was directly sprinkled on the Potato Dextrose Agar (PDA) medium and incubated at 28 ± 2°C for 3 days (2). *Aspergillus flavus* isolates were identified on Sabouraud dextrose agar, yellow green colony at room temperature based on microscopic and macroscopic characterization and transferred. The screening was performed by desiccated coconut agar and quantification of aflatoxin by liquid ammonia vapour test and Enzyme-Linked Immunosorbent Assay (ELISA) (7).

Statistical Analysis

Occurrence of *Aspergillus flavus* in different brands of poultry feeds, Frequency of the total *Aspergillus flavus* level and Frequency of *Aspergillus flavus* in all sample collected from the study area, were presented using bar charts and pie chart.

RESULTS AND DISCUSSION

Occurrence of *Aspergillus flavus* in different brands of poultry feeds in the study area.

Aspergillus flavus is one of the major species that produces toxin secondary metabolites (2). High presence of humidity and temperature are optimal for mold growth and toxin production (1). The occurrence of *Aspergillus flavus* in the presence study area revealed that, of most of the various poultry brands of feeds samples collected from the local governments (figure 1), 90% were found to be positive for the detection of *Aspergillus flavus* ranging from between 43 to 99ppb. This result is in agreement with the research conducted by (8) where they reported high levels of fungal contamination in feed. These might be as a result of lack of awareness for proper storage by poultry feed retailers, wholesalers or distributors, other factors such as lack of ventilation, maintaining minimal temperature, humidity and storage facilities.

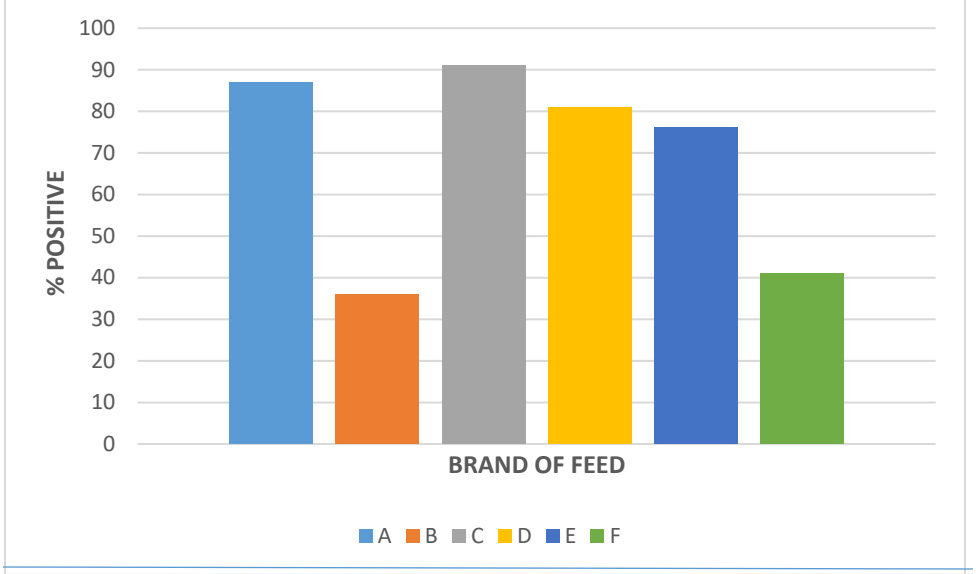

Figure 1: Presence of *Aspergillus flavus* in different brands of poultry feeds

Frequency of the total *Aspergillus flavus* level in brands of poultry feeds supplied in local Governments of the study area.

Frequency of *Aspergillus flavus* level was determined in the selected study area (Lafia, Obi, Doma Keana and Awe) of Nasarawa state ecological zone (figure 2). The highest frequency of *Aspergillus flavus* was reported in total samples (600) obtained from Awe local Government where 96% of the feed samples collected were contaminated with *Aspergillus flavus* followed by Keana (92%), Obi (79%), Doma (68%) and Lafia (43%). These might be as a result of lack of awareness for proper storage by poultry feed retailers and wholesalers or distributors, other factors such as lack of ventilation, maintaining minimal temperature, moderate humidity and storage facilities.

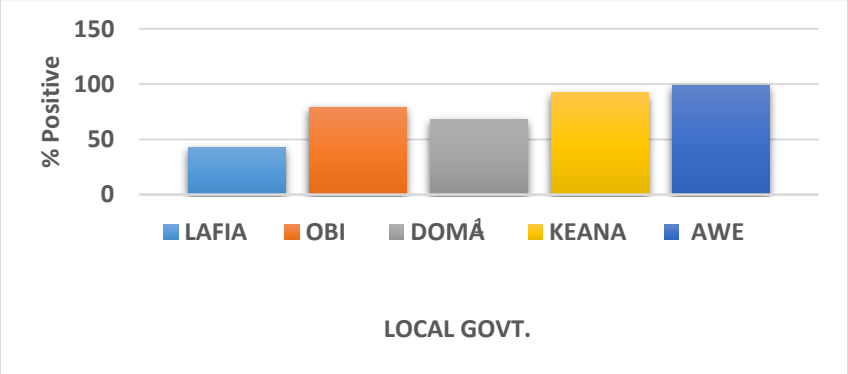

Figure 2: Total *Aspergillus flavus* level in brands of poultry feeds in local Governments of the study area

Frequency of *Aspergillus flavus* in all sample collected from the study area

A total of 600 samples were analyzed from the selected study area southern ecological of Nasarawa state. Out of the total 600 samples collected from the study area, 96% (*n*= 578) were found positive for *Aspergillus flavus*, while 4% (*n*= 22) were negative (fig.3).

The high concentration of *Aspergillus flavus* in this study was compared to many of the studies reported previously and in line with the report of (8).The results warrant the need for surveillance, constant monitoring programs and awareness to farmers, retailers and distributors. The higher concentration of *Aspergillus flavus* in these study area might risk the poultry farmers an increased in economic losses. To ensure food safety, contamination of poultry feed should be monitored regularly.

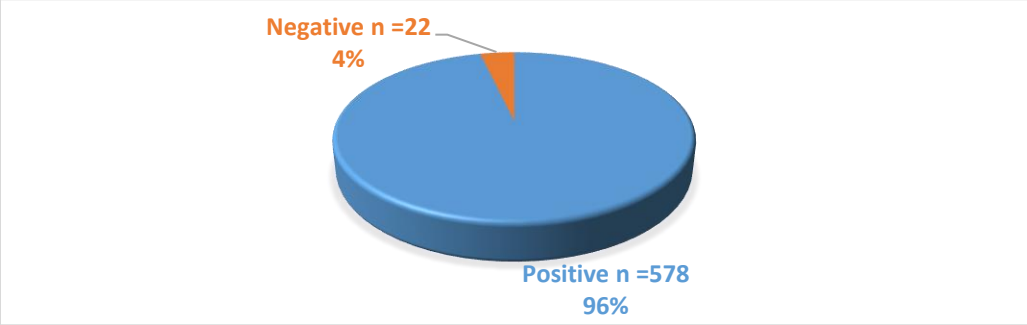

Figure 3: Frequency of *Aspergillus flavus* in all sample collected from the study area

CONCLUSION AND APPLICATION

The study showed high contamination of *Aspergillus flavus* in poultry feeds in most of the poultry feeds in the study area, hence further investigations are needed to address the causes. The study can be useful for preventive strategies of Aflatoxin contamination in poultry feeds in Nasarawa state.

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Animal Products and ProcessingTechnology: APP002

BREED EFFECT ON ORGANOLEPTIC PROPERTIES OF CHICKEN MEAT

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ABSTRACT

The study was conducted to evaluate the effect of breed on organoleptic properties of broiler birds and Nigerian chickens. The birds used were Arbor Acre, Ross 308, Naked neck, Noiler and Normal feather breeds of chicken. The birds were fed on commercial diets. On day 56 of the experiment, ten birds from each breed were selected for organoleptic test. The birds were starved for 12 hours, five birds that were closest to the mean were selected tagged and slaughtered then scalded in hot water of 55°C for one minute and dressed to evaluate organoleptic properties. Ten panelists were chosen for the organoleptic test. Data were collected based on the information generated from the nine (9) point hedonic scale. The panelists evaluated the samples for colour, flavour, juciness, tenderness, taste and general appearance. Results obtained showed significant differences *(P<0.05)* for all the parameters tested except for the appearance which showed non-significant effect *(P>0.05)*. Thus, breeds have effect on organoleptic quality of the chicken meat.

Keywords: broilers, Nigerian chicken, breeds, meat, organoleptic quality.

DESCRIPTION OF PROBLEM

Food scarcity is a plague in many developing countries of the world, including Nigeria where daily intake of animal protein per capital falls far below the normal intake as recommended by F (1). The past few years have witnessed a rapid growth in human population of developing countries including Nigeria with resultant increase in demand for protein of animal origin which is in short supply. Feed constitutes about 70-80% of the total cost in poultry production (2). The bulk of the feed cost arises from energy and protein concentrates such as maize, soybean, fish meal and groundnut cake. The increase in feed prices and the scarcity of grains and protein plant supplements are important constrains hampering livestock production sector in Nigeria and in many other countries. Therefore, reducing the production cost is the main objective of farmers in order to maximize their net revenue, produce animal products in large quantity and with better taste. Hence, the need to harness the potential of the numerous breeds have been advocated. The overall purpose of using better breeds of chickenis to reduce the cost while improving or at least not affecting organoleptic characteristics (3). However, it is possible that feeding commercial poultry diets may affect the composition and quality characteristics of broiler and Nigerian chicken meats. Hence, the aim of this study is to determine the effect of breed on the organoleptic characteristics of the different chicken breeds.

MATERIALS AND METHODS

Study area and management of birds: The experiment was carried out at the Poultry unit of Teaching and Research farms of the Department of Animal Science, University of Agriculture and Environmental Sciences Umuagwo Imo State, Nigeria. The birds used for this study comprised of two strains of broiler chicken namely the Arbor Acre and Ross 308 and three breeds of Nigerian chicken, the Noiler, Naked neck and Normal feather chicken. The birds were brooded and reared to the market weight. Feed and water were provided *adlibitum*. Routine managements of washing of the feeder and drinker were done. Good biosecurity was maintained Vaccination and medication schedule of the Teaching and Research farms were strictly followed.

Organoleptic test

Organoleptic test was carried out at the Department of Animal Science, Chukwuemeka Odumegwu Ojukwu University, Anambra state. On day 56 of the experiment, ten birds from each breed were selected for organoleptic test. The birds were starved for 12 hours, five birds that were closest to the mean were selected tagged and slaughtered then scalded in hot water of 55^{o}C for one minute.

The meat samples weighing 30-35g were cooked under steam for 30 minutes. The meat was then served to 30 members trained panel drawn from 500 level students of the Department. The panelists evaluated the samples for overall appearance, taste, color, flavor, juiciness, tenderness and general acceptability; using a 9 (nine) point hedonic scale as described by (4). The scores were arranged in a descending order, the maximum score 9 (nine) was given extremely like while 1 (one) was for the poorest condition (extremely dislike).

Statistical Analysis

The meat samples were subjected to 9 (nine) point hedonic scale and the data generated from the finding of mean values were subjected to one-way analysis of variance (ANOVA) using the analytical software Statistical Package for Social Sciences (SPSS, 2012). The differences between the means were separated using Duncan multiple range test as outlined by the same SPSS package.

RESULTS AND DISCUSSIONS

Table 1: Effects of breed on organoleptic properties of different chicken meat

Parameters	Ross308	Normal feather	Naked Neck	Noiler	Arbor acre	SEM
Appearance	6.50	5.50	54.50	3.50	4.50	0.62
Colour	6.50^{ab}	5.50^{ab}	4.00^{b}	4.00^{b}	7.50^{a}	0.52
Flavour	7.50^{a}	5.50^{ab}	5.00^{ab}	3.00^{b}	7.50^{a}	0.68
Tenderness	8.50^{a}	6.50^{ab}	3.50^{c}	5.00b^{c}	8.50^{a}	0.63
Juiciness	7.50^{a}	5.50^{ab}	2.50^{b}	3.50^{b}	7.50^{a}	0.73
Taste	6.50^{ab}	4.00^{c}	4.00^{c}	5.00b^{c}	8.00^{a}	0.54

^{ab} means with the same superscripts in the row are significantly different *(P<0.05)*
SEM = Standard Error of Mean

Organoleptic properties of the experimental birds

The result of the organoleptic properties of different breeds of chicken is shown in Table 1. All the parameters tested were significant *(P<0.05)*except for the appearance of the meat which showed non-significant *(P>0.05)* difference. The colour of the meat showed significant effect in which Arbor acre had the highest value of 7.50 *(P<0.05)*, followed by Ross 308 in that order which recorded a value of 6.50. Normal feather had a value of 5.50, while Naked neck and Noiler had the least value of 4.00 each. Ross 308 and Arbor acre had the same value of flavor and juiciness (7.50) which differed significantly *(P<0.05)* from other chicken meat. Trailed behind by Normal feather which recorded a value of 5.50 both for flavor and juiciness. Naked neck recorded a mean value of 5.00 while Noiler had the least value of flavor (3.00). on the other hand, Naked neck recorded the least value of juiciness (2.50). The tenderness of the meat appeared to be significantly affected too. Arbor acre and Ross 308 recorded highly significant *(P<0.05)* values of 8.50 each. This was followed by Normal feather with a value of 6.50. Noiler and Naked neck recorded least value of 3.50 each.

DISCUSSION

Organoleptic Properties

The sensory meat evaluation which constitute first basis for consumer's perception is the color and next to it is the texture. The colour of the meat samples from the chickens had significant difference among the

breeds used for the study, this suggested that different breeds of chicken have different colour of meat. However, the significant difference across the breeds for color had no effect on the panelist's overall view on the appearance of the meat samples. Thus, meat from the chicken breeds appeared similar to the panelists with the above threshold score value of 4 (5).

The high juiciness of the meat recorded for Ross 308 and Arbor Acre and reduced juiciness of the meat of the Naked neck and Noiler breeds of chicken could be attributed to their genetic components. Environmental factors played no role in this study since the birds were housed within the same building and fed the same commercial diets.

In all the organoleptic characteristics tested, the broiler chickens were most preferred with respect to appearance, color, taste, flavor, tenderness, juiciness and taste.

CONCLUSION AND APPLICATION

In conclusion, breeds of chicken have effects on the organoleptic quality of chicken meat. Broiler chicken meat appeared to be most preferred chicken meat in terms of appearance, colour, flavour tenderness, juiciness and better taste than other breeds of chicken meat in this study.

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Animal Products and ProcessingTechnology: APP003

MINERAL COMPOSITION OF MEAT FROM RABBITS FED DIETS CONTAINING GRADED LEVELS OF AFRICAN WILD GRAPE (*Lannea microcarpa*) LEAF MEAL

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ABSTRACT

This experiment was conducted to ascertain the mineral composition of meat from rabbits fed diets containing African wild grape (*Lannea microcarpa*) leaf meal at different levels of inclusion. Forty (40) mongrel weaner rabbits, of about six (6) weeks of age weighing 750g±50 were randomly allotted to five (5) dietary treatments, replicated four (4) times with two (2) rabbits per replicates in a completely randomized design (CRD). Five (5) diets of 16% crude protein consisting of *Lannea microcarpa* leaf meal at 0, 5, 10, 15, and 20% were formulated as treatment 1, 2, 3, 4 and 5 respectively. Results indicated that all parameters measured were significantly different ($p < 0.05$). Sodium and calcium contents of raw rabbit meat were highest in T4 and lowest in T2 and T3. Highest magnesium content was observed in T5 and lowest in T1, while T3 recorded the highest contents of potassium and iron compared to T1 and T2. All mineral contents observed in *Berbaque* meat differed significantly ($p < 0.05$) across the treatments. The highest sodium content was observed in T5 and lowest in T3. The highest magnesium, potassium and iron contents were recorded in T4 while the lowest contents of these minerals were recorded in T3. Calcium (Ca) was higher ($p < 0.05$) in T2 and lowest in T4. It is therefore concluded that African wild grape (*Lannea microcarpa*) leaf meal has no adverse effect on both raw and *berbaque* meat minerals of weaner rabbit and farmers can supplement up 20% in rabbit diets.

Keywords: African wild grape, Raw, *Berbaque*, Minerals and Weaner rabbit.

INTRODUCTION

Rabbit meat shows excellent nutritional and dietetic properties; moreover, it can also be effectively fortified with bioactive compounds to provide consumers an outstanding functional food (1). Rabbit meat possesses a very low content of fat and cholesterol, a high level of proteins with essential amino acids (AA), no uric acid and low purine content (2). Furthermore, rabbit meat is low in monounsaturated fatty acids, high in n-3 polyunsaturated fatty acids and it is a significant source of vitamin B (vitamins B2, B3, B5, B6 and B12) and it is low in sodium (Na) and rich in phosphorus (P) and selenium (3). Its high contents of unsaturated fatty acids (UFA, especially Omega-3 and Omega 6) and good ratio of polyunsaturated fatty acids and very good source of minerals (P, K, Ca, Se, and Co) and has the highest concentration of Fe (2.9 mg/100 g to 4.9 mg/100 g rabbit meat) when compared with 2.6 mg/100 g beef, 1.9 mg/100 g lamb, 1.3 mg/100 g chicken and 0.9/100 g mg pork. Rabbit Meat is a good source of vitamins: B3, B6, and B12 (4). The highest content of B12: content has (8.7–11.9 mg/100 g) and is three times more than those found in beef (1). *Lannea microcarpa* leaves and shoots have been reported as a potential source of natural antioxidants and as a food supplement (5).

MATERIALS AND METHODS

Location of the experiment

The research was conducted at the Teaching and Research Farm of Federal University Dutse, Jigawa State, Nigeria. Dutse is located between latitude 11^0 45´ 22.25" and longitudes 9^0 20´ 20.26" E, at an altitude of 485 m above sea level and the state is situated within the Sudan Savannah Vegetation Zone, but there are traces of Guinea savannah in the southern region of the State (6).

Experimental design

Forty (40) mongrel weaner rabbits, of about six (6) weeks of age weighing averagely 750g±50 were randomly allotted to five (5) dietary treatments, replicated four (4) times with two (2) rabbits per replicates in a completely randomized design (CRD). Five (5) diets of 16% crude protein consisting of *Lannea microcarpa* leaf meal at 0, 5, 10, 15, and 20% were formulated as treatments 1, 2, 3, 4 and 5, respectively.

Source of experimental materials

African wild grape leaves were sourced from Jahun Local Government Area, Jigawa State. The leaves were collected and transported in jute bags to the Teaching and Research Farm of Federal University Dutse, where they were air-dried for 5 days and later milled with a milling machine Abro (P 207) and bagged for diet formulation.

Table 1: Composition and calculated analysis of the experimental diet (%)

	Treatments				
Ingredient	**(T_1)0%**	**(T_2)5%**	**(T_3)10%**	**(T_4)15%**	**(T_5)20%**
Maize	43.00	43.00	43.00	43.00	43.00
Soya bean cake	15.90	15.90	15.90	15.90	15.90
African wild grape leaf	0.00	5.00	10.00	15.00	20.00
Wheat offal	36.60	31.60	26.60	21.60	16.60
Bone meal	3.50	3.50	3.50	3.50	3.50
Table salt	0.30	0.30	0.30	0.30	0.30
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20	0.20
Vitamin premix	0.30	0.30	0.30	0.30	0.30
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Analysis					
Crude protein (%)	16.00	16.00	16.00	16.00	16.00
Metabolized energy(kcal/kg)	2270	2267	2263	2259	2256
Crude fibre (%)	15.23	19.17	17.90	16.63	15.34
Ether extract (%)	4.56	4.45	4.98	5.33	5.12
Ash (%)	6.32	6.19	5.34	6.02	5.88

Determination of Minerals

Macro minerals, Calcium (Ca) and micro minerals such as iron (Fe) as well as magnesium (Mn) was measured using a Perkin Elmer Atomic Absorption Spectrometer (A Analyst 800) by the procedures (8). Sodium (Na) and Potassium (K) were determined by Flame photometry 1.0 g of the sample were digested with 20 mL of acid mixture (650 mL of concentrated HNO_3; 80 mL PCA; 20 mL concentrated H_2SO_4) and aliquots of the diluted clear digest taken for photometry using flame analyser. Absorption for Na is read at 767 nm while that for K is read at 589 nm. Sodium and potassium concentrations were obtained from the calibration curves obtained from standards by AOAC (9) Four samples were collected from five treatments of both raw and *barbeque* meat.

Statistical analysis

The data collected were subjected to analysis of variance (ANOVA) to determine significant differences among treatment means according to Steel and Torrie (7). Means were separated using the Duncan's Multiple Range Test.

RESULTS

Mineral Composition of Raw Meat from Weaner Rabbit Fed Diet Containing African Wild Grape Leaf Meal at Different Levels of Inclusion

The result of mineral composition of raw meat from weaner rabbit fed diet containing African wild grape leaf meal at different levels of inclusion was presented on Table 2. All parameters were significantly different ($p < 0.05$). Sodium and calcium values were highest in T4 and lowest in T2 and T3. Highest magnesium content was observed in T5 and lowest in T1, while T3 recorded the highest contents of potassium and iron.

Table 2: Mineral Composition of Raw Meat Obtained From Weaner Rabbit Containing African Wild Grape Leaf Meal at Different Levels of Inclusion

Parameters (mg/100g)	Treatments					
	T1	**T2**	**T3**	**T4**	**T5**	**P- values**
Sodium	205.97±1.07^{c}	158.70±0.64^{e}	239.93±0.07^{b}	254.73±5.07^{a}	168.48±0.38^{d}	0.0001
Magnesium	2.51±0.119^{d}	2.80±0.005^{c}	2.94±0.002^{b}	3.08±0.004^{b}	3.66±0.07^{a}	0.0001
Potassium	163.3±0.04^{d}	159.5±0.52^{e}	401.47±0.11^{a}	219.3±0.59^{d}	232.3±0.27^{b}	0.0001
Calcium	58.05±0.06^{b}	54.28±0.10^{c}	9.04±0.19^{d}	63.56±0.16^{a}	54.53±0.23^{c}	0.0001
Iron	2.02±0.009^{b}	1.53±0.005^{d}	2.99±0.011^{a}	1.77±0.019^{c}	2.00±0,009^{b}	0.0001

^{abcde} Means in the same row with different superscripts differ significantly (P< 0.05)

Minerals Composition of *Berbaque* Rabbit meat Fed Diet Containing African Wild Grape Leaf Meal at Different levels of Inclusion

Result shows that the minerals composition of *berbaque* rabbit meat fed diet containing African wild grape leaf meal at different levels of inclusion was presented in Table 3. All parameters observed were significantly different ($p < 0.05$). The highest sodium content was observed in T5 and lowest in T3. The highest magnesium, potassium and iron contents were recorded in T4 while the lowest contents of these minerals were recorded in T3. Calcium (Ca) was higher ($p < 0.05$) in T2 and lowest in T4.

Table 3: Minerals Composition of *Berbaque* Rabbit meat Fed Diet Containing African Wild Grape Leaf Meal at Different levels of Inclusion

Parameters (mg/100g)	Treatments					
	T1	**T2**	**T3**	**T4**	**T5**	**P- values**
Sodium	71.19±0.38^{c}	58.73±0.22^{d}	46.18±0.14^{e}	140.0±0.44^{b}	151.56±0.67^{a}	0.0001
Magnesium	2.23±0.005^{b}	2.14±0.006^{c}	1.56±0.004^{d}	2.61±0.008^{a}	2.13±0.006^{c}	0.0001
Potassium	147.1±0.524^{b}	100.6±0.167^{d}	62.56±0.539^{e}	286.7±1.85^{a}	142.3±0.285^{c}	0.0001
Calcium	11.10±0.434^{b}	20.84±0.017^{a}	10.71±0.097^{b}	7.09±0.008^{d}	9.05±0.018^{c}	0.0001
Iron	2.08±0.004^{c}	1.28±0.004^{d}	0.51±0.003^{e}	3.86±0.012^{a}	2.53±0.026^{b}	0.0001

Note: ^{abcde} Means in the same row with different superscripts differ significantly (P< 0.05)

DISCUSSION

Minerals Composition of Rabbit meat Fed Diet Containing African Wild Grape Leaf Meal

Mineral contents in both *berbaque* and raw weaner rabbit meat varied in this study. Potassium (K) is the most abundant mineral in rabbit meat (3), which is in agreement with the results of this study. The K

concentration in both raw (159.53 – 401.47 mg/100g) and *berbaque* (62.56 – 286.77 mg/100g) rabbit meat were higher than the range of 232.9 – 250.3 mg/100g reported by (11) which can be compared with higher ranges from other reports (10).

Sodium (Na) level of rabbit meat in this study was also higher than 55.4 – 58.3 mg/100g reported by (11). This may attributed to the genetic predisposition some rabbit breeds may naturally have higher sodium levels in the (13). Rabbit meat is also highly recommended for its magnesium (Mg) content (10), through Mg's role in enzyme activation; this mineral stimulates muscle and nerve contraction, it also plays an important role in many other metabolic functions in humans (13). Very low contents of Mg (1.56 – 3.66 mg/100g) were recorded in this study, which was below the ranges reported in many researches (10). The calcium (Ca) content of the *berbaque* rabbit meat in this study (7.09 – 20.84 mg/100g) can be compared with 6.73 – 17.83 mg/100g and 21.4 mg/100g reported by (14). Calcium helps to develop and maintain strong bones and teeth, increases the utilization of other minerals (i.e., P, K) and its adequate intake contributes to the prevention of cardiovascular diseases (13).

Iron contents of both raw (1.53 – 2.99 mg/100g) and *berbaque* (0.51 – 3.86 mg/100g) were considerably very high when compared with 1.1–1.3 mg/100g, 0.66–0.99 mg/100g, 0.390 – 0.495 mg/100g and 1.01 – 1.03 mg/100g reported by (15). African wild grape leaf has antioxidant properties which help to reduce stress in rabbits leading to better meat quality (5).

CONCLUSION

The optimal inclusion levels of African wild grape leaf in this study is 15-20 which offers improved meat quality and nutritional content without adverse effect,

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Animal Products and ProcessingTechnology: APP004

CARCASS EVALUATION AND ORGAN WEIGHT OF BROILERS FED DIETS CONTAINING WOOD CHARCOAL AT DIFFERENT INCLUSION LEVELS.

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ABSTRACT

The study evaluates the influence of wood charcoal on carcass parameters and organ weights of broilers in a feeding trial. 120 Ross 308 broilers of both sexes gotten at one day-old were randomly allocated to four treatments with three replicates of 10 birds each, in a Completely Randomized Design. They were fed diets containing wood charcoal at T 1 (0%), T 2 (2.5%), T 3 (5%), and T 4 (7.5%) levels of inclusion in a two-staged system (Starter and Finisher). At the end of rearing period, the result showed that carcass parameters and organ weight were significantly (P<0.5) enhanced by the dietary treatments, where the highest mean of live weight, bled weight, defeathered weight, shank, thigh, neck, gizzard, liver, lungs, pancreas, small intestine, proventriculus, and spleen weight were found at T2 (2.5%). It was concluded that addition of wood charcoal at 2.5% gave the best result for carcass parameters and organ weight.

Key Words: Carcass Parameters, Broilers, Organ Weight, Wood Charcoal

DESCRIPTION OF PROBLEM.

Charcoal has been proposed as feed additive to stimulate feed intake and digestion, thereby enhancing growth performance of broiler chicken in Iran, Cameroon and Poland (1,2,3). According to Ayanwale *et al.* (4) pullets fed activated charcoal were high in economic returns and this results were attributed to increase mineral intake and utilization enhanced by charcoal supplementation and also improved absorption capacity of charcoal for dietary fat. It also has a good adsorption capacity of toxins and therefore has the potential to improve birds' health (3,5). Charcoal's favorable influence on increasing the body weight of broiler chickens, their survival and feed utilization has been described by (6,7,8). This research aimed at ascertaining whether wood charcoal added at different levels would influence carcass characteristics and organ weight in broilers.

MATERIALS AND METHODS.

One hundred and twenty, unsexed Ross 308 broilers were used for this study from one day old. The birds were brought from Agrited Hatchery and transported to experimental site at Nnamdi Azikiwe University, Latitude 6° 5' 10.1"N and Longitude 7° 08'31.9" E. Four dietary treatments were formulated containing charcoal powder at varying inclusion levels. Treatment 1 (control diet) with 0% charcoal added while treatments 2, 3, and 4 has charcoal added at 2.5%, 5%, and 7.5% respectively. The birds were weighed and randomly allotted to the four (4) dietary treatments replicated three (3) times with each replicate having ten (10) birds in a completely randomized design (CRD), managed under a deep liter system with four (4) treatment groups and three replicates per treatment, each of the replicates having 10 birds. The statistical model used was Completely Randomized Design (CRD)

The birds were managed purely on concrete floor with wood shavings on it, demarcated with wire mesh. Feed and clean water were supplied *ad libitum*. At the end of eight weeks, three birds were collected from each treatment (one bird from each replicate), starved overnight, weighed early the following morning to obtain live weight and slaughtered. Bled weight was taken, and plucked weight was taken after defeathering. They were eviscerated and eviscerated weight was recorded. The weight of the organs - the heart,

proventriculus, filled and empty gizzard, large and small intestine, liver, lungs, pancreas, and spleen were all measured and recorded using sensitive scale (model and brand name of scale

Data collected was subjected to Analysis of Variance (ANOVA) in a Completely Randomized Design (CRD) and the significant means were separated using Duncan's New Multiple Range Test. The result was expressed in plus-minus as mean of Standard Error of Mean. Carcass yield and organ weight were compared by between groups by one way ANOVA. SPSS Statistic Package (Version 22, Release 22.0.0.0. IBM)

RESULTS AND DISCUSSION

Table 1: Mean carcass characteristics of chicken fed wood charcoal at different levels of inclusion.

	Mean		**carcass weight for broiler chicken ± SEM**	
Carcass Parts (g)	T1 (0%)	T2 (2.5%)	T3 (5%)	T4 (7.5%).
Live weight	1618.67^{a}±32.34	2161.00^{c}±5.51	1946.67^{b}±113.85	2021.33^{bc}±55.41
Bled Weight	1570.00^{a}±29.45	2064.00^{b}±26.67	1909.00^{b}±103.23	1961.13^{b}±36.41
Defeathered weight	1509.00^{a}±28.01	2002.67^{b}±16.58	1830.33^{b}±99.70	1902.00^{b}±12.29
Head	54.67^{a}±3.48	60.00^{a}±2.89	51.67^{a}±6.17	61.00^{a}±2.89
Shank	74.65^{a}±1.45	88.67^{a}±3.18	76.00^{a}±4.58	82.33^{a}±6.64
Wing	132.33^{a}±5.21	172.33^{b}±1.20	168.00^{b}±8.08	176.00^{b}±5.57
Thigh	195.00^{a}±2.89	260.00^{b}±2.20	243.00^{b}±23.86	224.00^{ab}±8.72
Drum stick	175.00^{a}±6.93	215.67^{b}±3.18	210.00^{b}±11.02	236.33^{b}±13.37
Breast	325.67^{a}±10.12	365.00^{a}±12.70	401.67^{b}±37.24	411.33^{b}±3.67
Neck	83.67^{a}±1.45	113.00^{b}±1.15	112.00^{b}±1.00	106.33^{b}±3.84
Back	204.67^{a}±1.45	329.00^{bc}±11.27	297.67^{b}±14.35	349.00^{c}±14.18

The result on carcass characteristics of broiler birds fed diets containing wood charcoal presented in table 1 above shows that there is positive significant differences ($p<0.05$) in all the parameters, that is the measured parameters were significantly affected ($p<0.05$) where the highest mean weight of live weight, bled weight, defeathered weight, shank, thigh and neck were found at T2 (2.5%). This is in accordance with the findings reported by (9) who reported that the supplementation of activated coconut charcoal has significant effect ($p<0.05$) on carcass characteristics of broiler. This could be attributed to increased feed intake and nutrient digestibility as was evident with improved conversion efficiencies in charcoal groups as was reported by authors sited above. This disagrees with the findings of (10) whose research work sates that broiler cut-up parts did not exhibit any major discernible response with the use of wood charcoal. This could be as a result of location, climate, different management practices and his supplementing some percentage of wood charcoal with vegetable oil.

The mean weight of bled weight, de-feathered weight, eviscerated weight, wing, thigh, drumstick and neck in T2 (2.5%), T3(5.0%) and T4 (7.5%) show no significant difference ($p<0.05$). This is in agreement with the findings of (9) and and disagrees with the findings of (10) whose research work states that broiler cup-up parts did not exhibit any major discernible response with the use of wood charcoal. It also agrees with the work of (2) who observed that the addition of charcoal has no significant effect on carcass dressing percentage and the proportion of muscles in body weight. In a previous study conducted by (6), a similar trend was noted in broilers as a result of 0.3% charcoal supplementation. This could be as a result of any nutritional factors such as phytate, saponin, and alkaloids found in charcoal.

The organ weight of broilers shows that there is significant difference ($p<0.05$) among the treatment groups. Table 2 revealed that the highest mean of Gizzard, Liver, Heart, Lungs, Pancreas and spleen found was found at T2 (2.5%). This is compatible with the findings of (9) who reported that there was significant difference ($p<0.05$) in the weights if gizzard, heart and spleen among the different levels if charcoal inclusion used in his experiment. The authors concluded that feeding activated charcoal could be the reason for the largeness

of the gizzard. The report was not in line with the findings of (11) who reported otherwise. The mean weight of spleen and pancreas shows no significant difference ($p<0.05$) among the different treatments. The mean weight of Gizzard, Liver, Heart and Lungs in T3 (5.0%) and T4 (7.5%) shows no significant difference ($p<0.05$)

Table 2: Mean organ weight characteristics of chicken fed wood charcoal at different levels of inclusion.

	Mean organ weight for broiler chicken ± SEM			
Ogans (g)	T1 (0%)	T2 (2.5%)	T3 (5%)	T4 (7.5%).
Gizzard (filled)	46.67a±1.45	62.67c±2.03	48.67a±1.76	56.33a±1.76
Liver	34.00a±2.89	54.33b±0.33	35.67a±3.33	35.33a±0.88
Heart	8.00a±0.00	12.67b±0.33	11.33b±0.88	11.67b±0.88
Small Intestine	71.67ab±8.95	81.67b±2.60	63.67ab±0.88	54.00c±6.00
Large Intestine	41.67a±0.33	20.33b±0.33	12.33a±0.88	21.33b±1.86
Gizzard (empty)	30.33a±1.45	37.00b±1.16	36.33b±0.67	40.67c±0.88
Lungs	8.33a±0.33	15.67b±0.88	9.35a±0.33	9.00a±0.58
Pancreas	4.67a±0.33	6.00a±0.58	6.00a±1.00	5.00a±0.58
Proventriculus	9.00a±0.58	15.67b±1.86	11.00a±0.58	7.67a±0.88
Spleen	1.67a±0.17	2.00a±0.00	2.00a±0.00	1.83a±0.17

CONCLUSION AND APPLICATIONS

1. It can be concluded that addition of wood charcoal into the diets of broiler chicken had positive effect on the broiler carcass parameters and the organ weight.
2. With regards to most of the carcass parameters and organ weight measured, T2 treatment with 2.5% wood charcoal added to broiler feed had the best result. Therefore, wood charcoal can be added to broiler feed at 2.5% for both starter and finisher feeds to achieve a better performance.

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Animal Products and ProcessingTechnology: APP005

PROXIMATE COMPOSITION AND SENSORY PERCEPTION OF BEEF SAUSAGE GARNISHED WITH BEETROOT POWDER (*Beta vulgarisL.*)

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ABSTRACT

Sausage is a processed food product made from reconstituted animal products. However, frequent consumption of red meat has been linked to various cardiovascular diseases. The meat processing industries are seeking measures of incorporating non-meat ingredients to enhance the nutritional and sensory properties of their final products. Garnishing sausage with beetroot powder creates a functional product that mitigates concerns associated with red meat, leveraging the numerous nutritional benefits of beetroot. Therefore, this study was performed to evaluate the sensory perception of beef sausage garnished with beetroot powder *(beta vulgaris)*. Samples were prepared with different levels of beetroot powder inclusion to represent T1, T2, T3 and T4 with 0, 2.5, 5.0 and 7.5% respectively. Proximate compositions of beetroot powder, beef sausage as well as sensory characteristics of different prepared samples were determined using standard procedures. Data were analysed using descriptive statistics and ANOVA at α0.05. Proximate composition of beetroot powder showed that carbohydrate has the highest value (74.11%), whereas in the proximate composition of beef sausage, T1 had highest value for moisture (47.03%) and protein (23.37%) while T4 had highest values for ash (15.67%), fibre (6.29%) and carbohydrate (21.97%). Statistically, there was significant difference among these variables ($P<0.05$) except crude fat with similar values. The eating quality showed highest preference for products with 7.5% (T4) beetroot inclusion in terms of tenderness, colour, juiciness and appearance. However, the overall acceptability showed lowest preference for T4 as against similar preference for treatments with no added beetroot and those with 2.5 and 5.0% beetroot inclusion.

Key words: Meat, Sausage, Beetroot, Product, Nutrition

DESCRIPTION OF PROBLEM

Sausage is a processed food product made from reconstituted animal products and by-products, often utilizing less prominent animal parts. Meat and meat products, including sausage, play a vital role in human nutrition, providing a rich source of protein, a balanced array of amino acids, B vitamins, and essential minerals [1]. However, frequent consumption of red meat and other processed meat products, like sausage, has been linked to various cardiovascular diseases [2]. This has prompted some individuals to avoid these nutritionally balanced foods. In response, the meat processing industry has started adopting the practice of incorporating non-meat ingredients as a key strategy to enhance the nutritional and sensory properties of their final products [3]. Garnishing sausage with beetroot powder creates a functional product that mitigates the potential health concerns associated with red meat, leveraging the numerous nutritional benefits of beetroot. Beetroot, an herbaceous biennial from the Chenopodiaceae family, offers various varieties with bulb colors ranging from yellow to red. Its versatility allows for uses in diverse forms, including as a natural red food coloring in products like tomato paste, sauces, desserts, and baked goods, as well as in dried forms like chips, tea, powder, and supplements, expanding its applications in the food industry [4].

MATERIALS AND METHODS

The study was conducted at the Animal Product and Processing Laboratory, Department of Animal Science, University of Ibadan, Nigeria.

Preparation of Beetroot Powder

The beetroots (*Beta vulgaris L.*) used in this study were purchased from Bodija market, Ibadan, Oyo State. They were washed, peeled, sliced into thin flakes and sun dried for four weeks. Following that, the dried beetroots were milled into a fine powder, which was then analyzed for proximate analyses using standard procedures.

Production of Sausage

A fresh boneless lean beef (12kg) and lard were obtained from Amosun abattoir in Ibadan, Oyo state. Beef cut was minced using a 3-mm plate mincer (LinkRich, Model TJ12F, United Kingdom). Four batches (according to percentage inclusion of minced meat) were prepared comprising of salt (2.30%), phosphate (0.30%), nitrite (0.01%) and ice water, and manually mixed for each of the treatments. Beetroot powder was added to each of the four treatments at 0%, 2.5%, 5.0% and 7.5% levels of meat replacement as shown in Table 1. This was followed by the addition of rendered lard, spices and all were thoroughly mixed to make batter. The batter was then stuffed into Ram intestine as casing material using a manual stuffer. The stuffed samples were cooked with slow heat to a core temperature of 72°C after which samples were cooled and proximate composition of sausages were determined using standard procedures.

Table 1: Sausage Ingredients as Influenced by Different Levels of Beetroot powder

Ingredients (%)	Treatments			
	T1 (0%)	T2 (2.5%)	T3 (5.0%)	T4 (7.5%)
Lean meat	70.0	68.25	66.50	64.75
Lard	12.00	12.00	12.00	12.00
Nacl	2.30	2.30	2.30	2.30
Water (as ice)	9.30	9.30	9.30	9.30
Starch (corn)	3.00	3.00	3.00	3.00
Phosphate	0.30	0.30	0.30	0.30
Sodium nitrite	0.01	0.01	0.01	0.01
BRP	0.00	1.75	3.50	5.25
Spices mixture	3.09	3.09	3.09	3.09
Total	100	100	100	100

Table 2: Percentage Spice Mixture used in Sausage Formulation

Spice mixture	Amount (%)
Black pepper	30.0
Red pepper	10.0
Nutmeg	15.0
Garlic	15.0
Onion	15.0
Ginger	15.0

Sensory Analysis

Sensory evaluation of sausage samples was conducted by 25 panelists from the University of Ibadan using a 9-point scale to assess various attributes. The data was analyzed using ANOVA and Duncan's multiple range test to compare means and identify significant differences at a 5% level.

RESULTS AND DISCUSSION

Beetroot powder showed percentage composition of 6.99 moisture, 8.76 ash, 2.78 fat, 5.39 crude fibre, 74.11 carbohydrate and 1.97 protein. These values are very close to those obtained by [6]. This shows that beetroot powder is a good source of carbohydrate and crude fibre qualifying it as a potential ingredient in many dishes for enhancing the nutritional value of food. The result of the proximate analysis of BRP is presented in Table 3.

Table 3: Proximate Composition of Beetroot Powder

Parameters	% Composition
Moisture	6.99
Ash	8.76
Fat	2.78
Protein	1.97
Carbohydrate	74.11
Crude Fibre	5.39

The result of the proximate analysis of reformulated beef sausage is presented in Table 4.
The result of proximate composition of sausage reformulated with beetroot powder shows that there is significant difference (P<0.05) for the values observed for moisture content with T1 having the highest value of 47.03[a]. It was observed that there was a reduction in moisture content of the products as the percentage meat substitution level with beetroot powder increased in the order 0, 2.5, 5.0 and 7.5 percentages across treatments (T1, T2, T3 and T4) respectively. Meat contains 75% moisture and some are lost as a result of muscle fiber contraction due to the cooking heat which squeezes out the juice in form of moisture [7]. Hence, the resultant decrease in moisture content across treatments as the minced meat inclusion decreased. The beetroot powder showed high content of ash. This could be the reason 7.5% (T4) inclusion recorded highest value (15.67[a]) which decreased down the treatments. There was no statistical difference in the fat content (ether extract) across treatments as this was a fixed ingredient that did not find entry into the product through any other source. The increment in levels of carbohydrate and fibre content across treatments in the sausage formulation with beetroot powder is an indication that this plant when used in sausage production could be an important source of energy for consumers [8]. However, this plant has low value on protein. Hence, there is significant difference across treatments as meat which is the primary source of protein decreased across row.

Table 4: Proximate Composition of Beef Sausage Enriched with Different Levels of Beetroot Powder.

Parameters	T1	T2	T3	T4	SEM	P value
Moisture	47.03[a]	40.60[b]	31.10[c]	22.40[d]	0.06	<0.0001
Ash	1.94[d]	6.46[c]	11.60[b]	15.67[a]	0.03	<0.0001
Fat	20.87	20.46	21.64	20.90	0.05	0.2722
Protein	23.37[a]	20.10[b]	16.71[c]	12.78[d]	0.03	<0.0001
Carbohydrate	5.69[d]	10.19[c]	15.34[b]	21.97[a]	0.03	<0.0001
Crude Fibre	1.10[d]	2.20[c]	3.56[b]	6.29[a]	0.02	<0.0001

abcd: Means with different superscripts within the same row and for the same parameter are statistically significant (P<0.05). SEM = Standard Error of Mean

Table 5. presents eating evaluations by twenty-five-man semi-trained panelist on the qualities of beef sausage as influenced by different levels of beetroot. The flavour of the product is one of the sensory impressions the panelists experienced while consuming the sausage. Within species, aroma or flavour can be further discriminated according to feeding and age of the animal and these differences can influence consumer acceptability. In addition, mode of heat processing and the nature of additives used may have a profound effect on the flavour of prepared meat products. Beef sausage flavour had no significant difference (P<0.05) among T1 (7.44[a]), T2 (7.38[a]) and T3 (7.34[a]) except T4 (4.84[b]). The results showed that the flavour decreased slightly among the first three treatments. However, T4 with the highest level of inclusion (7.5%) of beetroot powder, had the lowest flavour acceptability. This could be due to the earthy taste of the beetroot powder, which contributed into sensory parameter. The earthy flavour in red beets comes from geosmin (a volatile aromatic compound), which is a naturally occurring metabolite that gives red beets their distinctive soil-like flavor and smell [9]. The juiciness of beef sausages showed little significant difference (P<0.05) among treatments. The increased beetroot powder level in beef sausages gave rise to slight increase in the juiciness which was found along the increased percentage levels of beetroot powder. Tenderness is a characteristic of meat that is related to the coarseness of meat fiber. There was an increase in tenderness with the increasing level of beetroot powder. Research showed that the denaturation of myofibrillar proteins make the meat

tougher, but the gelatinization of connective tissue (which the beetroot powder effects) re-tenderizes the meat [10]. The colour of meat is often used as an indicator of meat wholesomeness on which consumers base their purchasing decisions. Hence, it is an important sensory attribute that attracts attention of meat science researchers worldwide. The colour of meat products could be influenced by several factors including the ingredients used in the reformulation of the product, bacterial development, lipid oxidation and action of myoglobin on the processing meat. Colour showed significant effects from beetroot powder substitutions in product samples ($P<0.05$). The results showed that the substitution levels of beetroot powder affect the redness colour in an increasing order of treatments 1 - 4. Higher redness colour made beef sausage become more attractive for the consumer. The betalain contained in beetroot powder might be primarily responsible for the increasing redness [11]. Overall acceptability showed no significant difference ($P<0.05$) amongst treatments 1, 2 and 3 although T_3 had highest value (7.88^a). The overall acceptability was found quite satisfactory as compared to the control (T1). All the products developed were acceptable except T4 which had high amount of earthy flavour and tenderness. In general, it could be shown that beef sausage trials containing the beetroot powder at all different levels exhibited a good sensory properties and better acceptability with the exception of T4 with 7.5% inclusion of beetroot powder. However, treatment T3 (5.0% beetroot powder) compared favourably with control T1 (0% beetroot).

Table 5: Eating Qualities of Sausage as Influenced by Different Levels of Beetroot

	T1	T2	T3	T4	SEM	P value
Flavour	7.44^a	7.38^a	7.34^a	4.84^b	0.0140	<0.0001
Tenderness	6.12^c	6.84^b	7.48^b	8.28^a	0.0119	<0.0001
Colour	5.04^d	6.52^c	7.52^b	8.32^a	0.0106	<0.0001
Juiciness	5.96^b	6.52^b	7.64^a	7.80^a	0.0106	<0.0001
Appearance	4.84^c	6.60^b	7.92^a	8.28^a	0.0132	<0.0001
Overall Acceptance	7.36^a	7.28^a	7.88^a	4.96^b	0.0133	<0.0001

abcd: Means with different superscripts within the same row and for the same parameter are statistically significant ($P<0.05$) SEM = standard error of mean

CONCLUSION AND APPLICATION

This study was able to provide an in-depth awareness on the outcome of garnishing a meat product with a plant-based ingredient that resulted in greater acceptability by consumers even when the cost of production is presumably lower than that of the control. Hence, it was recommended that at 5% level of inclusion of BRP, a well garnished functional meat product is obtainable.

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Animal Products and ProcessingTechnology: APP006

A REVIEW ON MICROBIAL COUNTS OF KILISHI

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ABSTRACT

Meat which is an animal tissue, often muscle that is eaten as food has been considered as one of the most nutritious animal products because it is a rich source of valuable nutrients which are essential for human health. Meat has short shelf life at ambient temperature unless it is processed. Therefore processing of meat helps to improves sensory quality, nutritive value, extend its shelf life by reducing microbial spoilage and maintain its safety. Due to the sophistication of present-day techniques of meat preservation and processing simple technologies that are affordable and suitable to the local are preferred for processing and preserving meat. Drying is one of the oldest methods used in prolonging the shelf-life of foods In Nigeria, one of the dry products produced by drying is kilishi, Kilishi is a traditional sun-dried meat made from beef, mutton or chevon, It is a rich nourishing snack with a supplementary plant protein that is formulated using hurdle technology Its production is mainly localized in the northern parts of Nigeria due to abundance of livestock and relatively dry weather, Kilishi is moderately acidic yet it has stable shelf life, which is enhanced by its low moisture contents and improved storage conditions. In recent times however, consumption of kilishi is increasingly being criticized due to the safety of traditional methods and practices involved in kilishi production and an awareness of the effects of diet on human health and well-being, are becoming issues. There is need therefore to review the microbial counts of kilishi

KEYWORDS: Meat, Processing, Kilishi, Beef

DESCRIPTION OF PROBLEM

Meat is an animal tissue, often muscle that is eaten as food (1). It has been considered as one of the most nutritious animal products because it is a rich source of valuable proteins, vitamins, minerals, micronutrients and fats, which provide multifaceted nutrient for human health (2). Demand for meat and meat products is ever increasing with increase in population, urbanization, awareness of its nutritional value and changing dietary preferences and socio-economic factors (3;4). Meat has short shelf life at ambient temperature unless it is processed. (5). Processing of meat helps to improves improve taste, flavor, nutritive value, extend its shelf life, reduce microbial spoilage, maintain its safety, add value to it by producing variety of meat products and also ease transportation and storage (6;7). The present-day techniques of meat preservation and processing are sophisticated, often requiring stable power supply. Therefore, simple technologies that are affordable and suitable to the local environment in terms of social and economic conditions are preferred for processing and preserving meat. One of such technologies is drying. Drying is one of the oldest methods used in prolonging the shelf-life of foods. It reduces the moisture content of the products to very low levels thereby limiting the growth and proliferation of spoilage microbes (8). Drying is core to the production of many traditional meat products all over the world such as fermented sausages, dry-cured hams, koppa, speck or pastrami (Europe), jerky (North America), bresaola (Italy), biltong (Southern Africa) and etc (9;10). In Nigeria, dry meat products include traditionally processed ready-to-eat meat products such as balangu (roasted meat), kilishi, dan-bu-nama, tsire, jirga, ndako, banda, suya, etc. These products are highly cherished due to their unique flavours (11; 9) and cultural significance (10). In Nigeria and some other countries in sub-Saharan Africa, kilishi is increasingly gaining widespread acceptance and importance in recent times. Kilishi is a sundried meat that is made from beef, mutton or chevon, however, beef is mostly used (12,) It is a rich nourishing snack with a supplementary plant protein that is formulated using hurdle technology (13). It is made from thinly sliced fresh lean strips or slices of meat which is dipped into slurry and then sundried (14; 12). Its production is mainly localized in the northern parts of Nigeria due to

abundance of livestock and relatively dry weather and is largely in the hands of traditional producers (15). Kilishi is moderately acidic yet it has stable shelf life, which is enhanced by its low moisture contents and improved storage conditions (12). However In recent times consumption of kilishi is increasingly being criticized due to the safety of traditional methods and practices involved in kilishi production and an awareness of the effects of diet on human health and well-being, are becoming issues of great concern for many consumers. There is need therefore to review the microbial load of kilishi in Nigeria.

MATERIALS AND METHOD

Kilishi Production

Kilishi is a Hausa word which literally means a sun-dried meat. It is a meat snack product usually sold by hawkers in streets, on the roadsides, at bus stops, in marketplaces and other areas of business attraction (16). The product was developed as a means of preserving meat, in the absence of facilities such as refrigeration by the early Fulani and Hausa herdsmen. Kilishi is traditionally made from beef, mutton or chevon and its production is mainly localized in the Northern part of Nigeria due to abundance of livestock production and relatively dry weather condition (12). Beef is mostly used in the production of kilishi (12) and is made from thinly sliced fresh lean strips of about 0.17 – 0.5 cm thick, which is dipped into a slurry made of defatted groundnut powder, spices and other seasoning agents. The defatted groundnut paste helps to bind the ingredients thereby increasing the yield of the final product while the spices used in kilishi production not only add 321lavor but to ward off insects and control the proliferation of microbes. According to (17), the spice mix significantly reduces the thiobarbituric acid value (TBA) in pre-cooked dehydrated meat products. More so several studies have shown that spices generally have flavouring, antimicrobial and antioxidant activity on the kilishi (18; 19). In addition the use of extracts from herbs and spices to enhance sensory characteristics and retard lipid oxidation (20), and extend the shelf-life of meat and other foods products have been reported by (21). (22) reported that garlic powder as additive up to 8% may improve chemical characteristics, organoleptic properties and delay lipid oxidation in kilishi. Common salt (NaCl) used in seasoning of kilishi is known to preserve food products by reducing water activity (23).

RESULTS AND DISCUSSIONS

Shelf Life and Microbial Load Of Kilishi

Shelf life is the length of time for which a material remains usable, fit for consumption, or saleable. Kilishi is shelf stable. It has been reported to have a shelf life of over sixty weeks in dry environments (15). (24) reported 24 weeks of shelf life for different meat types of kilishi while (14) reported shelf life of 36 weeks of storage. On the other hand microbial quality and safety of meat products are very important in ensuring consumers health and food security after production (25). Several researchers have reported that the quality of meat and meat products could be compromised by spoilage organisms (bacteria, fungi, yeast and molds) especially during processing, handling, storage and market (26). However, traditional production of kilishi under strict hygienic conditions free of microbial contamination is usually difficult to achieve in Nigeria. This is due to the nature of the raw material (fresh meat) which attracts agents of spoilage such as insects, which feed on the moisture exudates from the product (27). The degree of contamination and spoilage is usually influenced by the concentration and availability of nutrients, presence of oxygen, storage temperature, pH at storage, initial microbial load at the beginning of production, poor handling of meat, non-observance of good manufacturing practices during production and use of contaminated utensils and equipment and poor personnel and environmental hygiene during processing (28). (29) reported that kilishi had mean bacterial counts and *fungi* counts of 8.9 $x10^3$ cfu/g, 1.04 $x10^3$ cfu/g for a period of 2 months; 13.5 $x10^3$ cfu/g, 2.0 $x10^3$ cfu/g for 4 months; and 18.27 $x10^3$ cfu/g, 3.2 $x10^3$ cfu/g for a period of 6 months, respectively. (30) reported that kilishi stored for 21 days had range of Aerobic plate count of 7.0 x 10^4 cfu/g on day 1, 1.0 $x10^4$ cfu/g on day 7, 1.2 x 10^4 cfu/g on day 14, and 1.8 x 10^2 cfu/g on day 21, respectively. The presence of *E. coli*, *Salmonella* species, *Staphylococci* and *Clostridium perfringens* were found in spices used in the production of kilishi (25). (31) identified *Bacillus spp*. and *Botryodiplodia theobromae* from freshly prepared kilishi.. (31) reported 2.1 x 10^2cfu/g as minimum growth of bacteria on kilishi from companies and 4.32 x 10^3 CFU/ml bacterial growth on fresh kilishi samples from the locally processed

vendors in Port Harcourt, Nigeria Therefore, it is essential to increase meat quality assurance through microbial load assessment (32). Roasting the sun-dried product gently decontaminates it by destroying vegetative bacterial cells but may not destroy some spores. Therefore, (31) reported that the critical control point during production of kilishi is roasting temperature

CONCLUSION

The production of Kilishi in Nigeria is a nuance process that involves a delicate balance between traditional methods and contemporary considerations. Traditional production of kilishi under strict hygienic conditions free of microbial contamination is usually difficult to achieve. This is due to the nature of the raw material (fresh meat) which attracts agents of spoilage such as insects, which feed on the moisture exudates from the product, poor handling of meat, non-observance of good manufacturing practices during production, use of contaminated utensils and equipment and poor personnel and environmental hygiene during processing. Therefore, it is essential to increase meat quality assurance through microbial load assessment, careful selection of raw materials and adherence to quality control measures im other to produce wholesome product and ensure consumer safety

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Animal Products and ProcessingTechnology: APP007

MEAT QUALITY AND AMINO ACID PROFILES OF BROILER CHICKENS FED ON DIETARY SOYBEAN WASTE REPLACEMENT

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ABSTRACT

The feeding trial was conducted to determine the meat quality and amino profile of broiler chicken's meat fed dietary Soybean waste (SBW) supplementation at different inclusion levels. Three hundred day- old Abor- acre chicks were randomly allocated into five dietary treatments with replacement levels of SBW 0% (control), 0.2% (T_2), 0.4% (T_3), 0.6%(T_4) and 0.8%(T_5), in 3 replicates each in a completely randomized design. The feeding trial was for a period of 8 weeks in which the birds were fed diets (23 % CP and 2800 Kcal/kg ME) and (20 % CP and 3000 Kcal/kg ME) at interval of 4 weeks each. Data were collected on meat quality such as Water holding capacity (WHC), colour coordinate, sensory evaluation and amino acid profiles. There is significant influence on the colour of the broiler breast meat by SBW. The supplementation of soybean meal with SBW 0.2 % showed higher ($p<0.05$) WHC value than other treatments. While SBW 0.4 % had higher ($p<0.05$) pH value compared with other treatments. Apart from appearance perception, there were no significant difference in taste, aroma, texture and overall acceptability of the broiler chicken meat on dietary graded levels of soybean waste replacement. The appearance perception of birds on SBW 0.8 % diet were significantly higher ($p <0.05$) compared with other treatments. Dietary birds fed SBW 0 % had higher essential amino acid (methionine, histidine and lysine) compared to other treatments. Replacement of SBW 0.4% is relatively comparable to birds on dietary SBW 0 %, the control treatment.

Keywords: Soybean Waste, Meat Quality, Amino acid Profiles, Replacement

DESCRIPTION OF PROBLEM

Research indicates that substituting soybean waste for a portion of the soybean meal in broiler diets can improve performance, carcass attributes, and meat quality [7]. It can boost meat quality characteristics like tenderness and juiciness as well as growth performance and carcass weight. To achieve performance, it is essential to strike the optimum balance and guarantee proper nutrient content in the feed. The replacement of soybean waste in broiler chicken diets has been the subject of numerous articles. In a study by [1] which examined the results of substituting brewery-dried grains for soybean meal in broiler diets, results showed that adding fermented soybean waste enhanced growth, increasing body weight and feed conversion efficiency. The effects of substituting defatted soybean waste for soybean meal in broiler diets were assessed by [4]. The study found that adding defatted soybean waste improved carcass characteristics (breast muscle yield and decreased abdominal fat deposition). In addition, a study by [5] examined the impact of switching from soybean meal to high-fibre sunflower meal as the main source of protein in laying hens, their findings showed no negative effects on body weight. They claimed that adding soybean hulls improved the qualities of meat, such as increased softness and reduced cooking loss. All the studies mentioned above point to the possibility of improving broiler chicken performance, carcass features, and meat quality by replacing dietary soybean waste. It is crucial to keep in mind that the precise outcomes can change based on the type and processing of soybean waste, as well as the total diet composition. This study intends to ascertain the amount of soybean waste that, when used in place of soybean meal, will produce the same growth performance and good carcass qualities.

MATERIALS AND METHODS

Study Area
The experiment was carried out at the poultry unit of the Teaching and Research Farm of the Department of Animal Production, Kwara State University, Malete, as described by [8].

Experimental Animals and Diets
The experimental animals and the diets used were discussed in the feeding trial previously conducted by [8].

Data Collection
Data were collected on initial body weight, final body weight, feed intake, and feed conversion ratio. [8]. Nutrient digestibility was determined at the 4th and 8th weeks of the feeding trial [8].

Data were collected on meat quality, and the following parameters were used to test for the quality of the meat:

- Water holding capacity, drip loss, cooking loss and pH
- Colour coordinate.
- Sensory evaluation.

Water holding capacity, drip loss, cooking loss and pH
Drip and cooking losses were measured according to the methods described by [9].
Drip loss (%) = $W1 - W2 \div W1 \times 100$ ……..(i)
Cooking loss (%) = $W1 - W2 \div W1 \times 100$…….(ii)

Colour Coordinate
Colour coordinates were measured according to the methods described by [10].
Sensory Evaluation
5g of the breast meat were trimmed free from external fat, labelled and cooked in water bath at 80 °C for 10 minutes. The meat samples were wrapped in aluminium foil cooled and kept in oven at 30 °C until evaluation. A 20 trained panellist was used to determine the sensory evaluation using a 9-point hedonic scale, procedure described by [20]. 9 indicating like extremely and 1 indicating dislike extremely.
Amino acid profiles
Amino acid profiles were determined using procedure described by [17].

Data Analysis
Data obtained from all determined parameters were subjected to ANOVA using the PROC MIXED procedure of the SAS package (2014). Means were separated using the Tukey HSD test at $P<0.05$ significant level.

RESULTS AND DISCUSSION

Result of growth performance, carcass attributes and nutrient digestibility on broiler chickens on dietary soybean waste replacement has been published [8].

The pH of birds on dietary SBW 0.4 % (5.87) were significantly higher ($p <0.05$) than those birds in dietary SBW 0 % and 0.2 % which in turn is significantly higher ($p <0.05$) than SBW 0.6 % (5.79) and 0.8 % (5.80). Birds on dietary supplementation SBW 0.4 % (5.87) performs better than other treatment including the control. This could be because of low content of crude protein in the diet compared to control which after slaughter metabolism stop (anaerobic condition). The glycogen reserved in the tissue will be converted to lactic acid and the more the muscle becomes acidic, the more the softness of the tissue. This result correlated with [11] which findings were fully fit within the pH range (5.40 - 5.99) accepted for poultry meat production. The water holding capacity (WHC) of birds on dietary SBW 0.2 % (22.62) were significantly higher ($p<0.05$) than birds on other treatments. Drip loss (DL) of birds on dietary 0 % (5.37) were significantly higher ($p <0.05$) than birds on dietary SBW 0.2 %, 0.4 %, 0.6 % and 0.8 %. For many years,

drip loss has been widely recognized in meat science as an indicator of meat quality and factor that could be applied to distinguish between deteriorated meats from normal muscle [12]. Meat of good quality is characterized by lesser drip loss. [21] showed the significant effect of ultimate pH on drip loss with a higher level in meat with low pH. Birds on dietary SBW 0.6 % had a lower mean value (1.27) as related to the meat pH. This could be because of low content of crude protein present in the diet.

Lightness (l*) of bird's meat on dietary SBW 0 % (18.87) and 0.2 % (17.52) were similar but significantly higher ($p < 0.05$) than those bird's meat on dietary SBW 0.4 % (5.24) and 0.8 % (8.66). The l* values of bird's meat fed SBW supplementation decreases down as the protein were reduced. Bird's meat on SBW 0 % has the highest mean value (18.87) while SBW 0.4 % has the lowest mean value (5.24). This could be because of high protein concentrate fed to the birds on SBW 0 %. The glycogen reserved in the tissue after slaughtering which is converted to lactic acid result in PSE (pale, soft and exudative) of the breast meat. This result disagreed with [14] who reported that there was no significant difference in dietary supplementation of black soldier fly as a source of protein on breast meat. Redness (a*) of bird's meat on dietary SBW 0.4 % (10.47) and 0.6 % (9.17) were similar but significantly higher ($p<0.05$) than bird's meat on dietary SBW 0.2 % and 0.8 %. Yellowness (b*) of bird's meat on dietary SBW 0.6 % and 0.8 % were similar but significantly higher ($p < 0.05$) than bird's meat on dietary SBW 0 %, 0.2 % and 0.4 %. This could be because of high pH levels in the meat which might be due to lack of glycogen which produces lactic acid and H+ postmortem in the breast muscle [3]. The result obtained from this study is consistent with the observation of [2] who reported that diets with higher fibre content and low metaboliseable energy will increase the WHC, pH, lightness, reduced the redness and yellowness in the breast meat of broiler chicken.

The appearance of bird's meat on dietary SBW 0.8 % (9.00) was significantly higher ($p<0.05$) than bird's meat on 0.2 % (8.67) and 0,6 % (8.00). The good appearance perception of bird's meat on SBW 0.8 % could be because of high dietary fibre in the diet which will not hinder the assimilation and utilisation of essential amino acids present in the diet as compared with the control despite its high content of essential amino acids but its assimilation and utilisation by birds may be hindered by the presence of oil in the diet. The result obtained in this study contradict the result of [2] who reported that there was no significant difference on bird fed with whey protein concentrations in broiler diets.

Table 1: Meat Quality (WHC, Cooking & Drip loss, colour coordinate) of Broiler Chicken Fed Dietary Soybean Waste Meal.

PARAMETER	TREATMENT						
	SBW 0%	SBW 0.2%	SBW 0.4%	SBW 0.6%	SBW 0.8%	SEM	P.VALUE
pH	5.84^{b}	5.82^{b}	5.87^{a}	5.79^{c}	5.80^{c}	0.00	<0.0001
WHC	16.78^{b}	22.62^{a}	16.27^{b}	17.84^{ab}	16.52^{b}	1.19	0.0179
Colour Coordinates							
Cooking Loss	38.65	40.57	41.21	38.78	39.02	0.88	0.2179
Drip Loss	5.37^{a}	1.62^{b}	1.61^{b}	1.27^{b}	1.89^{b}	0.25	<0.0001
Lightness l*	18.87^{a}	17.52^{a}	5.24^{b}	0.00^{c}	8.66^{b}	0.78	<0.0001
Redness a*	6.25^{ab}	3.15^{b}	10.47^{a}	9.17^{a}	4.10^{b}	0.94	0.0010
Yellowness b*	6.07^{b}	5.32^{b}	6.12^{b}	12.39^{a}	11.70^{a}	1.15	0.0026

^{a,b,c} means in the same row having different superscripts are significantly different ($p>0.05$).

Amino acid composition

Glycine acid of bird's meat on SBW 0.6% were significantly higher ($P< 0.05$) than those birds on SBW 0.4% which in turn significantly higher ($P<0.05$) than those on SBW 0% and 0.8%. Valine acid of those birds on SBW 0% were significantly higher ($P<0.05$) than those on SBW 0.4% which in turn higher than those birds on SBW 0.8%. Leucine acid of birds on SBW 0.2% were significantly higher ($P<0.05$) than those birds on SBW 0% treatment. However, there were similarities in leucine values of birds in dietary SBW (0.4%, 0.6% and 0.8%) treatments. Isoleucine acid of birds on SBW 0.6% were significantly higher ($P<0.05$) than those birds on SBW 0% which in turn significantly higher than those birds on SBW 0.8%. Proline acid

of birds on SBW 0.2% were significantly higher (P<0.05) than those birds on SBW 0.6% which in turn were significantly higher than those on SBW 0.8%. Threonine acid of birds on SBW 0.2% were significantly higher (P<0.05) than those birds on SBW 0% which in turn higher than the birds on SBW 0.8%. Methionine acid of birds on SBW 0.4% were significantly higher (P<0.05) than those birds on SBW 0% which in turn were significantly higher (P<0.05) than those on SBW 0.2%. Glutamine acid of birds on SBW 0.8% were significantly higher (P<0.05) than birds on SBW 0.6% which in turn were significantly higher (P<0.05) than SBW 0%. Lysine acid of birds on SBW 0.2% were significantly higher(P<0.05) than SBW 0.8% which in turn significantly higher than those on SBW 0.4%. Histidine acid of birds on SBW 0% were significantly higher (P<0.05) than those on SBW 0.4% which in turn significantly higher than those on SBW 0.6%. Tyrosine acid of birds on SBW 0.6% were significantly higher (P<0.05) than those on SBW 0.8% which in turn were significantly higher than those on SBW 0.2%. Tryptophan acid of birds on SBW 0.8% were significantly higher (P<0.05) than SBW 0.6% which in turn were significantly higher than SBW 0%. The catabolism of amino acid and its metabolic processes through conversion of protein is diet based dependent [16]. Despite its nutritional importance for humans, the amino acid content and profile of chicken meat has been scarcely investigated in literature. Findings of the present study confirmed that essential amino acids; histidine, methionine and valine were well adsorbed by birds on dietary treatment SBW 0 %. Lysine, phenylalanine, leucine and threonine are abundant in birds' meat on dietary SBW 0.2 %. Isoleucine in SBW 0.6 % diet and tryptophan in SBW 0.8 % diets were found to be deposited on the bird's meat. This could be because of the birds' ability to synthesize available essential amino acids in the diet. This finding is consistent with the result obtained by [17]. This result also agrees with [18] who observed that the glutamine amino acid level of broiler chickens fed low crude protein diet under tropical condition increased the amino acid digestibility.

Table 2: Sensory Evaluation of Broiler Chicken Meat Fed Dietary Soybean Waste Meal

PARAMETER	TREATMENT						
	SBW 0%	SBW 0.2%	SBW 0.4%	SBW 0.6%	SBW 0.8%	SEM	P-VALUE
Appearance	7.67^{c}	8.67^{b}	7.00^{c}	8.00^{b}	9.00^{a}	0.42	0.0470
Taste	8.33	9.00	7.67	8.67	8.33	0.47	0.4083
Texture	7.67	8.33	8.00	8.00	8.67	0.45	0.5962
Aroma	8.67	9.00	8.67	8.67	8.67	0.30	0.9032
Overall Acceptability	8.00	8.67	8.00	8.33	7.67	0.52	0.7091

^{a,b,c} means in the same row having different superscripts are significantly different (p>0.05).

CONCLUSION AND RECOMMENDATION

The results obtained showed that broiler chickens with replacement level of 0.4 % could also be an effective means of meat quality improvement. As a result, broiler chickens' diets containing soybean meal could be replaced with up to 0.4 % of soybean waste.

TABLE 3: Dietary Soybean Waste Supplementation on Amino Acid Profile of Broiler Chicken Meat

	Treatments						
Amino acid	SBW0%	SBW0.2%	SBW 0.4%	SBW0.6%	SBW0.8%	SEM	P value
Glycine	27.02^{c}	1.00^{e}	36.82^{b}	37.12^{a}	7.54^{d}	0.0027	<0.0001
Valine	18.58^{a}	0.00^{d}	16.32^{b}	0.00^{d}	12.21^{c}	0.00008	<0.0001
Leucine	0.06^{b}	22.98^{a}	0.00^{c}	0.00^{c}	0.00^{c}	0.00005	<0.0001
Isoleucine	15.65^{b}	0.00^{e}	13.42^{d}	23.75^{a}	15.40^{c}	0.0009	<0.0001
Proline	9.30^{c}	23.70^{a}	14.70^{b}	23.61^{a}	14.72^{b}	0.006	<0.0001
Threonine	4.08^{b}	6.68^{a}	0.00^{d}	0.00^{d}	2.17^{c}	0.0001	<0.0001
Methionine	0.73^{a}	0.47^{c}	0.65^{b}	0.00^{d}	0.00^{d}	0.0001	<0.0001
Cysteine	0.06^{d}	0.00^{e}	2.86^{a}	0.16^{c}	0.68^{b}	0.0001	<0.0001
Glutamine	1.07^{c}	0.12^{d}	0.00^{e}	5.48^{b}	9.39^{a}	0.0001	<0.0001
Lysine	0.33^{d}	8.74^{a}	1.06^{c}	0.20^{e}	3.28^{b}	0.0002	<0.0001
Histidine	36.22^{a}	0.00^{d}	0.44^{b}	0.24^{c}	0.00^{d}	0.0001	<0.0001
Tyrosine	0.32^{d}	0.42^{c}	0.21^{e}	1.63^{a}	0.67^{b}	0.0002	<0.0001
Tryptophan	0.36^{c}	0.00^{e}	0.27^{d}	0.52^{b}	11.03^{a}	0.0001	<0.0001
Alanine	0.00^{d}	1.46^{c}	0.00^{d}	6.61^{b}	20.63^{a}	0.0001	<0.0001
Asparagine	0.00^{b}	3.51^{a}	0.00^{b}	0.00^{b}	0.00^{b}	0.00002	<0.0001
Phenylalanine	0.00^{b}	0.14^{a}	0.00^{b}	0.00^{b}	0.00^{b}	0.00002	<0.0001
Serine	0.00^{c}	0.00^{c}	3.27^{a}	0.00^{c}	1.95^{b}	0.00005	<0.0001
Aspatic acid	0.00^{d}	0.00^{b}	0.00^{b}	0.65^{a}	0.00^{b}	0.00002	<0.0001

$^{a-e}$ means in the same row with different superscripts differ significantly(P<0.05). SBW – soybean waste

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Animal Products and ProcessingTechnology: APP008

EFFECT OF DIFFERENT COLOURANTS (TURMERIC AND *JA'WA* POWDER) ON THE ORGANOLEPTIC PROPERTIES OF BROILER MEAT

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ABSTRACT

This research was conducted to evaluate the effect of different colourants (turmeric and *Ja'wa* powder) on broiler chicken meat. The broiler meat was divided into 3 equal parts, in which the two-part of meat was cured with these colourant (turmeric and *Ja'wa* powder) at 5 and 1% respectively while the last part was not cured with any colour, this served as the control. The cooked broiler chicken meat was served to 20 semi trained panelist to grade the products using 5-point hedonic scale. The results showed that there were significant different (P<0.05) in all the measured parameters: colour, aroma, tenderness, juiciness, and overall acceptability. In terms of colour, the panelist prefers the meat with *Ja'wa* powder with 4.53 point above the other meat cured with turmeric at 3.07 point and the control 2.05 point (without colorant). Meanwhile, in term of aroma, tenderness and juiciness, the panelist prefers the meat cured with both turmeric and *Ja'wa* powder above the control. The results of overall acceptability showed that the panelist prefer meat cured with *Ja'wa* and turmeric powders above the control. In conclusion, meat processors can use turmeric powder as natural colourant in replacing the synthetic *Ja'wa* powder.

Key words: Organoleptic Properties, Colourants, Turmeric Powder, J*a'wa* Powder

DESCRIPTION OF PROBLEM

Colour is one of the most important sensory qualities, as it helps us to accept or reject particular food items [1]. Colour is used to add or restore colour of a food in order to enhance its visual appeal and to match consumer expectations [2]. Presently, there is an increased global trend towards usage of natural colours in food, pharmaceutical and personal care industries, such as turmeric, beet juice among others. Currently, people prefer natural food, herbal medicines, natural curing practices and even organic farming above the rampant use of synthetic chemicals such as *Ja'wa* powder (Sudan dye), Tartrazine among others and adopting a more natural way of life.[3]

Turmeric (*Curcuma longa*), is a rhizome used as a culinary spice and traditional medicine. It is commonly used in foods as a color agent because of its yellow color characteristic [4]. In addition, turmeric can be used as a food additive in curries to enhance aroma, storage conditions, palatability and preservation [5].
Ja'wa (Sudan dye) is a synthetic red colourant powder commonly found among the meat and meat products, food, chilli pepper and palm oil sellers [6]. It is used to make the food and meat products appealing to the consumers [7].

MATERIALS AND METHODS

Twelve (12) kg of broiler meat was bought from Animal product laboratory of Animal Science Department, Ahmadu Bello University, Zaria and the colourants were purchased from Samaru market. The meat was divided into three (3) equal parts, the first part was cured with turmeric powder at 5%, the second part was cured with *Ja'wa* powder 1% while the third part was not cured with any colourant and this served as the

control. These meats were cooked in different cooking pots for 20minutes, it was cut into eatable size and was served to twenty (20) semi trained panellist to grade products based on five hedonic scale on an assessment sheet provided. Cracker biscuit and water was served to panellists to rinse their mouth after tasting each sample to reduce carry over effects from one sample to another.

Statistical Analysis

All data obtained from this study was statically analysed using the general linear model procedure of statistically Analysis systems software package while significant difference between treatment means was separated using turkey procedure [8].

RESULTS AND DISCUSSION

The effects of different colourants on the organoleptic properties of broiler chicken meat, is presented in Table 1. The results showed that there was significant difference ($P<0.05$) in all the measured parameters: colour, aroma, tenderness, juiciness, and overall acceptability. Results on the colour assessment showed that *Ja'wa* significantly improved the appearance of the broiler chicken meat, achieving a score of 4.53, which is notably higher than both the Control (2.47) and Turmeric (3.07). The result from this study is in agreement with [6] who reported that addition of *Ja'wa* to palm oil and chilli pepper improved the colour and marketability. This indicates that *Ja'wa* is highly effective in enhancing the visual appeal of the meat, which could be particularly important for consumer perception and marketability.

In terms of aroma, Turmeric was the most effective, with a score of 4.07 which fell within reported value of [9], who reported the effect of different levels of turmeric powder on sensory quality of beef stick products compared to the Control (2.07) and *Ja'wa* (2.60). The marked improvement in aroma with Turmeric suggests that it could be an excellent additive for enhancing the sensory appeal of broiler chicken meat through smell. Since aroma is a critical factor influencing consumer preference and perception of freshness, Turmeric inclusion in processed meat product could lead to higher consumer satisfaction and acceptance.

The tenderness of the meat was also positively influenced by the addition of colorants. Turmeric (3.60) and *Ja'wa* (3.40) significantly improved the tenderness of broiler chicken meat while the control (2.80) had lower preference. This result of this study is line with the report of [10] who reported that feeding turmeric powder to broiler chicken improved the tenderness of the meat. This implies that turmeric and *Ja'wa* powders enhance the textural quality of broiler chicken meat, making it more appealing. Tenderness is a key quality attribute in meat products, and improvements in this area can contribute to better consumer enjoyment and repeat purchases.

Results on juiciness revealed that meat processed with turmeric (3.20) and *Ja'wa* (3.07) had higher scores compared to the control (2.67) with lower value. This is line with report of [9][10] that addition of turmeric improved the juiciness of broiler meat. This implies that the additives do not only enhances the flavour profile but also contributes to the perceived moisture content of the meat, which is crucial for a satisfying eating experience.

The results on overall acceptability showed that the preference of the consumers, was highest for *Ja'wa* (4.27) and turmeric (4.00), which were significantly ($P<0.05$) higher than preference for meat in the control (2.53) group. The high scores for acceptability suggest that incorporating these colorants could lead to greater consumer satisfaction and potentially higher sales.

The significant improvement in the organoleptic properties of broiler chicken meat with the use of Turmeric and *Ja'wa* colorants suggests that these additives can be employed to enhance the sensory qualities of meat products. More so, utilization of turmeric powder can lead to better consumer acceptance and satisfaction, potentially increasing meat quality, market demand and profitability.

Table 1: Effect of different colourants on organoleptic properties of chicken meat

	Different Colourants			
Parameters	Control	Turmeric	*Ja'wa*	SEM
Colour	2.47[c]	3.07[b]	4.53[a]	0.20
Aroma	2.07[c]	4.07[a]	2.60[b]	0.14
Tender	2.80[b]	3.60[a]	3.40[a]	0.28
Juiciness	2.67[b]	3.20[a]	3.07[ab]	0.17
Acceptability	2.53[b]	4.00[a]	4.27[a]	0.17

[abc]Means with different superscripts along the same row are significantly (P<0.05) different, SEM: standard error of means.

CONCLUSION AND APPLICATION

There was significant improvement in the organoleptic properties of broiler chicken meat with the use of turmeric and *Ja'wa* colourants in all the traits measured (colour, aroma, tenderness, juiciness, and overall acceptability) over the control group.

For meat processor, the use of natural colourants like turmeric can serve as a marketing advantage, appealing to consumers seeking products with natural additives over synthetic ones.

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Animal Products and ProcessingTechnology: APP009

INFLUENCE OF TURMERIC (Curcuma longa L.) LEAF MEAL ON MEAT QUALITY OF BROILER CHICKENS

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ABSTRACT

This study evaluated the effect of Turmeric leaf meal (TLM) on meat quality of broiler chickens. Fresh Turmeric leaves were sliced oven dried at 50°C for two days and ground to powder. The TLM was incorporated into the feed at 0g, 0.5g, 1.0g and 1.5g forming the experimental Treatments. A total of 108 one-day-old chicks (Ross 308) were allotted to four treatments with three replicates in a completely randomized design. Three birds from each treatment were picked, slaughtered and dressed. About 40g of meat was excised from the breast of each chicken and subjected to Crude protein, crude fat, moisture, ash, mineral content, pH, cooking loss and sensory evaluation following standard procedures. The crude protein, moisture, ash contents were not influenced by the turmeric leaf meal. There was a linear reduction in Crude fat as the levels of TLM increased. Zinc, Cu, Fe were lower in meat from TLM fed birds while Mn and Iodine were higher in TLM fed birds. Potassium and Phosphorus were reduced in meat from birds fed TLM. Calcium and Na were increased in meat from birds fed TLM while Mg was not affected by TLM. There was a reduction in pH and higher cooking loss of the meat from TLM fed birds. Increased flavour, juiciness and acceptability of broiler breast meat were observed in broiler meat with 0.5 g of TLM. Therefore, addition of Turmeric leaf meal at 0.5g into broiler feed produced leaner meat with improved eating quality.

Keywords: Turmeric leaf meal, broilers, meat quality, feed additive, minerals

DESCRIPTION OF PROBLEM

The poultry industry has been faced with the challenge of finding alternative substances to the use of antibiotics as a growth promoter in animal feed following its ban in the EU in January 2006. These alternative substances to antibiotics have drawn attention towards phytogenic and herbal products which consumers perceive as natural additives (1). Various plants and their derivatives such as basils, garlic, ginger, moringa and turmeric have been investigated. Turmeric, a plant belonging to the family zingiberaceae with oblong or lanceolate leaves have been used for culinary and medicinal purposes. The rhizome when ground produces a golden yellow powder. The active ingredient that gives it the yellow colour is Curcumin which is a polyphenol that acts against free radicals. The Turmeric rhizome is prominent for its anti-cancer, antioxidant (2), anti-bacterial (3) anti-fungal and anti-inflammatory properties (4; 5)

Due to these unique properties, several authors have carried out numerous researches to harness these benefits. (6; 7; 8; 9; 10). The leaves are also known to possess various properties too. They are used mainly in aryuvedic medicine and to season full flavoured foods such as chutney, curry dishes and pickled fish. Turmeric leaves are known to be cathartic, astringent and antiseptic. Uwa *et al.*, (11), reported that Turmeric leaf meal is a good ingredient for livestock feed production. There is paucity of information on improvement of meat quality with the usage of this feedstuff. Therefore, this study evaluated the effects of Turmeric leaf meal on the meat quality of broiler chicken.

MATERIALS AND METHODS

Experimental Site

The study was conducted at the Poultry unit of the Teaching and Research Farm, Department of Animal Science and Biochemistry Laboratory respectively in University of Uyo. Uyo is located on latitude 5.32°N and longitude 7.54°E with average rainfall of about 800-3200mm and with the average temperature 22.5°C to 32.2°C.

Procurement and Processing of the Experimental Materials and Animals

The turmeric leaves used as experimental material were sourced within the University of Uyo Annex Campus, Akwa Ibom State. The leaves were harvested, washed to remove debris, shredded and oven dried at 50°C for two days. The dried leaves were manually blended into powder to form a leaf meal. The turmeric leaf meal was further thoroughly mixed with other feed ingredients like maize, Soya bean meal, groundnut cake, sesame seed cake, fish meal, wheat offal, bone meal, common salt, Vitamin/mineral, premix, lysine and methionine feed at the rate of 0g, 0.5g, 1.0g, 1.5g of feed respectively. The poultry house was washed, disinfected and left to air-dry for two weeks before the arrival of the chicks. A total of 108 day-old, Ross 308 broiler chicks were purchased from a reputable hatchery in Uyo, Akwa Ibom State.

Experimental Design and Layout

On arrival, the Initial weights of the birds were taken before they were randomly allotted to four treatments, (T_1, T_2, T_3, T_4) and with three replicates of 9 birds per replicate in a Completely Randomized Design (CRD). Feed and water were supplied to the birds *ad-libitum* throughout the experimental period. Four dietary treatments were formulated for the starter and finisher phase. Treatment one (T_1) the control had no Turmeric leaf meal while T_2, T_3, and T_4 had 0.5g, 1.00g and 1.50g per 100kg of feed. The birds were kept on the starter feed for four weeks and four weeks on finisher diet.

Chicken meat preparation

The slaughtered chickens were properly dressed and the breast cut was excised for the experiments. About 40g each of the breast meat were cut, weighed using a sensitive scale- SF-400 and labeled in polythene bags, closed loosely with string. The carefully labeled 'meat bags', were cooked for 30 minutes in a water bath pre-heated at 100^0C.

Parameters Measured

Chemical Analysis

The breast meat from chickens fed TLM were analysed for proximate composition and minerals using the procedure of (12).

pH

The pH values of the breast meat from chickens fed TLM were determined by weighing five (5) grams of a uniform and representative sample, combined with 50ml of distilled water and blended for 1min until a smooth slurry was formed. The microcomputer pH meter (HANNA instrument 4824) was placed in the solution and allowed to equilibrate for one minute before the reading was taken. Three readings were taken and averaged as the pH of each sample.

Cooking Loss

This was determined by the procedure of (13). The chicken breast meat cut was weighed and packed into thin polyethylene bags which were labelled according to their treatment and broiled for 30 minutes at 100°C temperature in a water bath. After 30 minutes respectively, the released water was manually separated from the meat samples and allowed to cool for 30 minutes. The sample were weighed to determine the cooking loss. Cooking loss was determined thus:

$$\text{Cooking Loss} = \frac{\text{Weight of meat before cooking (g) - weight after cooking (g)}}{\text{Weight of meat before cooking}} \times \frac{100}{1}$$

Sensory Evaluation

The cooked sample was served to a 10- member panel of under-graduate students of the Department of Animal science for the evaluation of the palatability attributes. The panelists were pre-trained on the general procedure for evaluating the samples and were served with seven coded samples. Each served sample was about 1g. A 9-point hedonic scale (1= extremely poor, undesirable extremely dry extremely difficult, extremely tight, extremely present, extremely dislike, dark respectively and 9= extremely desirable extremely juicy extremely easy extremely loose, extremely absent, extremely like, extremely light, respectively) was used to evaluate flavour, juiciness, tenderness and overall acceptability of the meat and Colour. Panelists were required to cleanse their palate between samples with water and biscuit (14).

Statistical Analysis

Data obtained were subjected to Analysis of Variance in a Completely Randomized Design where significant differences occurred the means were separated using Duncan Multiple Range Test (DMRT) on Statistical package for the Social Sciences (SPSS) version 20 (15).

RESULTS AND DISCUSSION

Table 1: pH of chicken breast from broilers fed turmeric leaf meal

Parameters	T1(0g)	T2 (0.5g)	T3 (1.0g)	T4 (1.5g)	SEM
pH	5.99[a]	5.75[c]	5.73[c]	5.81[b]	0.01
Cooking loss (%)	12.95[c]	14.81[b]	14.83[b]	15.09[a]	0.01

a-c means of the same superscript on the same row in the significantly (P<0.05) different.

The pH and cooking loss of chicken breast from broilers fed Turmeric leaf meal are shown in Table 1. The pH ranged from 5.75- 5.99. There were significant (P<0.05) variations in the TLM treated meat samples (5.75, 5.73, 5.81 for T2, T3, T4 respectively) compared to the control (5.99). The pH of TLM fed broiler chicken breast were lower than the control samples indicating reduced meat spoilage due to addition of the leaf meal. This may be attributed to the presence of bioactive compound in the turmeric leaves. A lower pH improves shelf life of meat as a high pH reduces shelf life leading to meat spoilage because it creates a favourable environment for bacteria (16). In consonance with the result of this study, are the reports of (17) and (18) on a decline in the pH of meat due to addition of phytogenics.

Cooking loss was highest (P< 0.05) in the TLM fed broiler chicken meat samples (14.81, 14.83, 15.09) with the least seen in the control (12.95) (Table 1). This implies that Turmeric leaf meal enhanced the shelf stability of the meat by reducing moisture content thereby creating a less favourable environment for microorganisms. It is a known fact that when cooking loss is high the amount of water retained in the meat (WHC) is reduced. This affects meat yield because there is weight reduction as a result of moisture loss. This moisture loss comprises other nutrients including fat. The increasing cooking loss with increasing levels of TLM obtained from this study is in accordance with the results of (19) who studied the effect of *Acacia angustissima* leaf meal on yield of carcass components and meat quality of broilers and (20) who studied the effect of neem (*Azadirachta indica*) leaves infusion on growth performance and carcass quality of broiler chickens. However, the result of this study disagrees with the results obtained by (21), for cooking loss of broiler leg meat from broiler served with *Mentha arvensis* and *Geranium thunbergii* in drinking water.

Table 2: Proximate composition of Chicken Breast from broilers fed Turmeric leaf meal

Parameters (%)	T1(0g)	T2 (0.5g)	T3 (1.0g)	T4 (1.5g)	SEM
Crude protein	24.13	24.38	24.38	24.62	0.21
Crude fat	3.84[a.]	3.52[b]	3.29[c.]	2.82[d]	0.03
Ash	1.19	1.26	1.21[.]	1.23	0.03
Moisture	76.93	76.85[.]	76.9	76.93	0.11

[a-d]: means in a row with different superscript are significantly (P<0.05) different. SEM: standard error of mean

The Proximate composition of Chicken breast from broilers fed Turmeric leaf meal are presented on Table 2. There were no significant differences (P>0.05) in crude protein, ash and moisture content of chicken breast meat. The crude fat of the chicken breast was higher (P<0.05) in control group (3.84) relative to the TLM group (3.52, 3.29, 2.82). There was a linear reduction in the crude fat of the chicken breast fed TLM. This result could be related to cooking loss as it is known that the exudate let out during cooking comprises not only moisture but other nutrients such as fat. This may be attributed to the antioxidant properties of the bioactive compounds found in the leaves of Turmeric. Antioxidants are known to prevent auto oxidation thereby reducing fat. This is in line with the results of (22) and (23) that neem leaves, garlic leaves and plantain leaves reduced the ether extract of broiler meat. Several authors have reported the antioxidative ability of herbal extracts - neem leaves (24), garlic leaves (25), and plantain (26).

Table 3: Micro and Macro minerals of Chicken breast meat fed Turmeric leaf meal

Parameters (mg/kg)	T1(0g)	T2 (0.5g)	T3 (1.0g)	T4(1.5g)	SEM
Micro minerals					
Zn	0.59^{a}	0.58^{b}	0.57^{c}	0.52^{d}	0.00
I	0.22^{c}	0.22^{b}	0.23^{a}	0.24^{a}	0.00
Mn	0.17^{c}	0.18^{c}	0.20^{b}	0.22^{a}	0.00
Fe	0.57^{a}	0.56^{b}	0.55^{c}	0.52^{d}	0.00
Cu	0.57^{a}	0.43^{b}	0.39^{c}	0.37^{c}	0.01
Macro Minerals					
K	65.23^{b}	61.22^{c}	70.54^{a}	68.84^{a}	1.471
Ca	42.90^{c}	50.33^{a}	47.80^{b}	50.76^{a}	0.449
Na	33.16^{d}	38.62^{c}	44.55^{b}	48.44^{a}	1.459
P	241.5^{a}	237.6^{b}	233.6^{c}	237.2^{b}	0.676
Mg	26.39	25.84	26.24	26.12	0.293.

a-d; means in a row with different superscript are significantly (p<0.05) different; SEM standard error of mean

Table 3 shows micro and macro minerals of chicken breast fed turmeric leaf Meal. There were significance differences (P<0.05) among the micro and macro minerals. The Zn content of the TLM fed broiler meat (0.58, 0.57, 0.52) was linearly reduced relative to the control (0.59). Same trend was seen for Fe (0.56, 0.55, 0.52) and Cu (0.43, 0.39, 0.37) and their control (0.57, 0.57 respectively). A reverse trend was seen for Iodine (0.22, 0.23, 0.24) and Manganese (0.18, 0.19, 0.22) and their control (0.21, 0.17) respectively. K, Ca, and Na were least in the control group compared to TLM group while P was higher (P< 0.05) in the control and least in the TLM treated groups. Mg was not affected by the Turmeric leaf meal. These variations may be attributed to the Turmeric leaf meal as mineral composition of meat is known to be influenced by the type of feed the animal ingested (27). Uwa *et al.*, (11) reported that Turmeric leaves are rich in macro and micro minerals. Minerals are beneficial to health and their deficiencies have been linked to many ailments/diseases (28).

Table 4: Sensory Evaluation of Chicken Breast from broilers fed Turmeric leaf meal

Parameters	T1 (0g)	T2(0.5g)	T3(1.0g)	T4(1.5g)
Flavour	6.90 ± 0.56^{b}	8.00 ± 0.14^{a}	7.70 ± 0.42^{ab}	7.95 ± 0.07^{a}
Juiciness	5.80 ± 0.70^{c}	8.30 ± 0.14^{a}	7.10 ± 0.0^{b}	7.90 ± 0.14^{ab}
Ease of fragmentation	6.90 ± 1.56	7.80 ± 0.28	7.40 ± 0.57	8.05 ± 0.42
Apparent adhesion	6.85 ± 0.64	6.90 ± 0.57	5.60 ± 2.56	7.25 ± 0.78
Residue after chewing	6.0 ± 0.57^{ab}	7.70 ± 0.00^{ab}	5.30 ± 1.41^{b}	7.35 ± 0.64^{a}
Acceptability	6.50 ± 0.79^{b}	8.40 ± 0.14^{a}	7.95 ± 0.07^{ab}	7.65 ± 0.21^{ab}
Colour	6.40 ± 0.85	8.35 ± 0.07	7.45 ± 0.78	7.35 ± 1.48

a-c means with different superscript on the same row are significantly (P<0.05) different; ± standard deviation

Sensory parameters measured were flavour, juiciness, ease of fragmentation, residue after chewing, colour and overall acceptability (Table 4). There were significant (P<0.05) differences in Flavour, Juiciness, Residue after chewing and acceptability while Ease of Fragmentation, Apparent adhesion and colour were not influenced (P>0.05) by Turmeric leaf meal. The flavour of the meat from TLM fed birds were more desirable compared to the control. Meat samples from T2 (0.5%) TLM were rated to be most desirable and very juicy in terms of flavour and juiciness respectively. Residue after chewing was most visible in T4 (1.5% TLM) and varied (P>0.05) from T3 (1.0% TLM). The Control was similar to T2 (0.5% TLM). This may be attributed to the Turmeric leaf meal that was fed to the broilers as leaf meals are known to be rich in protein (29; 30) thereby enhancing the collagen content of the meat. There were no significant (P>0.05) differences in Ease of fragmentation, Apparent Adhesion and Colour. The panelist liked meat from the T2 (0.5% TLM) birds more than the control. The control meat was slightly liked with least acceptability. The most important factors for eating satisfaction according to consumers are flavour, juiciness and tenderness (31). Addition of Turmeric leaf meal into broiler feed increased the flavour, juiciness and acceptability of broiler breast meat fed Turmeric leaf meal. On the contrary, Chaves *et al.* (32) reported that the supplementation of natural anti-oxidants to the lamb, pigs and poultry did not have adverse or beneficial effects on sensory characteristics of meat.

CONCLUSION AND APPLICATION

1) The meat quality characteristics of broiler chickens fed Turmeric leaf meal was assessed. The Crude protein, moisture, and ash contents were not influenced by Turmeric leaf meal except the crude fat which was seen to reduce linearly across the TLM fed meat samples. This tends to produce more lean meat which will be of benefit to consumers.
2) There was an inverse relationship between the pH and cooking loss of TLM fed meat samples implying a more stable shelflife. Sensorially, the planelist rated flavour and juiciness of the TLM fed meat samples better and were highly accepted.
3) On the whole, inclusion of TLM at 0.5g which was T2 yielded more consistent results across the parameters measured. It is recommende therefore that for leaner meat and enhanced shelflife, TLM should be fed at 0.5g per 100kg to broiler chickens.

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EFFECTS OF DIFFERENT TRADITIONAL PRESERVATION METHODS ON INTERNAL EGG QUALITY PARAMETERS ISA BROWN LAYER CHICKEN

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ABSTRACT

This study was carried out to evaluate the effect of traditional preservation methods on ISA brown layer chicken eggs. A total of three hundred and forty (340) ISA Brown eggs were collected from a reputable farm in Jigawa state, Nigeria. The eggs were traditionally preserved using three (3) preservation methods; coating with Groundnut (Groundnut) oil, milk butter and honey), and were taken periodically at 7, 14, 21 and 28 days of storage and analyzed for internal egg quality parameters such as pH and Haugh units, egg weight albumin height, width and index, yolk height, width and index. The results revealed that eggs preserved with honey were significantly ($p<0.05$) better in terms of egg weight at day 28. All treated groups resulted in better internal egg quality parameters across the four (4) stage periods. It was concluded that preservation using honey as the traditional method of storage resulted in better quality at the end of the trial compared with the other traditional methods.

Key words: Internal egg quality; traditional preservation methods; storage period; Isa brown chicken, Haugh unit.

DESCRIPTION OF PROBLEM

Eggs are extremely perishable and can quickly lose their freshness. Egg quality has become a major worry for consumers recently (4). Long-term storage of eggs would cause their quality to decline, rendering them unfit for human consumption. Therefore, using the right technique while storing eggs is crucial to maintaining their quality. Although, refrigeration of egg is expected to result in longer shelf life and reduce spoilage, by reducing the possibility of infection of the internal portion by the spoilage- and disease-causing organisms (6), this technology however, is out of reach to most population residing in rural areas and some peri-urban centers. The current study, therefore, employed traditional approach to persevering egg quality.

MATERIALS AND METHODS

Description of the Study Area

The study area was Dutse Local Government Area, Jigawa State, which is located on latitude 11.70^0N and longitude 9.34^0N. The LGA experiences an average rainfall of 650mm annually; the rain normally starts in May and ends in October of each year. Temperature also changes from minimum of 10^oC (harmattan) to maximum of 42^oC (between March – September) with an average relative humidity of 12% annually (3)

Experimental Animals and Managements

Eggs from Fifty-two (52) weeks old ISA brown chicken was used for the study. The birds were brooded in a deep litter floor up to point-of cage (12weeks old) when they were transferred to the production pen of battery cages. Birds are on commercial layers diet (Hybrid feed).

Treatment and Experimental Design

The treatment applied for the experiment are; Control, Groundnut oil, Honey, and Butter representing T1, T2, T3, and T4 respectively. The design of the experiment was Completely Randomized Design (CRD) with four (4) treatments and 80 replicates.

Sources of ingredients

The test ingredients were sourced from Shuwarin weekly market, Kiyawa Local Government Area, Jigawa State.

Collection of Eggs

A total number of (340) eggs of Isa Brown laying birds were collected from Hajjiya Saadatu Farm in Dutse Local Government Area, Jigawa State. The eggs were stored at room temperature and assessed for quality traits. Soft, cracked, and small eggs were excluded. Eggs were preserved by coating individually with vegetable oil, butter, or honey, and labelled and numbered immediately after collection. Eggs were taken periodically at 7 days' interval for total duration of 28 days of storage period (7, 14, 21 and 28 days).

Data Collection

Eggs were weighed according to date of collection by using sensitive scale. After taking the weight, the eggs were broken with the blunt end of knife, the content were poured on a flat glass sheet. The height of albumen was measured by using the tip of Vernier calliper in millimetres in which it was inserted close to the yolk while and width was measured as the diameter of the albumen from three points and recorded.
Albumen index (%) was determined using the ratio of the height and width of the albumen (1)

$$\text{Albumin Index (\%)} = \frac{Height\ of\ thick\ albumen}{Mean\ diameter\ of\ thick\ albumen} \text{ X } 100$$

The yolk height and diameter were measured using a Vernier calliper, and the Yolk Index (%) was calculated using Funk (1948) formula. Albumen and yolk concentration were mixed.

$$\text{Yolk Index} = \frac{Yolk\ height\ (mm)}{Mean\ yolk\ diameter\ (mm)} \text{ X } 100$$

Statistical Analysis

The data collected was subjected to Analysis of variance (ANOVA) using the General Linear Model procedure of the Statistical Package for Social Science (SPSS) Version 22.0. While means were separated using Tukey

RESULTS AND DISCUSSION

The results for effect of traditional preservation methods on ISA brown internal egg quality parameters is depicted in Table 1. Results showed that at 7 days, all internal egg quality parameters were unaffected ($p>0.05$), except albumin width. At 14 days, albumin index, yolk height, and yolk index were affected by the treatments. At 21 days, albumin width and yolk width were significantly ($p<0.05$) different, with the control group having the least impact. All the internal egg quality parameters assessed were shown to be affected ($p<0.05$) at 28 days of storage. Eggs preserved with honey were shown to be significantly ($p<0.05$) better compared with other preservation methods of Groundnut oil, milk butter and control for albumin height, albumin index, yolk height and yolk index, respectively. However, the significant ($p<0.05$) difference was found between the control and honey preserved eggs for albumin width and similar in other treatment groups. Similarly, the yolk width of the control group eggs was higher ($p<0.05$) when compared to other preservation methods. The study found that albumin width was the highest at 7 days of preservation control, while Groundnut oil and milk butter had less width than honey. At 14 days, albumin width was higher in control, Groundnut oil, and milk butter. At 28 days, highest albumin width was found in eggs preserved at control. Similar results were reported by (7), who observed that albumin of refrigerated eggs was higher than eggs stored at room temperature and other storage methods. The study found that eggs preserved in honey had the highest albumin height at 28 days of preservation, followed by those in milk butter, Groundnut oil, and control which was consistent with previous research (8) that found a decrease in albumin height with

temperature. Yolk height was highest at 14 days, while yolk width was highest at 21 days. The study also found that the highest yolk index was observed at 14 days, and the lowest at 28 days. The findings suggest that traditional preservation methods may not be effective in preserving eggs.

Table 1: Effects of traditional preservation methods on ISA Brown internal egg quality parameters

Days	Parameters	Treatments				P-value
		Control	Groundnut	Milk Butter	Honey	
Day 7	AH (mm)	7.29 ± 0.38	7.68 ± 0.19	7.64±0.22	7.52±1.01	0.725
	AW (mm)	77.35±1.51^{a}	70.48±1.45^{ab}	66.49±1.4	68.88±1.23^{b}	0.001
	AI (mm)	9.54 ± 0.53	11.03 ±0.41	11.04±0.42	10.96±0.38	0.38
	YH (mm)	10.70 ±0.72	11.46 ± 0.81	11.35±0.86	11.66±0.54	0.817
	YW (mm)	38.95 ±0.81	37.30 ± 0.44	53.85±16.75	34.59±0.59	0.371
	YI (mm)	0.28 ± 0.19	0.30 ± 0.21	0.31±0.24	0.34±0.01	0.209
Day 14	AH (mm)	5.31 ± 0.28	5.75 ± 0.19	5.57±0.28	5.90±1.19	0.407
	AW (mm)	88.31±1.92^{b}	82.45±1.69^{b}	75.48±1.50^{c}	73.52±1.68^{c}	0.001
	AI (mm)	6.12 ± 0.45^{b}	7.08 ± 0.35^{ab}	7.51±0.49^{ab}	8.11±0.47^{a}	0.018
	YH (mm)	8.57 ± 0.56^{b}	9.70 ± 0.23^{ab}	9.89±0.23^{ab}	10.31±0.57^{a}	0.035
	YW (mm)	43.1± 0.76	60.13±20.02	35.14±0.80	34.63±0.82	0.251
	YI (mm)	20.14±1.46^{b}	23.22 ±1.35^{b}	28.50±1.03^{a}	34.63±0.82^{a}	0.001
Day 21	AH (mm)	4.59 ± 0.35	5.06 ± 0.27	4.66±0.37	5.21±0.29	0.461
	AW (mm)	75.90 ±171^{a}	67.36 ± 1.7^{b}	68.91±1.94^{b}	67.32±1.15^{b}	0.001
	AI (mm)	6.08 ± 0.43	7.62 ± 0.51	6.85±0.59	7.85±0.47	0.064
	YH (mm)	6.51 ± 0.59	8.62 ± 0.56	7.92±0.51^{b}	8.32±0.61^{b}	0.053
	YW (mm)	44.79±0.91^{a}	35.53±1.35^{b}	35.93±0.84^{b}	36.10±0.96^{b}	0.001
	YI (mm)	14.47±1.29^{b}	24.94 ±1.89^{a}	22.50±1.68^{a}	23.234±1.17^{a}	0.001
Day 28	AH (mm)	1.97 ± 0.12^{c}	3.37 ± 0.29^{b}	4.27±0.32	4.42±0.36	0.001
	AW (mm)	79.26±1.19^{a}	75.43±1.55^{ab}	75.49±1.60^{b}	72.77±1.36^{b}	0.021
	AI (mm)	2.48 ±0.13^{c}	4.59 ± 0.49^{b}	5.75±1.60^{b}	6.15±0.56^{b}	0.001
	YH (mm)	2.72±0.25^{c}	6.90 ± 0.44^{b}	7.95±0.52^{b}	8.52±0.64^{b}	0.001
	YW (mm)	47.76±1.09^{a}	38.83±0.52^{b}	37.42±0.76^{b}	39.04±0.84^{b}	0.001
	YI (mm)	5.68 ±0.51^{c}	17.82±1.16^{b}	21.62±1.69^{b}	21.70±1.52^{b}	0.001

Values (Mean ± SD) with different superscripts in a column differ significantly; ($p<0.05$) Ah=Albumin height, Aw=Albumin width, Ai=Albumin index, Yh=Yolk height, Yw=Yolk width, Yi=Yolk index

The study examined the effects of traditional preservation methods on ISA brown egg weight (Table 2). Results showed no significant difference in weight loss between treatment groups except for 28 days. The control group had higher weight loss at 28 days, while eggs preserved with honey had higher weight at 28 days. The highest weight loss was observed in the control group at 28 days, while the least was in Groundnut at 14 days. The results were similar to (6) findings. Weight losses in eggs are attributable to many factors, such as due to loss of water, carbon dioxide, ammonia, nitrogen and hydrogen Sulphur (H_2S). Eggs preserved with Groundnut, milk butter and honey loss less water compared to that of control. This is because of the viscosity of the liquids, thus, not allowing the inner components of the eggs to escape.

Table 2: Effects of traditional preservation methods on ISA Brown egg Weight (g)

Treatments	Storage Days			
	7	14	21	28
Control	60.80 ± 1.2	55.81 ±0.8	55.35 ± 0.9	55.70 ± 0.9^{ab}
Groundnut	58.45 ± 0.8	57.45 ±1.0	54.75 ± 1.1	53.50 ± 0.6^{b}
Milk Butter	58.45 ± 0.7	56.55 ±0.9	57.25 ± 0.9	55.55 ± 1.0^{ab}
Honey	58.81 ± 0.5	56 ± 0.9	55.35 ± 0.9	57.85 ± 0.9^{a}
P-Values	0.091	0.584	0.27	0.008

Values (Mean ± SD) with different superscripts in a column differ significantly; ($p<0.05$)

CONCLUSION

The study showed that the best traditional preservation methods of ISA brown eggs is honey, followed by milk butter and Groundnut. The poorest preservation method of fresh ISA brown egg is Groundnut oil. It can also be concluded that traditional preservation methods practiced by farmers improved most of the internal egg quality parameters. It was also discovered that as the storage duration advances, the egg internal quality deteriorates. It is recommended that honey preservation method should be adopted for fresh ISA brown eggs preservation. In rural areas where there is no adequate electricity honey preservation method should be used.

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Animal Products and ProcessingTechnology: APP011

SENSORY CHARACTERISTICS OF SPENT HEN CHICKEN NUGGET WITH VARYING INCLUSION LEVELS OF GINGER AND GARLIC PASTES

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ABSTRACT

Spent hens are rich have similar nutritional quality with broiler but have minimal economic values due to their high collagen content. However, the sensory enjoyment of spent hen meat can be improved through value addition. Spent hens were slaughtered, defeathered, meat excised from all chicken parts and minced (using commercial meat grinder (5mm plate). Five Spent Hen Chicken Nugget (SHCN) emulsions were formulated and to each was added 1.5% Ascorbic, 0.5% ginger paste, 1.5% ginger paste, 0.5% garlic paste and 1.5% garlic paste (T5). Each formulation were cut (20×20 cm; approx. 50±1 g/ piece) and deep fried. Crude protein (%), fat (%) and organoleptic characteristics were assessed on fresh nugget. Data were analysed using ANOVA and means separated by DUNCAN at pα0.05. Crude protein 14.39 (0.5% garlic) and 14.33 (1.5% garlic) were similar (P>0.05) but significantly lower (P<0.05) than 15.03 (ascorbic), 16.44 (0.5% ginger) and 17.23 (1.5% ginger). Fat 19.79 (0.5% ginger) and 19.37 (1.5% ginger) were similar (P>0.05) but higher (P<0.05) than 18.09 (0.5% garlic) and 17.89 (1.5% garlic) and lower) than 22.44 (ascorbic). Juiciness, 5.70 (1.5% ginger) and 6.50 (0.5% garlic) are similar (P>0.05) but higher (P<0.05) than 5.00 (ascorbic), 5.10 (0.5% ginger) and 4.80 (1.5% garlic). Tenderness 5.80 (1.5% ginger) was higher (P<0.05 than 3.50 (0.5% garlic) but similar to 4.70 (ascorbic), 4.30 (0.5% ginger) and 4.70 (1.5% garlic). No significant differences in aroma (4.00-4.90) and over all acceptability (5.00-6.40). The production and processing of spent hen meat products could be a way of increasing its eating quality.

Keywords: Spent hen, ginger, garlic, nugget, shelf life

DESCRIPTION OF PROBLEM

Nuggets are a ready to cook and ready to eat meat product and its simple preparation makes it a popular choice for a quick meal among consumers (1). They are usually prepared with chicken meat and it is one of the popular and generally acceptable fried meat products all over the world (1). Generally, chicken nuggets are prepared using broiler chicken meat because of its high carcasses, better tenderness and other quality characteristics when compared to the spent hen meat (2). However, broiler chicken meat is a principal source of meat proteins and has a good demand with economic importance for direct consumption as meat throughout the world (3). Spent hens are byproduct of the egg industry, they are rich in fat and cholesterol contents. They are similar nutritional quality with broiler meat (4) but in spite of this spent hens have minimal economic values (5). This is due to their poor functional characteristics and some sensory properties such as juiciness and tenderness which is attributed due to high collagen content they possess (6).
The aim of this study is increase and influence the sensory enjoyment of spent hen meat through value addition.

MATERIALS AND METHODS

Source of materials

Food grade ascorbic acid where purchased from a standard and reputable food stall market. Fresh garlic (FG) bulbs (*Allium sativum*, var. Chinese white garlic) and ginger were purchased from Bodija a local market within University of Ibadan environment. Dry garlic skins were removed and flesh crushed finely using a kitchen grater. For ginger (*Zingiber officinale* Roscoe), peels were removed and the fingers cut into slices for easy grinding (blender). Both were used fresh and as pastes in the nugget formulation.

Sample preparation (raw and cooked nuggets)

Spent hens (30) were slaughtered, defeathered, skin removed, cut into chunks and minced using a commercial meat grinder (5mm plate). Five chicken nugget emulsions were formulated (7). To each mix, 1.5% Ascorbic acid, (T1), 0.5% ginger (T2), 1.5% ginger (T3), 0.5% garlic (T4) and 1.5% garlic was added. The mixtures from each formulation were filled into boxes (20×10 cm) (raw nuggets), weighed to provide individual nugget pieces (50±1 g/ piece), and deep fried in Grand Soya oil® at 190±2ºC for 10 minutes with intermittent turning. The deep fried nuggets were cooled down to room temperature. The experiment was replicated three times.

Parameters measured

Proximate composition

Spent Hen Chicken Nugget (SHCN) was analyzed for its moisture, protein, ash, and fat contents according to the methods of AOAC.

Sensory analysis

Aroma, Colour, flavour, tenderness, juiciness and overall acceptability of cooked spent hen nuggets were organoleptically evaluated on a nine point hedonic scale (9= extremely liked and 1 extremely dislike) using 20 panelists (both staff and students) from, Department of Animal Science, Faculty of Agriculture, University of Ibadan.

Statistical Analysis

All data were generated in triplicates and subjected to ANOVA using SAS 9.2. Means were separated using DUNCAN Multiple Range Test at pα0.05

RESULTS AND DISCUSSION

Proximate composition of spent hen meat nugget with varying levels of ginger and garlic

Moisture 57.03 contained in ascorbic SHCN was significantly higher than 47.02 (0.5% ginger), 37.54 (1.5% ginger), 53.03 (0.5% garlic) and 52.48 (1.5% garlic). Crude protein contained in 0.5% garlic (14.39) and 1.5% garlic (14.33) were similar (P>0.05) but significantly lower (P<0.05) than 15.03 (ascorbic), 16.44 (0.5% ginger) and 17.23 (1.5% ginger). Fat 19.79 (0.5% ginger) and 19.37 (1.5% ginger) were similar (P>0.05) but higher (P<0.05) than 18.09 (0.5% garlic) and 17.89 (1.5% garlic) but lower (P<0.05) than 22.44 (ascorbic). Ash 7.57 (1.5%) and 7.23 (0.5% garlic) are similar but significantly higher than 5.32 (ascorbic) and 6.22 (0.5% ginger) but lower than 7.70 (1.5% garlic) (Table 1). The moisture content of the cooked chicken nuggets increase with higher level of ginger paste inclusion while it decreases with garlic inclusion. The moisture content obtained in this study fall within 40-56% obtained in Malaysian commercial nuggets (1).Irrespective of the inclusion level of ginger or garlic the fat contents of SHCN were lower than what was obtained in

SHCN with ascorbic. This implied that consumption of nuggets with ginger and garlic will reduce the intake of fat from this meat products.

Table 1: Proximate composition of spent hen meat nugget with ginger and garlic pastes

		Ginger		Garlic			
Parameters (%)	Ascorbic	0.5	1.5	0.5	1.5	SEM	P-Value
Moisture	57.03^{a}	37.54^{e}	47.02^{d}	53.05^{b}	52.48^{c}	0.019	<.0001
Crude protein	15.03^{c}	16.44^{b}	17.23^{a}	14.39^{d}	14.33^{d}	0.083	<.0001
Fat	22.44^{a}	19.79^{b}	19.37^{b}	18.09^{c}	17.89^{c}	0.092	<.0001
Ash	5.32^{d}	6.22^{c}	7.57^{b}	7.23^{b}	7.70^{a}	0.115	<.0001

$^{abcd-}$ Means of different superscripts on the same row are significantly different (P < 0.05)

Sensory evaluation of spent hen chicken nuggets with ginger and garlic pastes

The sensory values for deep fried spent hen chicken nuggets with different equivalent amounts of ginger and garlic showed (Table 2) that colour 6.70 (1.5% ginger) was significantly higher than 4.80 (ascorbic), 5.30 (0.5% ginger), 5.60 (0.5% garlic) but similar to 5.90 (1.5% garlic). Flavour and juiciness (6.00; 5.70) with 1.5% ginger and 0.5% garlic (5.90; 6.50) are similar but higher than 5.10; 5.00 (ascorbic), 5.00; 5.10 (0.5% ginger) and 5.10; 4.80 (1.5% garlic). Tenderness 5.80 (1.5% ginger) was significantly higher than 3.50 (0.5% garlic) but similar to 4.70 (ascorbic), 4.30 (0.5% ginger) and 4.70 (1.5% garlic). No significant differences in aroma (4.00-4.90) and over all acceptability (5.00-6.40).

It was observed that the colour scores for the deep fried spent hen chicken nuggets increased with increasing amount of added ginger while the panelists were indifferent about the colour of the nugget with addition of garlic. The panelists were indifferent in the flavour and juiciness of SHCN with 1.5% ginger and 0.5% garlic and both were rated high in both flavour and juiciness. The high rating of 1.5% ginger paste nugget could be as a result of the high crude protein and fat contents while that of the 0.5% garlic could only be attributed to its fat contents only. This is because fat is one of the nutritional component that provides sensory characteristics such as flavour, juiciness and mouth feel to products (8). Again, it was also observed that as inclusion of ginger increased, the flavour and juiciness of the nuggets increased while garlic inclusion reduced both in flavour and juiciness. The reduction in flavour of the garlic formulated SHCN could be that at this inclusion the intensity and pungency of the garlic in the nugget is more pronounced on the taste of the panelists because garlic is associated with distinctive pungent smell (9). However, the flavour, tenderness and juiciness ratings of SHCN with ginger paste at lower and garlic paste at higher inclusions did not differ from the flavour, tenderness and juiciness ratings of nugget with ascorbic acid. This evidently showed that using either ginger or garlic paste at these concentrations in the preparation of SHCN will not reduce the flavour or juiciness of the nugget. The increased tenderness of ginger paste SHCN could be the tenderizing tendency of ginger. For instance, ginger powder has been used to improve flavour and meat tenderness in chicken kabab (10). SHCN

CONCLUSION AND APPLICATION

Spent hen being a good protein source can be effectively used for production of convenient chicken products such as nuggets by incorporating ginger and garlic into its formulation. The juiciness and tenderness of spent hen meat can be improved through value addition and the production and processing of spent hen meat products could be a way of increasing spent hen eating qualities.

Table 2: Sensory analysis of spent hen meat nuggets with ginger and garlic pastes

		Ginger		Garlic			
Parameters	**Ascorbic**	**0.5**	**1.5**	**0.5**	**1.5**	**SEM**	**P-value**
Aroma	4.00	4.90	4.80	4.70	4.20	0.61	0.210
Colour	4.80^{bc}	5.30^{b}	6.70^{a}	5.60^{b}	5.90^{ab}	0.46	0.0002
Flavour	5.10^{b}	5.00^{b}	6.00^{a}	5.90^{a}	5.00^{b}	0.32	0.0018
Tenderness	4.70^{ab}	4.30^{ab}	5.80^{a}	3.50^{b}	4.70^{ab}	0.52	0.050
Juiciness	5.00^{b}	5.10^{b}	5.70^{a}	6.50^{a}	4.80^{b}	0.62	0.03
Overall acceptability	5.00	6.40	6.30	6.30	5.70	0.66	0.53

$^{abc-}$ Means of different superscripts on the same row are significantly different P (< 0.05)

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Animal Products and ProcessingTechnology: APP012

PHYSICOCHEMICAL PROPERTIES OF BROILER BREAST MEAT STORED FOR DIFFERENT PERIOD ON ICE

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ABSTRACT

The study on the physicochemical properties of broiler breast meat stored for different periods on ice was conducted. Twenty-four birds of table size were procured and randomly assigned to four treatments, with six birds per treatment. The treatments consist of storage for zero day, one day, two days, and three days for treatments 1, 2, 3, and 4, respectively. The birds were slaughtered and cut into primal parts, out of which the breast meat was used for the experiment. At the end of the storage period, the samples were obtained from each treatment for physicochemical evaluation. The data were analyzed using a one-way analysis of variance. There were significant differences ($p<0.05$) in pH, cooking loss, and 349alondialdehyde (MDA), but glycogen content did not differ ($p>0.05$) across treatments measured. The pH level of treatment 4 has a higher ($p<0.05$) value than the other treatments but is similar to that of treatment 3. The cooking loss of treatment 1 is higher ($p<0.05$) than all other treatments. The MDA contents were higher ($p<0.05$) in treatment 1 compared with treatments 3 and 4, but similar to treatment 2. The research concludes that ice, which is economically cheaper, can be used for storing broiler breast meat with no detrimental effect on physicochemical properties. Based on the findings of this study, it is recommended that meat sellers use ice as a means of storing meat.

Keywords: Broiler, Breast meat, Physicochemical properties, and Ice

DESCRIPTION OF PROBLEM

Poultry meat is very high in poly unsaturated fatty acids (PUFA) which have been one of the most unstable fatty acids that are vulnerable to lipid oxidation (1). Despite the fact that chicken meat contains a high protein and low fat content and considered as the principal source of PUFA (2). (3) reported that lipid oxidation results to breaking down of fat causing flavor deterioration and resulting in the development of off-flavor that are undesirable to consumers.

Meat acidity is one of the most objective features that inform about the rate of post slaughter glycolysis, which is the primary cause of meat quality diversity (4). After slaughter, glycolysis continues until the accumulation of lactic acid causes the pH to reach about 5.5 (4). One significant post-mortem changes in muscle due to anaerobic metabolism is lowering of the pH in the muscle. During anaerobic metabolism, muscles preferentially utilized over the remaining free glucose in the muscle (5).

The worldwide commercialization of meat calls for frozen meat which can be preserved for long periods of time with lower transportation cost and lower price compared with fresh meat (6). Therefore, in the present situation of power scarcity in Maiduguri, meat retailers resorted to storing their excess meat stocks using ice-block. This experiment set to provide information on the use of ice-block in storing broiler breast meat, how it affects some of the physicochemical properties.

MATERIALS AND METHODS

Study Area

The experiment was carried out at the Poultry Unit, Department of Animal Science, University of Maiduguri, Borno State. Maiduguri is located within the Sahelian (semi-arid) region of West Africa on an elevation of 354 m above sea level in the North-eastern part of Nigeria on Latitude 11.51^0North and Longitude 30.05^0 East. Characterized by three distinct seasons namely Wet (June-September), dry cold (October-January) and dry hot (February-May). The hottest season is between April and May, which is characterized with bright sunny day and the atmospheric temperature fluctuates between 35 – 45^{o}C. During the rainy season, the temperature may drop to about 30^0C or less (7).

Animals and Experimental Design

Broiler birds were bought within Maiduguri Metropolitan Council (MMC). 24 birds at table size, fed untreated diet were used. The birds were numbered with tag using masking tape and subsequently allocated to four treatments using completely randomized design (CRD) making six birds per treatment. The treatments consists of; T_1 = storing breast meat for 0 day, T_2 = storing breast meat for 1 day, T_3 = storing breast meat for 2 days, T_4 = storing breast meat for 3 days.

Sampling procedure

Six birds for each treatment were selected at random using balloting technique. The selected birds were fast for 12 hours, there after they were humanely slaughter, dress eviscerate, cuts to primal parts and the breast meat was obtained for storing 0, 1, 2 and 3 days. The meat samples from each treatment were weight and stored with ice-block of same weight in cooler. At the end of storage time, three meat samples for each treatment were obtained for chemical and physical properties assay.

Physical properties of breast meat samples were carried out in the Food Science Laboratory, Department of Food Science and Technology, University of Maiduguri. Three breast meat samples were randomly selected from each treatment for pH and Cooking loss analyses. The meat samples were cut into 50 g weighed, packed and tied in polyethylene bags and then boiled in hot water at 100°C for 25 minutes. The boiled samples were then removed, cooled and dried from fluids using tissue paper and reweighed. Cooking loss were estimated as loss in weight by the breast meat during cooking; expressed as a percentage (8). The percent cooking loss were calculated using the formula below;

$$\% \text{ cooking loss} = \frac{W1 - W2}{W1} \times 100$$

W1 = weight of sample before cooking;
W2 = weight of sample after cooking

The pH values of the samples were measured by using a digital pH meter. The pH meter electrode was calibrated by using one standard solution of pH 7.00 (Mettler Toledo). The pH determination was carried out as described by (9); by immersing the pH meter glass electrode into the sample and the readings on the pH meter were recorded. The pH meter calibration was repeated for every reading to check if the pH had a deviation of more than 0.01 units.

The chemical properties of breast meat samples were carried out in Biochemistry Laboratory, University of Maiduguri. Three meat samples were selected from each treatment for determination of Glycogen and melondialdehyde (MDA) content. Glycogen content of breast meats stored for 0, 1, 2 and 3 days was determined based on a colored reaction that occurs when a dilute solution of glucose is heated with concentrated sulphuric acid (H_2SO_4) as described by (10). After subtraction of the originally free glucose, the glycogen content was expressed in g per kg of the sample. The MDA content of the samples were analyzed using the colorimetric reaction with thiobarbituric acid (TBA) as described by (11).

Data Analysis
All data collected were subjected to analysis of variance (ANOVA), where significant differences (P<0.05) occur, means were separated using Least significance difference (LSD).

RESULTS AND DISCUSSION

Physical Properties of Broiler Breast Meat Stored for Different Period on Ice
The results of physical properties of broiler breast meat stored on ice are presented in (Table 1) below. There were significant differences (p<0.05) in all the physical properties measured. The pH level of breast meat stored for 3 days (treatment 4) has higher (p<0.05) value than the other treatments but similar to the meat stored for 2 days (treatment 3). The percentage of cooking loss of breast meat stored for 0 days (treatment 1) is significantly (p<0.05) higher than all those stored on ice (treatments 2, 3 and 4).

Table 1: Physical Properties of Broiler Breast Meat Stored on Ice for Different Period

Treatment	pH	Cooking loss (%)
1	6.67^{c}	40.96^{a}
2	7.00^{bc}	37.12^{b}
3	7.17^{ab}	36.5^{b}
4	7.50^{a}	36.84^{b}
SEM	0.12	1.11

- $^{a, b, c}$ - means on the same column bearing different superscripts differ significantly P<0.05
SEM - Standard error of mean

A high pH level was obtained in the breast meat stored on ice for 3 days. The finding of this study is in line with the work of (12) which indicated an increase in pH level with increase in storage time of lamb meat during 30 days frozen storage. However, research by (13), indicated the pH value of frozen broiler chicken breast muscle in appropriate condition decreases along with prolongation of frozen storage. The lowest pH value of treatment is recorded in treatment 1 which is 6.67 while his own is in treatment 3 which is 5.84. However, the highest pH value was recorded in treatment 4 which is 7.50 while his own is recorded in treatment 1 which is 6.00. The difference may be due to the storage process which is on ice not in a freezer. The lower cooking loss was recorded in the breast meat stored for 3 days and it decreases from lower to higher as the storage period decreases. The longer the storage period the lower the cooking loss. High cooking loss is observed on breast meat stored on ice for 0 day. However, in a study by (14) frozen-stored beef samples were characterized by greater cooking loss than fresh samples, even though the differences between frozen samples stored for different period of time were not significant (p>0.05).

Chemical Properties of Broiler Breast Meat Stored for Different Period on Ice
The results of chemical properties of broiler breast meat stored on ice for different period are presented in (Table 2).There were significant differences (p<0.05) across the treatments of MDA (Melondialdehide) content tested. The storage of breast meat on ice activates significant increase and decrease within the treatments of MDA in (Table 2). The glycogen content were not significantly (p>0.05) difference across the treatments means. The MDA concentration was higher in breast meat stored for 0 day (treatment 1) than the meat stored for 2 and 3 days (treatment 3 and) but similar with the meat stored for 1 day (treatment 2).

The MDA concentration values of broiler breast meat stored on ice tend to decrease significantly with increase in the duration of storage on ice. This shown that storage of the meat on ice tends to decrease lipid oxidation. Where highest value was recorded in treatment 1 which is 0.19 and the lowest in treatment 3 which is 0.02. The values are lower than (15) who recorded the lowest value in treatment 3 which is 0.03 which is higher than my own which is in treatment 3 which is 0.02. However, he recorded the highest value in treatment 4 which is 0.40 which is higher than my own which is recorded in treatment 1 which is 0.19. The difference might be due to the longer period of storing which shows that the longer the storage period the lower the MDA content.

Table 2: Chemical Properties of Broiler Breast Meat Stored on Ice for Different Period

Treatment	Glycogen (g/kg)	MDA (mg/kg)
1	0.40	0.19^{a}
2	0.47	0.13^{ab}
3	0.59	0.02^{c}
4	0.32	0.08^{bc}
SEM	0.19	0.02

- $^{a, b, c}$ - means on the same column bearing different superscripts differ significantly P<0.05
SEM - Standard error of mean; MDA - Melondialdehide

CONCLUSION AND RECOMMENDATION

The research deduces that ice which is economically cheaper can be used for storage of breast meat with no adverse effect on glycogen concentration.
Based on the findings of this study, it is recommended that meat sellers/consumers to use ice as a means of storing there poultry meat to avoid spoilage which is economical and require little space.

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Animal Products and ProcessingTechnology: APP013

PROXIMATE COMPOSITION OF DIFFERENTLY PROCESSED AFRICAN PALM WEEVIL LARVAE AND PHYSICOCHEMICAL CHARACTERISTICS OF SAUSAGE PRODUCED WITH DIFFERENTLY COOKED LARVAE

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ABSTRACT

African Palm weevil larvae (APWL) is a widely relished indigenous insect larvae whose properties is affected by processing methods. This study aimed at assessing effect of processing methods on the nutrients of APWL and the cost implication of sausage produced with differently processed APWL. African Palm Weevil Larvae (APWL), 65-80 days old were procured from mini livestock farm in the Department of Crop Protection and Environmental Biology University of Ibadan, while lard was obtained from a reputable abattoir. Larvae was asphyxiated at 4ºC and use in sausage production in three processed forms: raw (APWL-R), Moist Cooked (APWL-MC) and smoked (APWL-S). Lard was rendered and Sausages (S): APWL-RS, APWL- MCS, APWL-SS and Lard sausage were produced according to standard procedures. Proximate composition of APWL, Product Yield (PY %), Water Holding Capacity (WHC) and cost/100g (#) of sausages were determined using standard procedures. Data were subjected to ANOVA at α0.05. Crude protein (26.80) (APWL-MC) and 27.68 (APWL-S) were similar and higher ($P<0.05$) than 19.63 (APWL-R). Ash, 5.05 (APWL-R) is similar ($P>0$ .05) to 4.75 (APWL-S) but higher ($P<0.05$) than 4.45 (APWL-MC). Fat, 25.15 (APWL-MC) was higher ($P<0.05$) than 24.30 (APWL-S) and 22.05 (AFPWL-R).Moisture contents 61.69 (APWL-R), 62.15 (APWL-MC) are similar ($P>0.05$) but higher ($P<0.05$) than 59.60 (APWL-S). Higher yields (90.51; 91.62; 96.15) and low cost of production (71.255; 709.38; 679.07) were recorded in all APWL sausages. The high product yields from all APWL confirmed that the larvae will be highly desirable for sausage production.

Key words: Insect larvae, processing methods, sausages, cooking yield,

DESCRIPTION OF PROBLEM

Edible insects have played a nutritional role in the diet of people in many parts of the world (1) and have accounted for about 5-10 % of the consumed protein in the diet of communities where they are consumed (2). African Palm Weevil Larvae (APWL) *Rhynchophorus phoenicis* is one of the popular edible insect larvae globally consumed as food (3). However different processing methods such as defatting, drying, heat treatments when applied to edible insects usually have impact and influence on the end-products (4). The inclusion of APWL in sausage production have been reported to increase the nutritional qualities of sausage (5) but its inclusion when differently processed have not been given much attention. Therefore, this study evaluate the nutritional composition of differently processed APWL and the physicochemical properties of sausage with differently processed APWL inclusion.

MATERIALS AND METHODS

African Palm weevil Larvae procurement

African Palm weevil larvae between 65-80 days of age were harvested from the mini livestock farm located at the department of Crop Protection and Environmental Biology University of Ibadan, Nigeria.

African Palm weevil larvae preparation and sausage production

Whole larvae were asphyxiated in the refrigerator at 4ºC, allowed to thaw before use as raw, for moist cooked processing, thawed larvae were placed in cellophane bags and boiled in water (100ºC for 20 minutes) while for smoked processing, thawed larvae were smoked dried in the smoke chamber at 50 ºC for 20 minutes. All processed larvae were grounded separately and use in sausage production according to (6)

Parameters measured

Proximate composition

This was carried out following procedures of (7)

Product Yield (%) and Water Holding Capacity (WHC) were calculated and expressed as

$$Product\ yield\ (\%) = \frac{Final\ weight\ of\ cooked\ sausage}{Initial\ weight\ of\ raw\ sausage} x\ 100$$

$$Water\ Holding\ Capacity\ (WHC) = 1 - \frac{Total\ area - Meat\ film\ area}{Meat\ film\ area}\ x\ 100$$

Cost of production

This was calculated by first costing the total expenditure incurred on each of the sausage produced divided by each product yield (g) multiplied by 100g. This will give the cost of 100g by weight of sausage.

$$Cost\ of\ 100g\ (\#) = \frac{Total\ cost\ of\ producing\ 1kg\ of\ sausage\ (\#)}{Product\ Yield\ from\ sausage\ (g)}\ x100\ (g)$$

Statistical Analysis

All data were generated in triplicates and subjected to ANOVA using SAS 9.2. Means were separated using DUNCAN Multiple Range Test at pα0.05

RESULTS AND DISCUSSION

Crude protein (26.80%) of moist cooked larvae (MCL) and smoked larvae (SL) (27.68%) were significantly higher (P<0.05) than 19.63% (raw larvae (RL)) (Table 1). Ash content (4.45%) of MCL and 4.75% (SL) are similar (P>0.05) but higher (P<0.05) than 5.05% (RL). Significant differences exists (P<0.05) in the crude fat (22.05 (RL), 24.30 (SL) and 25.15 (MCL)). No statistical variation exist (P>0.05) among moisture content recorded in RL (61.69) and MCL (62.15) and these are significantly different (P<0.05) from 59.60 found in SL

It is evident that different processing methods adopted in preparing APWL have effect on their composition as shown in this study. The ash contents of processed larvae irrespective of the processing methods were higher than 4.90% (dried) and 1.24% (roasted) (8) but lower than 7.70% (roasted) (9) recorded in larvae. The contents of protein in smoked larvae (30.69 % and 29.57 %) as reported by (8) were higher than what was obtained in all the processed larvae in this study. The nutrient compositions of APWL as obtained in this study showed that its inclusion in sausage production will make the product more nutritious (high protein) and healthy (low fat) for consumption. This nutritional benefit was also observed by (10) and (5) when lard was partially replaced with palm weevil larvae in frankfurter production. The nutrient composition of APWL used in this study further confirmed that insects are rich in relevant dietary nutrients and when added to foods will increase the nutritional contents (11).

Table 1: Proximate composition of differently processed African Palm weevil larvae

Parameters (%)	Raw Larvae	Moist Cooked Larvae	Smoked Larvae	P-value
Crude protein	19.63[b]±0.95	26.80 [a]±0.42	27.68 [a]±2.31	0.002
Ash	5.05[a]±0.21	4.45[b]±0.07	4.75[ab]±0.07	0.005
Ether extract	22.05[c]±0.21	25.15[a]±0.04	24.30[b] ±0.04	0.000
Moisture	61.69[a]±0.06	62.15[a]±0.23	59.60[b] ±0.58	0.013

[abc] Means on the same raw with similar superscripts are not significantly different (P>0.05)

Table 2: Physico-chemical characteristics, yield and cost of cooked sausage prepared with differently processed African Palm Weevil Larvae

		African Palm Weevil Larvae Sausages			
Parameters (%)	Lard Sausage	APWL-RS	APWL-MCS	APWL-SS	P-Value
pH	5.96	5.93	5.96	5.91	0.020
WHC	43.04[b]	43.13[b]	44.22[b]	60.41[a]	0.026
Product yield	88.71[c]	90.51[b]	91.62[b]	96.15[a]	0.009
Cost/kg (₦)	7,326.46	7,125.51	7,093.76	6,790.74	
Cost/100g (₦)	732.65	712.55	709.38	679.07	

[abc] Means on the same raw with similar superscripts are not significantly different (P>0.05)
APWL-RS=sausage with raw larvae; APWL-MCS= sausage with moist cooked larvae; APWL-SS=sausage with smoked larvae

As displayed on Table (2) no statistical differences in pH (5.91-5.96), WHC (60.41%) (APWL-SS) was higher (P<0.05) than 43.04% (lard), 43.13% (APWL-RS) and 44.22% (APWLS-MCS). Product Yield (96.15) of APWL-SS sausage was significantly higher (P<0.05) than 88.71% (lard), 90.51% (AFPWL-RS) and 91.62% (APWL-MCS). The cost of producing 1kg of each sausage are #7,326.46 (lard), #7,125.51 (APWL-RS), #7,093.76 (APWL-MCS) and #6,790.74 (APWL-SS). The cooking yield of sausages with APWL were high irrespective of the processing methods of the larvae before usage. This suggest that the larvae will be highly desirable for chopped meat or powdered food production as reported by Ash *et al.* (2017 (13). The high cooking yield of APWL-SS sausage was probably because of its high water holding capacity compared with other APWL emulsions because WHC and yield are directly proportional. The low cost of production of sausage containing African palm weevil larvae irrespective of the processing methods also highlighted that its presence in the sausage apart from the nutritional benefits will also reduce the cost of production which will invariable make the product consumer friendly.

CONCLUSION AND APPLICATION

The inclusion of African Palm weevil larvae in sausage production could lead to novel insect-based food. Also processing it before usage will give the product a higher economic returns.

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Animal Products and ProcessingTechnology: APP014

PHYSICOCHEMICAL AND MICROBIOLOGICAL PROPERTIES OF MILK FROM MARADI GOATS RAISED SEMI-INTENSIVELY IN OGBOMOSO NORTH LOCAL GOVERNMENT AREA, NIGERIA

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ABSTRACT

The study investigates the physicochemical and microbiological characteristics of Maradi goat milk from Ogbomoso North Local Government Area, Oyo State, Nigeria. Comprehensive analyses were performed on milk composition, vitamin and mineral content, and microbial load on 25 lactating goats. Results revealed a pH 6.31, total solids 12.63%, protein 3.12%, fat 3.55%, ash 0.30%, lactose 4.46%, specific gravity 1.11, viscosity 7.72 mL/s, density 1.11 g/mL, and titratable acidity 0.89%. The vitamin content includes Vitamin A (26.49 mg/100 ml), B1 (1.43 mg/100 ml), B3 (2.71 mg/100 ml), and C (7.22 mg/100 ml). The mineral content includes calcium (125.23 mg/100 ml), sodium (38.10 mg/100 ml), phosphorus (84.79 mg/100 ml), magnesium (11.61 mg/100 ml), iron (0.08 mg/100 ml), zinc (0.30 mg/100 ml), and chlorine (63.23 mg/100 ml). High levels of Vitamin A and potassium, along with significant calcium and phosphorus, underscore the nutritional value of Maradi goat milk. The microbiological analysis revealed total virus count (5.63 cfu/ml), total bacteria count (3.18 cfu/ml), total fungi count (1.99 cfu/ml), and total coliform count (1.72 cfu/ml). The dominant bacteria isolates were Lactobacillus species including *L. cellobiosus, L. salivarius, L. coryniformis, L. casei, L. fermentum, and S. lactis*. The significant microbial load suggests potential benefits for fermentation processes. In conclusion, Maradi goat milk exhibits favourable physicochemical properties with high total solids and beneficial vitamin and mineral profiles. The presence of diverse microbial populations indicates potential for fermentation, supporting its role in regional dairy production.

Keywords: Maradi goat milk, physicochemical properties, microbiological analysis, Ogbomoso North, nutritional value.

DESCRIPTION OF PROBLEM

Milk provides energy, protein and other nutrients for humans and thus, has a major role in achieving food security in Nigeria. The large ruminants particularly the cattle have been the major sources of domestic meat and milk supply (1). Milk supply from other animals, such as goats, is minimal. (2). However, in 2017, the global dairy goat population was estimated to be 218 million (FAO, 2011) with Nigeria contributing close to zero. Goat milk is a notable contributor to global dairy production, making up 2.3% of the total (3). Consumption of goat milk is increasing due to its nutritional benefits and superior digestibility compared to cow milk. Goat milk contains higher levels of certain vitamins and minerals, making it and its products a preferred choice for many (4). In tropical regions like Nigeria, the growing demand for dairy products highlights the need to optimize local milk production. The traditional dairy sector, mainly composed of indigenous cattle breeds and minimal dairy goats, has significant untapped potential (5). The Maradi goat (Red Sokoto) is a prominent breed known for its resilience and milk production capabilities in Nigeria (6). Therefore, there is a need to appraise the local goat milk, its production and improved acceptability. This study assessed the physicochemical and microbiological characteristics of Maradi goat milk in the Ogbomoso North Local Government Area, providing insights into its potential for local dairy industries.

MATERIALS AND METHODS

Animals and Experimental Design

The study was conducted in Ogbomoso North Local Government Area, Oyo State, a semi-derived Savanna of Nigeria. Twenty-five lactating Maradi does, aged 3-5 years, managed by owner farmers who spread across the ten wards were used for the study. The goats were managed semi-intensively, housed at night, grazed for 3-5 hours daily, and supplemented with agricultural by-products such as cassava peel, corn bran and palm kernel cake. Milk was collected twice daily at 7 am and 4 pm, beginning seven days post-parturition to allow colostrum intake by kids. The manual milking method was used with milk let-down stimulated by suckling.

Chemical Analysis

Milk samples were analyzed for proximate composition using (7) methods. Fat content was determined by the Gerber method, moisture content by oven-drying at 105°C until constant weight, ash content by furnace-drying at 550°C, and protein content by digestion, distillation, and titration (nitrogen *6.38). (7) Carbohydrate content was calculated as the difference between 100% dry matter and the sum of fat, moisture, ash, and protein percentages(7). Vitamin and mineral contents were measured using high-performance liquid chromatography and atomic absorption spectrophotometry, respectively. Microbiological analyses included: Total Bacterial Count with plate count agar; Total Coliform Count with MacConkey agar; Total Fungal Count with Sabouraud dextrose agar; Total Viable count using pour plate method and microbial identification by biochemical tests and selective media (7).

Statistical Analysis

Data were analyzed using the General Linear Model (GLM) procedure of SAS Version 9.2 (8). Descriptive statistics were used to summarize the results.

RESULTS AND DISCUSSION

Physicochemical Properties of Raw Milk Samples Collected from Maradi Goats in Ogbomoso North Local Government Area

Table 1 shows the Physical Characteristics and Proximate Composition of the Raw Milk Samples Collected from Maradi Goats in the Ogbomoso North Local Government Area which include; pH, Total solid, Protein, Fat, Ash, Lactose, Specific Gravity, Viscosity, Density and Titratable acid and their values include 6.31, 12.63%, 3.12%, 3.55%, 0.30%, 4.46%, 1.11, 7.72ml/s, 1.11g/ml and 0.89% respectively. Total Solid had a high value of 12.63% and a moderate percentage for Ash (0.30%).

The proximate composition data show that Maradi goat milk has a high total solids content. High total solids content suggests that the milk is rich in nutrients thus contributing to its overall quality and nutritional value. The protein and fat contents are comparable to other studies (9,10). The protein content is within typical ranges (3-3.5%) (11) for goat milk, indicating a good source of essential amino acids necessary for growth and repair. Fat level in this study, which is important for energy and fat-soluble vitamins, is within typical ranges (11), though the variation in fat content may be attributed to management and environmental factors. Lactose, the primary carbohydrate in milk, is essential for energy. The levels are consistent with those in goat milk (11), making it a suitable alternative for those with lactose sensitivity. Viscosity measures the milk's flow properties, which can affect processing and consumer acceptance.

The Vitamins include Vitamin A, B_1, B_2, B_3, C and minerals are Calcium (Ca), Sodium (Na), Potassium (K), Phosphorus (P), Magnesium (Mg), Iron (Fe), Zinc (Zn), Chlorine (CL). The Values of Vitamin A, B_1, B_2, B_3, C are 26.49 mg/100ml, 1.43 mg/100ml, 0.36 mg/100ml, 2.71 mg/100ml and 7.22 mg/100ml. The raw milk is highly rich in Vitamin A which is 26.49mg/100ml.

The values of minerals are Calcium (Ca), Sodium (Na), Potassium (K), Phosphorus (P), Magnesium (Mg), Iron (Fe), Zinc (Zn) and Chlorine (CL) are 125.23, 38.10, 166.01, 84.79, 11.61, 0.08, 0.30 and 63.23mg/100ml. Calcium and Potassium had the higher value of 125.23 and 166.01mg/100ml. The high

Vitamin A and potassium levels are notable, with calcium and phosphorus contents supporting the nutritional value of Maradi goat milk. The high Vitamin A and potassium content adds to its nutritional value, supporting its potential role in regional dairy production.

Microbiological Characteristics of the Raw Milk Samples Collected from Maradi Goats in Ogbomoso North Local Government Area

Table 2 revealed the microbiological Characteristics of the Raw Milk Samples Collected from Maradi Goats in Ogbomoso North Local Government Area which include Total Viable Count, Total Bacteria Count, Total Fungi Count, Total Coliform Count and microbial isolates. The value of Total Viable Count, Total Bacteria Count, Total Fungi Count and Total Coliform Count are 5.63 cfu/ml, 3.18 cfu/ml, 1.99 cfu/ml and 1.72 cfu/ml. Total virus count had the higher value in the milk sample followed by Total bacteria count. The microbial isolate includes *L. cellobiosus, L. salivarius, L. coryniformis, L. caseiL. fermentum, L. coagulansL. helveticus* and *S. lactis.* The microbiological characteristics indicates significant bacterial and fungal populations, and could be beneficial for fermentation. Microbiologically, the presence of bacteria and fungal species suggests potential for fermentation processes but highlights the need for careful management to avoid spoilage. The microbial counts are consistent with those in other goat milk studies (12).

Table 1: Physicochemical Properties of the Raw Milk Samples Collected from Maradi Goats in Ogbomoso North Local Government Area

Parameter	Milk samples from Maradi goat in Ogbomoso North LGA	Range	
		Minimum	Maximum
pH	6.31 ± 0.07	5.94	6.76
Total solid (%)	12.63± 0.05	12.34	12.98
Protein (%)	3.12 ± 0.03	2.87	3.28
Fat (%)	3.55 ± 0.03	3.32	3.66
Ash (%)	0.30 ± 0.01	0.27	0.34
Lactose (%)	4.46 ± 0.02	4.36	4.61
Specific Gravity	1.11 ± 0.00	1.11	1.11
Viscosity (ml/s)	7.72 ± 0.26	6.40	9.30
Density (g/ml)	1.11 ± 0.00	1.11	1.11
Titratable Acid (%)	0.89 ± 0.02	0.83	1.03
Vitamin A (mg/100ml)	26.49 ± 0.11	25.86	27.13
Vitamin C (mg/100ml)	7.22 ± 0.16	6.48	8.11
Vitamin B_2 (mg/100ml)	0.36 ± 0.01	0.22	0.37
Vitamin B_1 (mg/100ml)	1.43 ± 0.04	1.16	1.63
Vitamin B_3 Niacin (mg/100ml)	2.71 ± 0.10	2.25	3.24
Calcium (mg/100ml)	125.23 ± 0.95	118.80	130.11
Sodium (mg/100ml)	38.10 ± 0.71	35.82	43.54
Potassium (mg/100ml)	166.01 ± 1.98	153.91	174.69
Phosphorus(mg/100ml)	84.79 ± 0.84	81.60	90.07
Magnesium (Mg/100ml)	11.61 ± 0.17	10.70	12.60
Iron (mg/100ml)	0.08 ± 0.00	0.06	0.09
Zinc (mg/100ml)	0.30 ± 0.01	0.25	0.37
Chlorine (mg/100ml)	63.23 ± 0.79	58.04	67.07

CONCLUSION AND APPLICATION

The physicochemical analysis of milk from Maradi goats in Ogbomoso North LGA reveals a rich and consistent nutrient profile. The pH, total solids, protein, fat, lactose, vitamins, and minerals are all within

recommended ranges for high-quality goat milk. High levels of essential nutrients like calcium, potassium, and various vitamins highlight the potential health benefits of this milk, making it a valuable dietary component. Additionally, the presence of microbial populations suggests that Maradi goat milk could be advantageous for fermentation processes. The study supports the role of Maradi goat milk in enhancing regional dairy production, providing a valuable resource for both nutritional and economic purposes. Future research should focus on optimizing management practices and exploring the commercial viability of Maradi goat milk products.

Table 2: Microbiological characteristics of the Raw Milk Samples Collected from Maradi Goats in Ogbomoso North Local Government Area

Parameters	**Milk samples from Maradi goat in Ogbomoso North LGA**	**Range**	
		Minimum	**Maximum**
TVC × 10^{-8} cfu/ml	5.63 ± 0.09	5.255	6.140
TBC × 10^{-3} cfu/ml	3.18 ± 0.03	2.964	3.325
TFC × 10^{-2} cfu/ml	1.99 ± 0.02	1.890	2.109
TCC × 10^{-2} cfu/ml	1.72 ± 0.02	1.620	1.837
Microbial isolates	*L. cellobiosus, L. salivarius, L. coryniformis, L. casei, L. fermentum, L. Coagulans, L. helveticus and S. lactis*		

TVC: Total Viable Count, TBC: Total Bacteria Count, TFC: Total Fungi Count, TCC: Total Coliform Count

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Animal Products and ProcessingTechnology: APP015

INFLUENCE OF POST STORAGE PROCESSING OF BOVINE BLOOD ON ITS NUTRITIONAL QUALITIES AND MICROBIAL COMPOSITIONS

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ABSTRACT

This study was conducted to evaluate the influence of post storage processing of bovine blood on its nutritional qualities and microbial compositions. Bovine blood for the study was obtained from the Central Abattoir, Uyo Meteropolis, Akwa Ibom State. The experiment had four treatments designated as T_1 containing blood processed after 8 hours, T_2 contained blood processed after 10 hours, T_3 contained blood processed after 12 hours and T_4 contained blood processed after 14 hours. T_3(12 hours) showed a significant difference ($P< 0.05$) in gross energy, (5.76) amino acid profile, mineral composition and microbial count (0.50 Cfu/g x 10^2) as compared to other treatments. High gross energy values and low microbial counts were unique attributes that were observed in T_3 (12 hours). In conclusion, T_3 samples can be used for livestock feeds by feed-millers and farmers.

Keyboard: Bovine blood, Post-storage Processing, Nutritional Qualities, Microbial composition

DESCRIPTION OF PROBLEM

Nigerian livestock sector is one of the widespread enterprises that ensures the availability of quality animal proteins in the form of meat and eggs, income earnings and job engagements to both consumers and producers [1]. These contributions to human health and socioeconomic development are currently being undermined by the escalating cost and scarcity of conventional feed ingredients especially for intensively reared monogastrates whose feed usually account for 60- 70% of the total production cost [2] and this has led to unprofitable investment production [3].

The profiling of feed composition for monogastric reveals that both energy and protein feedstuffs have been the major contributors to the present high feed cost due to competition for conventional feedstuffs between human and industries [4, 5]. In order to lessen the ever-demanding pressure from energy and protein resources in livestock, numerous attempts have been made by animal nutritionists to overcome these challenges with search and research for alternatives that are cheap, safer and comparative nutritive value over conventional ones and stable physiology of concerned animals [4, 6]). Amongst the vast abundance of non-conventional feedstuffs are abattoir slaughter wastes, chiefly blood, bone and meat meal appear to offer a lot of hope in reducing high cost of animal protein resources in livestock feed production [7]. Animal blood is the first by-product obtained after slaughter, and blood taken from a healthy animal is often sterile and as such, any contamination might be due to the bleeding techniques, utensils and drainage system employed during collection [8].

Blood and blood products intended for humans and animals are generally obtained from bovine and porcine species, perhaps due to large volume of drained blood and large number of animal slaughtered [1]. Bovine blood had been reported [8] to contain 80.9%, water, 17.3% protein, 0.23% lipids, 0.70% carbohydrates and 0.62% minerals. Bovine blood can be processed into blood meal, a dark chocolate colour product with an unpalatable taste and pungent smell [9]. Blood meal has been reported to contain a reasonable crude protein of 80-85%, 1% fat and 5% ash [9]. While blood meal is known for appreciable quantities of amino acids such as lysine, methionine, histidine, arginine, leucine and tryptophan, it is also deficient in isoleucine and

glycine [10]. Additionally, blood meal is a dependable source of iron and zinc but low in calcium. The percentage level of amino acids in blood meal has been reported by several authors to be a function of processing method employed [9]. According to [11], blood meal could be a readily replacement for the expensive fish meal in livestock vis-à-vis poultry diets.

Therefore, prompted by the desire to reduce the cost of expensive animal protein source in monogastric nutrition, this study is initiated to evaluate the influence of twelve (12) hour post-storage processing of bovine blood on its nutritional qualities and microbial compositions.

MATERIAL AND METHODS.

Study location: The study was undertaken in the Department of Animal Science Laboratory, University of Uyo Annex. Uyo lies within the tropical rainforest zone of the Nigerian vegetational belt with annual rainfall ranges of 2000mm-300mm, average temperatures at 26 ^{o}C - 28^{o}C and relative humidity of 85-90% (University of Uyo Meteorological Station Forecast, 2023).

Preparation of test material (blood meal)

Fresh bovine blood was collected from the Central Abattoir in Uyo Meteropolis, Akwa Ibom State. The blood was processed by cooking after 8, 10,12 and 14 hours post-storage. Each treatment was processed for 5 minutes at 100 ^{o}C after which the samples were further ovendried at low temperature of 55 ^{o}C for 3 days before being ground into blood meal and stored in an airtight container to prevent mould formation.

Chemical analysis of blood meal

Dried bovine blood meal (BBM) was analysed in the laboratory using chemical procedures, of [13] for proximate composition, gross energy was estimated by calculation while amino acids were determined using mass spectrometer. Microbial count was carried out by plating and using microscope.

Experimental design and statistical analysis

The experimental design used was Completely Randomized Design (CRD) for four treatments designated as T_1, T_2, T_3 and T_4, with each indicating bovine blood meal processed 8 hrs, 10hrs, 12hrs and 14hrs respectively. Data obtained from these parameters were subjected to Analysis of Variance (ANOVA) while significant means were separated by Duncan Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

The proximate composition and gross energy of bovine meal is presented in Table 1. Significant difference ($P< 0.05$) was observed in parameter of T_3 (12 hours) as compared to other treatments as well as indicating highest values in both gross energy (5.76 kcal/g) and crude protein level (89.73%). Given these appreciable values, the bovine blood meal is a rich source of energy and crude protein required for livestock, particularly poultry species. Being hydroscopic in native, BBM is believed to attain more gross energy value as the post storage durations increased due to saturation effect from water loss. The values obtained in the present study are within the range of values reported by [9] that blood meal is known to contain a reasonable crude protein range from 80-85%.

The essential and non-essential amino acid profile of bovine blood meal are presented in Table 2. Significant differences ($P<0.05$) were observed in BBM for both essential and non- essential amino acids. T_3 (12 hours) indicated the highest values in leucine (12.55%) and lysine (9.30%) for essential amino acid when compared with other treatments, while arginine (7.50%) and glycine (5.10%) also showed highest values for non-essential amino acids However, percentage values for certain amino acids is dependent on many factors such as processing methods, sex, breed and nutrition employed. Being limiting amino acids in nature, methionine, arginine, isoleucine and tryptophan values in the present study were dismal, thus contrasting with the report by [10] that blood meal is a rich source of methionine, histidine and trytophan. Similar low values of methinonine, isoleucine and lysine were observed across the treatment by [1] thus, substantiating the report of [12].

Also, the result of the microbial load of BBM is given in Table 4 and the microrganisms isolated from the BBM samples were indicated. Significant difference ($P<0.05$) was observed among the treatments with T_1,

T_2, and T_4 having the higher values while T_3 (12 hours) recorded the least values for total microbial count (2.19 Cfu/gx10^7), bacterial count (1.63 Cfu/g x10^2), fungi (0.68 Cfu/g x 10^2), and yeast (0.50 Cfu/g x 10^3). Unlike other parameters, the low microbial composition observed in T_3, might be due to several hours of prolonged exposures of fresh blood to atmosphere whereby sufficient water loss occurred, thus the saturation effect deprived the microrganisms a convenient medium of growth. Low values for T_3 (12 hours) were desirable for BBM use in feed formulation for monogastrates especially poultry as reduction in pathogenic organisms associated with protein feedstuffs such as BBM enhance their utilization as safe feedstuff as opposed to the generally held motion that BBM is a potential sources of disease transmission and for that reason, it should not be used for human and animals foods. This present study has contradicted with the report of [8].

Table 1: Proximate Composition and gross energy of bovine blood meal processed 12 hours post storage

Parameters	T_1 (8 hours)	T_2 (10 Hours)	T_3 (12 hours)	T_4 (14 Hours)	SEM
Crude protein (%)	84.84^d	8.5 53^c	89.73^a	88.63^b	0.04
Crudefat (%)	1.39^d	1.51^c	1.76^a	1.64^b	0.01
Crude fibre (%)	0.91^d	1.06^c	1.24^a	1.17^b	0.02
Crude ash (%)	2.80^d	2.93^c	3.77^a	3.63^b	0.02
Dry matter (%)	87.66^d	87.89^c	92.72^a	91.66$_b$	0.03
Gross energy (k cal/g)	5.61^d	5.63^c	5.76^a	5.64^b	0.01

a-d means in a row with different superscripts were significantly different (P<0.05); SEM= Standard Error of Means

Table 2: Essential and Non- essential amino acid profile of bovine blood meal processed 12 hours post storage

Parameters	T_1 (8 hours)	T_2 (10 Hours)	T_3 (12 hours)	T_4 (14 Hours)	SEM
Essential amino acids:					
Histidine (%)	5.80^d	6.40^c	7.30^a	6.95^b	0.09
Isoleucine (%)	0.60^d	1.00^c	1.75^a	1.25^b	0.07
Leucine (%)	10.15^d	11.05^c	12.55^a	11.45^b	0.12
Lysine (%)	8.00^c	8.80^b	9.30^a	8.95^b	0.12
Methionine (%)	0.35^c	0.60^c	1.20^a	0.70^b	0.07
Phenylalanine (%)	5.20^d	5.70^c	7.35^a	6.50^b	0.09
Threonine (%)	3.45^d	4.00^c	5.15^a	4.45^b	0.08
Tryptophan (%)	0.40^d	0.65^c	1.50^a	1.05^b	0.09
Valine (%)	7.05^d	7.60^c	9.00^a	8.40^b	0.12
Non-essential amino acids (%):					
Alanine (%)	6.05^d	6.50^c	7.50^a	7.00^b	0.09
Arginine (%)	2.95^c	3.40^b	3.55^b	4.10^a	0.11
Aspartic acid (%)	9.60^d	9.85^c	11.35^a	10.70^a	0.09
Cysteine (%)	1.50^d	1.95^c	3.65^c	2.35^b	1.14
Glutanlic (%)	8.20^d	8.60^c	9.70^a	9.20^b	0.08
Glycine (%)	3.30^d	3.95^c	5.10^a	4.35^b	0.14
Proline (%)	2.70^d	3.21^c	4.05^a	3.60^b	0.10
Tyrosine (%)	2.25d	2.70c	3.45a	3.60b	0.11
Ornithhine (%)	0.17a	0.13b	0.07c	0.12b	0.01
Cystine (%)	0.45d	0.80c	1.15a	0.75b	0.05
Serine (%)	3.60d	4.05c	4.95a	4.26b	0.12

[a-d]Means in a row with different superscripts were significantly different (P<0.05); SEM= Standard Error Means

Table 4.3: Microbial compositions of bovine blood meal processed 12 hours post storage

Parameters	T_1 (8 hours)	T_2 (10 Hours)	T_3 (12 hours)	T_4 (14 Hours)	SEM
Total microbial Count ($X10^7$)	2.69a	2.55^b	2.31^c	2.31^c	0.02
Bacterial Population (Cfu/g)	1.95^a	1.88^b	1.63^d	1.70^c	0.02
Fungi (Cfu/g/$10X10^2$	1.14^a	1.06^b	0.68^d	0.80^c	0.01
Yeast mould (Cfu/g/$10X10^2$	2.28^a	2.22^b	0.50^d	0.61^c	0.01

[a-d]Means in a row with different superscripts were significantly different (P<0.05); SEM= Standard Error Means

CONCLUSION

Fresh bovine blood can be kept for up to 12 hours before being processed into blood meal without spoilage; and blood meal so obtained, can be used for livestock feeds especially for monogastrates, without any adverse effect.

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EFFECT OF ANTIBIOTIC GROWTH PROMOTERS ON BREAST MEAT LIPID PROFILE OF BROILERS

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ABSTRACT

This study aimed at assessing the effects of Cinnamon powder (CP), ginger powder (GP) and Moringa leaf meal (MLM) dietary supplementation on breast meat lipid profile of broilers. A basal diet divided into four portions were designated as diet 1 (control), diets 2, 3 and 4 supplemented with 0.2% Cinnamon powder, 0.2% ginger root and 0.2% moringa leaf meal, respectively. One hundred and twelve (112) day old broiler chicks (Cobb 500) breed were randomly assigned to the four experimental diets comprising of 28 birds per diet, 7 birds per replicate in a Completely Randomized Design. At the expiration of the study (56 days), 50g of meat samples were collected from the breast region of birds selected for carcass characteristics for the determination of breast meat lipid profile of broilers as affected by the antibiotics growth promoter. The cholesterol (3.35, 3.20 and 3.31), triglycerides (1.21, 1.15 and 1.25) and low density lipoprotein (1.71, 1.61 and 1.66) values recorded for birds on diets 2, 3 and 4 , respectively were similar ($p>0.05$) but significantly ($p<0.05$) lower than birds on diets 2, 3 and 4 which were similar ($P>0.05$) but significantly ($P<0.05$) lower than the values recorded for control diet. The high density lipoprotein values of birds on diets 2, 3 and 4 were similar ($P>0.05$) but significantly ($P<0.05$) higher than control diet. It can be concluded that antibiotic growth promoters used in this study reduced the meat lipid profile of cholesterol, trigyceride and low density lipid protein and increase high density lipoprotein.

Keyword: Broiler, lipid profile, cinnamon powder, ginger root, moringa leaf meal

DESCRIPTION OF PROBLEM

Due to rapid growth, broiler chickens are primarily raised for their meat. Furthermore, broiler chicken meat is a good source of protein which makes it has a high demand among consumers. Broiler meat is also a healthier option for consumers due to its low lipid content. However, meat from broilers become a significant component of human meals. As a result, there was an increase in demand for more meat globally (1) (2). Consumers are interested in meat that can increase their level of satisfaction. Additionally, consumer preference has changed from the whole bird to its processed parts, raising the value of the meat yield and its quality characteristics even further. To win over consumers, efforts are being made to enhance meat quality and expand its storage capability. Compared to meat from other species, chicken breast meat contains a higher proportion of polyunsaturated fatty acids, making it important for diets (3), (4).

Antibiotics have been used in broiler feed for years to treat and prevent illnesses, enhance performance, and increase feed efficacy (5). Antibiotics are more likely to accumulate in residual form when used non-therapeutically than when used medically, which increases the risk of antimicrobial resistance. In addition, the European Union banned the use of antibiotics in animal diets in 2006 due to toxicity issues and the emergence of microbial resistance. Therefore, it is essential to produce broiler chicken meat without the use of antibiotics in order to safeguard against the development of antibiotic resistance (6). Additionally, consumers are concerned about antibiotic residue in addition to nutritional value and flavor. Finding suitable alternatives for growth promotion and feeding effectiveness was thus also necessary.

In recent years, the feed industry has come to understand the potential of compounds derived from plants for various animal species. As a result, the use of phytogenic feed additives is rising, particularly in feeding plans for pigs and poultry. Herbs, spices, essential oils, and non-volatile extracts from plants like clove, anise, thyme, fennel, or melissa, among many others, are examples of phytogenic materials used in PFAs (7). Numerous phytogenic activities that promote growth and health have been identified in an increasing number of scholarly literatures. According to (8), phytogenics enhance poultry growth performance. Although the precise mechanism of action of phytogenics is still unknown, their positive benefits are explained by their antibacterial, immunomodulatory, and antioxidant capabilities (9) (10) (11). Recently, it has been demonstrated that PFA can improve feed efficiency (FE) and slightly increase breast output by modulating the expression of feeding-related hypothalamic neuropeptides (12) (13). The aim of this study is to determine the breast meat lipid profile as affected by Cinnamon powder (CP), ginger powder (GP) and Moringa leaf meal (MLM).

METHODOLOGY

Location and experimental site: The study was carried out at the Poultry Unit of Teaching and Research Farm, Department of Agricultural Technology, The Federal Polytechnic Ado Ekiti, Ekiti state, Nigeria. The state is located in South Western part of the country, Ekiti state covers a land area of 6353km square (2453sqmi) with a population estimated in 2005 to be 2737,186. It enjoys tropical climates with two distinct seasons, there are rainy season (April to October) and dry season (November to March). Ado Ekiti has a temperature ranges between 21^{o}C to 28^{o}C.

Site preparation: The poultry house was thoroughly washed, fumigated with disinfectant. The poultry house was allowed to stay and dried for two weeks before the arrival of the experimental birds. Proper weeding of the surrounding was carried out to prevent predators and pests.

Test ingredients: The test ingredients Cinnamon *(Cinnamomum ceylon) and* Ginger root *(Zingiber officinale)* used were gotten from a local market in Ado Ekiti while moring*a leaves* (M*oringa oleifera)* were harvested within the premises of The Federal Polytechnic Ado Ekiti. The Ginger roots were sliced, air-dried for 7 days, while Moringa was air-dried for a period of 7 days, in order to reduce the moisture content. They were milled into fine particles and used to formulate the diet.

Management of experimental birds: A total of one hundred and twenty-one birds of Cobb-500 breeds were used for the experiment. The chicks were brooded for two weeks for acclimatization using electric bulb as source of light and heat in the pen. In the brooder house, enough provision were made for space, Ventilation, polythenes were also used to cover the pen to provide warmth, and protection against predators and cold extreme weather. Proper and adequate management practices were undertaken. Vaccinations and medications were given appropriately. Throughout the durations of the experiment, feed and water were supplied *ad-libitum.*

Experimental diets: The composition of experimental diets is presented in Table 1 below. The basal diets were formulated for broiler starter (0-28) days and finisher phase (29-56) days. The basal diets were divided into 4 diets: Diet 1- Control diet (without supplementation) , diet 2- Contained 0.2% Cinnamon powder supplementation (CP), diet 3- Contained 0.2% of ginger powder supplementation, diet 4: Contained 0.2% of Moringa leafmeal leaf meal(MLM).

Experimental design: The experimental design used was Completely Randomized design (CRD) with a total number of 16 experimental units. The study adopted a true experimental research, which investigated effect of phytogenic supplements on growth performance of broilers chicken by exposing them to 4 treatments which were replicated 4 times with 7 birds per replicates.

Data Collection: Fifty grams (50g) of meat samples were collected each from the breast region of birds selected for carcass characteristics for the determination of total cholesterol, triglyceride, High-Density Lipoprotein (HDL), Low Density Lipoprotein (LDL).

Statistical Analysis: All data collected from this study were subjected to Analysis of Variance using SPSS. Duncan's Multiple Range test of one-way ANOVA was used to analyze the mean differences of the parameters measured. Significant differences were considered where necessary at a level of ($P < 0.05$).

Table 1 Composition of experimental diet (%) for broiler starter and finisher

Ingredients	Broiler starter	Broiler finisher
Maize	53.00	58.00
Soybean cake	22.00	22.00
Groundnut cake	16.00	11.00
Fish meal	2.00	2.00
Bone meal	3.00	3.00
Limestone	2.00	2.00
Broiler premix	0.25	0.25
Methionine	0.25	0.25
Lysine	0.25	0.25
Common salt	0.25	0.25
Vegetable oil	1.00	1.00
Total	100.00	100.00
Calculated composition		
Metabolizable Energy	2980.00	3019.70
Crude protein	21.80	19.86
Calcium	1.99	1.98
Phosphorus	0.69	0.68
Lysine	1.33	1.27
Methionine	0.60	0.58

Vitamin-mineral premix will provide per kg the following: Vit.A 1500 IU; Vit.D_3 3000IU; Vit.E 30 IU; VitK 2.5 mg; Thiamine B_1 3 mg; Riboflavin B_2 6mg; Pyrodoxine B_6 4 mg; Niacin 40 mg; Vit. B_{12} 0.02 mg Panthothenic acid 10mg; Folic acid 1mg; Biotin 0.08; Chloride 0.125mg; Mn 0.0956g; Antioxidant 0.125g; Fe 0.024g; Cu 0.006g; Se 0.24g; Co 0.240g

RESULT

The cholesterol, triglycerides and LDL values recorded for birds on diets 2, 3 and 4 were similar ($p>0.05$) but significantly ($p<0.05$) lower than the values recorded for control diet. The cholesterol, triglycerides and LDL values were recorded for birds on diet 4 at 3.31, 1.25 and 1.66 respectively

The High Density Lipoprotein (HDL) of birds fed diets 2, 3 and 4 were similar ($P>0.05$) but significantly ($P<0.05$) higher than control diet. The percentage difference in which diets 2, 3 and 4 were higher than control diet are 68.18%, 63.83% and 67.26%, respectively.

Table 3: Effect of phytogenic supplements on breast meat lipid profile

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	±SEM	P-Value
Cholesterol	4.00^a	3.35^b	3.20^b	3.31^b	0.03	0.01
Triglycerides	4.20^a	1.21^b	1.15^b	1.25^b	0.30	0.01
HDL	1.50^b	2.20^a	2.35^a	2.23^a	0.12	0.05
LDL	2.19^a	1.71^b	1.61^b	1.66^b	0.08	0.01

^{a,b} means in the same row with different superscripts are significantly ($p<0.05$) different; SEM: standard error of the mean. HDL: High density lipoprotein, LDL: Low density lipoprotein

DISCUSSION

The cholesterol and fatty acids types are of health importance to the consumers because of existing relationship between the consumption of high cholesterol and saturated fat and their effects such as increased

possibility of acquiring diseases such as high blood pressure, heart diseases and obesity. The reduced meat cholesterol, triglycerides and low density lipoprotein recorded in birds fed cinnamon, ginger root and moringa leaf meals supplemented diets compared to those fed the control diet in this study may have an interaction with the phytogenic supplements which reduced the aforementioned parameters. However, the reduced meat cholesterol, triglycerides and low density lipoprotein levels recorded in these birds is of health benefit because of the enormous health complication associated with the ingestion of high cholesterol meat.

Triglycerides are the most common type of fat in the body because they store excess energy in the diet. A high triglycerides level combined with high LDL (or low HDL) is linked with fatty acid build up within the artery walls, which increases the risk of heart and stroke. The phytogenic supplement lowered the level of triglycerides of broiler chicken because people are conscious of what they consume. High Density lipoprotein (HDL) Cholesterol, sometimes called "good" cholesterol absorbs cholesterol in the blood and carries it back to the liver. The liver then flushes it from the body. High levels of HDL cholesterol can lower the risk of heart diseases and stroke in consumers (14)

LDL (Cholesterol is considered to be “bad” cholesterol, because it contributes to fatty acid buildups in arteries. This narrows the arteries and increase the risk for heart attack, stroke and peripheral artery diseases. The phytogenic supplement is low and it has no negative effects on the meat (15).

CONCLUSION

The phytogenic supplements used in this study reduced the meat lipid profile of cholesterol, triglyceride and low density lipid protein and increase high density lipoprotein. This improved the health benefit because meat with high lipid profile can be associated with a disease called arteriosclerosis
Application: Based on the findings obtained in this study**,** 0.2% ginger root can be recommended for lowering the values of cholesterol and triglycerides. For further research, the inclusion rate of ginger root maybe increased.

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Animal Products and ProcessingTechnology: APP017

SENSORY QUALITY OF CHICKEN PATTIES PREPARED WITH SELECTED ESSENTIAL OILS

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ABSTRACT

The study was aimed at evaluating the effects of selected essential oils on the sensory properties of chicken patties. Essential oils have demonstrated antimicrobial and antioxidant activities that are beneficial in food preservation. In addition to their preservative qualities, essential oils offer unique flavour profiles that can enhance the sensory appeal of chicken patties. Chicken patties used in this study were prepared in five treatments (T). T_1 (0% essential oil), T_2 (0.05% Cinnamon Bark Essential Oil), T_3 (0.05% Oregano Essential Oil), T_4 (0.05% Thyme Essential Oil) and T_5 (0.05% Lemon Essential Oil). Sensory evaluation including flavour, juiciness, tenderness, appearance, taste, and overall acceptability was evaluated on the chicken patties using a hedonic scale from 9 (extremely liked) to 1 (extremely disagreeable) by a 25man taste panel made up of the department's staff and students. The evaluation was carried out day 1, day 7, day 14 and day 21 after production. Overall, lemon essential oil improved overall acceptability, while oregano essential oil lowered it. However, the control patties did not differ significantly in most sensory attributes. Lemon essential oil had more positive effect on the organoleptic properties of the chicken patties particularly the colour, texture, juiciness and overall acceptability of the chicken patties and is therefore more recommended for food producers. Other essential oils such as ginger and rosemary essential oils can also be investigated in future researches.

Keywords, Essential oils, Thyme, Lemon, Oregano, Cinnamon Bark

INTRODUCTION

Chicken meat is a popular and widely consumed animal protein source, known for its nutritional benefits and relatively lower fat content compared to other meat sources [1]. However, due to its biological composition, chicken is regarded as a highly perishable food commodity [2]. Thus, preservation of chicken meat and its products is vital in ensuring safety, controlling spoilage and extending the shelf-life of meat. Chicken patties are widely consumed due to their convenience, taste, and nutritional profile. However, they are also prone to quality degradation during storage and handling, which can lead to spoilage, reduced shelf life and acceptability [3]. Essential oils, such as those extracted from oregano, rosemary, thyme, and clove, have demonstrated antimicrobial and antioxidant activities that are beneficial in food preservation [4]. These oils can be incorporated into chicken patties during processing or used as part of marinades or coatings to enhance preservation. In addition to their preservative qualities, essential oils offer unique flavour profiles that can enhance the sensory appeal of chicken patties. This dual functionality makes them attractive to food manufacturers and consumers seeking natural and flavourful options. This study aims at evaluating the effects of selected essential oils on the sensory properties of chicken patties

DESCRIPTION OF PROBLEM

Several ingredients have been incorporated to meat products for reasons such as enhancement of organoleptic properties, increasing shelf life/preservation, e.t.c. However, the use of some synthetic ingredients has been limited due to their potential negative impacts on consumer health. With naturally occurring essential oils' high antioxidative and aromatic properties, they have strong potentials to improve organoleptic properties of meat products without posing additional health risks to consumers.

MATERIALS AND METHODS

Location of the study
The investigation was conducted in the Animal Products and Processing Laboratory of the Department of Animal Science, Faculty of Agriculture, University of Ibadan, Ibadan.

Chicken source
Live 8 weeks broilers was purchased from Saklad farm along Akobo junction, Ibadan. The birds were slaughtered on farm and refrigerated immediately after evisceration. The breast muscles was then excised after 24hours .

Essential oils source
Thyme, Lemon, Oregano and Cinnamon Bark Essential oils used for the experiment was obtained from a reputable source (Blomera oils, Lagos State).

Soybean flour preparation
The soybean was obtained from a local market in Ibadan. The beans was picked to separate sand, dust and other foreign bodies away from the soybean. The soybean was then soaked in water for 48 hours. The soybean was washed thoroughly to separate the shaft from the soybean. The soybean was then spread in a clean room and air-dried for 3 days before blending it to powder.

Non-meat Ingredients
Other ingredients such as margarine, spices, salt and sugar were purchased from a reputable supermarket in Ibadan.

Meat Patties Preparation/ Experimental Design
Breast muscle obtained from 8-week-old Arbor Acre broiler chickens was minced and deboned manually. Subsequently, the deboned chicken breast was diced into smaller pieces with an average thickness of 2mm and dimensions of 3cm x 3cm. A total of 6kg of emulsion was prepared for the production of chicken patties, with 1,200g allocated for each treatment; each treatment was replicated four times in a completely randomized design, with each replicate receiving 300g of emulsion. Following this, 100g portions of the thoroughly mixed emulsion were shaped into patties using a cutter and cooked in an electric oven at 180°C until they reached an internal temperature of 72°C. The oven was preheated for 10 minutes to ensure uniform temperature distribution before cooking commenced. Once cooked, all patties were allowed to cool to room temperature (27°C) before being chilled overnight at 2°C. Subsequently, the chilled patties were weighed, tightly packed, and individually placed in ziplocs before being stored at -4°C for further analysis. To facilitate identification, the chilled samples were labeled as T1, T2, T3, T4, and T5, corresponding to treatments 1, 2, 3, 4, and 5, respectively.
The essential oil was added to the portion as follows;

1. Treatment 1, no inclusion of essential oil
2. Treatment 2, 0.05% Cinnamon bark Essential Oil
3. Treatment 3, 0.05% Oregano Essential Oil
4. Treatment 4, 0.05% Lemon Essential Oil
5. Treatment 5, 0.05% Thyme Essential Oil

Sensory evaluation of meat patties
Sensory evaluation including flavour, juiciness, tenderness, appearance, taste, and overall acceptability were evaluated on the chicken meat patties using a hedonic scale from 9 (extremely liked) to 1 (extremely disagreeable) by a 25man panelist made up of the department's staff and students. The procedure was done on day 1 of patty production and repeated on day 7, day 14 and day 21 after production.

Statistical analysis

The data generated from the study was subjected to one-way analysis of variance (ANOVA) and significant differences (P<0.05) between means was determined by Scheffe multiple comparison test using SPSS (2006) 16.0.1 for Window.

RESULTS

Table 1 shows the main effect of essential oils on the sensory quality of patties. There exist significant (p<0.05) difference in the sensory quality of patties processed from different essential oils but were not significantly (p>0.05) different from the control except the overall acceptability. There exist significant (p<0.05) difference in the colour of patties processed with different essential oils but not all the essential oils are not significantly (p>0.05) different from the control. Patties with Lemon oil had significantly (p<0.05) the highest (6.89) colour value while patties with Thyme oil had significantly (p<.0.05) the lowest (5.86) colour value. Also, patties processed with Oregano oil had significantly (P<0.05) the higher (5.75) flavour while patties with Lemon oil had significantly (p<0.05) lower (4.58) flavour. The texture and juiciness of patties processed from Lemon oil had higher values (5.50, 6.03, respectively) while Oregano oil processed patties had lower (4.58, 5.00) texture and juiciness respectively. patties processed with Lemon oil had the highest (6.50) overall acceptability while pattiess from Oregano oil had the least (2.39) acceptability value and not significantly (p>0.05) different from Cinnamon bark oil (3.08).

Table 1: Effect of different essential oils on the organoleptic properties of chicken patties.

Sensory Variables	Control	CEO	OEO	TEO	LEO	SEM
Colour	6.16^{abc}	6.66^{ab}	6.00^{bc}	5.86^{bc}	6.89^{a}	0.11
Flavour	5.47^{ab}	5.34^{ab}	5.75^{a}	5.03^{ab}	4.58^{b}	0.17
Texture	4.84^{ab}	5.45^{a}	4.58^{b}	4.81^{ab}	5.50^{a}	0.13
Juiciness	5.24^{ab}	5.39^{ab}	5.00^{b}	5.42^{ab}	6.03^{a}	0.13
Overall Acceptability	4.82^{b}	3.08^{d}	2.39^{d}	3.81^{c}	6.50^{a}	0.16

^{a,b,c,d}: means with different superscripts on the same row are significantly different (p < 0.05)
CEO: Cinnamon Bark Essential Oil
OEO: Oregano Essential Oil
TEO: Thyme Essential Oil
LEO: Lemon Essential Oil
SEM: Standard Error of Mean

DISCUSSION

The study reveals significant sensory differences in chicken patties processed with various essential oils, primarily in colour and overall acceptability. LEO enhanced colour significantly, suggesting it improves visual appeal, supported by studies such as [5], which highlight citrus oils' impact on meat colour. TEO resulted in lower colour values, aligning with research by [6] indicating that its darkening effect on meat. Flavour differences were notable, with OEO enhancing flavour, supported by the findings of [7] on oregano's strong flavour profile, while LEO reduced flavour scores. Texture and juiciness were highest with LEO, consistent with [8], who observed citrus oils' positive impact on meat texture.

CONCLUSION

Lemon essential oil had more positive effect on the organoleptic properties of the chicken patties particularly the colour, texture, juiciness and overall acceptability of the chicken patties patties and is therefore more recommended for food producers. Other essential oils such as ginger and rosemary essential oils can also be investigated in future researches.

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Livestock Economics and Extension: LEE001

PROFITABILITY ANALYSIS OF FOUR-WEEK-OLD BROILER PRODUCTION ENTERPRISE IN OKITIPUPA TOWNSHIP, ONDO STATE

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ABSTRACT

The study investigates the profitability of four-week-old broiler enterprise in Okitipupa, Ondo state. The study was conducted in Adeomoh farm enterprise using five cycles of 4-week-old broilers. Data were collected for the study using participatory approach and analysed with budgetary analysis. Data were collected on input and output variables. Results revealed that the mean total revenue, variable, fixed and total costs were ₦319,120, ₦184,920, ₦3,840 and ₦ 188,760 respectively, while the mean gross margin was ₦134,200 at 35.6%. The study concluded that the enterprise is profitable. Therefore, youths and unemployed Nigerians can seek livelihood in four-week-old broiler production enterprise.

Keywords: Profitability, analysis, broiler production, enterprise.

INTRODUCTION

Livestock production constitutes a critical and basic part of the agricultural economy of Nigeria, where poultry is an important enterprise. Poultry is an important subsector in the livestock industry, comprising of chickens, turkeys, ducks, quails, peafowl, guinea fowls among others. However, chicken alone constitutes as much as 95% of all poultry reared worldwide [1]. The industry has been described as the fastest means of solving the problem of protein deficiency in Nigeria and also a viable small and medium enterprises [1]. Broiler production is one of the fastest growing poultry enterprise with good return on investment [2]. Specifically, investment in broiler production is attractive because production cost per unit is low relative to other types of livestock [3]. The rate of growth and return on investment is high making the enterprise economically viable [4]. Most profitability studies addressed layers birds, while the few studies on broiler addressed table sized broilers, hence, the study.

RESEARCH METHODOLOGY

Area of Study

The study was conducted in Ade-Omoh farms, Okitipupa, Okitipupa Local Government Area of Ondo State. The farms produces broilers, layers and turkey.

Data Collection

Data for the study were collected through the direct participation of the researchers in raising 4-week old broiler in the farm. The farm manager was interviewed to clarify information gathered during the on-the-sight observation. Data were collected on input and output variables. Procedures were established to ensure data accuracy, reliability, and confidentiality. For accuracy, data collection form was designed, clearly defining the variables and providing instructions for data entry. Regular checks and validation processes were conducted to minimize errors. To ensure reliability, data were collected for five production circles under the same management and operational activities

Method of Data Analysis

Budgetary technique were used to analyze the data collected. Budgetary technique is an analytical method used to determine the residue of income or revenue over and above cost of production. The total budgetary component is expressed as:

$\Pi = TR - TC$

Where:

Π = Net revenue or profit

TR = Total revenue

TC = Total Cost.

$TR = pq$

Where:

p = price per unit of chicks

q = quantity of output/chicks

$TC = TFC + TVC$

Where:

TFC = Total fixed cost

TVC = Total variable cost

Profitability Analysis of four-week-old broiler

Table 1 presents the financial performance of four-week-old broiler production across five production cycles in Okitipupa Township, Ondo State. The mean total revenue generated from broiler production was while the mean total variable and fixed costs were ₦184,920 and ₦3,840, respectively. The mean total cost of production was ₦188,760 while the mean gross margin was ₦134,200. The mean net revenue was 130, 360 while the mean net profit margin was 35.56%, respectively. The result implies that a very small scale four-weak-old broiler production enterprise is profitable.

Table 1: Costs and return analysis of 4 weeks broiler production (pooled)

Items	C 1	C 2	C 3	C 4	C 5	Pooled
Total Revenue	352,800	153,000	505,800	304,000	280,000	319,120
Variable cost	210,000	123,900	197,450	162,750	230,500	184,920
Fixed cost	6,400	3,200	3200	3200	3200	3,840
Total cost	216,400	127,100	200,650	165,950	233,700	188,760
Gross Margin	142,800	29,100	308,350	141,250	49,500	134,200
Net Revenue	136,400	25,900	305,150	138,050	46,300	130,360
Net profit margin	38.7%	16.9%	60.3%	45.4%	16.5%	35.56%

Source: Data obtained from Adeomoh Farm through self-participation.

Note: C=Circle.

CONCLUSION

The study concluded that four-week-old broiler production enterprise is a profitable enterprise, with high return on investment.

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Livestock Economics and Extension: LEE002

ECONOMICS OF FEEDING *BRACHIARIA MULATO II* HAY AND CONCENTRATE IN A TOTAL MIXED RATION (TMR WITH C: BMH RATIOS %) TO GROWING RABBITS

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ABSTRACT

A study was conducted to evaluate the economics of feeding concentrate in a total mixed ration and *Brachiaria mulato* II hay (TMR with c: BMH ratios %) to growing rabbits**.** A total of 16 mixed breeds of California, Newzealand, Chinchilla, and Dutch and mixed sex growing rabbits weighing averagely 1.02kg were used for the experiment. The animals were allotted to four dietary treatments (T1; 100% concentrate: 0% *Brachiaria mulato* II hay, T2; 75% concentrate: 25% *Brachiaria mulatu* II hay, T3; 50% Concentrate: 50% *Brachiaria mulatu* II hay and T4; 25% Concentrate: 75% *Brachiaria mulatu* II hay) respectively, with four animals per treatment replicated four times in a completely randomized design (CRD). The result showed that, more gain was realized by feeding growing rabbits on 75%C:25% BMH and50%C:50%BMH at a lower cost, thereby making it more profitable. Therefore, farmers are recommended to feed their Growing rabbits with BMH and concentrate diet in a ratio of 50:50 for higher profit.

Keywords: Total Mixed Ration, *Brachiaria mulato* II Hay, Growing Rabbit

INTRODUCTION

In Recent years, there has been considerable interest in *Brachiaria* grasses in Africa, and several initiatives are on-going to promote *Brachiaria* to support the emerging livestock industry in the region, especially in the dry season (4). *Brachiaria* grasses have several desirable traits that include: adaptation to marginal soils, water stress, shade tolerance, and high biomass production potential (5).

Rabbit (*Oryctolagus cuniculus*) is increasingly becoming an important meat source and is recommended for production in countries that are experiencing meat shortage. Rabbits have been recommended as having the best productive advantages to bridge the protein deficiency gap (1). Similarly, (2) reported that increased rabbit production is one sure way of meeting the animal protein requirements of the populace.

Poor economic conditions in many tropical countries and associated increase in the shortage of animal protein has turned attention to rabbit production as a ready solution to the problem (3). This is in view of the rabbit's fast growth and short generation interval. The problem for most producers however, is the high cost of concentrates feed for the rabbits (1). This has necessitated the need to seek for alternative feed sources in forages. This is especially so because of the greater availability of forages and ability of rabbits to convert forage into meat for human consumption (1).

MATERIALS AND METHODS

Experimental Site

The experiment was carried out at the Rabbitary and Swine Research Programme farm of the National Animal Production Research Institute (NAPRI), Shika, Zaria. Zaria is located in Northern Guinea Savannah zone of

Nigeria, latitude 11^0 14' 44'N and longitude 7^0 38' 65' E at an altitude of 610m above sea level, along Zaria-Funtua characterized by a defined wet and dry season. Wet season starts from late April to early May and ends in late September to early October, while the dry season is from October to April. The total annual rainfall ranges from 950-1215mm with a long term average of 1076mm. Maximum air temperature were recorded in May and minimum air temperature of 27.5^0C in October and relative humidity of approximately 53.8% during the rainy season (IARMS, 2021).

Experimental animals

Sixteen (16) growing rabbits (8-9weeks) of mixed breeds of California, New Zealand, Chinchilla and Dutch and mixed sex weighing averagely 1,02kg were sourced from Swine and Rabbit Research Program of National Animal Production Research Institute Shika- Zaria (NAPRI).

Preparation of hay

The *Brachairia mulatoII* forage was harvested at week 12 and air dried under a shade for two weeks. After which it was grounded using a feed-miller. The grounded *Brachairia mulato II* hay was fed with other feed ingredients in total mixed rations to experimental rabbits.

Experimental diets, animals' management and design of experiment

The experimental diets used for this experiment (100% Concentrate: 0% *Bracharia mulato II* hay, 75%C: 25%BMH50%C: 50BMH,25C:75BMH %). Moreover, sixteen (16) rabbits aged 8-9weeks of mixed breed and sexes and weighted 1.02kg averagely ware used for this study. The rabbits were allotted to four treatments, with four rabbits per treatment, a rabbit represent a replicate in a Completely Randomized Design (CRD).

The rabbits were individually housed in metal cages located in a well-ventilated house. The rabbits were fed at 3% of their body weights daily (8:00am and 2:00pm, respectively). The study lasted for 8 weeks with an initial oneweek adjustment period. Prior to the commencement of the experiment, the cages were thoroughly cleaned and disinfected. The experimental animals were kept, maintained and treated in adherence to accepted standards for the humane treatment of animals, in Ahmadu Bello University, Zaria (ABUCAUC).

Table 1: Proximate Composition of Experimental Diets (TMR with C: BMH Ratios %)

Parameter (%)	100:0	75:25	50:50	25:75
Dry Matter	95.98	95.55	85.19	94.96
Crude protein	18.70	16.06	14.43	12.15
Crude fibre	4.74	27.17	30.45	35.23
Ether extract	3.86	1.85	1.20	1.05
Ash	7.33	4.66	6.00	5.33
NFE	65.37	51.26	48.92	48.24

BMH= *Brachiaria mulatoII*Hay, C= concentrate, NFE= nitrogen free extract

Statistical Analysis

In experiment 1, data on growth component was analyzed using the repeated measure analysis of variance (ANOVA) of SAS,(2005). Means ware compared using Duncan Multiple Range Test of the SAS package

Experiment model

$Y_{ij} = \mu + a_i + e_{ij}$

Where

Y_{ij} = Overall observation ofi^{th} diet.

μ = overall mean

a_i = effect of i^{th} diet ratio of concentrate: BMH (100:0, 75:25, 50:50, 25:75,)

e_{ij} = Random Error

RESULTS AND DISCUSSION

Economics of feeding *Brachiaria mulato II* hay and concentrate in a total mixed ratio (TMR) to growing rabbits.

The economic analysis of rabbits fed *Brachiaria mulato II* hay and concentrate in a total mixed ration shows that rabbits fed 25%C:75%BMH had the lowest feed cost of (N103.81) followed by 50%C:50%BMH (N148.04) and 75%C:25%BMH (N192.90) respectively.

Table 1. Economics of feeding *Brachiaria mulatoII* hay and concentrate in a total mixed ration (TMR with C: BMH Ratios %) to growing rabbits

Parameter	100:0	75:25	50:50	25:75
Cost/kg of feed(₦)(a)	237.77	192.90	148.04	103.18
Total feed consumed (kg)(b)	2.39	2.11	1.99	1.71
Cost of feeding (₦/rabbit)(c)	568.27	407.02	294.59	176.44
Weight gain(kg)(d)	0.75	0.93	0.90	0.41
Cost of feed/kg gain (₦/kg)(e)	757.67	437.66	327.32	430.34
Value of gain(₦)(f)	1125	1395	1350	615
Cost over gain(₦)(g)	0.67	0.31	0.24	0.70

N =Naira; Cost of feed(₦)=a; Total feed consumed(kg)=b; Cost of feeding(₦ /rabbit)=c= a x b; Weight gain=d; Cost of feed/kg gain(N /kg)=e=c/d; Value of gain=f(weight gain x 1500 ₦ per kg live weight.(market price); Cost over gain=g= (e/f). C= concentrate, BMH=*Brachairia mulato* II hay, average market price per kg live weight₦1500

The concentrate had the highest feed cost of (₦ 237.33).This is as a result of the high cost of the ingredients used in the formulation of the diet. Inclusion of BMH in the TMR reduced the cost of feeding the rabbits. The best performance was observed in diet 2 (75%C:25%BMH) and diet 3 (50%C:50%BMH) which had higher and similar gain of 0.93 and 0.90kg respectively followed by 100% C:0%BMH and the least was 75%BMH:25%C. The results further indicated that feed cost per kilogramme for the growing rabbits decreased with feeding rabbits grass/concentrate mixtures. In terms of value of gain rabbits fed (75%C:25%BMH) and (50%C:50%BMH) were the best as they gave highest return of (₦1395 and ₦1350) which is higher than that reported by Christopher *et al*. (2003), ₦660.70 who fed weaner rabbits with mixture of grass and concentrate. Feeding 50C:50BMH hadthe lowest cost over gain(0.24) compared to 100C:0BMH, 75C:25BMH and 25C:75BMH(0.67,0.31 and 0.70) respectively

CONCLUSION

It was concluded that, *Brachiaria mulato II* and concentrate fed to growing rabbit at50:50(%C: BMH) was economically better.

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Livestock Economics and Extension: LEE003

SOCIAL, CULTURAL AND INSTITUTIONAL PASTORALISM INNOVATION SYSTEMS FOR SUSTAINABLE LIVESTOCK PRODUCTION IN KANO STATE, NIGERIA

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ABSTRACT

This paper examines the role of social, cultural, and institutional innovations in promoting sustainable livestock production among pastoral communities in Nigeria. Pastoralism is a crucial livelihood strategy but faces significant challenges, including environmental degradation, resource conflicts, and socio-economic pressures. By analyzing various case studies and theoretical frameworks, the paper identifies key innovations that have emerged within these communities. These include community-based resource management, culturally sensitive conflict resolution mechanisms, and supportive institutional policies. The findings suggest that integrating these innovations into pastoral systems can enhance sustainability, improve livelihoods, and contribute to broader developmental goals. The paper concludes with recommendations for policymakers, stakeholders, and researchers to support and scale up these innovative practices.

Key words: Social, cultural, institutional, innovations, Pastoralism

INTRODUCTION

Pastoralism, the practice of raising livestock by moving herds to access grazing resources, plays a vital role in the livelihoods of many communities in Nigeria (1). It is deeply intertwined with the social, cultural, and economic fabrics of these communities (5). However, the sector faces numerous challenges, including climate change, land degradation, and conflicts over resources (3). These challenges necessitate innovative approaches to ensure sustainable livestock production. Social, cultural, and institutional innovations can offer pathways to enhance pastoralism's sustainability, resilience, and productivity (2). This paper explores the dynamics of such innovations in Nigeria, highlighting their potential to transform pastoral systems and contribute to national food security and economic development.

MATERIAL AND METHODS

Study Location

The experiment was conducted at Nigerian institute of animal science (NIAS), center for innovation and training in animal husbandry, kabo, kano state. Kano State lies in the north-central part of Nigeria's northwest region with Latitude and Longitude: Approximately 11.5°N, 8.5°E. It is bordered by Jigawa State to the northeast, Katsina State to the northwest, Bauchi State to the southeast, and Kaduna State to the southwest (4). Agriculture in Kano State is one of Nigeria's major agricultural hubs.

Sampling Technique

Multistage sampling procedure was used in this study. At First Stage, Jigawa, and Kano state was purposely selected and Second stage, Dutse/Hadejia zone in Jigawa State and Kabo/Ajingi in Kano state were selected. While at second stage, 50 percent of the pastoralist participating in the livestock production were selected, given a total number of (100) Fulani in the area of the study.

Method of Data collection

The main source of data for this study is Primary which was collected from the field survey, using structured questionnaires and interviews. Primary data contained information like age, marital status, years of livestock rearing, and occupation.

Methods of Data analysis

Basically, descriptive statistics was used to analyse objectives of this study. This involves the use of percentages and frequency counts, presented in tabular forms. Descriptive statistics and Logit regression analysis were used to analyse the results. The Logit regression model was used to determine the challenges and opportunities face by pastoralist.

RESULT AND DISCUSSING

Socio Economic Characteristics of the Respondents

Age

Table 1 above shows that 21% of the respondents are females, while 79% of the respondents are males. Therefore, most of the respondents are males. Also, above shows that, 3% of the respondents are within the age bracket of 18-22 years of age, 7% of the respondent are within the age of 32-35 years of age, while 44% of the respondents are within the age of 27-31 years of age and 46% of the respondents are within the age of 23-26 years of age. Therefore, most of the respondents are within the age bracket of 23-26 years of age.

Marital Status

Table 1 above entails marital status of the respondents, were 6% of the respondents are either divorced or separated, 43% of the respondents are single and 51% of the respondents are married. This shows that, most of the respondents are married.

Educational Background

Table 1 above shows the educational background of the respondents. 4% of the respondents attend secondary education, 6% of the respondents attend tertiary education, and 21% attend primary education, while 69% attend Quranic education. This shows that, most of the respondents attend Quranic education with highest response.

Occupation

Table 1 above shows occupational status of the respondents. 0% of the respondents are crop farmer, 35% are crop/livestock farmers, and 65% of the respondents are livestock farmers. This shows that, most of the respondents are livestock farmers.

BACKGROUND ON PASTORALISM

How long have you been involved in pastoralism?

Table 2 above shows long of involved in pastoralism. 6% of the respondents has 21 and above years of pastoralism experience, 9% of the respondents are 16-20 years of pastoralism experience, 21% of the respondents with 11-15 years of pastoralism experience, while 28% of the respondents with 6-10 years of pastoralism experience and 36% of the respondents with 1-5 years of pastoralism experience. Therefore, most of the respondents has 1-5 years of pastoralism experience.

What is the primary reason for your involvement in pastoralism?

Table 2 above shows primary reason for involvement. 36% of the respondents are as a result of tradition, while 64% of the respondents are as a result of economic necessity. Therefore, most of the respondents their primary reason for involving in pastoralism.

Table 1 Distribution of Respondents based on Socio Economic Characteristics

Variables	Frequency	Percentage
Age		
18-22	3	3.0
23-26	46	46.0
27-31	44	44.0
32-35	7	7.0
Total	**100**	**100.0**
Marital status		
Single	43	43.0
Married	51	51.0
Divorced	6	6.0
Total	**100**	**100.0**
Educational background		
Quranic education	69	69.0
Primary education	21	21.0
Secondary education	4	4.0
Tertiary education	6	6.0
Total	**100**	**100.0**
Occupation		
Livestock famer	65	65.0
Crop farmer	0	0.0
Crop/livestock farmer	35	35.0
Total	**100**	**100.0**

Source; Author; Field survey, 2024

Table 2 Background on Pastoralism

Variable	Frequency	Percent
How long have you been involved in pastoralism?		
1-5	36	36.0
6-10	28	28.0
11-15	21	21.0
16-20	9	9.0
21 and above	6	6.0
Total	**100**	**100.0**
What is the primary reason for your involvement in pastoralism?		
Tradition	36	36.0
Economic necessity	64	64.0
Others	0	0.0
Total	**100**	**100.0**

Source; Author; Field survey, 2024

INSTITUTIONAL INNOVATIONS

Are there any local institutions (government or non-governmental) supporting pastoralism in your area?

Table 3 above shows local institutions supporting pastoralism. 47% said yes they are supported by local institutions e.g. Government and non-governmental, while 53% of the respondents are not supported. This shows that most of the respondents answer no.

If yes, what type of support do these institutions provide?

Table 3 above shows what type of support provided. 8% of the respondent supported by local institutions are supported legal support, 22% of the respondents are veterinary services, while 24% of them are

financially assisted and 46% of the respondents are train and educated. Therefore, most of the respondents answer yes are supported on training and education.

How effective do you find the support provided by these institutions?
Table 3 above shows how effective do you find the support provided by institutions. 5% of the respondents are ineffective, 23% of the respondents are very effective, while 24% of the respondents are neutral and 48% of the respondents are effective. Therefore, most of the respondents are effective.

What improvements would you suggest for institutional support systems?
Table 3 shows improvements suggest for institutional support system. 3% of the respondents are community empowerment and participation, 8% of the respondents are market access and economic opportunities, 14% of the respondents are conflict resolution mechanism, while 23% of the respondents are enhance education and training and 52% of the respondent's health and social services. Therefore, most of the respondents are health and social services.

Table 3: Institutional Innovations

Variables	Frequency	Percent
Are there any local institutions (government or non-governmental) supporting pastoralism in your area?		
Yes	47	47.0
No	53	53.0
Total	**100**	**100.0**
If yes, what type of support do these institutions provide?		
Financial assistance	24	24.0
Training and education	46	46.0
Veterinary services	22	22.0
Legal support	8	8.0
Others	0	0.0
Total	**100**	**100.0**
How effective do you find the support provided by these institutions?		
Very effective	23	23.0
Effective	48	48.0
Neutral	24	24.0
Ineffective	5	5.0
Total	**100**	**100.0**
What improvements would you suggest for institutional support systems?		
Enhance education and training	23	23.0
Market access and economic opportunities	8	8.0
Health and social services	52	52.0
Conflict resolution mechanism	14	14.0
Community empowerment and participation	3	3.0
Total	**100**	**100.0**

Source; Author; Field survey, 2024

CHALLENGES AND OPPORTUNITIES

What are the main challenges you face as a pastoralist?
Table 4 above shows the challenges face. 17% of the respondents face their challenge institutionally, 17% of the respondents face socially, while 27% of the respondents face environmentally and 39% of the respondents face economically. Therefore, most of the respondents face challenges economically.

What opportunities do you see for the future of pastoralism in your community?
Table 4 above shows opportunities of pastoralism in community. 13% of the respondents are research and education, 20% of the respondents are sustainable practice, while 25% of the respondents are climate resilient breeds and 42% of the respondents are technological advancement. Therefore, most of the respondents are technological advancement.

Table 4 Challenges and Opportunities

Variables	Frequency	Percent
What are the main challenges you face as a pastoralist?		
Economics	39	39.0
Environmental	27	27.0
Social	17	17.0
Institutional	17	17.0
Total	**100**	**100.0**
What opportunities do you see for the future of pastoralism in your community?		
Sustainable practice	20	20.0
Technological advancement	42	42.0
Climate resilient breeds	25	25.0
Research and education	13	13.0
Total	**100**	**100.0**

Source; Author; Field survey, 2024

CONCLUSION

The study highlights significant gender and age disparities among pastoralists, with a predominance of young males. Economic necessity drives their involvement in pastoralism. Institutional support, where available, is mostly effective, especially in training and education. However, a substantial number of respondents do not receive any support.

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Livestock Economics and Extension: LEE004

ANALYSIS OF THE DRIVERS OF POVERTY STATUS AND CONSTRAINTS TO BROILER PRODUCTION IN SABON GARI LOCAL GOVERNMENT AREA OF KADUNA STATE, NIGERIA

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ABSTRACT

This study investigated the Drivers of Poverty Status and Constraints to Broiler Production in Sabon Gari Local Government Area of Kaduna State, Nigeria. A sample of 162 broiler chicken producers was selected using a mixed-methods sampling approach, with data collected through structured questionnaires and analysed using descriptive statistics, FGT, and Tobit regression models. The poverty status estimation reveals that 65.8% of broiler producers are considered poor, emphasising the prevalence of poverty in the study area. Addressing constraints in broiler chicken production is crucial. The most significant constraint, affecting all respondents (100%), is the high cost and price instability of feed. Limited access to capital (63%), and insufficient water supply (59%), further restrict the ability of producers to scale their operations. Obtaining high-quality day-old chicks also presents a hurdle for 53% of producers, potentially impacting flock productivity and profitability. Interestingly, disease outbreaks were reported by a smaller percentage (34%), suggesting potential shortcomings in preventative measures, which could still pose a significant economic threat. It is concluded that overcoming identified constraints through policy interventions, such as credit provision, feed mill establishment, biosecurity training, extension services, and cooperative development, is crucial to maximising the poverty reduction potential of small-scale broiler production.

Keywords: Drivers, Constraints, Poverty Status, Broiler Chicken, Production

INTRODUCTION

poultry industry, particularly broiler production, is a vital economic sector, contributing significantly to GDP and employment ([10]). Small-scale farmers play a crucial role alongside larger commercial enterprises ([1]). Despite its potential for poverty reduction, many small-scale broiler producers face challenges hindering their success ([10]). Nigeria's broiler chicken industry, with its origins in the colonial era, has evolved into a substantial economic sector ([2]). Small-scale and large-scale producers collectively contribute significantly to the national economy. Despite robust industry growth and increasing domestic consumption, a complex interplay of factors impedes the sector's potential to alleviate poverty ([11]). Numerous challenges, including limited income, high input costs, and market instability, constrain the livelihoods of broiler farmers, particularly marginalised groups ([12, 4]). This study aims to identify drivers of poverty status and constraints to broiler production in Sabon Gari Local Government Area of Kaduna State, Nigeria.

METHODOLOGY

The study was conducted in Sabon Gari Local Government Area, Kaduna State, Nigeria, located between latitudes 11°9'50" N and longitudes 7°41'49" E of the equator, predominantly agrarian, with a growing population of 430,500 in 2022 ([9]); the region spans approximately 263 square kilometres ([3]). Characterised by a distinct wet and dry season, with rainfall ranging from 1000mm to 1300mm annually, the area experiences temperatures peaking at 35°C in April. The LGA's economy is predominantly agrarian, with crop cultivation, livestock rearing, including broiler production, and trade as primary occupations ([6, 13]).

A multi-stage sampling technique was employed to select a sample of 162 broiler producers from Sabon Gari Local Government Area. The study area was purposively selected based on its significant broiler production activities, followed by a random selection of wards and communities within those wards. The sample was determined using the Yamane formula, ensuring representativeness of the study population. The formula is given as follows:

$\mathbf{n} = \frac{\mathbf{N}}{\mathbf{1+N\ (\alpha)^2}}$ Where, n = Sample size, N = Population size (Sampling Frame) and e = Significance level (0.05), $n = \frac{278}{1+278*(0.05)^2}$=162

Table 1: Population and sample size of broiler Chicken Producers in the study area

LGA	Ward	Community	Sample frame	Sample size (58.2%)
Sabon Gari	Samaru	Ganga Uku	16	10
		Dan raka	20	14
		‘Yar dorawa	24	10
		Unguwan gwaiba	18	14
		Mangorori	28	11
		Area C	18	14
		Sub-total	**124**	**73**
	Dogarawa	Unguwan gwarzo	18	10
		Gwanda	26	10
		Zangon Dan Barno	16	10
		Sakadadi	18	11
		Sub-total	**78**	**41**
	Basawa	Unguwan rimi	20	13
		Palladan	16	12
		Layin zomo	22	10
		Dufa-dufa	18	13
		Sub-total	**76**	**48**
		Grand total	**278**	**162**

**Reconnaissance survey, 2022*

Primary data was collected from small-scale broiler producers using structured questionnaires. Information on socio-economic characteristics, production practices, and constraints was gathered. Data was collected for the period 2021-2022.

Descriptive statistics, Foster-Greer-Thorbecke (FGT), and Tobit regression analysis were employed for data analysis. Tobit regression, a model suitable for censored data, was used to determine factors influencing poverty status among broiler producers. Tobit regression, a hybrid of discrete and continuous models, addresses censored data where the dependent variable is observed only for positive values, extending the probit model to account for such data limitations ([14, 7]). The Tobit regression is based on the following model:

$$S_{ik}^* = a_{ik}F_{ik} + E_{ik} \ldots \quad (1)$$

$$S_{ik}^* = \begin{cases} if\ S_{ik}^* \geq 1 \\ if\ S_{ik}^* < 0 \end{cases} \ldots \quad (2)$$

$$S_{ik}^* = Q_0 + Q_1 Z_1 + Q_2Z_2 + Q_3Z_3 + Q_nZ_n + \cdots + e_{ij} \ldots \quad (3)$$

$$y = 0\ if\ Y_i^* < 0 \ldots \quad (4)$$

$$y = Y_i\ if\ Y_i^* \geq 0 \ldots \quad (5)$$

$$Y_i^* = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \cdots + \beta_{11}X_{11} + e \ldots \quad (6)$$

$$i = 1,2, \ldots ,11$$

Where Z_1 to Z_n be the independent variables in the Tobit regression model, Q_0 to Q_n are the parameters estimated for each variable, e_i Is the error term., S_{ik}^* Is the dependent variable (index).
Foster-Greer-Thorbecke was used to determine the poverty status of broiler chicken producers. The model is specified as:

$$P_\alpha = \frac{1}{N}\sum_{i=1}^{Hi}\left(\frac{Z-Y_i}{Z}\right)^\alpha \quad (7)$$

$$P_0 = \frac{H_O}{N} \quad (8)$$

$$P_1 = \frac{1}{N}\sum_{i=1}^{Hi}\left(\frac{Z-Y}{Z}\right) \quad (9)$$

$$P_2 = \frac{1}{N}\sum_{i=2}^{Hi}\left(\frac{Z-Y}{Z}\right)^2 \quad (10)$$

The FGT poverty index, parameterised by α, measures the severity of poverty. When α equals 0, 1, or 2, it represents the headcount ratio, poverty depth, and poverty severity, respectively. A higher α value indicates greater aversion to poverty. N= No. of Respondents, Hi = head count of the poor (number of poor households), *Yi* = per capita annual income in Naira, Z = poverty line using 2/3 of the mean per capita annual income of broiler chicken producers in the study areas.

PCFI = TFI/HHS………………………………………………………………………………... (11)
MPCFI = TFI /TNR ……………………………………………………………………………. (12)
PL = 2/3 * MPCI………………………………………………………………………………… (13)
Where: PCFI = Per Capita Annual Income
TFI = Total Income
HHS = Household Size
MPCFI = Mean Per Capita Annual Income
TNR = Total Number of Respondent

The poverty line was placed at the two-thirds mean per capita annual income of respondents, as adopted by ([5]) and the World ([15]). Those earning above two-thirds of the mean per capita annual income, specifically above ₦133,813.7 per production cycle, were classified as non-poor. Conversely, individuals earning below this threshold were categorized as poor.

RESULTS AND DISCUSSION

Poverty Status of Broiler chicken Producers
Table 2 reveals a high prevalence of poverty among broiler producers, with 65.8% of respondents falling below the poverty line of ₦133,813.73 per production cycle.

The study reveals a high incidence of poverty among broiler producers, indicating the sector's limited capacity to uplift farmers from economic hardship. Despite the sector's potential for income generation, a significant proportion of producers remain below the poverty line. The depth of poverty, as measured by the poverty gap index, is substantial, highlighting the urgent need for targeted interventions to improve the economic well-being of broiler producers.

Estimate of the Determinants of Poverty Status in the Study Area
The regression model, as presented in Table 3, demonstrates a significant relationship between poverty status and several socio-economic factors among broiler producers. Key determinants of poverty include years of schooling, experience, labor, membership in a cooperative, household size, and feed costs, which exhibit varying levels of statistical significance.

Table 2: Estimation of the poverty status of broiler chicken producers

Poverty Category	Frequency	Percentage
Non-Poor	55	34.2
Poor	107	65.8
Total	**162**	**100**
FGT Poverty Indices		
Poverty Incidence (Po)	0.658	
Poverty Depth (P_1)	0.324	
Poverty Severity (P_2)	0.211	
Poverty Lines:		
MPCFI = ₦ 200, 720.60 Per one production cycle		
2/3*(MPCFI) = ₦ 133, 813.73 Per one production cycle		

Household size was found to be positively correlated with poverty status among broiler producers. A larger household size was associated with a 0.046 increase in poverty reduction, suggesting that larger households may be better equipped to manage economic challenges. Education level negatively influences poverty status among broiler producers. While higher education may offer alternative income sources, its negative association with poverty status suggests the need for further exploration of the complex interplay between education and livelihood diversification in this sector. Years of farming experience negatively correlates with poverty status among broiler producers. This suggests that while experience is valuable, it may also hinder the adoption of new technologies and practices, limiting income growth and poverty status potential. The results indicate that each additional year of experience decreases the likelihood of escaping poverty.

Table 3: Estimate of the determinants of poverty status in the study area

Variable	Coefficient	Std. Error	T-value	Marginal effect
Constant	0.6827418	0.328468	2.08	
Age	0.006067	0.00156	3.89	0.0600
Marital status	-0.01951	0.01894	-1.03	-0.0165
Household Size	0.0308278**	0.0194925	1.58	0.03821
Year of Schooling	-0.0347087***	0.00584	-5.95	-0.02847
Experience	-0.02328***	0.0186273	-5.21	-0.053
Association	0.1233935**	0.05254	2.35	0.7234
Flock size	0.000141	0.0001	1.47	0.0089
Labour	-4.59E-06***	0	-2.91	-4.09E-06
Feed cost	2.83E-07*	0	1.95	2.03E-07
Output	7.84E-09	0	0.52	4.84E-09
Sigma	0.023761	0.002286		
Log likelihood	79.9370			
LR chi^2 (10)	57.56			
Prob> chi^2	0.0000			
Pseudo R^2	-0.57005			

*Note: The asterisks ***, ** and * denote statistical significance at probability of 1%, 5%, 10%*

The study found that longer membership duration correlates with lower poverty status. This suggests cooperatives contribute to poverty reduction by providing access to resources, enhancing social capital, and fostering entrepreneurial skills. Labour input is negatively associated with poverty among broiler producers, indicating that its marginal impact on poverty status is relatively small. Strategic investments in labour-intensive activities may contribute to broader economic growth and poverty alleviation within the agricultural sector. Marital status negatively correlates with poverty among broiler producers, contrary to expectations. Married farmers exhibit lower poverty rates, potentially due to shared responsibilities, social support, and increased economic opportunities. Feed costs were found to be positively correlated with

poverty status among broiler producers. While counterintuitive, this relationship may reflect the impact of higher feed costs on increased production and subsequent income generation.

Constraints in Broiler Chicken Production

The findings of this study underscore the complex challenges confronting broiler producers in the study area. The identified constraints, including high feed costs, price instability, inadequate access to capital and water resources, and concerns over chick quality and disease outbreaks, collectively impede the sector's profitability and sustainability. These challenges collectively hinder production efficiency, profitability, and overall farm sustainability.

Table 5: Distribution of constraints associated with Broiler chicken production

Constraints	Frequency	Percentage	Rank
High mortality rate	24	20.0	9th
Disease outbreak	41	34.1	7th
Poor quality DOC	64	53.3	5th
Inadequate capital	76	63.3	2nd
High cost of feed	120	100.0	1st
High cost of drugs and vaccines	4	3.3	10th
High cost of labour	2	1.6	11th
Price instability	120	100.0	1st
Seasonality in demand and supply	70	58.3	4th
Lack of training	47	39.1	6th
Lack of association	37	30.8	8th
Inadequate water supply	71	59.1	3rd

Multiple responses allowed.

CONCLUSION AND RECOMMENDATIONS

The study concludes that realising the full potential of small-scale broiler production for poverty reduction necessitates addressing key obstacles through government-backed financing, local feed mill establishment, biosecurity training, strengthened extension services, and cooperative promotion.

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Monogastric Animal Production: MGP 001

NUTRIENT DETERMINATION OF CASSAVA PLANT MEAL

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ABSTRACT

The study assessed the nutrient profile in composite Cassava Plant Meal (CPM) with a view to enhancing its efficiency through bio-fortification. Three CPM products were developed from Tropical *Manihot* Species (TMS) 30572 harvested at 24 months. The sun-dried unpeeled cassava root meal, cassava leaf meal and tender cassava stem meal were mixed at ratios 2:1, 2.5:1 and 3:1 while the ratio of the leaves to tender stems was 5:1 across the three cassava plant meal products. The proximate composition, minerals, amino acids and vitamins contents of CPM and maize were determined. Results of proximate contents showed that CPM products had comparable crude protein and nitrogen free extract as maize. CPM products showed superiority (p <0.05) in calcium content over maize meal though maize meal was significantly higher (p <0.05) in phosphorus content compared to the three CPM products. All evaluated parameters of amino acids showed differences (p<0.05) although methionine contents were lower in all CPM products and maize. CPM products had significantly (p <0.05) higher values than maize in all evaluated vitamin contents. Based on the findings of this study, it can be concluded that CPM products had comparable nutrient profile as maize with CPM product 1 comparatively better in all evaluated nutrient profile.

Key words: Cassava plant meals, TMS 30572, maize, nutrients.

DESCRIPTION OF PROBLEM

Improving livestock productivity especially poultry and swine production require adequate supply of low-cost feeding ingredients. The cost of feeding has been reported to be 65 – 80 % of the total cost of production [1] with maize constituting 40 – 60 % of a balanced maize-soy based diet for poultry and swine. However, the seasonal feed deficit, ever rising cost of feeding ingredients and competition with human food consumption have consistently driven efforts towards the use of alternative dietary energy feed resources for monogastrics [2]. One of such alternative dietary energy feedstuff is cassava. Cassava and its components have enjoyed widespread patronage as potential energy source for animal production in Nigeria. It is cheap, widely grown with a yearly tuber production of 63.031 million tons and grows at an annual rate of + 4.0 %; the largest in the world [3]. However, after harvesting the value-giving component, substantial proportion of the co-products (leaves and tender stems) are allowed to rot on farms and homesteads [4]. The incorporation of these cassava fractions to form composite cassava plant meal (unpeeled cassava tuber meal + cassava leaves and tender cassava stem meal) had been shown by previous studies to enhance performance of pigs [5, 6] and poultry [7, 8]. Similarly, studies have reported detailed information on the efficiency and nutrient profile of cassava flour [9, 10] or leaves or peels [11] and its acceptability as energy source for livestock. Nevertheless, the detailed nutrient profile of CPM has not been widely documented. Detailed information on feed resource could support sustainable livestock production and offer wider feed options in livestock production system [12]. The research was carried out to characterise the nutrients in cassava plant meal with a view to enhancing its efficiency through bio-fortification.

MATERIALS AND METHODS

Experimental location and preparation of test ingredients

The experiment was carried out at the Poultry Meat Laboratory of the Department of Animal Sciences Obafemi Awolowo University, Ile-Ife and the Laboratory of Animal Science, University of Ibadan, Ibadan. The cassava variety of Tropical *Manihot* Species (TMS) 30572 aged 24 months were purchased from a commercial farm at Ile-Ife. The roots were lifted and soil was shaken off the roots while the cassava leaves were harvested from the plant stem and the tender stems were harvested at 5 cm, usually 6 to 7 nodes from the top of the plant. All the cassava components were harvested between June and November 2018. The fresh roots (unpeeled cassava root) were washed and chopped into small pieces, sun-dried on a concrete floor for an average of 5 – 6 days depending on the intensity of the sunlight, milled with 3 mm sieve mesh and packed into sacks. Also, the fresh cassava leaves and tender stems were sun-dried for about 3-4 days and about 5 days respectively after harvesting, milled and packed into separate sacks. The composite cassava plant meal products were mixed in line with the procedure of Akinfala *et al.* [7] at three different ratios of 2:1, 2.5:1 and 3:1 represented as products 1, 2 and 3 respectively. The mixing ratio was in attempt to have comparable minimum crude protein content of 10 % as maize.

Nutrient determination

The nutrients determined in the cassava plant meal products include amino acids (essential and non-essential amino acids), vitamins (fat and water soluble vitamins) and minerals (calcium, phosphorus, zinc and copper). The fat soluble vitamins were determined following the procedure outlined by Adams and Moss [13] while the water soluble vitamins were determined by the spectrophotometric method. The amino acid profile was carried out using the spectrophotometric determination of Ninhydrin chemical reaction. Mineral (Ca, P, Zn and Cu) contents and proximate composition were determined following the methods of AOAC [14].

RESULTS AND DISCUSSION

Proximate composition of maize and cassava plant meal products

The three cassava plant meal (CPM) products had comparable values with maize in the crude protein, ether and nitrogen free extracts (Table 1). Although, significant difference (p <0.05) exists in the values obtained for the crude fibre and ash with maize having the lowest values while CPM product 1 had the highest. The ash content of the CPM products decreases with increased inclusion of unpeeled cassava root meal in the mix.

Table 1: Proximate composition of maize and cassava plant meal products

Proximate Composition (%)	Maize	CPM1	CPM2	CPM3	SEM	*p*
Dry Matter	88.05	90.18	90.17	90.06	0.36	0.15
Crude Protein	10.38	12.62	12.25	12.51	0.56	0.24
Crude Fibre	2.57^{d}	8.05^{a}	4.69^{c}	6.81^{b}	0.79	0.01
Ash	2.82^{c}	6.69^{a}	6.53^{a}	6.15^{b}	0.60	0.01
Ether Extract	4.53	5.38	3.12	3.33	0.37	0.30
Nitrogen Free Extract	67.75	57.44	63.58	61.26	0.07	0.28

^{a,b,c,d} *means in the same row having different superscripts differ at p <0.05; SEM: Standard Error of Means*

CPM Product 1 contained sun dried unpeeled cassava tuber meal + cassava leaf meal + tender cassava stem meal mixed at a ratio of 2:1 while the ratio of the leaves to tender cassava stems was 5:1 while CPM Products 2 and 3 contained the same components but mixed at ratios 2.5:1 and 3:1 respectively.

Mineral composition of maize and cassava plant meal products

The mineral contents of maize and cassava plant meal is shown in Table 2. The CPM products have significantly (p <0.05) higher values than maize for calcium but the values obtained for phosphorus content of CPM were lower than maize. The calcium and phosphorus contents of CPM increased significantly (p

<0.05) across products 1 through 3. Lower calcium values (1.93 ppm and 0.28 ppm) were reported by Akinfala *et al.* [8] who determined the mineral contents of CPM product 2 and maize. The minerals (zinc and copper) composition of CPM was comparable with maize. The variations observed in the mineral composition of CPM and maize may be due to variations in their ash and fibre contents.

Table 2: Mineral composition of maize and cassava plant meal products

Minerals	Maize	CPM1	CPM2	CPM3	SEM	*P*
Calcium (%)	0.055^{b}	0.302^{a}	0.411^{a}	0.433^{a}	0.08	0.021
Copper (g/Kg)	0.018	0.025	0.022	0.024	0.03	1.00
Phosphorus (%)	0.512^{a}	0.104^{b}	0.120^{b}	0.121^{b}	0.079	0.001
Zinc (g/Kg)	0.120	0.122	0.117	0.122	0.003	0.16

means having different superscript in a row differ significantly (p <0.05)

Amino acid composition of maize and cassava plant meal products

Significant differences (p <0.05) exist in all evaluated amino acid contents of maize and except tryptophan CPM (Table 3). There was a steady decrease in the amino acid contents of CPM products from CPM 1 through 3. This may be due to the increasing levels of unpeeled cassava root meal across CPM 1 through 3. Unsurprisingly, CPM products and maize had lower tryptophan, methionine and cystine contents, which followed a decreasing order from CPM 1 through 3. The lower contents observed for these corroborates the findings of earlier reports [15] that plant-based diets are poor sources of methionine, cystine and tryptophan and should be adequately supplied in diets for poultry and pigs for feed efficiency and growth.

Table 3: Amino acid composition of maize and cassava plant meal products

Parameters (g/100 g)	Maize	CPM 1	CPM2	CPM 3	SEM	*p*
Leucine	8.23^{a}	7.59^{ab}	7.18^{b}	6.59^{b}	0.22	0.03
Lysine	4.14^{b}	4.61^{a}	4.35^{ab}	4.08^{b}	0.07	0.01
Isoleucine	3.08^{b}	3.80^{a}	3.54^{a}	3.14^{b}	0.10	0.007
Phenylalanine	4.43^{b}	4.97^{a}	4.61^{b}	3.90^{c}	0.12	0.001
Tryptophan	0.89	1.00	0.89	0.73	0.34	0.56
Valine	3.80^{b}	4.21^{a}	3.97^{ab}	3.27^{c}	0.12	0.003
Methionine	1.23^{a}	1.28^{a}	1.20^{a}	0.96^{b}	0.04	0.08
Proline	4.47^{a}	4.87^{a}	4.06^{b}	3.65^{c}	0.15	0.001
Arginine	5.68^{b}	6.19^{a}	5.50^{b}	5.16^{b}	0.14	0.02
Tyrosine	3.44^{ab}	3.61^{a}	3.44^{ab}	3.10^{b}	0.07	0.04
Histidine	2.68^{b}	2.87^{a}	2.49^{c}	1.98^{d}	0.10	0.001
Cystine	1.33^{a}	1.45^{a}	1.39^{a}	0.97^{b}	0.06	0.01
Alanine	4.32^{b}	5.23^{a}	4.93^{a}	3.72^{c}	0.18	0.001
Glutamic acid	13.32^{c}	14.53^{a}	14.08^{b}	12.87^{d}	0.20	0.001
Glycine	3.37^{b}	3.70^{a}	3.61^{a}	3.04^{c}	0.08	0.001
Threonine	3.22^{c}	3.77^{a}	3.55^{b}	2.94^{d}	0.09	0.001
Serine	3.78^{c}	4.43^{a}	4.05^{b}	3.89^{bc}	0.08	0.001
Aspartic acid	7.38^{c}	8.56^{a}	7.94^{b}	7.07^{d}	0.17	0.001

means having different superscript in a row differ significantly (p <0.05)

Vitamin composition of maize and cassava plant meal products

The values obtained for CPM products 1 and 3 were higher (p<0.05) in all evaluated vitamin contents compared to CPM 2 and maize. The CPM 1 showed superiority over maize and other CPM products in all evaluated parameters. CPM products have the most significantly higher values of vitamins A (retinol) and niacin. The lower values of vitamin contents reported in this study could be due to the large proportion of cassava root contained in the composite mix. Similar findings of lower values were reported by Bayata [16] and Salvador *et al.* [17] who evaluated the contents of whole cassava root, unpeeled cassava root meal and cassava root meal respectively.

Table 4: Vitamins composition of maize and cassava plant meal products

Vitamins	Maize	CPM1	CPM2	CPM3	SEM	*p*
A (µg/100g)	11.40[d]	15.17[a]	13.28[c]	14.40[b]	0.53	<0.001
D (µg/100g)	0.17[d]	0.29[a]	0.25[c]	0.26[b]	0.016	<0.001
E (µg/100g)	0.13[d]	0.19[a]	0.15[c]	0.16[b]	0.007	<0.001
K (µg/100g)	0.09[d]	0.12[a]	0.10[c]	0.11[b]	0.003	<0.001
C (mg/100g)	0.10[d]	0.18[a]	0.15[c]	0.17[b]	0.012	<0.001
Thiamin (mg/100g)	0.21[d]	0.24[a]	0.22[c]	0.23[b]	0.003	0.01
Riboflavin (mg/100g)	0.07[d]	0.10[a]	0.08[C]	0.09[b]	0.003	0.01
Niacin (mg/100g)	2.06[d]	2.28[a]	2.10[c]	2.17[b]	0.03	0.011
Pyridoxine (mg/100g)	0.29[c]	0.31[a]	0.30[b]	0.30[b]	0.003	0.002
Folate (mg/100g)	0.10[c]	0.12[a]	0.10[c]	0.11[b]	0.002	0.038
Cobalamin (mg/100g)	0.012[d]	0.028[a]	0.017[c]	0.022[b]	0.002	0.027

means having different superscript in a row differ significantly (p <0.05)

CONCLUSION AND APPLICATION

Based on the findings of this study, it can be concluded that cassava plant meal products had comparable nutrient profile as maize with CPM product 1 comparatively better in all evaluated nutrient profile. It is therefore recommended that CPM be supplemented with ample quantity of phosphorus and methionine to enhance desirable performance of livestock.

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Monogastric Animal Production: MGP 002

PERFORMANCE, CARCASS EVALUATION AND ECONOMY OF BROILERS FED DRIED GROUNDNUT HUSK MEAL SUPPLEMENTED WITH HEMICELLULASE AND ORGANIC ACID

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ABSTRACT

A total number of 90 ROSS 308 broiler chickens of a old age were allotted to five dietary treatments having three replicates of 6 birds each in a completely randomized design, to assess growth performance, economics of production and carcass characteristics of broilers fed diets substituted with dried groundnut husk meal (DGHM) and supplemented with hemicellulase and organic acid. Five experimental finisher diets were formulated which replaced maize at 0% (control, T1), 5% DGHM (T2), 10% DGHM (T3), 15% DGHM (T4) and 20% DGHM (T5). Results showed no effect on final weight, feed Intake and FCR (P>0.05). Body weight gain of birds fed the supplemented diets was not significantly different (P>0.05) from T1 except for birds fed T4 which significantly reduced (P<0.05) when compared to birds on T1. The results showed that the dressing percentage improved (P<0.05) for T2, T3 and T4. However, there was evidence that the cut parts and organ weight showed significant differences (P<0.05). Birds on T2 had a bigger back size compared to the control (P<0.05) while birds on T2, T3 and T4 had a smaller spleen compared to the control (P<0.05). The cost of feed and production reduced (P<0.05) across all treatments. Revenue and gross profit of the birds fed DGHM did not differ from the birds fed with T1. Therefore, dried groundnut husk meal supplemented with hemicellulase and organic acid can be substituted up to 20% with maize in practical broiler diet without detrimental effects on broilers' growth performance and also for profit maximization.

Keywords: Dried Groundnut husk meal, hemicellulase, organic acid, carcass, cost indices

DESCRIPTION OF PROBLEM

Nigeria is third among the producers of groundnut in the world producing large quantities of groundnut husk (GH) as a by-product of the processing of groundnut. Unfortunately, GH is underutilized and it contains a remarkable amount of crude protein, fibre, calcium, phosphorus and other nutrients. Groundnut is considered fibrous since it contains about 10% crude fibre (CF), multiple skin and shell residue (1). Groundnut husk can be used as a replacement ingredient which could lead to a reduction in the feeding cost of birds. However, little or no research has been carried out on using GH supplemented with hemicellulase and organic acid (OA). The limiting factor for its use in rations was the high CF content because poultry cannot digest CF (2). Exogenous non-starch enzymes are an important component of poultry diet, they improve the digestibility of feed, reduce environmental pollution, and reduce the cost of production which in turn leads to an increase in the safety and productivity of poultry (3). Hemicellulase belongs to the enzymatic family of glycoside hydrolyses, it breaks the bond of glucose and polymers present in plant fiber with water molecules, this reaction leads to hydrolysis of hemicellulose, which facilitates the digestion of carbohydrates to release energy. Legumes have NSPs like hemicellulose, mannan, and raffinose (4). Enzyme supplementation is considered to break the bond among NSPs and result in improved nutritional value of feed materials (4). Use of OAs to replace antibiotics is a new trend in poultry nutrition and it supports the growth of broilers and has been reported to exhibit antimicrobial activities (5). Hence the objective of this study is to evaluate the

growth performance, carcass characteristics and cost indices of broiler chickens fed dried groundnut husk meal supplemented with hemicellulase and organic acids.

MATERIALS AND METHODS

The study was conducted at the Faculty of Agriculture and Agricultural Technology Research Farms, Benson Idahosa University, Benin City, Edo State. Groundnut husk used for this study was obtained from different farms in Abuja where the husks were indiscriminately dumped after removing the groundnut seed. The GH was sundried for three days before milling. They were ground through a 2-mm screen using a hammer mill and chemically analyzed (Table 1) for diet formulation.

Table 1. Gross composition of broiler finisher diet

Ingredients	D1 (control)	D2 (5%DGH)	D3 (10%DGH)	D4 (15%DGH)	D5 (20%DGH)
Maize	55.10	52.34	49.59	46.85	44.08
DriedGroundunt Husk	0.00	2.76	5.51	8.25	11.02
Wheat offal	4.50	3.70	3.70	3.70	3.70
Fish meal	11.50	11.50	11.50	11.50	11.50
Soya Oil	10.00	10.00	10.00	10.00	10.00
Soyabean meal	15.00	15.00	15.00	15.00	15.00
Vit. Premix	0.20	0.20	0.20	0.20	0.20
Limestone	0.20	0.10	0.10	0.10	0.10
Dicalcium phosphate	0.25	0.15	0.15	0.15	0.15
Hemicellulase	0.00	1.00	1.00	1.00	1.00
Titanium dioxide	2.50	2.50	2.50	2.50	2.50
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Calculated Nutrients					
DM	46.84	47.74	49.36	50.98	52.61
ME Kcal/Kg	3181.10	3133.00	3103.57	3074.24	3044.59
CP	21.18	20.97	20.90	20.83	20.77
Ash	3.83	3.87	3.95	4.03	4.11
CF	3.06	3.95	4.92	5.88	6.85
EE	3.84	3.72	3.65	3.57	3.50
NFE	68.08	67.49	66.59	65.69	64.78

[1]*Composition of vitamin premix per kg of diet: vitamin A, 12500 I.U; vitamin E, 40mg; vitamin K , 2mg; vitamin B1, 3mg; vitamin B2, 5.5mg; niacin, 5.5mg; calcium pantothenate, 11.5mg; vitamin B6, 5mg; vitamin B12, 0.025mg;choline chloride, 500mg, folic acid,1mg; biotin, 0.08mg; manganese, 120mg;iron 100mg; zinc, 80mg; copper, 8.5mg; iodine, 1.5mg; cobalt, 0.3mg;selenium, 0.12mg, anti-oxidant, 120mg,*
All diets were formulated to meet or exceed (6) nutrient requirements for broilers. Birds were group weighed by pen, and feed intake and BWG was determined weekly.

Experimental animals, feeding and management

A total of 90-day-old ROSS 308 broiler chicks were obtained and grown over 46 days. The animals were adapted for one week before the commencement of the experiment. Experimental animals were randomly

allotted to five dietary treatments with five replicates each and six animals per replicate. Dried groundnut husk meal partially replaced maize in the control diet. Hemicellulase and citric acid (added to the drinking water of birds on T2, T3, T4 and T5 at the inclusion rate of 1g citric acid to 1liter of water). Birds were slaughtered on day 46 and carcass evaluation was obtained.

Feed cost analysis: The market cost of feedstuff during the study was used to calculate the total cost of feed, cost of feed per kg and cost per kg live weight.

Evaluation of Carcass Quality: At the end of the 46-day feeding trial, 3 birds per replicate were randomly selected with their live weights taken before carcass evaluation after fasting them for 16 hours. The birds were slaughtered and their internal contents were neatly removed and weighed (evisceration) followed by the cutting of the carcass into retail parts and weighed. Dressed weight was recorded after evisceration. The weights were expressed as percentages of dressed weight.

RESULTS AND DISCUSSION

The results of the proximate composition of groundnut husk meal (DGHM) were Dry matter 93%; ME(Kcal/kg) 2129.68; Protein 7.50%; Ash 4.2%; Crude Fibre 37.8% and Ether Extract1.31%. The nutrient (proximate) compositions of the diets were adequate and within the recommended range for broiler finishers as reported by (7).

Table 2. Performance of broiler finisher fed dried groundnut husk meal supplemented with hemicellulase and organic acid

Parameters (Av.wt./b)	T1 (control)	T2 (5%DGH)	T3 (10%DGH)	T4 (15%DGH)	T5 (20%DGH)	SEM
Initial Weight	0.146^{a}	0.146^{a}	0.156^{ab}	0.160^{b}	0.157^{ab}	0.002
Final weight	2.276	2.185	2.230	2.107	2.274	0.036
BWG	2.136^{b}	2.039^{ab}	2.074^{ab}	1.947^{a}	2.117^{b}	0.005
Feed Intake	0.342	0.313	0.351	0.273	0.343	0.024
FCR (feed:gain)	1.813	1.394	1.079	2.339	1.120	0.335

^{abc} Means in the same column without superscript in common are different at P<0.05. BWG: Body weight gain

Overall, (d 1 to d 46) average final weight, feed intake and FCR were not altered by DGHM and supplementation of hemicellulase (Table 2), suggesting that moderate levels (i.e. 20%) of DGHM had no adverse effect on broiler growth performance. Body weight gain (BWG) of birds fed the supplemented diets were not significantly different (P>0.05) from T1 except for birds on T4 which significantly reduced (P<0.05) when compared with birds on T1. According to (8) weight gain was influenced by the amount of ration consumed and the quality of the ration. Added by (9) BWG was influenced by the amount of ration consumed by broilers. The findings of the experiment were also in line with the report of (10) who reported that birds given diets with combination of organic acid and hemicellulose improved weight gain resulting in better economics (2).

Live weight and dressed weight of birds were similar (P<0.05) across all the treatment means. Dressing percentage (DP) of birds increased significantly for birds fed 5%, 10% and 15% DGHM. This may be associated with the beneficial effect of enzyme and organic acid activity. This work agrees with (10) reported that the DP was improved when it was supplemented with organic acid and enzymes. However, there was evidence that the cut parts and organ weight showed significant differences (P<0.05). Birds on T2 had a bigger back size (P<0.05) while birds on T2, T3 and T4 had a smaller spleen also when compared with the control (P<0.05). The organ weights obtained were in agreement with those reported by (11) who confirmed that there were no gross morphological changes in the organs of birds fed DGHM supplemented with hemicellulase and organic acid.

Result of economics of production (Table 4) revealed that cost of feed and COP significantly decreased (P<0.05) across the treatments.

Table 3. Carcass characteristics of broiler finisher fed dried groundnut husk meal supplemented with hemicellulase and organic acid

Parameters kg/b	T1 (control)	T2 (5%DGH)	T3 (10%DGH)	T4 (15%DGH)	T5 (20%DGH)	SEM
Live wt	2.276	2.184	2.230	2.107	2.274	0.037
Dressed Wt	1.381	1.495	1.425	1.461	1.398	0.086
Dressing percentage(%)	60.576[a]	68.526[b]	64.206[b]	67.933[b]	60.891[a]	3.418
Cut Parts						
Breast	0.529	0.485	0.463	0.515	0.513	0.026
Drumstick	0.252	0.238	0.226	0.237	0.220	0.006
Thigh	0.215	0.213	0.242	0.227	0.190	0.009
Back	0.290[ab]	0.355[a]	0.341[ab]	0.312[ab]	0.272[b]	0.013
Wing	0.247	0.170	0.174	0.177	0.198	0.015
Shank	0.096	0.094	0.091	0.074	0.071	0.005
Neck	0.201	0.088	0.800	0.230	0.917	0.037
Organ						
GIT	0.111	0.110	0.097	0.223	0.102	0.024
Liver	0.043	0.037	0.040	0.037	0.040	0.001
Spleen	0.003[a]	0.002[b]	0.002[bc]	0.002[bc]	0.003[ab]	0.0002
Heart	0.011[a]	0.010[ab]	0.010[ab]	0.009[b]	0.009[b]	0.0003
Pancrease	0.004	0.005	0.006	0.005	0.005	0.0003
Gizzard	0.055	0.507	0.050	0.051	0.490	0.001
Abdominal fat	0.023	0.009	0.025	0.045	0.021	0.006

[abc] Means in the same column without superscript in common are different at P<0.05. BWG: Body weight gain

Table 4. Cost indices of broiler finisher fed dried groundnut husk supplemented with hemicellulase and organic acid

Parameters	T1 (control)	T2 (5%DGH)	T3 (10%DGH)	T4 (15%DGH)	T5 (20%DGH)	SEM
Feed Intake(kg)	0.343	0.313	0.273	0.351	0.343	0.022
Cost of feed(₦kg)	429.10[a]	419.44[b]	413.17[c]	401.26[d]	392.22[e]	3.535
CFC	146.97	131.24	112.92	140.68	134.65	8.882
BWG/b	2.130[b]	2.038[ab]	2.074[ab]	1.947[a]	2.117[b]	0.005
Feed Cost/BWG	116.95[ab]	93.24[ab]	105.16[ab]	68.73[a]	138.91[b]	10.796
COP	6829.10[a]	6819.44[b]	6813.17[c]	6801.26[d]	6792.22[e]	3.535
Av. Final Weight	2.276	2.185	2.230	2.107	2.274	0.036
Revenue (₦kg)	7966.00	7646.33	7805.00	7627.93	7959.00	104.744
Grossprofit (₦kg)	1136.90	826.89	991.83	826.67	1166.78	104.779

[abc] Means in the same column without superscript in common are different at P<0.05. BWG: Body wt gain CFC: Cost of feed consumed. CFP: Cost of Production

This result agrees with (12) who advised the use of agro-industrial by-products with the inclusion of enzyme and organic acid for the sole purpose of reducing the cost of production which constitutes 60- 70% of the total cost. Revenue and gross profit were not significantly (P>0.05) different for all the treatments.

CONCLUSION

The results showed that feeding DGHM supplemented with hemicellulase and organic acid had no adverse effect on broiler performance and carcass characteristics. Therefore it can be used to replace maize, as a source of protein and fiber in broiler diets.

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Monogastric Animal Production: MGP 003

HAEMATOLOGY AND MICROBIAL ACTIVITIES OF BROILER FINISHERS FED DRIED GROUNDNUT HUSK MEAL SUPPLEMENTED WITH HEMICELLULASE AND ORGANIC ACID

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ABSTRACT

A total of 90 one-day old ROSS 308 broiler chickens were allotted to five dietary treatments having three replicates of six (6) birds each in a completely randomized design, to assess haematology and microbial activities of broilers fed diets substituted with dried groundnut husk meal (DGHM) and supplemented with hemicellulase and organic acid. Five experimental finisher diets were formulated which replaced maize at 0% (control, T1), 5% DGHM (T2), 10% DGHM (T3), 15% DGHM (T4) and 20% DGHM (T5). Results on haematological parameters were observed to be significantly ($P<0.05$) different. Results for packed cell volume (PCV), Mean corpusular haemoglobin (MCH), haemoglobin and lymphocytes % were highest ($P<0.05$) for birds on T5. Red blood cell (RBC) was similar for the control and T4 while the lowest was seen on T2. Mean corpuscular haemoglobin concentration (MCHC), mean corpuscular volume (MCV) and white blood cell (WBC) were not significantly ($P>0.05$) different in all treatments. Granulocytes (GRA) and lymphocytes count (LYM) on T5 were observed to be similar with the control (T1). Monocytes % and Monocytes count (MON) on T4 were also not significantly different from T1. All parameters used to determine microbial activities which include nutrient agar, macConkey agar, eosin methylene agar and salmonella agar showed no significant difference ($P>0.05$) among the different treatments. In conclusion, dried groundnut husk meal supplemented with hemicellulase and organic acid can replace maize at 20% by improving haemotological parameters as well as microbial activities of broiler chickens.

Keywords: Haematology, microbial activity, dried groundnut husk meal, hemicellulase, organic acid

DESCRIPTION OF PROBLEM

In poultry nutrition, optimizing feed formulations to enhance growth performance and overall health is paramount. Dried groundnut husk meal (DGHM) is an uncommon ingredient in poultry diets due to its high fibre content, but its inclusion can affect nutrient utilization and impact hematological parameters (1). Hemicellulase, an enzyme that the breakdown of high fibre content in combination with organic acid which is often supplemented in poultry diets to reduce microbial loads in the GIT of broilers. However, the combined effects of hemicellulase and organic acid on haematological indices and microbial activities in broiler chickens remain understudied. The presence of pathogenic microbial contaminants in livestock feed is a food safety issue because it constitutes a huge threat to animal and human health (2). The acquisition from feed is an established route through which livestock get colonized or infected by pathogenic microbes (3). Microorganisms in poultry feed originate from diverse sources such as contaminated feed stuff that are of plant and animal origin, of livestock feed, vectors and containers used in the preparation and packaging of feed (3). Environmental factors such as moisture and elevated temperature also make the poultry feed suitable for microbial growth (3). Nutrients in the feed are destroyed when used by organisms for growth, thus the nutrients become unavailable for the birds (4). Organic acids can easily penetrate the bacteria cell wall and disrupt normal cellular function (5). (6) reported that broiler chickens fed diets containing organic acid blends had less pathogenic bacterial loads but greater beneficial bacteria in the ileum (2). It is also likely

that the decreased pH in the GIT induced by dietary organic acids may play a role in preventing bacterial transfer from the diet or environment (6)

The objective of this study is to investigate the effect of dietary inclusion of dried groundnut husk meal supplemented with hemicellulase and organic acid on haematology and microbial activities of broiler finisher chickens.

MATERIALS AND METHODS

Animals and Experimental Design

A total of 90 day-old ROSS 308 broiler chicks were obtained and grown over a period of 58 days. The animals were adapted for one week before the commencement of the experiment. Experimental animals were randomly allotted to five dietary treatments with five replicates each and six animals per replicate. Dried groundnut husk meal partially replaced maize in the control diet. Hemicellulase and citric acid (added to the drinking water of birds on T2, T3, T4 and T5 at the inclusion rate of 1g citric acid to 1liter of water). At the end of the experiment (8 weeks) three birds per replicate were randomly selected and off feed overnight. They were weighed and bled via jugular vein for blood collection. At day 39, 3 birds per replicate were taken to the metabolic cage for the collection of faecal samples for microbial analysis. All data collected were analyzed using the (7) package. Table 1 shows diet formulation.

Chemical Analysis

1 ml of blood was collected into bottles containing 2 mg of ethylene diamine tetra-acetic acid (EDTA) to determine hematological parameters. Parameters determined included packed cell volume (PCV), red blood cell counts (RBC), haemoglobin concentration (Hb), WBC, MCH, granulocytes, lymphophytes and monocytes. Red blood cell and white blood counts were determined by haemocytometer method using Natt-Herrick solution. Packed cell volume was measured by micro-haematocrit method while haemoglobin values were measured by Sahli's method (8). Lymphocytes and monocytes were determined using procedures described by Ewuola and Egbunike (2008), while MCH, MCV and MCHC were calculated according to the procedures of (9).

RESULTS AND DISCUSSION

Results for PCV, MCH, haemaglobin and lymphocyctes were highest ($P<0.05$) for birds on T5. Red blood cell count was same for the control and T4 while the lowest was seen on T2 (0.67). MCHC, MCV and WBC were not significantly ($P>0.05$) different in all treatments. Granulocytes and lymphophytes count on T5 were observed to be similar with the control (T1). Monocyctes % and Monocyctes count on T4 were also not significantly ($P>0.05$) different from T1. This haematological result is an indication that the dietary treatment did not have negative effect on the health status of the birds. This coincided with the report of (10) that blood parameters are reflections of the effects of dietary treatments on the animals in terms of the type, quality and amount of the feed ingested and made available for the animal to meet its physiological, biochemical and metabolic necessities. The values obtained from this study were close to the report of (11) when broiler chickens were fed *Aspergillus niger*-fermented *Terminalia catappa* seed meal-based diet, and also close to the reports of (10) who studied the effects of raw and roasted kenaf seed meal as a replacement for full fat soybean meal on haematology, serum biochemistry and relative weight of broiler chickens.

All parameters for microbial activities which include nutrient agar (NA), macConkey agar (MCC), eosin methylene agar (EMB) and salmonella agar (SSA) showed no significant difference ($P>0.05$) among the different treatment means. Dietary organic acids could be the reason for the normalcy of microbial population. It may be expected, therefore, that the antimicrobial effects of organic acids would be more pronounced when birds are exposed to less sanitary conditions. This report agrees with the work of (12).

Table 1. Gross composition of broiler finisher diet

Ingredients	D1 (control)	D2 (5%DGH)	D3 (10%DGH)	D4 (15%DGH)	D5 (20%DGH)
Maize	55.10	52.34	49.59	46.85	44.08
DriedGroundunt Husk	0.00	2.76	5.51	8.25	11.02
Wheat offal	4.50	3.70	3.70	3.70	3.70
Fish meal	11.50	11.50	11.50	11.50	11.50
Soya Oil	10.00	10.00	10.00	10.00	10.00
Soyabean meal	15.00	15.00	15.00	15.00	15.00
Vit. Premix	0.20	0.20	0.20	0.20	0.20
Limestone	0.20	0.10	0.10	0.10	0.10
Dicalcium phosphate	0.25	0.15	0.15	0.15	0.15
Hemicellulase	0.00	1.00	1.00	1.00	1.00
Titanium dioxide	2.50	2.50	2.50	2.50	2.50
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Calculated Nutrients					
DM	46.84	47.74	49.36	50.98	52.61
ME Kcal/Kg	3181.10	3133.00	3103.57	3074.24	3044.59
CP	21.18	20.97	20.90	20.83	20.77
Ash	3.83	3.87	3.95	4.03	4.11
CF	3.06	3.95	4.92	5.88	6.85
EE	3.84	3.72	3.65	3.57	3.50
NFE	68.08	67.49	66.59	65.69	64.78

[1]*Composition of vitamin premix per kg of diet: vitamin A, 12500 I.U; vitamin E, 40mg; vitamin K , 2mg; vitamin B1, 3mg; vitamin B2, 5.5mg; niacin, 5.5mg; calcium pantothenate, 11.5mg; vitamin B6, 5mg; vitamin B12, 0.025mg;choline chloride, 500mg, folic acid,1mg; biotin, 0.08mg; manganese, 120mg;iron 100mg; zinc, 80mg; copper, 8.5mg; iodine, 1.5mg; cobalt, 0.3mg;selenium, 0.12mg, anti-oxidant, 120mg,*

Table 2. Microbial activities of broiler finisher fed dried groundnut husk meal supplemented with hemicellulase and organic acid

Parameters	T1 (control)	T2 (5%DGH)	T3 (10%DGH)	T4 (15%DGH)	T5 (20%DGH)	SEM
NA	179.67	188.33	177.00	182.17	198.5	20.54
MCC	131.83	139.50	137.17	143.67	141.50	71.23
EMB	124.67	131.83	144.50	146.5	120.00	67.36
SSA	226.33	190.83	198.83	239.17	190.67	76.63

[abc] *Means in the same column without superscript are not significantly different at P<0.05. nutrient agar (NA), macConkey agar (MCC), eosin methylene agar (EMB) and salmonella agar (SSA)*

Table 3. Haematology of broiler finisher fed dried groundnut husk meal supplemented with hemicellulase and organic acid

Parameters	T1 (control)	T2 (5%DGH)	T3 (10%DGH)	T4 (15%DGH)	T5 (20%DGH)	Normal ranges	SEM
Packed cell volume (%)	19.33[a]	19.33[b]	16.00[a]	17.67[a]	23.33[c]	16-30	1.30
RBC (x10^{12}/l)	2.53a	0.67b	2.83c	2.73ac	2.300d	2.5-3.5	0.21
MCHC (%)	33.36	33.22	33.35	33.33	33.32	30.2-36.2	0.22
MCV (fL)	76.94	166.65	58.63	67.85	104.18	65-140	10.42
MCH (pg)	25.65[a]	55.57[b]	19.58[c]	22.63[d]	34.72[e]	21-47	3.47
Haemoglobin (g/dl)	6.68[a]	3.34[b]	5.68[c]	6.35[d]	8.34[e]	5-10	0.43
WBC	1.67	1.20	1.83	1.33	1.60[a]	2-16	0.09
Granulocytes	0.49[a]	0.18[b]	0.79[c]	0.14[b]	0.34[d]	<1-4	0.07
GRA (%)	23.67[a]	20.67[b]	45.00[c]	10.67[d]	22.67[ab]	20-32	3.01
Lymphophytes	1.23[a]	0.73[b]	1.02c	1.15[d]	1.18[e]	<1-5	0.05
LYMP (%)	76.67[a]	80.67[b]	56.67[c]	88.33[d]	78.33[a]	55-87	2.82
Monocyctes	0.03[a]	0.00[b]	0.00[bc]	0.33[a]	0.00[b]	<1-5	0.004
MON (%)	1.33[a]	0.00[b]	0.00[bc]	1.67[a]	0.00[b]	<1-5	0.21

Means with no superscripts on the same row does not differ significantly (p>0.05), a, b: means with different superscripts on the same row differ significantly (P<0.05). SEM = Standard Error of Means, RBC=Red blood cell, WBC=White Blood Cell, MCV=Mean Corpuscular Volume, MCH=Mean Corpuscular Haemoglobin, MCHC=Mean Corpuscular Haemoglobin Concentration, GRA=Granulocycte count, LYMP= Lymphophytes count, MON= Monocyctes

CONCLUSION AND APPLICATION

The results of this study showed that the dried groundnut husk meal supplemented with hemicellulase and organic acid in broiler (58days-old) diets could be effectively utilized at 20% to obtain reasonably haematological parameters and reduced microbial infection in the finished broiler birds.

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INFLUENCE OF DIETARY ACTIVATED CHARCOAL ON THE PERFORMANCE AND HAEMATOLOGICAL INDICES OF GROWING RABBITS

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ABSTRACT

The study was conducted to investigate the influence of Activated Charcoal on the growth performances and haematological indice of growing rabbits. 24 rabbits aged between 5 to 7 weeks with body weight ranges from 300 to 600g were randomly allotted into the experimental design. ~~R~~esults revealed that the growth performance of dietary activated charcoal were not significantly ($p>0.05$) influenced by the inclusion levels of activated charcoal used. Daily weight changes of the experimental rabbits were in the range of 10.07 g and 11.88 g. Daily feed intake ranged between 51.55 and 60.74 g while feed conversion ratio were in the range of 4.90 and 6.00. Dietary activated charcoal had no significant ($p>0.05$) influence on the haematological parameters of rabbits except the Packed cell volume (PCV) and haemoglobin (Hb) were significantly ($p<0.05$) affected. The PCV values obtained in the experimental rabbits increased with increasing levels of activated charcoal in the diets. Least amount of PCV was observed in T3 (35.50%). The concentration of Hb was least ($p<0.05$) and comparable in T2, T1 and T4 (11.85, 12.85 and 13.15g/100ml, respectively).It is recommended that up to 4% activated charcoal can be utilized in the diets of rabbits to improve on their physiological status and utilization of nutrient from feed consumed.

Keywords-Dietary Activated charcoal, growing rabbit, haematological indices performance

DESCRIPTION OF PROBLEM

The production of animals like rabbits, with very short gestation periods and production cycles, can be a solution to the problem of protein shortage. Rabbits can be produced on forages alone, although production can be improved by adding other feed supplements. Nutritionally, rabbit has a higher protein (20-21%), low fat content (10-11%), when compared with meat from other livestock species. The challenge of feedstuffs at economic prices in developing countries of the world has compelled animal nutritionists to intensify research into alternative feed sources to reduce cost of animal proteins (3). Such alternatives could be by-products from processing of grains and legumes as food for humans. The use of feed additives with potential for detannification such as charcoal as well as those that will improve gut health for improved nutrient digestibility and overall performance of the animal (4,5). One of such feed additive is biochar. Charcoal is normally obtained from burning of wood, peat, nones, cellulose and other carbonaceous substance with little or insufficient air. When ingested, it prevent toxic absorption from the intestine and also improve the gut environment by increasing beneficial micro flora for improve overall performance of the animal. Charcoal contain micro pores which are responsible for its high absorptive capacity (5). This research therefore, is designed to assess the performance and haematological indices of rabbit on diets containing varying levels of activated charcoal.

MATERIALS AND METHODS

Experimental Site

The experiment was carried out at the Teaching and Research Farm of College of Agriculture, Science and Technology, Lafia, Nasarawa State Nigeria. Lafia is located on latitude 08^0.33N and longitude 08^0.32E. The relative humidity is 87% and the temperature is 32^0C. Nasarawa lies in Guinea Savannah vegetation zone of Nigeria, with an average rainfall of about 832mm annually (7).

Preparation of Activated Biochar

African Iron tree (*Prosopis africana)* was used in preparing the charcoal. The wood were burnt anaerobically under a mud heap to obtained the charcoal and later ground to very fine particles.The reagent used for the activation was lemon juice of about 2000ml which was mixed with 2000 grams of charcoal. The mixture was stirred to paste, ~~and properly~~ soaked and then left for 24hours. Afterwards, the slurry was drained of the remaining liquid, rinsed in distilled water and ~~left~~ allowed to dry in an oven at temperature range between 100^{o}C-200^{o}C for 5 hours for activation.The activated charcoal were then kept in a clean airtight container to prevent it from absorbing the surrounding smell and substance.

Experimental Animals and Management

A total of 24 young rabbits of mixed breeds, sexes and ages between 5 - 7 weeks were procured from Dagwam farm at Vom, Plateau State, Nigeria. They were randomly divided into four (4) treatment groups of six (6) rabbits per treatments. Each treatment was replicated three (3) times with two (2) rabbits in a Completely Randomized Design (CRD). Four diets were formulated to contain activated charcoal at 0.0%, 0.2%, 0.3%, and 0.4% respectively (Table 1). The rabbits were housed in a well ventilated room in hutches. The hutches were fitted with drinkers and feeders. The rabbits were pre-conditioned for two weeks during which they were dewormed twice (once a week) against parasites infections with Ivermec subcutaneously. They were offered feed and fresh water over the 12 weeks of the experimental period.

Statistical analysis

The data on growth and blood profile were subjected to analysis of variance using SAS (2000) Statistical Software and differences in means were separated using Duncan's Multiple Range Test at 5% ($p<0.05$) levels of probability.

Performance Data

The initial weights of the rabbits were determined before the commencement of the study and thereafter on weekly basis for determination weekly weight gain. The amount of feed given and left over was recorded on daily bases and it was used for determination of feed intake. Feed intake and weight gain recorded were used to determine feed conversion ratio.

Blood Sample Collection

At the end of the feeding trials, blood (3ml) was collected from each rabbits via the vein around the ear region. Blood sample for haematological indicies were emptied into battle containing Ethylene DiamineTetra Acetic Acid (EDTA) for Haematological analysis which include Packed cell volume, (V) Haemaglobin concentration Hb, Red blood cell (RBC) count or Erythrocytes and White blood cell (WBC) count or Leucocytes and Differential counts. Other such as Mean Corpuscular Haemoglobin (MCH), Mean Corpuscular Volume (MCV) and Mean Corpuscular Haemoglobin concentration (MCHC) (10).

RESULTS AND DISCUSSION

The result of growth performance of rabbits on diets containing different levels of Activated charcoal is presented in Table 2. All growth parameters measured were not significantly ($p>0.05$) influenced by the inclusion levels of Activated charcoal in the diets. Growth performance indices are a measure of diet appreciation by animals generally.The Non-significant differences observed for growth indices in this study by rabbits could be that the inclusion of activated charcoal did not alter the microbial community structure in the caecum compared to the control animals. (2) has reported that feeding 1.5 and 3% activated coconut biochar in goat diets did not alter the microbial structure of the animals.

Table 1: Composition of experimental diet containing graded levels of activated charcoal

Ingredient	T1	T2	T3	T4
Maize	46.69	46.69	46.69	46.69
Rice offal	20.00	20.00	20.00	20.00
Full fat soya beans	30.31	30.31	30.31	30.31
Bone Ash	2.50	2.50	2.50	2.50
Salt	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100**	**100**
Calculated Analysis				
ME (kg/kg)	**2800.00**	**2800.00**	**2800.00**	**22800.00**
Crude protein(%)	**19.70**	**19.70**	**19.70**	**19.70**
Crude fibre (%)	**3.20**	**3.20**	**3.20**	**2.20**
ther extract(%)	**2.11**	**2.11**	**2.11**	**2.11**
Calcium (%)	**0.33**	**0.33**	**0.33**	**0.33**
Phophoru(%)	**0.56**	**0.56**	**0.56**	**0.56**

Table 2: Growth performance of rabbits on activated charcoal supplemented diets

Parameter	T1	T2	T3	T4	SEM
Initial weight (g)	888.75	875.00	885.25	619.25	50.56
Final weight (g)	1858.67	1824.33	1814.00	1566.33	44.46
Daily feed intake (g)	52.24	52.11	50.02	50.04	1.64
Weight gain (g)	974.67	906.33	928.75	1069.00	46.38
Daily weight gain (g)	10.83	10.07	10.31	11.88	0.52
Feed intake(g)	56.10	53.23	59.83	51.55	1.82
FCR	5.99	6.00	5.87	4.90	0.50

FCR – Feed conversion ratio SEM – Standard error of means AC = activated charcoal T1=Control T2= 2% AC T3= T2= 3% AC T4 = T2= 4% AC

Table 3: Haematological parameters of rabbit fed diets containing varying levels of activated charcoal

Parameter	T1	T2	T3	T4	SEM
Packed cell(%) volume	38.50^{b}	35.50^{c}	41.50^{a}	39.50^{bc}	1.78
Red blood cells ×106/l)	6.65	6.10	7.10	5.50	0.26
White blood cells(×103/l	3.10	3.50	2.50	5.00	0.56
Haemoglobin (g/100ml)	12.85^{c}	11.85^{d}	13.80^{a}	13.15^{b}	0.59
MCV(%)	60.10	60.30	58.10	72.50	3.22
MCH(%)	20.05	20.15	19.45	24.15	1.06
MCHC(%)	33.35	33.35	33.20	33.25	0.02

^{a,b}Means with different superscript along the same row are significantly different ($p<0.05$) MCV=mean corpuscular volume MCH =mean corpuscular haemaglobin MCHC=mean corpuscular haemaglobin concentration

The result of haematological parameters of rabbits fed diets with varying levels of activated charcoal is presente d in Table 3. Packed cell volume (PCV) and haemoglobin (Hb) were significantly ($p<0.05$) affected by the varying levels of activated charcoal in the diets. Changes in haematological parameters are often used to determine stress due to nutrition and other factors. (8) reported that PCV, Hb and MCH were major indices for evaluating circulating erythrocytes, diagnosising anaemia and also serve as useful indices of bone marrow capacity to produce red blood cells as in mammals. The amount of PCV in the rabbits increased

with increasing levels of activated charcoal in the diets. Least amount of PCV was observed in T3 (35.50 %) and this was comparable to those in T1 and T4 (38.50 and 39.50%, respectively), with higher ($p<0.05$) comparable values in T5 and T6 (50.00 % and 50.50 %, respectively). Similar trend as in PCV were also observed for haemoglobin concentration in the rabbits. The concentratidon of Hb was least ($p<0.05$) and comparable in T2, T1 and T4 (11.85, 12.85 and 13.15 g/100ml), respectively). This however increased ($p<0.05$) in other treatment groups with comparable highest values found in T5 and T6 (16.65 and 16.80 g/100ml), respectively). (8) reported that haematological constituent reflect the responsiveness of the animal to its environments which include feed and feeding. All other haematological parameters measured were not affected ($p>0.05$) by the inclusion of varying levels of activated charcoal in the diets of rabbits.

CONCLUSIONS AND APPLICATIONS

1. The growth performance of rabbits were not influenced by the inclusion levels of activated charcoal in their diets.
2. Packed cell volume (PCV) and haemoglobin (Hb) as haematological indices were influenced by the inclusion levels of activated charcoal in the diets of the rabbits.
3. It is recommended that up to 4% activated charcoal can be utilized in the diets of rabbits to improve on their physiological status and utilization of nutrient from feed consumed.

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Monogastric Animal Production: MGP 005

SERUM INDICES OF FINISHER BROILER CHICKENS OFFERED BITTER LEAF (*Vernonia amygdalina*) EXTRACTS IN DRINKING WATER

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ABSTRACT

This study investigated the influence of bitter leaf extract in drinking water to the health of broiler chickens through the assessment of serum parameters. Ninety (90) Cobb 500-four weeks- old broiler chicks were assigned on weight equilisation to three (3) treatments (0ml, 50ml and 100ml per litre of drinking water) of constituted bitter leaf extract. The treatments were replicated three (3) times with ten (10) birds per replicate under a completely randomized design (CRD) experimentand the study lasted 4 weeks. Two birds per replicate were randomly selected for the collection of blood samples. The collected samples were allowed to coagulate to produce serum for blood serum chemistry measurements.data were analysed using One-way Analysis of Variance while means were separated by Duncan Multiple Range Test.Serum result showed that globulin significantly decreased while albumin significantly ($P<0.05$) increased with extract dosage. Furthermore, 100ml/L broilers had the lowest ($P<0.05$) serum urea and creatinine. Birds offered 50ml/L of the extract had the highest Aspartate transaminase(AST) andAlkaline phosphatase(ALP) valuesand 100ml/L had the highestAlanine transaminase (ALT) value. From the above, it can be concluded that oral dosage of bitter leaf extractcan be used for finisher broiler chickens at the rate of 50ml/L without any negative effect.

Key words: Blood; bitter leaf extract; feed additive; phytogenics.

DESCRIPTION OF PROBLEM

The poultry birds remain a relatively affordable source of animal protein especially broiler chickens (1). Broiler chickens reach table size within six weeks; at times left till seven weeks or more for those that have preference for relatively tough meat (2). Consumption of broiler chickens is gradually becoming part of daily diets, now that much awareness had been created on their rearing for family consumption and income. However, high cost of feed and other rearing inputs like medications tend to make chicken meat unaffordable for consumption. This experience prompted the majority of the poultry farmers to have deployed various indigenous knowledge into prevention and treatment of poultry diseases (3). This involve the use of herbs, generally referred to as phytogenics. The phytogenics are of plant origin incorporated into either feed or water of the birds to enhance productivity, nutrient absorption and elimination of pathogens in the gut of the birds (4). The use of these plant parts had been found effective as antioxidants with therapeutic and prophylactic properties (5). Hence, birds performance were enhanced with ease of preventing common poultry diseases like coccidiosis (6), Newcastle disease (4) and worm infestation (7). Bitter leaf has the potential of enhancing performance and health of poultry chickens. It has been proven that bitter leaf (*Vernonia amygdalina*) contain significant quantities of lipids, carbohydrates, proteins having high essential amino acid scores, fibre, iron, phosphorus, copper, calcium potassium, cobalt and manganese, appreciable amounts of biologically active compounds like ascorbic acid, saponins, alkaloids, steroids terpenes, flavonoids, coumarins, ligans, phenolic acids, edotides, xanthones, anthraquinone and sesquiterpenes and caroteinoids (5). Extracts from bitter leaf can be used as tonics to treat variety of ailments and maladies, including emesis, nausea, diabetes, anorexia, diarrhea, dysentery and other gastrointestinal tract issues (8). Bitter leaf (*Vernonia amygdalina*) is one of the medicinal shrubs common in Nigeria. It is also an edible vegetable used mostly to cook soup. While the bitter leaf plant is useful to man, it has a lot of antioxidants and therapeutic properties that are of importance to animals, especially poultry (9). The reports of 9 and 3 have highlighted the positive influence of bitter leaf extract on the growth and health performance of poultry.

Phytogenic like bitter leaf extract is a feed additive added to broiler drinking water to improve health, reduce morbidity and enhance production efficiency. This suggest that bitter leaf may contribute to the wellbeing of broiler chickens. However, the specific impact of bitter leaf extract in the drinking water of broiler chickens remains relatively unexplored.

This investigation assessed the impact of bitter leaf extract in drinking water to the health of broiler chickens through serum indices.

MATERIALS AND METHODS

Animals and Experimental Design

Location of study

The study was carried out at the Poultry Unit of the Teaching and Research Farm, Olusegun Agagu University of Science and Technology (OAUSTECH) Okitipupa, Nigeria. The OAUSTECH is located within the rainforest zone, Latitude 5° 28' N and longitude 4° 46' E at an elevation of about 200 m above sea level.

Sourcing and preparation of extract

Fresh bitter leaf (*Vernonia amygdalina*) was harvested from the Teaching and Research Farm, Olusegun Agagu University of Science and Technology (OAUSTECH) Okitipupa. Ondo State, Nigeria.

Two hundred grammes (200gms) of freshly harvested bitter leaves were washed thoroughly without squeezing with clean water to remove dirt (sand and dust). The washed leaves were put in a bowl containing two litres of clean water and then squeezed to have the leaves extract. The extract was constituted into one litre of water at different volume of the extract to form the treatments.

The broiler chicks were obtained from Zartech farm, Ibadan, Oyo State.

Experimental design and bird's management

The four weeks old ninety (90) Cobb 500broiler chickensobtained from Zartech farm, Ibadan, Oyo State at day-old; were randomly assigned to three (3) treatments (0ml, 50ml and 100ml per litre of drinking water) of constituted bitter leaf extract. The treatments were of 30 birds each. The treatments were replicated three (3) times with ten (10) birds per replicate under a completely randomized design (CRD) experiment. Thebirds were fed *ad libitum* with finisher diet (Metabolizable energy of 2750kcal/kg and 19%Crude Protein) and exposed to the experimental drinking water without restriction for 4 weeks.

Blood collection

At the end of the fourth week, two birds per replicate were randomly selected for the collection of blood samples. The collected samples were allowed to coagulate to produce serum for blood serum chemistry measurements (10). The samples were immediately transported to the laboratory for analysis. The samples were first centrifuged and decanted. Sigma kits were thereafter used to determine protein, globulins and albumins. Serum aspartic aminotransferase (AST), alkaline phosphatase (ALP) and alkaline aminotransferase (ALT) were determined using the procedure of (11).

Statistical Analyses

All experimental data were analysed using One-way Analysis of Variance while means were separated by Duncan Multiple Range Test at 95 % level of significance (SAS Inst. Inc., Cary, NC).

RESULTS AND DISCUSSION

Effect of treatments on serum indices of finisher broiler chickens

Table 1 showed the serum indices of finisher broiler chickens offered bitter leaf extract in drinking water. All the indices except total protein and glucose were significantly ($P<0.05$) affected by the bitter leaf extract in drinking water. The birds offered100ml/litre of drinking water had the highest albumin value and was significantly ($P<0.05$) different from those offered 50ml/litre of drinking water and 0ml/litre of drinking water that were not significantly ($P>0.05$) different from one another. The globulin values for birds under 100ml/litre of drinking water and 0ml/litre of drinking water were significantly ($P<0.05$) differentfrom those

under 50ml/litre of drinking which is statistically similar to birds offered 0ml/litre of drinking water. The Aspartate transaminase (AST) value for the birds under 50ml/litre of drinking water was significantly (P<0.05) different from those birds under 100ml/litre of drinking water and 0ml/litre of drinking water that were not significantly (P>0.05) different from one another. The Alanine transaminase (ALT) values were significantly (P<0.05) different among the three treatments with values 12.00, 7.00 and 9.00µ/L for 100, 50 and 0 ml/litre of drinking water respectively. Birds under 100ml/litre of drinking water had the least Alkaline phosphatase (ALP) and significantly (P<0.05) differed from treatments offered 50ml/litreand 0ml/litre of drinking water that were not significantly (P>0.05) different from one another. The values for Chloride, Urea and Creatinine showed similar trends among the treatments. Birds under 100ml/litre of drinking water had the least values for these parameters that were significantly (P<0.05) different from values under 50 and 0ml/litre of drinking water that were not significantly (P>0.05) different from one another. The serum values are essential in the assessment of clinical and health status of broiler chickens. Blood urea, nitrogen and creatinine are the final product of protein metabolism, and they are often regarded as indicator of renal functions (12). In the study, the low level of urea and creatinine in the highest dosage of the extractsuggest that bitter leaf extract did not affect renal function or reduced skeletal muscle breakdown. Furthermore, creatinine, an indicator of skeletal muscle breakdown can increase in the blood serum due to heat stress (13). Thus, it also indicate that it can help alleviate broiler heat stress even in tropical environment. The activities of ALT and AST reflect the integrity of hepatocytes and are often used as indicators of liver injuries/infarction. This is because, when liver damages occur, there is leakage of some of these organ specific enzymes beyond the concentration expected in the blood. Although these enzymes are available in the blood at a level, undue increases could suggest a liver damage especially with ALT enzyme (14). Although 50ml/L had the highest AST and ALP value and 100ml/L had the highest ALT value, they reflect had no negative effect of treatments.

Table 2: Serum indices of finisher broiler chickens offered bitter leaf extract in drinking water

Parameters	Level of bitter leaf extract		
	0ml\L	50ml\L	100ml\L
Total Protein (g/L)	80.00±5.00	77.00±2.00	78.00±3.00
Albumin (g/L)	34.00±2.00[a]	34.00±1.00[a]	38.00±2.00[b]
Globulin (g/L)	46.00±2.00[b]	43.00±1.00[ab]	40.00±2.00[a]
Aspartate transaminase (AST) (µ\L)	7.00±1.00[a]	10.00±1.00[b]	7.00±1.00[a]
Alanine transaminase (ALT) (µ\L)	9.00±1.00[b]	7.00±1.00[a]	12.00±1.00[c]
Alkaline phosphatase (ALP) (µ\L)	19.80±0.20[b]	21.30±1.30[b]	17.60±1.10[a]
Glucose (mmol\L)	5.90±1.05	7.00±1.00	6.00±0.20
Chloride (mmol\L)	93.00±1.00[b]	94.00±2.00[b]	89.00±2.00[a]
Urea (mmol\L)	3.70±0.10[b]	3.90±0.15[b]	2.70±0.05[a]
Creatinine (mmol\L)	70.10±9.45[b]	71.30±0.70[b]	50.10±0.60[a]

Mean±Standard Deviation
[abc] Means with different superscripts along the rows are significantly different (P<0.05)

CONCLUSION AND APPLICATION

The study has demonstrated that:

1. Application of bitter leaf extract in finisher broiler chickens water up to 50ml/L did not compromise the health of finisher broiler chickens in terms of serum indices.
2. Bitter leaf extract has the potential of being used as alternative to antibiotics in the rearing of finisher broiler chickens.

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Monogastric Animal Production: MGP 006

UTILIZATION OF HIGH QUALITY CASSAVA PEELS (HQCP) DIETS BY BROILER STARTER BIRDS

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ABSTRACT

The study was conducted to assess nutrient utilization and digestibility of high quality cassava peels (HQCP) in starting broiler chickens. A total of one hundred and fifty day-old chicks of the Arbor Acre strain were randomly allotted to five dietary treatments. HQCP replaced 0%, 25%, 50%, 75% and 100% maize in the diets. Each treatment group had thirty birds replicated thrice, resulting in ten birds per replicate. The study period was 28 days. Digestibility trial was performed at the fourth week and lasted for five days. Two birds from each replicate were picked at random and placed in the digestibility cage and fed the test diets. Body weight changes during the trial were recorded. Performance indices were measured. Final body weight, daily weight gain, and daily feed intake increased ($P<0.05$) with an increase in HQCP up to 50%. As the level of HQCP increased, feed cost per kg decreased ($P<0.05$), while the cost per unit weight gain reduced up to 50% of the HQCP level in the diets. Nutrient digestibility was influenced *($P<0.05$)* by the level of HQCP in the diets. ME and CF digestibility decreased *($P<0.05$)* with an increase in the level of HQCP. It was concluded that up to 50% maize replacement in broiler starter diets by HQCP led to improved feed utilization coupled with reduced feed cost.

Key words: Maize, Cassava Peel, Digestibility, Nutrient, Utilization, Broiler, High Quality

DESCRIPTION OF PROBLEM

As an energy source for poultry feed, maize is the most commonly used conventional feed ingredient, but there has be a decline in the use of maize as animal feed due to increases in price and a rise in demand for human consumption [1].Poultry producers from all over the world are now looking for cheaper energy feedstuffs as convenient substitutes for maize. Less fibrous diets are required for the production of broiler chicken because of the nature of the digestive system. The recent introduction of cassava products as energy feed ingredients in poultry diets is a swift paradigm shift. Numerous studies have demonstrated that cassava peels can be a good energy feed base because of their high metabolizable energy. [2] replaced maize with up to 20% cassava peels without any detrimental effect on broiler chicken growth. Cassava peel makes up the outermost part of the cassava tuber, which is largely discarded by cassava processors. According to [3], the proximate composition of cassava peel is 3.1–5% and 9–12% crude protein and crude fibre, respectively. [4] reported that cassava peel is high in fibre and low in energy and protein. Also, the protein content in cassava peel meal (30–60 g/kg) is also less than that of most cereal grains [5]. There are many products that can be made from cassava, including tubers, peels, whole cassava plants, stems, leaves, and tender stems. There is the assertion that well-processed cassava could conveniently replace up to 50% of maize in poultry diets without exerting adverse effects on the health and performance of birds [6]. High-Quality Cassava Peels (HQCP) is a low-tech product created by processing wet cassava peels into high-quality, safe, and nutritious feed for livestock. High-quality cassava peel (HQCP) was reported to have been used to replace maize up to a 30% level.

This study was conducted to to assess how much high-quality cassava peel could be used and digested in starting broiler chickens.

MATERIALS AND METHODS

Animals and Experimental Design

The experiment was carried out at the Poultry Unit of the Teaching and Research Farm of Ekiti State Polytechnic, Isan Ekiti. Five isocaloric and isonitrogenous diets with separate inclusion levels of HQCP were formulated. HQCP with fine particle size was used in this trial. The diets were formulated and compounded with no other feed additives. Birds were brooded on a floor pen in an open-sided wall building using incandescent electricity bulbs and burning charcoal in pots. Nutrient digestibility studies were conducted in the fourth week of the trial and lasted five days. In a completely randomized design arrangement of five dietary treatment replicated thrice, two birds (2 per replicate) with total number of fifteen (15) birds were randomly selected, and placed in digestibility cages. Birds were fasted for 24 hours to empty the digestive tract after which they were fed the formulated diets. *Ad libitum* feeding and clean drinking water were provided. The standard technique of total fecal collection was followed. Faecal samples were collected daily over a period of five days. The collected faecal samples were weighed on a wet and dry basis to determine moisture and dry matter content. Data on body weight changes and feed intake were collected for five (5) days. Daily weight gain, daily feed intake, and feed conversion ratio (FCR) were determined.

Table 1: Gross composition of the Experimental diets of broilers starter fed High Quality Cassava Peels

	INCLUSION LEVELS				
Ingredients	0% HQCP	25% HQCP	50% HQCP	75% HQCP	100% HQCP
Maize	59.00	44.25	29.50	14.75	0.00
HQCP	0.00	14.75	29.50	44.25	59.00
Soy Bean Meal	31.00	31.00	31.00	31.00	31.00
Wheat offal	4.19	4.19	4.19	4.19	4.19
Bone meal	2.20	2.20	2.20	2.20	2.20
Fish meal	3.00	3.00	3.00	3.00	3.00
Broiler premix	0.01	0.01	0.01	0.01	0.01
Table salt	0.50	0.50	0.50	0.50	0.50
Methionine	0.05	0.05	0.05	0.05	0.05
Lysine	0.05	0.05	0.05	0.05	0.05
Total	100.00	100.00	100.00	100.00	100.00
Calculated nutrient values					
Crude protein (%)	21.90	21.31	20.69	20.08	19.48
ME (kcal/kg)	2903.32	2860.43	2814.52	2770.13	2725.73
Ether extract	2.96	2.45	2.26	1.90	1.55
Crude fibre	3.64	4.51	5.40	6.34	7.24
Calcium	1.06	1.06	1.05	1.05	1.04
Phosphorus	0.67	0.67	0.66	0.66	0.66

Note – ME- Metabolisable energy, HQCP – High Quality Cassava Peel

Chemical Analyses

The proximate composition of the high quality cassava peels, experimental diets and faecal samples was carried out as described by [7].

Statistical Analysis

Data were subjected to one-one analysis of variance (ANOVA) using the [8] package for Windows. To separate significant differences among means, a post hoc Duncan multiple range test was used.

RESULTS AND DISCUSSION

Proximate Composition of High Quality Cassava Peels HQCP

Proximate composition of High Quality Cassava Peel is presented in table 2.

Table 2: Proximate composition of HQCP

Parameters	HQCP (Whole)	HQCP (Fine)	HQCP (Coarse)
Starch	66.70	69.00	55.00
Protein (%)	4.50	4.60	2.80
Fat (%)	1.40	1.20	1.20
Crude Fibre (%)	9.80	8.20	15.60
Crude Ash (%)	5.80	6.60	3.50
ME (KCAL/KG)	2947	3039	2495

HQCP – High Quality Cassava Peels

Proximate composition of experimental diets.

Proximate composition of experimental diets are presented in Table 3. Proximate data obtained were similar to the calculated values obtained (Table 1).

Table 2: Proximate Composition of the Experimental diets of broilers starter fed HQCP

PARAMETERS	INCLUSION LEVELS				
	0% HQCP	25% HQCP	50% HQCP	75% HQCP	100% HQCP
Moisture (%)	10.46	8.45	8.06	7.59	6.93
Dry Matter (%)	89.54	91.55	91.94	92.41	93.07
Crude Protein (%)	21.90	21.31	20.69	20.08	19.48
Crude Fibre (%)	5.85	6.55	8.32	9.10	11.48
Ether Extract (%)	5.89	4.01	4.94	3.69	3.43
Ash (%)	6.91	5.41	5.12	5.21	3.84
NFE (%)	59.45	62.72	60.93	61.92	61.77
ME	3097.87	3039.84	3028.69	2940.01	2891.43

Note – NFE – Nitrogen Free Extract, ME- Metabolisable energy, HQCP – High Quality Cassava Peel

Growth performance characteristics of Broiler Starter fed High Quality Cassava Peel

Table 3 shows the performance characteristics of broiler starter fed HQCP for the digestibility trial.

The results indicated significant *(P < 0.05)* difference on the final body weight, daily weight gain, and daily feed intake. The final body weight, daily weight gain, and daily feed intake increased *(P < 0.05)* with increasing HQCP in diets up to 50% and decreased *(P < 0.05)* between 50% and 100% of HQCP. Birds on diet 3 (50% HQCP) recorded the highest final body weight and daily weight gain. The cassava peels can serve as a favorable energy feed base, as evidenced by the better performance of broiler birds in this study up to a 50% replacement level of maize with HQCP. High daily feed intake in Diet 5 (100%) HQCP could not improve the weight gain, which could be attributed to the fibre characteristics, which tend to have poor utilization of crude protein and metabolizable energy in the diet. This concurred with the earlier findings by [4], who stated that cassava peel is high in fibre and low in energy and protein. There were no differences in final body weight, daily weight gain, daily feed intake, or FCR among birds fed diets with 25% and 50% HQCP inclusions. The significant drop in FCR seen in birds that were fed diets with higher levels of HQCP might be because starch makes up a bigger part of HQCP [9]. With increased HQCP inclusions in diets, the cost of feed per kg decreased significantly. At the 50% HQCP level (N5.79), the cost per unit weight gain

was lower than at the 0% HQCP level (N7.76). This reduction in the cost of feed per kg of body weight gain was linked to the less expensive cost of HQCP, compared to maize.

Table 3: Growth Performance Characteristics of Broiler starter fed varying inclusion levels of HQCP

PARAMETERS	INCLUSION LEVELS						
	0% HQCP	25% HQCP	50% HQCP	75% HQCP	100% HQCP	SEM	p-value
Initial body weight (g/bird)	108.05	108.15	108.35	107.2	103.75	0.7714	0.3188
Final body weight (g/bird)	582.25^{b}	608.30^{ab}	669.05^{a}	512.50^{c}	449.10^{c}	26.1271	0.0019
Daily weight gain (g/bird)	47.42^{b}	50.02^{ab}	56.07^{a}	40.53^{c}	38.54^{c}	2.5583	0.0017
Daily Feed Intake (g/bird)	38.02^{c}	47.88^{a}	49.07^{a}	43.64^{b}	50.49^{a}	1.5288	0.0005
FCR	1.25^{a}	1.05^{abc}	1.14^{ab}	0.93^{c}	0.69^{d}	0.0658	0.0011
Fc/kg feed (₦)	368.18^{a}	345.05^{b}	323.92^{c}	301.88^{d}	279.68^{e}	10.4298	<.0001

***HQCP – High Quality Cassava Peel, FCR – Feed Conversion Ratio, Fc- Feed Cost, SEM: Standard Error of* Mean**

Table 4: Nutrient digestibility of High Quality Cassava Peel by Broiler starter

PARAMETERS	INCLUSION LEVELS						
	0% HQCP	25% HQCP	50% HQCP	75% HQCP	100% HQCP	SEM	p-value
Moisture (%)	7.90^{a}	6.85^{b}	6.70^{bc}	6.30^{cb}	5.93^{c}	0.2352	0.0137
Dry Matter (%)	92.10^{c}	93.15^{b}	93.30^{ab}	93.70^{ab}	94.07^{a}	0.2352	0.0137
Crude Protein (%)	3.31^{b}	3.92^{a}	4.19^{a}	2.85^{b}	2.00^{c}	0.2660	0.0012
Crude Fibre (%)	11.10^{a}	10.22^{b}	9.92^{b}	9.56^{c}	8.72^{c}	0.2625	<.0001
Ether Extract (%)	1.36^{b}	1.62^{a}	1.77^{a}	1.07^{bc}	0.95^{c}	0.1070	0.0026
ASH (%)	4.95^{d}	5.55^{ab}	5.90^{bc}	6.09^{ab}	6.38^{a}	0.1671	0.0013
NFE (%)	81.68^{a}	79.36^{b}	78.22^{c}	79.76^{b}	79.57^{b}	0.3771	0.0004
ME	3130.35^{a}	3093.08^{b}	3075.24^{b}	3024.05^{c}	2975.75^{d}	18.2015	0.0001

Note – NFE – Nitrogen Free Extract, ME- Metabolisable energy, HQCP – High Quality Cassava Peel

Nutrient Digestibility Parameters

Nutrient digestibility indices of Broiler Starter fed High Quality Cassava Peel are shown in table 4. The increasing level of inclusion of high-quality cassava peel significantly (P<0.05) affected the digestibility of crude protein, crude fibre, ether extract, and nitrogen-free extract. There was a significant increase (P<0.05) in the digestibility of crude protein and ether extract up to 50% HQCP, which was then reduced significantly from 50% to 100% HQCP. This is evident in Table 3 that showed deteriorating growth performance indices. Proximate values of Metabolizable energy and Crude fibre (%) digestibility decreased significantly *(P<0.05)* with increasing level of HQCP. It was found that the digestibility of crude protein (%), crude fibre (%), and ether extract (%) did not change between 25% and 50%. Metabolizable energy levels found in this study are between 2975.75 and 3130.35 kcal ME kg-1. These levels are within the range (3010 to 3225 kcal ME kg-1)of ME values that are thought to improve the performance of broiler chickens [10].

CONCLUSION AND APPLICATION

1. High Quality Cassava Peel can replace up to 50% maize in broiler starter diet
2. The use of HQCP as an alternate energy source in poultry feed will help in reducing the overall cost of broiler production.

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Monogastric Animal Production: MGP 007

PERFORMANCE CHARACTERISTICS AND BLOOD PROFILE OF BROILER CHICKS FED FERMENTED CORN COBS

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ABSTRACT

Two hundred (200) A-day old Marshall Strain broiler chicks were used for this experiment. Chicks were weighed and randomly assigned to five dietary treatments. Each treatment was replicated four times with ten birds each to make a total of 40 chicks per treatment in a completely randomized design experiment. Feed and water were supplied *ad libitum* for four weeks. Solid state fermentation of corn cobs was carried out using *Aspergillus flavus, Aspergillus fumigatus* and *Apergillus niger* obtained from prepared corn cobs agar mixture and were incorporated into the chicks' diets at 10% level each. The result revealed that there were significant (P<0.05) differences in performance characteristics of broiler chicken observed. Bird fed 10% *Apergillus niger* and 10% *Aspergillus fumigatus* fermented corn cobs based diet recorded the best final weight gain value and FCR value. The haematological parameters were significantly (P<0.05) influenced by the diets except for Packed cell volume and Red blood cell with the highest PCV and RBC values (26.84% and 2.82 10^{12}/L in T1 and T2 respectively). The serum biochemical indices were significantly (P<0.05) influenced by the diets except for Total protein, Albumin and Total globulin. However, values obtained in this study fell within the normal range recommended for healthy chicken. It was concluded that solid state fermentation of corn cobs improved the nutrient composition of the corn-cobs and up to 10% *Apergillus niger* fermented corn cobs and 10% *Aspergllus fumigatus* fermented corn cobs can be incorporated into the broiler diet without any detrimental effect on their performance and blood profile.

Keywords: Marshall Strain, Performance, Blood profile, Corn cob, Solid state fermentation

DESCRIPTION OF PROBLEM

Energy sources constitute an important and expensive feed stuffs especially maize which accounts for the largest proportion of about 50-55% ingredients of the poultry diet (1). Seeking and using alternatives therefore becomes a necessity. One of such potential source that has not been fully utilized is corn-cobs which are generally not used for human consumption. Corn-cob is considered as waste but readily available in Nigeria especially during the time of shelling and processing of harvested maize. Though the quantity of maize cob generated annually in the country increases as more people venture into the cultivation of maize, however, they have low feeding value because of its poor protein, energy, minerals and vitamins and high fibre content (2). The militating problem affecting the utilization of corn cobs in chicken diet is high fibre content. Monogastric animals also lack microorganisms in their gut for effective digestibility of fibre fractions in feedstuffs (3). The use of exogenous enzymes in monogastric animal feeding is on the increase to improve nutrient digestibility, availability and utilization especially when non-conventional feedstuffs are used (4). (5) had earlier reported that fermentation of corn cobs with *Aspergillus flavu, Aspergillus fumigatus* and *Apergillus niger* resulted in increased crude protein and reduced crude fibre fractions. The determination of blood component values is important for diagnosing several diseases and dysfunctions, as they provide reliable results, and may also give inputs for research studies on nutrition, physiology, and pathology (6).

The objectives of this study are to evaluate the performance and blood profile of broiler chickens fed diets containing solid state fermented corn-cobs.

MATERIALS AND METHODS

Experimental site: The experiment was carried out at the Poultry Unit of the Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso, Nigeria.

Collection and Preparation of test ingredient:
Corn cobs were sourced locally from the freshly harvested dried maize shelled at the Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso. Corn cobs fermented by the procedure described by (5) were used for the experiment.

Experimental Animals and Management: Two hundred (200) day old Marshall Strain of broiler chicks were used for the experiment. The chicks were weighed and randomly assigned to five dietary treatments. Each treatment was replicated four times with ten birds each to make a total of 40 chicks per treatment in a completely randomized design experiment. The birds were supplied feed and water *ad libitum* for four (4) weeks. The gross composition of the experimental diets is presented in Table 1.

Table1: Gross Composition of Experimental Broiler Starter Diets (%)

INGREDIENTS	T1	T2	T3	T4	T5
Maize	42.00	43.00	43.00	43.00	43.00
Soy bean meal	32.50	39.05	39.05	39.05	39.05
Palm kernal cake	2.00	2.00	2.00	2.00	2.00
Breweres dried grain	7.55	2.00	2.00	2.00	2.00
Fishmeal	2.00	2.00	2.00	2.00	2.00
Wheat offal	10.00	-	-	-	-
Corn cobs (Untreated)	-	10.00	-	-	-
Corn cobs treated with Fungi A	-	-	10.00	-	-
Corn cobs treated with Fungi B	-	-	-	10.00	-
Corn cobs treated with Fungi C	-	-	-	-	10.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Vitamin-Mineral Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.20	0.20	0.20	0.20	0.20
Total	100.00	100.00	100.00	100.00	100.00

T1: Positive Control diet (without corncobs), T2: Negative control (with unfermented corncobs), T3: *Aspergilus niger* fermented corn cobs, T4: *Aspergilus fumigatus* fermented corn cobs, T5: *Aspergilus flavus* fermented corn cobs

Data collection
Performance characteristics
The initial body weight(g) of the birds were taken on arrival with the use of a sensitive scale. Data on performance parameters were calculated according to the procedure of (7).

Blood Analysis:
At the 4th week of the experiment, blood samples were collected from two (2) birds per replicate. The blood samples meant for haematological studies were collected into EDTA tubes containing Ethylene Diamine Tetra-acetic acid as anti-coagulant, while the blood samples for biochemical measurements were collected into EDTA free tubes and allowed to clot for the separation of the serum from the clot. The hematological parameters to be measured include; Pack Cell Volume (PCV), The Hemoglobin (Hb) concentration which include; Mean Cell Hemoglobin (MCH), Mean Corpuscular Volume (MCV) and Mean Corpuscular Hemoglobin Concentration (MCHC) will be analyzed using sysmex KX-21N (Automated Hematological

Analyzer). Mean corpuscular hemoglobin concentration (MCHC) was computed according to the methods of (8) and alkaline phosphatase (ALP) were determined according to the technique of (9).

Statistical Analysis

The data collected was subjected to analysis of variance using the general linear procedure (GLM) of (10) and means were compared using Duncan's multiple range test of the same package.

RESULTS AND DISCUSSION

The growth performance of 4 weeks old broilers fed dietary inclusion of solid state fermented corn cob is presented in Table 2.

The final weight gain, Total weight gain, Daily weight gain, Daily feed intake and Feed:gain ratio were significantly (P<0.05) affected by the dietary inclusion of solid state fermentated corn cobs. Broilers fed positive control diet (T_1), those fed corn cobs fermented *with Aspergilus niger* (T3) and those fed corn cobs fermented with *Aspergillus fumigatus* (T_4) had similar final weight gained, total weight gain and daily weight gain which was higher than other diets containing corncobs. This showed that corn cobs fermentation with *Aspergilus niger* and *Aspergillus fumigatus* had significant effect on dietary treatments.

Table 2: Effect of dietary inclusion of solid state fermented corn cobs on performance of broiler at 4 weeks

Parameters	T_1	T_2	T_3	T_4	T_5	SEM
Initial weight (g)	33.40	32.40	35.20	34.67	34.27	0.30
Final weight (g)	599.57^{a}	558.90^{c}	589.57^{a}	597.73^{a}	568.40^{b}	6.09
Total weight gain (g)	566.17^{a}	524.63^{c}	554.37^{a}	565.53^{a}	533.73^{bc}	6.14
Daily weight gain (g)	20.22^{a}	18.73^{c}	19.79^{a}	20.19^{a}	19.06^{b}	0.22
Daily feed intake (g)	47.46^{c}	49.77^{a}	48.36^{b}	47.56^{c}	48.36^{b}	0.13
Feed: gain ratio	2.44^{c}	2.60^{a}	2.54^{b}	2.47b^{c}	2.59^{a}	0.12

^{abc} Means with similar superscripts along the same row are not significantly (P > 0.05) different.

T_1= Positive Control diet (without corncobs), T_2= Negative control (unfermented corncobs),T_3=*Aspergilus niger*fermented corn cobs,T_4= *Aspergilus fumigatus*fermented corncobs, T_5= *Aspergilus flavus*fermented corn cobs

Birds fed Negative control (T2) had the lowest final weight gain value (558.90g). This agrees with (11) that high crude fibre is a factor that causes depressing nutrient availability, absorption and utilization. This is because fibre entraps nutrients in insoluble complex in the cell wall of plants thus resisting its utilization by the endogenous enzyme in the gastrointestinal tract (GIT) of poultry (12)(13). Birds fed T1 and T4 had the highest (P<0.05) daily weight gain (20.22g and 20.19g respectively) with the lowest (p<0.05) daily feed intake value (47.46g and 47.56g respectively). The birds on T2 and T5 had the highest value (2.60 and 2.59 respectively) for Feed conversion ratio. This result corroborate the findings of (14) who reported that fermentation of corncobs using rumen filtrate resulted in an improvement in crude protein and reduction in crude fibre. The reduction in the crude fibre content of corncobs is an indication of secretion of cellulose/hemi cellulose degrading enzymes by the fungus during fermentation, several fungi including *Aspergillus niger*, *Trichoderma spp*, have been reported to degrade cellulose/hemicellulose in similar manner (15).

The haematological and serum biochemistry parameters of the birds fed dietary inclusion of solid state fermented corn cob are presented in Table 3. The Dietary treatment had significant (p<0.05) effect on haematological parameters. Haemoglobin (Hb) and WBC values of T_2 (untreated corncobs) were significantly (P<0.05) lower than those at T_1, T_3 and T_4. The red blood cell indices (MCHC, MCV and MCH) showed significant differences (p<0.05) for each treatment.

The significant reductions in the haematological values PCV, RBC, Hb, MCH, MCV, MCHC contents of the blood of broiler chicks in T_2 may be an indication that the oxygen carrying capacity of the animal's blood was reduced (16). (17) had earlier reported that inclusion of fibrous ingredients due to their inferior nutritional quality will frequently lower blood parameters (PCV, RBC, Hb, MCH, MCV, MCHC). However,

most of the haematology values obtained fell within the normal range of values enunciated by Mitruka and Rawsley (18) and (3) for broiler chicken implying sufficient nutrition and absence of adverse reactions from the test ingredient.

Table 3: Effect of dietary inclusion of solid state fermented corn cobs on haematology and serum biochemistry of broiler chicks at 4 weeks of age

Parameters	T_1	T_2	T_3	T_4	T_5	SEM
Haematology						
PCV (%)	26.84	25.82	25.90	25.94	25.84	0.16
Hb (%)	9.77^{a}	8.82^{b}	9.20^{a}	9.33^{a}	9.00^{a}	0.14
RBC(10^{12}/L)	2.43	2.82	2.33	2.33	2.26	0.16
WBC(10^{9}/L)	16.49^{a}	14.91^{b}	15.99^{a}	16.16^{a}	15.81^{a}	0.27
MCHC (Pg)	36.50^{a}	34.99^{b}	35.69^{a}	36.02^{a}	35.50^{b}	0.03
MCH (Pg)	43.19^{a}	37.17^{c}	39.48^{b}	40.76^{b}	39.18^{b}	0.06
MCV (fl)	119.91^{a}	104.14^{c}	110.64^{b}	115.00^{b}	107.34^{c}	0.07
Serum Biochemistry						
TP (g/dl)	3.94	2.99	3.83	3.87	3.65	0.13
ALB (g/dl)	1.60	1.34	1.48	1.57	0.42	0.11
TG (g/dl)	2.49	1.57	2.44	2.46	2.08	0.15
Cholesterol (mg/dl)	91.98^{a}	61.54^{b}	90.17^{a}	72.54^{b}	69.38^{b}	0.49
Triglyceride (mg/dl)	95.52^{a}	56.07^{b}	84.33^{a}	61.36^{b}	58.21^{b}	0.42
ALT (u/L)	13.67^{c}	22.33^{a}	16.67^{b}	14.33^{c}	18.00^{b}	0.34
AST (u/L)	110.74^{d}	383.80^{a}	163.06^{c}	140.03^{e}	181.07^{b}	0.87
ALP (u/L)	48.33^{d}	72.33^{a}	58.33^{c}	51.00^{d}	67.00^{b}	0.83

^{abcd} Mean with similar superscripts along the same row are not significantly (P > 0.05) different

T_1= Positive Control diet (without corncobs), T_2= Negative control (unfermented corncobs),T_3=*Aspergilus niger*fermented corn cobs, T_4= *Aspergilus fumigatus*fermented corncobs, T_5= *Aspergilus flavus*fermented corn cobs.

PCV=parked cell volume, Hb= Haemoglobin, RBC = Red blood cell, MCV=Mean corpuscular volume, MCH= mean corpuscular haemoglobin, MCHC = mean corpuscular haemoglobin concentration, WBC=white blood cell, TP=Total protein, TG=Total globulin. ALB=Albumin, ALP= Alanine phosphatase, AST = Aspartate amino acid transferase, ALT = alalnine amino acid transferas .

Cholesterol and triglycerides values in birds fed the positive control Diets T_1 were similar for those on T_3 (ANC) T_4 (AFMC), and T_5 (AFC) but higher ($p<0.05$) than T_2 (untreated corn cob). T_2 (untreated corn cob) however, was higher ($p<0.05$) for all serum enzymes (22.33u/L, 283.80 u/L, 72.3 u/L) for ALT, AST and ALP respectively. This agrees with the report of (19) that serum biochemical constituents are positively correlated with the quality of the diets.

CONCLUSION AND APPLICATION

Corn cobs, typically considered waste due to their high fiber content, can become a valuable nutritional component in animal feed through solid-state fermentation. This process boosts protein levels and lowers crude fiber content. Among various fermentation treatments, using *Aspergillus fumigatus* on corn cobs yielded the best results, with *Aspergillus niger* coming in second.

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Monogastric Animal Production: MGP 008

GROWTH PERFOMANCE AND ECONOMIC OF REPLACING CONCENTRATE DIET WITH HYDROPONIC MAIZE FODDER ON WEANER RABBITS.

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ABSTRACT

A 56 days feeding trial was conducted with 30 weaner rabbits to evaluate the effect of replacing concentrates diet with hydroponic maize fodder (HMF) on the growth performance and economy of rabbit production. The rabbits were randomly allocated to 5 treatment groups in a completely randomize design; each treatment replicated 3 times, having 2 rabbits per replicates. The replacement levels of HMF was 0% (100% conc), 30% (70% conc), 40% (60%), 50% (50% conc) and 60% (40% conc.). The parameters measured were initial weight, final weight, average daily feed intake, live weight changes, feed conversion ratio and total feed intake. Results on the performance shows dietary treatment had significant effect ($P<0.05$) on average daily feed intake and total feed intake. There was no significant different ($P>0.05$) on FCR, final body weight and total weight gain. *T*he economy of production revealed that the cost kg feed decreased as the level of HMF is increased. The best cost per kilogram of weight gain was obtained by rabbits fed T4 (50% concentrate + 50% HMF) diet while the poorest was recorded by rabbit in T1 (100% conc+0%HMF). Therefore 50% of HMF can replace up 50% without adverse effect on growth and economic performance. It was therefore concluded that 50% of hydroponic maize fidder can replace up 50% of concentrate without adverse effect on growth performance and haematological profile of rabbits.

Key words: Hydroponic Maize Fodder, Weaner Rabbits, Growth performance, Concentrate diet.

INTRODUCTION

The high cost of feed coupled with the ignorance of possible alternative and cheap feed ingredients are among important factors militating against increased commercial rabbit production in Nigeria. However, these have encouraged efforts of researches being directed towards finding and using alternative feed resources that are less competed for by humans, readily available and cheap. These can partly substitute the conventional feed stuffs in rabbits and other livestock diets. Identification of forage that has high nutritive value that could replace or reduce the need for concentrate feeding will keep the cost of rabbit production low and sustain growing interest as reported by [1]. The major factors responsible for the shortage of green fodder are scarcity of land due to small land holding size, water shortage and labour [2]. A possible way of solving this problem of feed scarcity in livestock industry is through the use of hydroponic farming systems. Fodder produced by growing plants in water or nutrient rich solution but without using any soil is known as hydroponics fodder, sprouted grains or sprouted fodder [2]. Production of hydroponics fodder involves growing of plants without soil but in water or nutrient rich solution in a greenhouse for a short duration approximately 7 to 9 days [3]. Hydroponics fodder is more palatable, digestible and nutritious, thus imparting other health benefits to the animals [4]. A yields of 5 to 6 folds of fresh hydroponics maize fodder in seven days [5]. Therefore, the objective of this study is to determine the effect of replacing concentrate diet with hydroponic maize fodder on the performance and economy of weaner rabbit production.

MATERIALS AND METHODS

The Experimental Site

The experiment was carried out at the Teaching and Research Farm of the Department of Animal Science and Range Management, Modibbo Adama University, Yola. The University is Located in Girei Local Government Area. Girei is located in Adamawa state at latitude 9.140 North and longitude 12.80 East. It has

a tropical climate with distinct dry and wet seasons. It has a seasonal change in temperature from January to December. The maximum temperature is 43^0C which occur in April and the minimum temperature is 180C between December and January. The average annual rainfall is put at about 960mm with the highest occurrence in August and September [6].

Experimental Animals and Management

The study was conducted using thirty (30) weaner rabbits aged 6 to 7 weeks and the animals were obtained from local market within Jalingo metropolis in Taraba State. The animals were dewormed with coopane® dewomer which is brand of piperazine® to eliminate any anticipated worms that might have infested the animals. The rabbits were individually housed in cage and equipped with feeding and watering troughs. A total of 100g of the experimental diet and the hydroponic maize fodder were given daily to the animals, and fresh water was provided *ad libitum.* The experiment lasted for eight (8) weeks after a period of one-week adaptation.

Experimental Design and Treatment

The design of the experiment was a Completely Randomized Design (CRD). The rabbits were allocated to five (5) treatments and each treatment was replicated three (3) times. Treatment one (T1) was fed 100% concentrate diet (conc. 100%) and 0% hydroponic maize fodder (0% HMF) which served as a control. Treatment two (T2) was fed 70% concentrate (conc. 70%) and 30% hydroponic maize fodder (30% HMF). Treatment three (T3) was fed 60% concentrate (conc. 60%) and 40% hydroponic maize fodder (40% HMF). Treatment four (T4) was fed 50% concentrate (conc. 50%) and 50% hydroponic maize fodder (50% HMF). Treatment five (T5) was fed 40% concentrate (conc. 40%) and 60% hydroponic maize fodder (60% HMF).

Experimental Concentrate Diet

The ingredients for formulating the experimental diet (concentrate) consisted of maize grain, maize bran, groundnut cake (GNC), groundnut haulms, fish meal, salt, bone meal, and premix. The composition and the calculated analysis of the experimental diets are shown in Table 1.

Table 1: Composition of Experimental Diet (Concentrate)

Ingredients	Percentage
Maize	32.45
Maize bran	17.90
GNC	16.00
Fish meal	5.00
Groundnut haulms	28.00
Salt	0.30
Bone meal	0.10
Premix	0.25
Total	**100**
Calculated Analysis	
Crude protein	17.53
Crude fibre	9.95
Ether extract	4.13
Metabolizable energy (kcal/kg)	2536.37
Sodium	0.118
Chlorine	0.18

Chemical Analysis

The Proximate analysis of hydroponic maize fodder samples was determined for dry matter (DM), crude protein (CP), crude fibre (CF), ether extract (EE) and ash. According to [7]

Growth Parameters Measured

Parameters measured during the feeding trial include initial live weight, weekly weight gain which was used to derive the average daily gain, and feed intake.

Statistical Analysis

All Data collected were subjected to Analysis of Variance (ANOVA), using Completely Randomized Design (CRD), and means differences were separated by Turkey using [8] version 10. A significance value of Alpha=0.05 was used to distinguish significance differences between treatments

RESULT AND DISCUSSION

Table 2: Effects of Feeding Hydroponic Maize Fodder on The Performance of Rabbits

Performance parameters	T1	T2	T3	T4	T5
Initial weight (g)	496±61.13	430.67±59.11	466.67±63.59	420±45.12	479.00±1.00
Final weight (g)	984.7±150.3	835.3±96.96	900.00±93.04	887.3±28.11	881.3±10.89
TWG (g)	488.7±89.67	404.67±38.32	433.33±29.45	467.00±61.55	402.33±10.17
ADFI(g)	59.26±1.36^{a}	55.82±1.75^{ab}	54.65±0.90^{ab}	54.72±1.17^{ab}	52.72±0.32^{b}
TFI (g)	2985±64.66^{a}	2609±82.02^{ab}	2598.67±42.48^{ab}	2571.67±55.19^{ab}	2477.64±15.17^{b}
FCR	6.10±1.27	6.45±0.68	5.99 ±0.36	5.50±0.72	6.15±0.12

Note: means bearing different superscripts within same row differ significantly (P<0.05)
FCR = Feed conversion ratio, ADFI = Average daily feed intake, TWG = Total weight gain
TFI = Total feed intake

Performance of Rabbits fed Hydroponic Maize Fodder

The results of hydroponic maize fodder on the performance of weaner rabbits are shown in table 2. There was no significant (P> 0.05) difference in initial body weight, final body weight and feed conversion ratio, whereas there was significance difference (P< 0.05) across the treatment in average daily feed intake and total feed intake. Feed dry matter intake is the amount of feed consume by the rabbit. The feed intake of rabbits in the present study decreased as the level of hydroponic maize fodder increased. Rabbits fed treatment 1 obtained a daily feed intake of 59.29g, T2 (55.82g), T3 (54.65g) and T5 (52.72g). This result is contrary to the findings of [9] who reported that dry matter intake increased as the level of hydroponic maize fodder increases when concentrate was replaced with hydroponic maize fodder. However, the results of this present study is in agreement with the findings of [10] who observed that it is not the hydroponic fodder that reduces dry matter intake, but the levels of sprouted grains used which might be responsible for the reduced feed intake. The range of total weight gain values recorded in this study (402.33 to 488.70g) disagreed with the findings of [9] who reported significant difference in total weight when they fed hydroponic maize fodder to Rabbits. The value of total weight gains in this present study (402.33 to 488.70g) is lower than 947.3g reported by [12], but much higher than (262 to 410g) reported by [9]. The results of present study agree with the findings of [10] who fed hydroponic wheat sprouted fodder to turkey. According to the present result, hydroponic Maize fodder has positive effect on live weight gains up to 50%, similarly, [2] also notice that, the higher performance in the body Weight gain of animals fed 40% hydroponic fodder could be due to the ability of the feed to supply necessary nutrients. The author also reported an increase in weight gain of lambs received hydroponic sprouts fodder may be attributed to enhancing of microbial activity in the rumen. The result of feed conversion ratio in the present study is in agreement with the findings of [9] who reported that replacement of concentrate with Hydroponic Maize fodder of up to 50% gave better FCR.

The Economy of Replacing Concentrate Diet with Varying Levels of Hydroponic Maize Fodder

It was observed that the cost of feed (₦/kg) decreased as the level of hydroponic maize fodder increased. Treatment (T1) had the highest cost of feed of ₦83.65/kg, while treatment five (T5) recorded the least cost of ₦48.46. The lower cost of feed obtained as the level of inclusion or replacement of hydroponic maize fodder (HMF) increased could be attributed to the lower cost of hydroponic maize fodder production compared to the cost of concentrate feed. The cost/kg gain in this present study is better than the one reported

by [13] when they fed different levels of cowpea tester meal which replaced wheat offal. Therefore, the cost/kg of feed decreased with increased levels of hydroponic maize fodder. The cost of feed intake (₦) was observed to be higher (₦233.38) in treatment three (T3) followed by treatment two (T2) ₦172.42, while treatment five (T5) had the least cost of total feed intake of ₦120.18. The variation in the total feed cost was as a result of the differences recorded in the total feed intake (kg/rabbit) and feed cost (₦/kg) in various treatment groups. The study is in agreement with the findings of [9] who replaced concentrate mixture with hydroponic maize fodder in New Zealand white rabbit's kids and revealed that feeding hydroponic maize fodder considerably reduces cost of feeding rabbits.

Table 3: Economy of feeding Hydroponic maize fodder

Parameters	**T1 (0%HMF)**	**T2 (30% HMF)**	**T3 (40%HMF)**	**T4 (50%HMF)**	**T5 (60% HMF)**
Total feed intake (kg	2.98	2.61	2.57	2.57	2.48
Total weight gain (kg)	0.49	0.40	0.43	0.47	0.40
Cost/kg feed (₦)	83.65	66.06	60.19	54.33	48.46
Total feed cost (₦)	233.38	172.42	154.69	139.63	120.18
Feed Cost/kg gain (₦)	476.29	431.01	359.74	297.09	300.45

CONCLUSION

It may be concluded that rabbits can be fed hydroponic maize fodder up to 60% without any effects on growth performance. In this study rabbit in treatment four (T4) which are fed 50% concentrate and 50 % hydroponic maize fodder showed better feed conversion ratio (5.50), total weight gain (467.00g) and low cost of production (N300). Thus, this study suggest that hydroponic maize fodder can be included in the diet of rabbit up to 50% level without any deleterious effect on the growth performance with concomitant reduction in cost of production and can successfully replace concentrate feed in rabbit diet as far as nutritional and health status of rabbits are concern.

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Monogastric Animal Production: MGP 009

EFFECT OF DIFFERENT LITTER MATERIALS ON PERFORMANCE OF BROILER STARTER CHICKS

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ABSTRACT

A four-week study was carried out to determine the effect of different litter materials used for raising broiler starter chicks. A total of 204 day-old broiler chicks of Ross 308 strain were used on a completely randomized design with four treatments of different deep litter materials comprising of wood shavings, rice husk, corn cobs and wheat straw. Each treatment had three replicates consisting of 17 birds/ replicate. A standard diet was compounded. Feed and water was provided *ad libitum*, vaccinations and management practices were adhered to. Significant differences (P<0.05) were recorded for final weight (1018g), weight gain (980g), daily weight gain(35g), feed intake(1531.93g), feed conversion ratio (1.56) for birds raised on wheat straw. Corn cobs and rice husk were similar but significantly (P<0.05) higher than wood shavings. The lower weight values recorded on chicks raised on wood shavings must have been as a result of the low feed intake (1466.18g). Feed cost/kg gain and litter cost/kg gain were significantly (P<0.05) the best on chicks raised on wheat straw, rice husk was better than corn cobs and wood shavings. It was concluded that any of the three bedding materials (wheat straw, corncobs and rice husk) may be used as litter material though wheat straw showed promising potential for enhancing weight gain. These materials are cheap and locally available to the poultry farmers where these crops are cultivated.

Keywords: Chicks, wheat straw, corncob, rice husk, wood shavings

INTRODUCTION

Poultry house management is essential to obtaining maximum broiler production potential. One of the management practices is the proper maintenance of poultry litter
[1]. Litter plays a vital role in absorbing the fecal moisture, promotes drying by increasing surface area of the house floor, insulates chick from cooling effects of the ground and provide a protected cushion [2]. A variety of litter material including paper products [3], hardwood bark [4], sand [5], rice and wheat straw [6], ground corn cob and soybean straw [7] have been used as substitute bedding materials with various level of success. Wheat straw and corncobs are usually left or burned on farms after harvest which prompted the aim of this study.

MATERIALS AND METHODS

Location

The experiment was conducted at the poultry unit of the Teaching and Research farm, Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University, Samaru-Zaria, within the Northern guinea savanna zone on latitude 11^0 9' 45"N and longitude 7^0 38' 8"E,on an altitude of 610m above sea level [8].

Experimental Materials and Sources

Four different litter materials were used for this experiment; Wood shavings (WDSHV), Rice husk (RHSK), Corn cobs (CCOB) and Wheat straw (WHST). Wood shavings and rice husk were sourced from timber shed and rice millers respectively while corn cobs and wheat straw were sourced from farms after harvest in the experimental area

Experimental birds, design, feed and management

A total of 204 day-old chicks were used for this study. The chicks were randomly allocated to four treatments (containing wood shavings, rice husk, corncobs and wheat straw as the litter materials) having three replicates each containing 17 birds per replicate in a completely randomized design. Birds were raised in a deep litter poultry house. Standard isocaloric and isonitrogenous diet was compounded (Table 1) and feed and water were provided *ad libitum.* Heat and light were provided throughout the brooding period using kerosene stoves, electric bulbs and charcoal. Routine vaccines were administered.

Data collection and analysis

On arrival, birds were weighed for initial weight and subsequent weight was taken at weekly intervals for four weeks. Feed was weighed weekly, given to the birds and remnant at the end of the week was weighed and computed for a veragefeed intake, average weight gain, average daily weight gain, average daily feed intake and feed conversion ratio were calculated. Data obtained were subjected to analysis of variance using the SAS package [9] and means were separated using the Duncan's multiple range test.

Table 1: Ingredient Composition of Experimental Diet

Feed Ingredients (%)	**Starter (**
Maize	51.00
Soyabean cake	28.75
Groundnut cake	11.00
Maize offal	5.00
Limestone	0.50
Bone meal	3.00
Salt	0.25
Premix*	0.25
Lysine	0.05
Methionine	0.20
Total	100
Calculated Analysis	
ME (kcal/kg)	2920
Crude protein (%)	23.39

*Premix supply per kg of diet: vit. A,10000iu; vit D_3 2000iu; vit E 23mg; vit K 2mg; calcium pantothenate 2.5mg; vit B_{12},0.051mg; Folic acid 0.75mg; Chloride 300mg; vit B_1 1.8mg; vitB_2 5mg; manganese 40mg; iron 20mg; zinc 30mg; copper 3mg; iodine 1mg; cobalt 0.2mg.

RESULT AND DISCUSSION

Table 2 shows the effect of different litter materials on performance of broiler chicks. Body weight of chicks at 28 days was significantly ($P<0.05$) affected by litter type. Chicks raised on wheat straw had the highest final weight (1018.96g), weight gain (980.96g) and daily weight gain (35.03g) which was significantly ($P<0.05$) different from other chicks raised on corncobs, rice husk and wood shavings. Chicks raised on corncobs and rice husk were statistically the same on final weight, weight gain and daily weight gain though both were superior to those raised on wood shavings. The weight differences can be attributed to bedding type as it significantly affects growth performance and carcass quality when broilers were raised on pine shavings and sand as stated by [9] [10] and beneficial effects of certain types of litter material (newspaper) on body weight have been reported by [12] [13]. Body weight of broilers at 42 days was significantly ($P < 0.05$) affected by the litter type as broilers grown on the rice hulls litter had the lowest body weight compared

to other litters [14].This study suggests that, wheat straw is a promising litter or bedding material which may lead to superior growth performance in broiler chicks and minimal dust generation compared to other materials, though corncobs and rice husk all performed better than wood shavings.

Table 2: Effect of different litter materials on performance of broiler chicks (0-4 weeks)

Parameters	WDSHV	RHSK	CCOB	WHST	SEM
Initial weight (g/b)	38.07	38.00	38.03	38.00	0.12
Final weight (g/b)	946.88^{c}	982.35^{b}	987.42^{b}	1018.96^{a}	9.02
Weight gain (g/b)	908.81^{c}	944.35^{b}	949.38^{b}	980.96^{a}	9.09
Daily weight gain (g/b)	32.46^{c}	33.73^{b}	33.91^{b}	35.03^{a}	0.32
Total feed intake (g/b)	1466.18^{b}	1501.27^{ab}	1529.69^{a}	1531.93^{a}	18.82
Daily feed intake (g/b)	52.36^{b}	53.62^{ab}	54.63^{a}	54.71^{a}	0.67
Feed conversion ratio	1.61^{b}	1.59^{ab}	1.61^{b}	1.56^{a}	0.02
Feed cost / kg gain (₦/kg)	968.11^{c}	954.07^{b}	967.15^{c}	937.04^{a}	4.76
LC/kg gain (₦/kg)	112.95^{d}	55.65^{b}	80.60^{c}	46.85^{a}	3.61

^{abcd}Means with the same superscripts along the rows are not significantly different (p>0.05), SEM: standard error of means. WDSHV : Woodshavings, RHSK: Rice husk, CCOB: Corncobs, WHST: Wheat straw, SEM: Standard error of means.

This result agrees with the findings of [15], who reported significantly different (P<0.05) feed efficiency and weight gain for broilers reared on chopped wheat straw and mixture of sawdust and whole wheat straw than wood shavings and rice hulls. It was observed that birds reared on wood shavings consumed apparently less feed that also resulted in less weight as compared to corn cob and wheat straw raised chicks. Rice husk raised chicks were statistically (P>0.05) similar to all treatments. Daily feed intake followed the same trend. The lower weight parameters recorded on chicks raised on wood shavings could be attributed to the depressed feed intake as compared to chicks raised on other litter materials which supports the findings of [15] who reported low weight gain on birds raised on rice hulls as a result of depressed feed intake. The best feed conversion ratio was recorded on chicks raised on wheat straw (1.56) which differed significantly (P<0.05) to corn cobs and wood shavings but the values for wheat straw and rice husk were statistically the same. Feed cost/kg gain and Litter cost/kg gain were statistically (P<0.05) superior to other litter materials as wheat straw was gotten at little or no cost. Corncobs and rice husk were cheaper compared to wood shavings.

CONCLUSION

The results of this experiment demonstrated that broiler chicks reared on wheat straw, corn cob and rice husk performed better than those reared on wood shavings in terms of weight gain and feed conversion ratio, feed cost/kg gain and litter cost/kg gain and can replace wood shavings where they are locally available.

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Monogastric Animal Production: MGP 010

PERFORMANCE CHARACTERISTICS AND NUTRIENT DIGESTIBILITY OF GROWING RABBITS FED DIETS WITH PELLETISED CASSAVA PEEL MEAL

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ABSTRACT

An eight weeks feeding trial experiment was conducted to determine the performance characteristics and nutrient digestibility of growing rabbits fed diets with varying inclusion levels of pelletized cassava peel meal. A total number of twenty growing rabbits of chinchilla breed were allotted to four dietary treatments in a Completely Randomized Design (CRD). Data were collected on performance characteristics (weight gain, feed intake, and feed conversation ratio) and analysed using analysis of variance, and the mean was separated using Duncan multiple range test. Study showed that there were no significant ($p>0.05$) differences in all the parameters measured for performance characteristics across the dietary treatments except for the weekly feed intake and weekly weight gain. The nutrient digestibility showed significant ($p<0.05$) differences in crude protein retention, crude fibre and fat. However, there was no significant ($p>0.05$) differences in ash and NFE digestibility. Furthermore, it was observed that rabbits fed 20% and 30% inclusion levels of CPM had no significant ($p>0.05$) differences across the parameters considered, in addition, they had the highest digestibility values in all the parameters which ranged between (96.67% to 99.00%). An inclusion level of 20% CPM had no deleterious effect on the growth performance and nutrient digestibility of growing rabbits

Keywords*:* Performance, Digestibility, Pelletised, Cassava peel meal

INTRODUCTION

The rabbit industry holds outstanding potentials that can be exploited to solve the shortage of premium animal protein in most developing countries like Nigeria. The population of rabbit in Nigeria as at 1993 was estimated to be 1.7million (Nigeria Tribune 1993). Rabbits can be considered as one of the several species quite suitable for meat production.

The majority of feed types, particularly energy sources used in animal nutrition are based on ingredients such as maize, millet, sorghum and soybeans, which compete directly with human feeding and have high market costs. However, to make rabbit production more sustainable, there must be a solid promotion for the development of alternative feed ingredients that would be relatively cheaper when juxtaposed with conventional feed stuffs. One of such alternative feed ingredients is cassava peel.

Pelletisation is also a potential technique to enhance the utilisation of cassava peel by reducing ant nutritional factors and improving its digestibility. The pelletised nature of the cassava peels meal makes it more desirable for use in rabbit feeding. It also reduces dustiness which causes irritation of the respiratory tract (3), and prevents selective feeding. The objective of this study was therefore, to determine the effect of diets containing varying inclusion levels of pelletised cassava peel meal on the growth performance characteristics and nutrient digestibility of growing rabbits.

MATERIALS AND METHODS

Experimental Location

The experiment was carried out at the Rabbit Unit of the Teaching and Research Farm of the Olusegun Agagu University of Science and Technology (OAUSTECH), Okitipupa, Ondo State, Nigeria.

Experimental animals and design

A total of twenty growing rabbits were purchased from the Federal College of Education Osiele, Abeokuta Ogun State. On arrival, the initial weight of the rabbits were recorded, and the rabbits were fed a common ration (control diet) for two weeks so as to adapt to the environment. However, after two weeks of adaptation, the rabbits were allotted on weight equalization into four treatments of five rabbits and each treatment were replicated three times with two rabbits each in a Completely Randomised Design (CRD).

Experimental diets

Four different experimental diets containing varying inclusion levels of CPM were formulated for twenty growing rabbits for a period of eight weeks. The control diet (Diet 1) contained 0% cassava peel meal while diets 2, 3 and 4 contained 10%, 20% and 30% cassava peel meal (CPM) respectively (Table 1). All the diets contained the same amount of other ingredients. The rabbits were fed based on their body weight and water was allowed *ad libitum* in concrete feeding and watering troughs for a period eight weeks.

Data Collection

Data collected on performance characteristics and nutrient digestibility were subjected to statistical analysis to determine the effect of varying inclusion levels of pelletised cassava peel meal.

RESULTS AND DISCUSSION

Table 1 shows that there were no significant ($p>0.05$) differences in the initial weight, final weight and feed conversation ratio (FCR). Rabbits fed diet containing 0% CPM had higher feed conversion ratio of 4.84 than their counterparts fed 10%, 20% and 30% CPM respectively. Hence, they had the least performance. The increase in fibre level brought about a decrease in body weight gain while feed conversion ratio increased with a decrease in daily feed intake (7). However, the best feed conversation ratio (FCR) value of 3.7 was obtained from rabbits fed diet containing 20% CPM. This finding was in line with the range of values reported by (10). However, when the protein need of rabbit is balanced in the feed and there is adequate supply of fibre using feed material such as cassava peel meal that contains also some levels of protein 3-5% (6), rabbit will attempt to increase its voluntary feed intake to satisfy its energy needs, and thus dry matter feed conversion is also improved. Furthermore, Cassava peel meal contains cyanogenic compounds which may leads to growth retardation and impaired reproductive capability to death (8).

Table 1: Effect of diets containingpelletised cassava peel meal at varying inclusion levels on performance characteristics of growing rabbits

	Inclusion levels of cassava peel meals				
Parameters	**T1(0%)**	**T_2(10%)**	**T_3(20%)**	**T_4(30%)**	**SEM**
Initial weight (g)	700.00^{a}	690.67^{a}	677.33^{a}	705.67^{a}	15.62
Final weight gain (g)	4750^{a}	4500^{a}	4800^{a}	4200^{a}	0.12
Weekly weight gain (g)	570.37^{a}	476.20^{ab}	515.37^{ab}	428.67^{b}	21.29
Weekly feed intake (g)	1206.06^{b}	1057.92^{b}	1535.84^{a}	1043.96^{a}	64.18
Feed conversion ratio (FCR)	4.84^{a}	4.46^{a}	3.72^{a}	4.44^{a}	0.23

.^{ab}means of difference superscript along the same row are statistically significant ($p<0.05$), SEM= standard error of mean

The lower weekly feed intake and weekly weight gain of rabbits fed inclusion level of 30% cassava peel meal when compared to other treatments were similar to the growth depression recorded by (1 and 4) in

rabbits due to the dietary inclusion of cassava peel and cyanide, respectively. These findings indicated that rabbits may not be able to tolerate the inclusion of CPM at 30% without experiencing growth depression.

The apparent nutrient digestibility (%) observed in rabbits fed diet containing 20% and 30% CPM showed that they had better nutrient digestibility than those fed 0% and 10% respectively (Table 2). However, the digestive health (mortality and morbidity) of rabbit is reliant on the level and quality of fibre content of the feed. A fibre deficient diet weakened significantly the digestive health of growing rabbits.

Table 2: Effect of diets containingpelletised cassava peel meal at varying inclusion levels on nutrient digestibility of growing rabbits.

	Inclusion levels of cassava meals				
parameters	**T1(0%)**	**T_2(10%)**	**T_3(20%)**	**T_4(30%)**	**SEM**
Crude protein %	93.33^{ab}	87.67^{b}	99.00^{a}	99.00^{a}	1.95
Crude fiber %	78.00^{a}	34.67^{b}	96.67^{a}	99.00^{a}	9.54
Fat (%)	91.33^{a}	36.67^{b}	99.00^{a}	99.00^{a}	8.74
Ash (%)	65.33^{b}	80.33^{a}	99.00^{a}	99.00^{a}	6.88
NFE (%)	94.00^{a}	89.67^{a}	99.00^{a}	99.00^{a}	1.66

ab means of differences superscript along the same row are statistically significant ($p<0.05$), SEM (standard error of the means), NFE (Nitrogen free extract)

Also, digestive issues are also rather reduced when adequate digestible fibres are included in the feed. Adequate fibre in the feed of rabbits has positive effect on the fermentative activity in the guts. (5). Therefore, higher values of percentage digestibility of nutrients in favour of rabbits fed 20% and 30% CPM could also perhaps be accredited to the higher fiber levels in the diets. This may be the optimum range for efficient nutrient utilization. High percentage digestibility of fibre recorded in this present study was contrary to the decrease in percentage digestibility of fibre that was reported by (1). These differences may be as a result of type of fibre contained in the diets of rabbits in both studiesbecause fibres are more digestible than the others. The improved crude protein digestibility in this study were similar with the findings recorded by (8). This study showed that inclusion level of CPM up to 20% as energy source with some levels of protein is necessary for enhanced performance, reduced feed cost and it is highly digestible.

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GROWTH INDICES OFISA-BROWN PULLETS ADMINISTEREDDIETS CONTAINING GRADED LEVELS OF*Phyllanthus niruri* LEAF MEAL AT GROWER PHASE

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ABSTRACT

The use of chemical growth promoters as additives in spite of their adverse effects on animal has compelled researchers to source for natural alternatives such as phytogenic feed additives.For eighty-four (84) days, a completely randomised design experimental layout was utilised to examine the growth performance of layer chickens fed diets containing *Phyllanthus niruri* leaf meal (PNLM) as supplementation. The pullets ranged in weight from 500.00 to 552.50 g.Fifteen birds were used in each of the four replicates of the following treatments: T1 (0.0% PNLM), T2 (antibiotics), T3 (0.2% PNLM), T4 (0.3% PNLM), T5 (0.4% PNLM), and T6 (0.5% PNLM). The weekly weight gain, feed intake, feed conversion ratio, and ultimate body weight were the parameters that were assessed. The findings demonstrated a significant ($P<0.05$) impact of dietary interventions on every parameter assessed during the grower's phase except feed conversion ratio. The pullets fed 0.5% PNLM finished up weighing 1593.75 g, which was substantially different ($p<0.05$) from the 1525.50 g ultimate weight of the T1 (0%PNLM) diet. Inclusion of PNLM produced better results of weight gain in T5 (1056.25 g), average daily feed intake (83.52 g/day/bird) in T6, compared to T1 (0% PNLM).Pullet chickens fed up to 0.5% levels fared better than the control group.Consequently, it can be concluded that PNLM can be included in the diets of pullet chickens at grower phase up to 0.5% level without having a negative impact on the growth performances.

Keywords*:* Growth indices, *Phyllanthus niruri* leaf meal, Pullet chickens

DESCRIPTION OF PROBLEM

Growth promoters and feed additives are often used to eliminate harmful micro-organisms in the intestine as well as to improve growth and performance. Poultry birds' performance is mostly improved with antibiotics.Consistent antibiotic use will cause a multitude of health issues and also impact the cost of feed. Toghyani(1) proposed that alternatives to antibiotics need to be sorted for in order to replace them effectively and economically. As defined by (2), phytogenic feed additives (PFA) are compounds of plant origin incorporated into animal feedto enhance livestock productivity through the improvementof digestibility, nutrient absorption and elimination of pathogens resident in the animal gut.

In livestock production, herbs and spices are increasingly being used because of their pharmacological properties, including antibacterial, antiviral, antioxidant, anti-inflammatory, anti-fungal, antimicrobial, sedative, stimulating appetite, feeding intake, and activating the immune system (3).

Variety of these herbs and spices such as ginger, garlic, turmeric, cloves,moringa, had been widely used as alternatives to synthetic antimicrobial growth promoter in livestock and poultry production.

One of the potential herbal plants, *Phyllanthus niruri*, contains a number of bioactive molecules that have high pharmacological properties. *Phyllanthus niruri* is widely used for conditions such as jaundice, liver disease, fever, kidney disease, and prostrate issues due to its therapeutic efficacy as noted by (4).Investigations into the pharmacological properties of this plant's bark and leaves have revealed strong antimicrobial activity (5), anti-inflammatory properties (6), anti-diabetic effects (7), antioxidant properties (8), anticonvulsant properties (9), and antitumor (10).

It has also been indicated that *Phyllanthus niruri* possesses hepato-protective, antitumor, anticancer and antiviral (11). Study existing indicated that it has been used in gastrointestinal and respiratory disorders (12). In line of the various significant importance of *Phyllanthus niruri*, this study was conducted to evaluate the effect of dietary inclusions of *Phyllanthus niruri* leaf meal on the performance of pullet chickens at grower phase.

MATERIALS AND METHODS

Experimental Site

The experiment was carried out at the Livestock Research Unit of the Federal Polytechnic, Ilaro Agricultural Farm.

Harvesting and Processing of Test Ingredient

Phyllanthus niruri were harvested within and around the Polytechnic surroundings. The leaves were harvested and air-dried at room temperature for 4 days to obtain constant weight and then milled to form *Phyllanthus niruri* leaf meal.

Experimental Diets

Phyllanthus niruri leaf meal (PNLM) was incorporated into diets using a total of 360 day Isa brown pullets at grower phase for the study. The birds were allocated into six (6) treatments with each treatment containing of 60 birds each. The treatment was further divided into 4 replicates of 15 birds each and randomly assigned to one of the 6 nutrition regimen of Basal diet (without any additive) PNLM (T1) (control), basal diet + antibiotics (Tylo-Dox Extra WPS (T2), basal diet + 0.2% PNLM (T3), basal diet + 0.3% PNLM (T4), basal diet + 0.4% PNLM (T5) and basal diet + 0.5% PNLM (T6).

Management of Experimental Birds

The Isa brown pullets were 8 weeks old and reared for 12 weeks in a battery cage system in which they were fed experimental diets for 84 days. Feed and water were provided *ad libitum* for all treatment groups. Necessary vaccination schedule was done as at when due.

Data Collection

The following growth performance indices were measured and recorded:

Feed intake= total feed offered – total left over feed

$$\text{Average feed intake/animal} = \frac{\text{Feed offered in (g) – feed left over (g)}}{\text{Total number of birds in the group}}$$

Body weight gain:

$$\text{Average body weight gain (g/bird)} = \frac{\text{Final weight gain (g) – initial weight gain (g)}}{\text{Total number of birds in the group}}$$

Feed conversion ratio (FCR)**:**

$$\text{FCR} = \frac{\text{Total feed consumed (g)}}{\text{Total Weight gain (g)}}$$

Percentage mortality:

$$\text{Mortality (\%)} = \frac{\text{Number of dead birds}}{\text{Total number of birds}} \times 100$$

Statistical Analysis

Data collected on growth performance (feed intake, changes in body weight, feed conversion ratio)were subjected to One-way Analysis of Variance (ANOVA). Significantly different means were separated using Duncan's New Multiple Range Test (DNMRT) (13).

RESULTS AND DISCUSSION

Performance indices of Isa-brown pullet fed *Phyllanthus niruri* leaf meal at the end of grower phase (day 57-140)

The growth indices of Isa-brown pullets fed ration containing varying levels of *Phyllanthus niruri* leaf meal (PNLM)are presented below. The final live weight (FLW) of birds ranged between 1525.00g/bird in T1 to 1593.75g/bird in T6. Weight gain (WG) was best in T5 (1056.25g/bird) and least in birds on T1 (995g). T1

had the highest feed conversion ratio (4.56), while T2 and T5 had the lowest (4.36) with no significant difference. No mortality was recorded for birds in T5 while T2 recorded 7.00% mortality.

Phyllanthus niruri contains several phytogenic molecules that may improve feed intake and feed efficiency when the amount of PNLM is increased, this observation may be attributed to the palatability of the phytogenic substances. This result, however, disagreed with that of (14) who observed a lower feed intake when ginger leaves were added to broiler bird diets. However, the feed intake values were in the range recommended by (15; 16). The average body weight rises as PNLM is incorporated into the diet to a greater extent($P<0.05$). This is also explained by the advantages of the phytogenic component found in *Phyllanthus niruri* leaves, which promotes improved growth in the test birds. This is consistent with the study by (17), which found that garlic increased the broiler growth. *Phyllanthus niruri* has promise as an antibiotic, antioxidant, antifungal, antiviral, and immune-stimulating agent; these properties may explain the lower mortalty rate observed in birds fed PNLM diets (8). This, in turn, may increase the liveability of birds. The significant differences ($P<0.05$) observed in the weight gain, and average weekly feed intake indices studied could be attributed to the nutritive value of *Phyllanthus niruri* leaf.

Table 1: Performance indices of Isa-brown pullet fed *Phyllanthus niruri* leaf meal at the end of grower phase (day 57-140)

Parameters	T1	T2	T3	T4	T5	T6	SEM±
ILW (g)	530.00^{ab}	507.50^{ab}	537.50^{ab}	533.75^{ab}	500.00^{b}	552.50^{a}	9.44
FLW (g)	1525.00^{c}	1528.00^{c}	1553.25^{ab}	1584.25^{b}	1556.25^{ab}	1593.75^{a}	2.21
WG (g)	995.00^{e}	1020.50^{d}	1015.75^{bc}	1050.50^{b}	1056.25^{a}	1041.25^{c}	4.17
AWFI (g)	566.38^{ab}	507.37^{c}	566.28^{ab}	578.86^{b}	571.28 ^{b}	584.61^{a}	2.84
ADFI (g/day/bird)	80.91	72.48^{b}	80.90	82.69	81.61	83.52^{a}	5.81
FCR	4.56	4.36	4.46	4.41	4.36	4.50	0.20
Mortality (%)	2.00^{b}	7.00^{a}	1.50^{ab}	1.50^{ab}	0.00^{d}	0.50^{c}	5.06

^{a,b}: Mean within the same row with different superscript letters were significantly different ($P<0.05$); ILW:Initial live weight, FLW: Final live weight, WG: Weight gain, AWFI: Average weekly feed intake, ADFI: Average daily feed intake, FCR: Feed Conversion Ratio, T1: negative control of basal diet without any additive; T2: positive control diet with Tylo-dox Extra WSP as antibiotics/100 kg feed; T3: Diet with 0.2% (200 g) of PNLM/ 100 kg of feed; T4: Diet with 0.3% 300 g of PNLM/100 kg of feed; T5: Diet with 0.4% (400g) of PNLM/100 kg of feed; T6: Diet with 0.5% (500 g) of PNLM/100 kg of feed.

CONCLUSION AND APPLICATION

The growth indices of birds fed *Phyllanthus niruri* leaf meal were significantly ($p<0.05$) different across treatment groups. The use of *Phyllanthus niruri* leaf meal (PNLM) in pullet feed did not produce notable side effect rather helped improve weight gain and reduce mortality.*Phyllanthus niruri* leaf meal can be included in the diets of pullets as an additive up to 0.5% level without any detrimental effect on weight gain.

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GROWTH PERFORMANCE AND ELECTROLYTES RESPONSES OF BROILER CHICKENS TO GINGER-BASED DIETS

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ABSTRACT

This study was carried out to determine the Effects of ginger-based diets on growth and electrolytes responses of broiler chickens were studied.120 day-old chicks were used. The chicks were first pre-conditioned to their new environment for 4 weeks via brooding after which birds were weighed and randomly assigned to four dietary treatments; 30 birds/treatment with 3 replicates of 10 birds/replicate. Completely randomized design was used in the study. Treatment 1 ($T_1$the control) contained 0 gram of ginger), treatment 2 (T_2) contained 4 gram of ginger, treatment 3(T_3) contained 6 gram of ginger and treatment 4 (T_4) contained 8 gram of ginger/kg of diet. Birds received their respective treatments for 4 weeks and birds re-weighed to obtain their final body weight. Nine birds from each treatment consisting of 3 birds from each replicate were slaughtered and their blood collected into non-ethylene diamine tetra-acetic acid tubes for electrolytes analyzes. Electrolytes analyzed for were potassium, sodium, chloride and bicarbonates. There were no significant ($P > 0.05$) differences in the average daily feed intake (ADFI) amongst treatment groups. However, there were significant ($P < 0.05$) differences in the average daily gains (ADG) as T_1, T_2, T_3 and T_4 had ADG of 44g, 62g, 78g and 88g respectively. Feed efficiency (FE) mirrored ADG as T_1, T_2, T_3 and T_4 had significant ($P < 0.05$) differences of 0.27, 0.38, 0.47 and 0.54. Ginger had no effect on all the electrolytes studied. It was concluded that ginger improved ADG and FE but had no effects on ADFI and electrolytes of broilers.

Key words: Growth Performance, Electrolytes, Ginger and Grower-finisher Broilers

INTRODUCTION

Antibiotics had been used as feed additives in poultry diets primarily to enhance broiler growth rates for many years principally due to their favourable effects on poultry growth rates and feed efficiency (11). Broilers are very fast-growing species reaching market weights of about 3kg in 8 weeks. Their fast-growing rates therefore is a potential risk factor on the birds through stress that is further compounded by environmental factors, including poor nutrition; which can lead to significant reduction in the farmer profitability, particularly in the commercial setting (7).Supplementing poultry diets with antibiotics at sub-therapeutic levels has been demonstrated to improve the animal growth rates (4) as they also play the roles of antioxidants (8). At present it has been shown that the use of antibiotics in poultry diets has some major drawbacks, such as pathogenic microbes showing resistance to antibiotics resulting to antibiotics residues in the final meat products and alteration to gut micro-flora (3). This is perceived to cause harmful effects on the health of consumers, leading to public outcry and rejection of meats produced with antibiotics (11). Therefore, at present their uses in broiler diets have been prohibited resulting in strategizing for their alternatives for the poultry industry. To this point, therefore, natural growth promoters like plants, including ginger have been suggested (11).Ginger (*Zingiber officinale*) is very renounced for diverse inherent bioactive constituents, such as *gingerol*, *shogoals* and *zingerone*. These compounds have been shown to possess potent antioxidants, anti-inflammatory and antimicrobial activities. These attributes of ginger are responsible to its positive effect on poultry overall health and improved performance (1).For example, the equilibrium of electrolytes in the broiler chicken is physiologically very critical to their overall well-being and performance. Therefore, disruptions in the electrolytes ions can result in a range of health-related problems, such as dehydration, muscular weakness and diminished growth rates (5).Therefore, the objectives of this study are:

to assess the effect of ginger on broiler growth parameters (ADFI, ADG and FE) as well as ginger effect on electrolytes' status namely: potassium, sodium, chloride and bicarbonate of the broiler chicken.

MATERIALS AND METHODS

Experimental site

The study was carried out at the Rivers State University Teaching and Research Farm, Port-Harcourt situated at an elevation of 18 meters above sea level (6).

Experimental animals, management and blood sample collection

A total of 120 Agrited day-old chicks were utilized in the study. Thorough cleaning and disinfection of the pens were undertaken before the arrival of the chicks. The chicks were brooded for 4 weeks to properly adapt them to their new environment. At the end of brooding, the chicks were weighed to obtain their initial body weight (BW) and randomly allotted to 4 dietary treatments. The birds were fed their respective experimental diets for 4 weeks. Feed intakes were closely monitored throughout the last 4 weeks of study and water was provided *ad libitum*. The birds were weighed at the end of the study to obtain their final BW to enable for the computation of the birds' ADFI, ADG and FE. Nine (9) birds from each treatment group comprising of 3 birds from each replicate were slaughtered and blood samples were collected into non-ethylene diamine tetra-acetic acid (non-EDTA) tubes for electrolytes analysis. The electrolytes were analyzed using the method of (2).

Experimental diets, design and statistical analyses

Experimental diets were similar in dietary nutrient contents except in their ginger contents where they differed as: Treatment 1 (T_1 the negative control, contained 0 gram of ginger), treatment 2 (T_2 contained 4 gram of ginger), treatment 3 (T_3 contained 6 gram of ginger) and treatment 4 (T_4 contained 8 gram of ginger)/kg of diet, respectively. Birds received their respective dietary treatments for 4 weeks (28 days). There were 30 birds/treatment with 3 replicates of 10 birds/replicate using the completely randomized design. Data obtained were subjected to analysis of variance (ANOVA) using general linear model (GLM) procedure of SAS. Treatment means were compared using Tukey's test. The model was: $Y_{ij} = \mu + X_i + E_{ij}$; where Y_{ij}= individual observation of the treatment, μ = population mean, X_i= effect of the i^{th} (i = 1, 2, 3,4) treatment and E_{ij}= the error term. An *α-level* of *0.05* was used for all statistical comparisons to represent significance.

RESULTS AND DISCUSSION

The results of growth performance of grower-finisher broiler chickens fed ginger-based diets are shown in Table 1.

Table 1. Mean growth responses of broiler chickens fed varied levels of ginger-based diets

	TREATMENTS				
Parameter	**T_1**	**T_2**	**T_3**	**T_4**	**SEM**
Initial BW (kg)	1.05	1.04	1.05	1.05	0.02
Final BW (kg)	2.35^{c}	3.42^{b}	3.79^{a}	3.84^{a}	0.07
ADFI (g)	165.00	164.45	165.00	164.51	0.01
ADG (g)	44.00^{d}	62.00^{c}	78.00^{b}	88.00^{a}	0.03
FE (%)	0.27^{d}	0.38^{c}	0.47^{b}	0.54^{a}	0.01

^{a,b,c,d}*Means within each row with different superscripts differed significantly (P < 0.05).*

As expected, there were no significant (*P > 0.05*) differences in the birds' initial BW for all treatment groups. However, there were significant (*P < 0.05*) differences in the birds' final BW as the rates of weight gains differed amongst treatments. There were no significant (*P > 0.05*) differences in the average daily feed intake (ADFI) amongst treatments. However, there were significant (*P < 0.05*) differences in the average daily gains (ADG) as T_1, T_2, T_3 and T_4 had an ADG of 44g, 62g, 78g and 88g, respectively with the T_1 group

having the lowest value. Feed efficiency (FE) mirrored ADG as T_1, T_2, T_3 and T_4 had significant ($P < 0.05$) FE of 0.27, 0.38, 0.47 and 0.54, respectively with the T_1 group showing the least FE.

The results of the effect of feeding ginger-based diets on electrolytes' levels of broiler chickens are shown in Table 2.

There were no significant ($P > 0.05$) differences in all the electrolytes studied for all the dietary treatment groups. The results of this study confirmed that ginger is not an anorectic agent as birds of the four treatment groups readily consumed their diets in a similar fashion without any signs of feed rejections. However, the different treatment groups gained weights at different rates.

Table 2. Electrolytes responses of broiler chickens fed varied levels of ginger-based diets

	TREATMENTS				
Parameter	**T_1**	**T_2**	**T_3**	**T_4**	**SEM**
K^+ (mmol/L)	4.43	4.40	4.40	4.40	0.02
Na^+(mmol/L)	134.78	135.00	135.00	135.00	0.10
Cl^-(mmol/L)	68.78	69.00	69.00	69.00	0.12
$HCO3^-$ (mmol/L)	25.00	25.00	25.00	25.00	0.01

***Keys**:SEM = Standard error of the mean; K^+ = Potassium, Na^+ = Sodium, Cl^-= Chloride and $HCO3^-$= Bicarbonate*

In the past, the use of antibiotics at sub-therapeutic levels to enhance animal growth had been employed with the purposes of enhancing growth and reproductive performances (9). At present, due to health implications as a result of antibiotics residues in the final meat products coupled with the resistance of some strains of pathogenic micro-organisms to some antibiotics, antibiotics uses in non-ruminant diets has been banned due to public outcry to avoid zoonosis (4; 7).With the ban on the use of antibiotics, particularly for poultry and swine, animal producers are strategizing for alternatives to antibiotics albeit to ensure sustaining and maintaining optimum animal performance without compromising animal welfare. (10) has advocated that ground ginger and garlic improved broiler growth, meat quality and other economic indices of production. Later,(11) further supported the findings of (10) that ginger and garlic powders also improved performance and hematological parameters of broiler chickens. In animal nutrition, growth rate and hematological parameters are some of the major means of assessing the soundness or efficiency of a diet of the animal (9). In other words, the findings of growth improvements and feed efficiencies found in this current study with ginger-based diets compared with the negative control treatment value are in agreements with those of (10) and (11).

CONCLUSION

Ginger is not an anorectic agent and improved the ADG and FE of broiler chickens. Therefore, it was concluded that ginger can be used to improve broiler production, especially when used at 8g/kg of diet. It was also concluded that ginger had no effects on electrolytes.

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COMPARATIVE EVALUATION OF EFFECT OF DIFFERENT STORAGE PERIOD ON EGG QUALITY OF TWO DIFFERENT STRAINS OF CHICKEN

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ABSTRACT

The study was conducted to evaluate the effect of storage period and two strains of hen: Lohmann Brown and Isa Brown strains on egg quality characteristics. A total of thirty eggs were collected from each strain at 20 weeks of age and kept across five storage periods (1, 5, 10, 15 and 20 days). Data collected were subjected to analysis of variance in a Completely Randomized Design (CRD). Six eggs were randomly sampled daily for analysis. Results revealed significant differences in egg quality parameters between the two strains. Lohmann Brown demonstrated superior characteristics in terms of egg weight, egg surface area, albumen height (ALH), egg weight (EW), and egg surface area (ESA). It was observed that Lohmann Brown strain has higher ALH, EW and ESA across all storage periods. It can be concluded that Lohmann Brown hens produce eggs with superior quality characteristics compared to Isa Brown hens, particularly in terms of egg weight, egg surface area, yolk weight, and albumen height. For commercial egg production, it is recommended to use Lohmann Brown hens and maintain stringent storage conditions to ensure optimal egg quality.

Key words: Egg quality, storage duration, strain variation, Lohmann Brown, egg weight.

INTRODUCTION

The chicken egg is a biological structure intended by nature for reproduction and it provides a complete diet for the developing embryo (1). Eggs are important components of the human diet, consumed by people throughout the world. They are versatile and wholesome and they have a natural balance of essential nutrients (2). The egg is perishable food product, which could lose its quality rapidly during the period between when it is laid and consumption (4). Eggs are highly susceptible to quality deterioration and microbial contamination during storage. These conditions can cause serious economic losses to the poultry industry (4). Several chemical and physical modifications occur inside an egg during the storage period. Easily observable physical changes include an increase in the air cell, thinning of the thick albumen and flattening of yolk (5). The physical appearance of an egg makes the first impression upon the consumer. If the product does not meet perceived expectations, consumer confidence diminishes (6). The objective of the present study is to investigate the effect of five storage periods and two strains of hen on egg quality parameters.

MATERIALS AND METHODS

Experimental site

The study was carried out at the Teaching and Research Farm of the Department of Animal Science, Faculty of Agriculture, Bayero University Kano. Kano is located between latitudes 10˚30'N and 12˚38'N and longitudes 7˚45'E and 9˚29'E, which falls within tropical continental (7). The average monthly minimum and maximum temperature are 18.6ºC and 34ºC respectively. The total annual rainfall and average relative humidity are 884 mm and 45.4 %, respectively (8).

Experimental Animals

Two strains of the experimental birds: Isa Brown and Lohmann Brown were sourced from Bashir's farm Ungoggo, Kano at the age of 16 weeks. The birds were treated with ivermectin against internal and

ectoparasite, and were allowed for two weeks of adaptation period. The birds were kept on deep litter/battery cage system.

Parameters Measured

Eight external and five internal egg quality were measured. The external quality traits taken include: egg weight, length, width, shell weight, thickness, specific gravity, shape index, and shell surface, while internal traits comprised of albumen weight, albumen height, yolk height, and Haugh unit. Measurements were taken using pair of vernier calipers, weighing scale, and micrometer screw gauges. Albumen weight was determined by subtracting yolk and shell weights from total egg weight. Haugh unit was calculated using a formula involving albumen height and egg weight. All measurements were taken by the same person to avoid individual variations due to help or assistance.

Experimental design

Thirty eggs were randomly selected from two-layer strains (Lohmann Brown and Isa Brown) and were assigned to five storage periods ranging from 1, 5, 10, 15 and 20 days. Six eggs, three from each strain, were randomly sampled and assigned per storage period for evaluation of internal and external egg characteristics on daily basis.–The study was laidout in a Completely Randomized Design (CRD) with 5x2 factorial arrangements. The factors were five storage periods (1, 5, 10, 15 and 20 days) and two strains of chicken (Isa Brown and Lohmann Brown) are the variables.

Statistical Analysis

The data collected for body weight and egg quality parameters were subjected to analysis of variance (ANOVA) with strain and storage periods as the main effects using SAS package. Where significant differences were observed, treatment means were separated using the least significant difference (LSD) and T-test means separation at 5% level of significance

RESULTS

Summary statistics for egg quality characteristics measured

Table 1 shows the descriptive statistics of egg quality characteristics of two strains of hen (Isa Brown and Lohmann Brown). The results reveal that egg surface area, haugh unit, and egg shape index had the highest means at 149.04±2.76 cm², 79.66±1.53, and 78.01±1.16, respectively, while shell thickness had the lowest mean at 0.37±0.02 mm. The percentage differences between the maximum and minimum values for these parameters are 22.36% for egg surface area, 23.47% for haugh unit, 24.80% for egg shape index, and 110.81% for shell thickness as shown in table 1.

Effect of strain on egg quality characteristics

Table 2 represents the effect of two strains of chicken on egg quality characteristics. The results revealed significant ($P<0.05$) differences in terms of egg weight, egg surface area, albumen height, and yolk weight. Lohmann Brown had the highest values for egg weight (43.20±1.45 g) compared to Isa Brown (41.74±0.99 g), and for egg surface area (7.90±4.06 cm²) compared to Isa Brown (6.96±2.77 cm²). The percentage differences for these parameters are 3.49% for egg weight and 13.51% for egg surface area, indicating that Lohmann Brown eggs are superior in these aspects. The results also showed that Lohmann Brown was significantly higher ($P<0.01$) in yolk weight (2.00±0.53 g) and albumen height (2.00±0.54 mm) compared to Isa Brown, which had yolk weight (1.00±0.61 g) and albumen height (2.14±0.38 mm). The percentage differences for these parameters are 100% for yolk weight and -6.54% for albumen height, showing that Lohmann Brown eggs have a markedly higher yolk weight, while Isa Brown eggs have a slightly higher albumen height.

Effect of storage time on egg quality characteristics.

Table 3 represented the effect of storage time. The result reveled that significant ($P<0.05$) differences in egg length, egg weight, and shell weight. haugh unit, egg specific gravity, albumen weight, shell thickness, yolk weight.

Interaction Effect of strain and storage time on egg quality characteristics

Table 4a and 4b presented the interaction effect of two strains of hen (Isa Brown and Lohmann Brown) and storage periods on external and internal egg quality parameters respectively. The result reveled significant differences (P<0.01) between Isa Brown and Lohmann Brown in term of ALH, EW, and ESA. However, no significant (P>0.05) differences observed regarding the EL, EWD and ESH. The findings showed that Lohmann Brown had the highest values for ALH, EW and ESA on all the storage period as showed in Table 4a. While Isa Brown had the least values for ALH, EW, and ESA as revealed in the table.

Table 1: Summary statistics for egg quality characteristics measured.

Parameters	Coefficient variation	Means±S.E	Minimum	Maximum
Egg Weight	14.56	53.09±0.98	47.33	59.20
Egg Length	3.14	54.66±0.45	50.93	58.27
Egg Width	4.87	42.61±0.57	39.70	49.39
Egg Shape Index	20.36	78.01±1.16	71.59	90.94
Egg Surface Area	114.79	149.04±2.76	132.85	166.17
Haugh Unit	35.52	79.66±1.53	70.31	89.01
Shell Weight	0.56	6.92±0.19	5.85	7.92
Shell Thickness	0.01	0.37±0.02	0.23	0.64
Egg Specific Gravity	138.97	32.40±3.04	15.00	59.00
Albumen Weight	11.10	28.92±0.86	22.76	33.71
Yolk Weight	5.51	15.79±0.60	11.83	21.92
Albumen Height	2.11	6.01±0.37	3.89	8.85

SE = Standard error.

Table 2: Effect of strain on egg quality characteristics.

	Treatment		
Parameters	**Isa Brown**	**Lohmann Brown**	**P-Value**
Egg Weight	41.74 ^{b}±0.99	43.20 ^{a}±1.45	<0.03
Egg width	147.16±0.70	159.63±0.44	>0.09
Egg shape index	81.07 ^{a} ±1.17	77.45 ^{b} ±0.86	<0.03
Egg surface area	6.96 ^{b}±2.77	7.90 ^{a}±4.06	<0.03
Haugh unit	0.37±1.54	0.37±1.91	>1.00
Shell weight	33.29 ^{b}±0.19	38.87 ^{a}±0.14	<0.02
Egg specific gravity	16.16±3.05	15.76±2.11	>0.60
Albumen weight	6.27±0.86	6.17±1.55	>0.93
Yolk weight	1.00 ^{b}±0.61	2.00 ^{a}±0.53	<0.01
Albumen height	2.14 ^{a}±0.38	2.00 ^{b}±0.54	<0.01
Shell thickness	28.31 ^{b}±0.10	32.25 ^{a}±0.041	<0.013
Egg length	76.37±0.46	77.41±0.70	>0.52

Means with different superscript within a column differed significantly (P<0.05).

Table 3: Effect of storage time on egg quality characteristics.

	Storage period					
Parameters	**1 day**	**5 days**	**10 days**	**15 days**	**20 days**	**P-Value**
Albumen height	5.85 [b]±0.24	5.68 [b]±0.20	5.44 [b]±0.14	7.46 [a]±0.45	6.20 [a]±0.30	<0.03
Egg weight	56.53±0.89	54.2[a]±1.01	57.7[a]±0.56	52.0[b]±0.72	50.7[b]±0.30	<0.03
Egg length	53.41±0.27	56.10±0.34	55.92±0.24	54.32±0.45	54.34±0.42	>0.06
Egg width	41.65±0.32	41.65±0.31	43.39±0.22	42.33±0.15	43.64±0.47	>0.07
Egg shape index	77.99 [a]±0.49	74.7[b]±0.46	77.6[a]±0.41	78.0[a]±0.41	80.5[a]±1.04	<0.03
Egg surface area	158.7[b]±2.50	152.2 [b]±2.8	162.0 [a]±1.6	148.7[c]±2.2	142.4[c]±0.9	<0.02
Haugh unit	77.02 [b]±0.72	77.98 [b]±1.1	75.05 [b]±0.6	83.79 [a]±5.2	81.7 [a]±0.95	<0.03
Shell weight	7.62 [a]±0.14	7.00 [a]±0.20	7.61 [a]±0.03	7.43±0.07	6.92 [b]±0.09	>0.056
Shell thickness	0.42 [a]±0.02	0.48 [a]±0.02	0.32 [b]±0.01	0.37 [b]±0.00	0.24[c]±0.01	<0.011
Egg specific gravity	45.83 [a]±1.33	27.66[c]±2.2	36.3±1.12	38.8 [b]±2.2	34.35 [b]±0.7	<0.03
Albumen weight	33.72 [a]±0.7	29.02 [a]±0.8	32.7 [a]±0.65	32.09±0.6	25.7 [b]±0.19	<0.03
Yolk weight	14.25[c]±0.17	17.1[a]±0.28	15.5 [b]±0.32	17.3 [a]±0.56	16.06 [b]±0.2	<0.03

a,b,c means with super script differ significantly at (P<0.05).

Table 4a: Interaction Effect of strain and storage time on egg quality characteristics.

		Parameters					
Storage interval	**Strains**	**EW**	**ALH**	**EL**	**EWD**	**ESHI**	**ESA**
0 days	Isa Brown	53.41[b]	5.57 [b]	52.94	41.87	79.13	149.9 [b]
	Lohmann Brown	59.67 [a]	6.15 [a]	53.88	41.44	76.86	167.5 [a]
5 days	Isa Brown	48.99 [b]	5.85 [a]	54.41	40.48	74.42	137.53[b]
	Lohmann Brown	59.44 [a]	5.53 [b]	57.81	43.35	75.03	166.9 [a]
10 days	Isa Brown	57.4 [b]	5.85 [a]	55.1	43.30	78.60	161.11[b]
	Lohmann Brown	58.06 [a]	5.04 [b]	56.75	43.49	76.65	162.0 [a]
15 days	Isa Brown	55.28 [a]	5.35 [b]	55.27	42.69	77.35	155.2[a]
	Lohmann Brown	50.67 [b]	9.58 [a]	53.38	41.99	78.72	142.23[b]
20 days	Isa Brown	50.40 [b]	7.44 [a]	55.59	44.72	80.59	141.48[b]
	Lohmann Brown	51.09 [a]	4.96 [b]	53.09	42.58	80.34	143.41[a]
	P-value	<0.01	<0.01	>0.09	>0.25	>0.92	<0.01

Note: EW = Egg weight, ALH = Albumen height, EL = Egg length, EWD = Egg Width, ESHI = Egg shape index, ESA = Egg shell area. a,b,c means with super script differ significantly at (P<0.05).

DISCUSSION

The study compared egg quality between Lohmann Brown and Isa Brown layers, revealing significant differences in egg weight, with Lohmann Brown producing heavier eggs, in line with previous research by Pott *et al*., (9), Arafa *et al*., (10), Monira *et al*., (11), and Alewi *et al*., (12). Egg shell weight and shape index showed no significant differences, possibly indicating a close genetic relationship between the strains, contrary to observations of Curtis *et al*., (13), Washburn (14), and Singh *et al*., (15). However, storage length significantly impacted external egg quality traits, causing a reduction in egg and shell weight, consistent with findings by Jones *et al*., (16), Samli *et al*., (17), Moula *et al*., (18), and Raji *et al*., (19).

Regarding internal egg qualities, Lohmann Brown eggs exhibited significantly heavier yolk weight, albumen weight, and better albumen height compared to Isa Brown eggs, aligning with Washburn (14). The study

also found a significant impact of storage length on internal qualities, with extended storage periods leading to dramatic changes in yolk height, haugh unit, and albumen height, in agreement with Scott and Silversides (20), Samli*et al*., (17), and Raji *et al*., (19). These findings highlight the importance of considering strain and storage length in assessing egg quality, with implications for both commercial and industrial use, as highlighted by Scott and Silversides, (20) and Raji *et a*l., (19).

Table 4b: Interaction Effect of strain and storage time on egg quality characteristics.

		Parameters					
Storage interval	**Strains**	**HU**	**SW**	**ST**	**ESG**	**ALW**	**YW**
0 days	Isa Brown	78.12 [a]	6.99 [b]	0.41	48.00 [a]	31.60	13.73
	Lohmann Brown	75.94 [b]	8.25 [a]	0.44	43.67 [b]	35.85	14.78
5 days	Isa Brown	81.7 [a]	5.96 [b]	0.40	16.33 [b]	25.38	16.97
	Lohmann Brown	74.27 [b]	8.05 [a]	0.56	39.00 [a]	32.66	17.29
10 days	Isa Brown	76.55 [a]	7.65 [a]	0.38	32.33 [b]	32.46	14.73
	Lohmann Brown	73.55 [b]	7.58 [b]	0.27	40.33 [a]	32.96	16.41
15 days	Isa Brown	76.21 [b]	7.56 [b]	0.36	30.33 [b]	29.04	18.22
	Lohmann Brown	91.38 [a]	7.31 [a]	0.39	47.33 [a]	35.15	16.39
20 days	Isa Brown	85.75 [a]	6.46 [b]	0.31	35.00 [a]	26.16	15.34
	Lohmann Brown	77.56 [b]	7.39 [a]	0.18	33.70 [b]	25.25	16.78
	P-value	<0.01	<0.01	>0.23	<0.01	>0.36	>0.61

Note: HW = Haugh unit, SW = Shell weight, ST = Shell thickness, ESG = Egg specific gravity, ALW = Albumen weight, YW = Yolk weight. a,b,c means with super script differ significantly at (P<0.05)

Lohmann Brown consistently displayed higher albumen heights compared to Isa Brown across all storage periods, with significant differences (P<0.01). This suggests that Lohmann Brown eggs have a higher quality of albumen compared to Isa Brown. Lohmann Brown also showed larger egg surface areas compared to Isa Brown, with significant differences (P<0.01) observed across all storage periods. This indicates that Lohmann Brown eggs have a larger surface area, potentially affecting aspects such as cooking and appearance. Lohmann Brown exhibited higher shell thickness compared to Isa Brown, the differences were significant (P<0.05) only in some storage periods. This suggests that the effect of strain on shell thickness may vary depending on the storage duration.

The interaction tables (Table 4a and 4b) investigate the impact of the combination of strain and storage time on egg quality characteristics. Presented below are significant findings: Table 4a (External Egg Quality Parameters): Lohmann Brown consistently demonstrated superior attributes in egg weight, albumen height, and egg surface area in comparison to Isa Brown across various storage periods. This implies that Lohmann Brown eggs generally uphold higher external quality features irrespective of storage duration. Table 4b showed that internal egg quality parameters like haugh unit, shell weight, and egg specific gravity exhibited variations in the effects of strain and storage time. Notably, Lohmann Brown displayed elevated haugh unit values than Isa Brown in certain storage periods, indicating enhanced internal egg quality.

Contrary to the consistent findings of higher egg weights in Lohmann Brown compared to Isa Brown, Bekele *et al.* (21) deduced that environmental conditions, management practices, diet composition, and genetic variations within strains could lead to scenarios where Isa Brown exhibits comparable or even higher egg weights. Similarly, while Lohmann Brown consistently displayed higher albumen heights across storage periods, Adeoye *et al.* (22) highlighted that optimized nutritional regimes or management practices could result in Isa Brown eggs showing superior albumen height. Additionally, although Lohmann Brown showed larger egg surface areas in this study, different housing systems or specific environmental stimuli could lead to situations where Isa Brown eggs have larger surface areas. Lohmann Brown generally had higher shell

thickness, Ezzat *et al.* (2023) concluded that factors like calcium supplementation or genetic variations within Isa Brown strains could promote thicker shells in Isa Brown eggs.

CONCLUSION

The study concluded that Lohmann Brown hens produce eggs with superior quality characteristics compared to Isa Brown hens, particularly in terms of egg weight, egg surface area, yolk weight, and albumen height. Proper storage practices are vital for maintaining egg quality, as eggs stored beyond five days exhibit a decline in quality. Therefore, for commercial egg production, it is recommended to preferentially use Lohmann Brown hens and maintain stringent storage conditions to ensure optimal egg quality.

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Monogastric Animal Production: MGP 014

LIPID PROFILES OF GROWER-FINISHER BROILER CHICKENS FED GINGER-BASED DIETS

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ABSTRACT

This study was carried out to determine the effect of ginger-based diet on lipid profiles of grower-finisher broiler chickens. The study investigated the effect of graded levels of ginger on the lipid profiles of grower-finisher broiler chickens. 120 day-old chicks were used in the investigation. The chicks on arrival at the venue of study were first brooded for 4 weeks to fully adapt them to their environment after which they were randomly allotted to their experimental diets. There were 30 birds/treatment with 3 replicates of 10 birds/replicate. Treatment 1 (T_1, control) contained 0 gram of ginger, treatment 2 (T_2) contained 4 gram of ginger), treatment 3 (T_3) contained 6 gram of ginger and treatment 4 (T_4) contained 8 gram of ginger/kg of diet. The birds received their respective experimental diets for 4 weeks. At the end of the last 4 weeks 3 birds from each replicate of the 4 treatments were slaughtered by severing their necks and blood collected into non-ethylene diamine tetra-acetic acid (EDTA) sample tubes for lipid profiles analyses. Results showed that birds of the T_1 group had significantly ($P < 0.05$) higher total cholesterol (TC), total glyceride (TG), low-density lipoprotein (LDL) as well as very low-density lipoprotein (VLDL) levels compared with ginger-containing diets' (T_2, T_3 and T_4) groups that had them slightly ($P < 0.05$) reduced; whereas, the T_2, T_3 and T_4 birds slightly had significantly ($P < 0.05$) higher levels of high-density lipoproteins (HDL) compared with the T_1 group of birds. It was concluded that dietary ginger lowered TC, TG, LDL and VLDL contents and simultaneously increased broiler HDL contents.

Key words: Lipids, Contents, Ginger, and Grower-Finisher Broiler Chicken

INTRODUCTION

Broiler chickens are fast-growing species reaching market weights about 3kg of body weight in 8 weeks. Consumers cherish poultry meat as it is recognized as 'white meat', indicating that it is not a pro-cardiovascular product (13). However, one of the environmental factors militating against broiler production thereby impeding its known fast-growing characteristics is nutrition, especially now that the use of antibiotics in the diets of non-ruminant animals have been banned (6).

Fats and oil are usually employed in poultry diets to increase their diet energy concentration (2). Furthermore, fat-enriched feeds increase the efficiency of the feed energy and thus animal productivity, more so as oil improves the absorption of fat-soluble vitamins, diet palatability and decreases feed dustiness. More importantly, it reduces the passage rate of feed in the gut thereby providing more time for sufficient absorption of dietary ingested nutrients (2). (2) also demonstrated that fatty acid profiles of muscle mirrors that of dietary profile that is capable of affecting or altering the blood levels of lipoproteins and glycerides. Lipid profile is simply a blood test that measures various lipid or fat-related parameters, particularly TC, TG, LDL, VLDL and HDL in the blood of the animal. Therefore, lipid profile can be used in assessing cardiovascular health due to lipid being highly correlated with heart diseases in both humans and animals (13). Increased levels of blood lipids are one of the major risk factors for cardiovascular diseases (16). Therefore, ideal cardiovascular health for humans and animals represents an important opportunity to improve the prevention of cardiovascular diseases (4). Ginger has been touted to improve lipid profiles of the animal (10).

In nutrition studies, changes observed in the constituents of blood of the animal after diet ingestions, including lipid profiles when compared to the control values can be used to explain at least in part the metabolic state of the animal, quality of feed and the health status of the animal, including meat quality (7). Therefore, the objective of this study is to investigate the effects of graded levels of dietary ginger on TC, TG, LDL, VLDL and HDL in grower-finisher broiler chickens.

MATERIALS AND METHODS

Location of Study

The study was carried out at the Rivers State University Teaching And Research Farm in Port Harcourt, Rivers State

Experimental Animals

A total of 120 *Agrited* day-old chicks were used in the study. The chicks on arrival at the Teaching and Research Farm Section of the Rivers State University where the study was conducted were first brooded to condition them to their new environment for 4 weeks. After brooding, the birds were randomly assigned to 4 dietary treatments. pens were thoroughly cleaned and allowed to dry before introducing the animals to their individual treatment pens. Animals received their respective experimental diets for 4 weeks and water was provided *ad libitum.*

Experimental Diets

The experimental diet fed to the birds in the last 4 weeks were similar in all nutrients except their dietary ginger concentrations as: Treatment 1 (T_1, control diet) contained 0 gram of ginger, treatment 2 (T_2) contained 4 grams of ginger, Treatment 3 (T_3) contained 6 grams of ginger and treatment 4 (T_4) contained 8 grams of ginger/kg of diet, respectively. There were 30 birds/treatment with 3 replicates of 10 birds/replicate.

Blood Sample Collection

At the end of the last 4 weeks of receiving experimental diets, 9 birds per treatment consisting of 3 birds from each replicate were slaughtered and blood samples were collected into non-EDTA sample tubes for lipid profiles analyses. Lipids were analyzed according to the method of (12).

Experimental Design and Statistical Analysis: The study was carried out using completely randomized design (CRD). Data were subjected to analysis of variance (ANOVA) using general linear model (GLM) procedure of SAS. Treatment means were compared using Tukey's test. Because CRD was used, the model was: $Y_{ij} = \mu + X_i + E_{ij}$; where Y_{ij}= individual observation of the treatment, μ = population mean, X_i= effect of the i^{th} (i = 1, 2, 3,4) treatment and E_{ij}= the error term. An *α-level* of *0.05* was used for all statistical comparisons to represent significance.

RESULTS AND DISCUSSION

The results of the feeding of ginger-based diets on grower-finisher broiler chickens' lipid profiles are shown in Table 1.

Table 1. Lipid Profiles of Grower-Finisher Broiler Chickens Fed Ginger-Based Diets

	DIETS				
Parameter	T_1	T_2	T_3	T_4	SEM
TC (mmo/L)	2.99^a	2.48^b	2.12^c	2.07^c	0.03
TG (mmo/L)	1.90^a	1.70^b	1.13^c	1.11^c	0.01
LDL (mmo/L)	1.90^a	1.69^b	1.36^c	1.11^d	0.01
VLDL (mmo/L)	0.82^a	0.77^b	0.65^c	0.45^d	0.00
HDL (mmo/L)	1.11^d	1.51^c	1.72^b	1.91^a	0.01

^{a,b,c,d}*Means within the same row with different superscripts are significantly (P < 0.05) different*

Keys: TC = *total cholesterol; TG = triglycerides; LDL = low density lipoprotein; VLDL = very low density lipoprotein; HDL = high density lipoprotein; SEM = standard error of the mean[OS26]*

All birds in the 4 dietary treatment groups readily consumed their diets and grew throughout the study period suggesting that ginger is not an anorectic agent. However, the ingestion of dietary ginger demonstrated

profound effects on the lipid profiles of the birds as evidenced by the quantitative variations in the serum lipid contents of the birds across the different treatment groups. Birds in the T_1 group significantly ($P < 0.05$) had the highest levels of TC after which it significantly ($P < 0.05$) linearly reduced with the T_4 group of birds having the lowest TC levels. The levels of TG, LDL and VLDL mirrored the pattern of TC except HDL that the T_4 birds significantly ($P < 0.05$) had the highest levels whereas the T_1 birds significantly ($P < 0.05$) had the lowest levels compared with other ginger-positive treatment groups. These results demonstrate that ginger significantly reduced TC, TG, LDL and VLDL serum levels and simultaneously significantly increased that of HDL.

Lipid profile is a blood test that measures the various lipid parameters, such as TC, TG, LDL, VLDL and HDL. This test is highly correlated or important in assessing cardiovascular health due to its association with heart diseases in humans and animals. High levels of blood lipids are one of the major risk factors for cardiovascular diseases (16). Conversely, humans and animals with ideal cardiovascular health have a very low lifetime risk of cardiovascular disease suggesting that ideal cardiovascular health represents an important opportunity in improving or preventing cardiovascular disease (4).

It has been reported globally that a low plasma level of HDL is a strong predictor of coronary heart disease (CHD). This is due to the fact that HDL aids in removing excess cholesterol from the bloodstream leading to a beneficial effect for heart health (9). Furthermore, HDL has a direct beneficial effect on the arterial wall. Metabolically, HDL induces the removal of cholesterol from cells, including those of atherosclerotic plaques (8). Thus, it is not a gainsaying to state that CHD develops as a result of high plasma levels of LDL as well as LDL modifications, such as its oxidation.

The medicinal values of plants have been identified as one of the major strategies in dealing with CHD as a result of some inherent bioactive compounds in the plants (5). Ginger is one of such plants because of its various bioactive compounds, including *gingerols* and *shogaols* (15). The major objective of this current study was to investigate the effects of dietary ginger on the lipid profiles of grower-finisher broilers. In this study, dietary ginger intake significantly reduced serum levels of TC, TG, LDL and VLDL and simultaneously increased that of HDL. These findings are in agreement with the data of (3) and those of (11). These authors attributed this effect of ginger to the bioactive compounds namely *gingerols* and *shogaols* found in ginger.

The findings of this study are in agreement with of those of (14) that reported that ginger reduced TC, TG and increased HDL levels by its anti-inflammatory and antioxidant properties thereby improved lipid profile. Furthermore, HDL has special features or plays some crucial roles in the protection against atherosclerosis, such as inhibiting lipid oxidation and plaque growth (1). Overall, ginger was found to improve lipid profile in this study by improving significantly HDL levels and significantly reduced those of TC, TG, LDL and VLDL.

CONCLUSION

Consumption of ginger could be beneficial in the attenuation of atherosclerosis development as it reduced serum contents of TC, TG, LDL and VLDL. Reduction in these lipids would lead to a reduced cellular cholesterol accumulation; the hall mark of atherosclerosis. This is further supported by the finding that ginger simultaneously increased HDL serum contents.

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NITROGEN INTAKE AND NITROGEN RETENTION IN WEANER RABBIT FED DIETS CONTAINING DIFFERENT PLANT PROTEIN SOURCES

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ABSTRACT

The study was conducted to determine the nitrogen retention in rabbits fed different plant protein sources in the Livestock Teaching and Research Farm, University of Maiduguri from May - August, 2023. The experimental diets were: T1, Groundnut cake, T2, Moringa leaves, T3, Cowpea husk and T4, Groundnut haulm in a whole diet. Twenty rabbits of mixed breed and sex with an average weight of 847.20g were randomly assigned to the four dietary treatments of five replicate. in a completely randomized design; 100g of feed was given on a daily basis while water offered ad-libitum. Rabbits fed T1 (groundnut cake) had significantly higher ($p<0.05$) nitrogen retention followed by rabbits in T2 (Moringa leaves), T3 (Cowpea husk) and T4 (Groundnut haulms). Therefore, groundnut cake, moringa leaves, cowpea husk and groundnut haulms were acceptable to rabbits when given as whole diets.

Keywords: Nitrogen Intake, Plant Protein and Rabbit

INTRODUCTION

Rabbits are pseudo-ruminants with the ability to convert roughages with high levels of fibre content to meat efficiently without alteration in the quality of meat produced (Iyeghe-Erakpotobor and Adeyegun, 2012). This could help in reducing the cost of feed for rabbits, since man does not utilize roughages as food. Hence competition between humans and rabbits can be greatly minimized if roughages are incorporated into rabbit feeds to supply fibre and also energy, protein, minerals and vitamins, especially from forages of legume species. Rabbits in the wild naturally feed on high fibre diets; this is a different scenario from intensive rabbit production. In the wild, there is a wide range of choices to make depending on availability and preference.

Nitrogen retention refers to the amount of nitrogen that is absorbed and retained by the body for growth and maintenance purposes, as opposed to the amount that is excreted in the urine and feces. Legumes are an important source of protein for rabbits, particularly during the weaning phase when they are transitioning to solid foods. Nitrogen retention is an important measure of the efficiency of dietary protein utilization by rabbits (Hassan *et al*., 2016).

The rabbit's digestive system is well adapted to herbivorous way of living (Aduku and Olukosi, 1990). The special adaptive features of rabbits include the nature of their teeth, bile production, voluminous intestine which has enlarged caecum ending in a vermiform appendix. These features make it possible for rabbits to handle forages successfully. Aderinola *et al*. (2008) included varying levels of *Centrosema pubescens* and *Calopogonium mucunoides* forage meals in dietary concentrate of rabbits and obtained good performance. Iyeghe-Erakpotobor (2006) included forages up to 50% of concentrate in a feeding trial and obtained weight gains with rabbits. Considering the advantages of using legume forages such as groundnut haulms, moringa and cowpea husk to feed rabbits, this study was conducted to investigate the nitrogen intake and nitrogen retention in grower rabbit fed diets containing different plant protein sources.

MATERIALS AND METHODS

***Experimental site*:** The experiment was conducted at the Rabbit Unit of the Livestock Teaching and Research Farm of the Department of Animal Science, University of Maiduguri.

***Source of experimental diets and materials*:** Feed ingredients were purchased from an open market within Maiduguri while rabbits were obtained from small holder rabbit farmer within Maiduguri Metropolitan Council. Maize, Maize offal, fish meal, plant protein source (groundnut cake, *Moringa* leaves, cowpea husk and groundnut haulm), lime stone, bone meal, vitamin premix, lysine and methionine where used to formulate a 13% crude protein diet. The plant protein sources were used as treatments as follows; groundnut cake as treatment 1 (T1), *Moringa* leaves as treatment 2 (T2)**,** Cowpea husk as treatment 3 (T3) and groundnut haulm as treatment 4 (T4) (Table 1). The experimental diet contains 12-13% crude protein.

Table 1: Ingredient composition of the experimental diets

Ingredients (kg/%)	Groundnut cake	*Moringa* leaves	Cowpea husk	Groundnut haulms
Maize	22	22	22	22
Maize offal	53	51	29	29
Fish meal	0	0	4	4
Limestone	1	1	1	1
Bone meal	2.5	2.5	2.5	2.5
Salt	0.5	0.5	0.5	0.5
Vitamin premix	0.5	0.5	0.5	0.5
L-Lysine	0.25	0.25	0.25	0.25
DI-Methionine	0.25	0.25	0.25	0.25
Wheat offal	10	10	10	10
Plant protein source	10	12	30	30
Total	**100**	**100**	**100**	**100**

***Management of experimental animals*:** Twenty growing rabbits of mixed breed and sex were randomly assigned to four dietary treatments (groundnut cake, moringa, cowpea husk, groundnut haulms) with five animals per treatment as replicates. The rabbits were allowed a week acclimatization period. The rabbits were housed individually in cages measuring 15cm×7cm (width × length height). The cages were each provided with feeder and drinker. The feeders, drinkers, and pen were cleaned daily.

***Nitrogen retention studies*:** At the end of the growth study, three rabbits from each treatment were randomly selected and housed in individual metabolism crates as described by Osuji *et al*. (1993)**.** The rabbits were maintained on the same treatment diets in the feeding trial. The animals were allowed 7 days' adjustment period to the feed and crates while 7 days was used to collect urine and faeces.

The total faecal output from individual animals as well as feed remnants were collected daily in the morning, weighed, mixed thoroughly and 10% sub sample taken for dry matter determination.

***Chemical analysis*:** The milled samples of the experimental diets and faeces were taken to the Department of Animal Science Laboratory, University of Maiduguri for proximate analysis according to the standard procedure of AOAC (2005).

The following parameters were determined; dry matter (%DM), crude protein (%CP), crude fibre (%CF), ether extract (%EE), Ash and Nitrogen free extractive (% NFE as:100 - (% CP + % CF + % EE + % Ash).

Nitrogen intake = $\%N/_{100}$ x intake; Nitrogen retention = Nitrogen intake –

Total Nitrogen Output while Total Nitrogen = Faecal Nitrogen – Urinary Nitrogen.

Data analysis: Data were subjected to analysis of variance (ANOVA), using the General Linear Model Procedure of SAS (2005). The treatment means were separated using the Duncan`s Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

***Proximate composition of experimental diets*:** Higher dry matter (DM) content was recorded in groundnut cake diet while lower value was observed in groundnut haulm diet which implies that the diets can be stored for longer period of time without spoilage. The crude protein increases across the dietary treatment. Higher crude protein (CP) content was recorded in groundnut cake diet, followed by *Moringa oleifera* diet while a lower value was observed in cowpea husk diet. This is attributed to higher crude protein content of groundnut cake and *Moringa oleifera* which concur with the report of (Anwar *et al.*, 2007; Abbas and Ahmed, 2012; Yaméog *et al.*, 2011). Higher crude fibre content was observed in groundnut haulm diet followed by cowpea husk diet while lower crude fibre content was observed in groundnut cake diet which can be attributed to variation in planting location, processing method, maturity, and weather condition.

Table 2: Proximate composition of experimental diets

Parameter (%)	Groundnut cake	Moringa leaves	Cowpea husk	Groundnut haulms
Dry matter	93.10	91.92	92.73	91.06
Crude protein	13.99	13.55	12.13	12.72
Ether extract	1.94	2.80	2.08	1.84
Crude fibre	10.36	10.69	14.86	15.32
Nitrogen free extract	47.78	14.85	42.34	51.57

***Nutrient intake of rabbits fed diets containing different plant protein sources*:** There is significant (P<0.05) difference among the parameters observed for nutrient intake (Table 2). The dry matter, crude protein, crude fibre and nitrogen free extract intakes increased across the dietary treatments. This study agrees with the findings of (Nuhu, 2010) who reported increase in intake of rabbits fed graded levels of *Moringa* leaves. Dry matter, crude protein, crude fibre and nitrogen free extract intakes were higher (P<0.05) for rabbits fed diets containing groundnut haulms, followed by cowpea husk while lower intakes were obtained for groundnut cake. This could be due to decrease caloric density of the diet with corresponding increase in dietary fibre, this is in consonance with earlier report that high fibre diet tends to increase feed intake in rabbits (de Blas, *et al.*, 1995; Jokthan, *et al.*, 2006). Rabbit like any other livestock voluntarily adjust their feed intake to meet their energy requirement. Ether extract intake was higher (P<0.05) for *Moringa* leaves, followed by cowpea husk while lower intake was recorded for groundnut cake.

Table 3: Nutrient intake of rabbits fed diets containing different plant protein sources

Parameters (%)	Groundnut cake	Moringa leaves	Cowpea husk	Groundnut haulms	SEM
Dry matter	46.23^{c}	50.67^{b}	62.93^{a}	65.74^{a}	1.96
Crude protein	6.94^{c}	7.46^{c}	8.23^{b}	9.18^{a}	0.28
Ether extract	0.96^{d}	1.54^{a}	1.41^{b}	1.32^{c}	0.04
Crude fibre	5.14^{d}	5.89^{c}	10.08^{b}	11.05^{a}	0.29
Nitrogen free extract	23.73^{c}	22.21^{c}	28.73^{b}	37.23^{a}	1.00

^{abcd}Means with different superscript within rows differed significantly (P<0.05), SEM = Standard error mean

***Nitrogen retention in rabbits fed diets containing different plant protein sources*:** The nitrogen retention in rabbits fed diets containing different plant protein sources is presented in Table 3. There was significant (P<0.05) effect of dietary treatment on the nitrogen retention parameters of rabbit. The nitrogen intake was observed to be higher (P<0.05) in diets containing groundnut haulm, followed by diets with cowpea husk while lower nitrogen intake was observed in rabbits fed diets with groundnut cake. Higher (P<0.05) total nitrogen loss was recorded in diets containing groundnut haulm, followed by diet with cowpea husk while lower feacal nitrogen loss was obtained in rabbits fed diets containing *Moringa* leaf which can be attributed to high nitrogen retention recorded for diets with *Moringa* leave (0.99%) and low in diet with groundnut

cake (0.82%) which is due to greater nitrogen availability of *Moringa oleifera* was consistent with its crude protein composition making it utilization better than diet with groundnut cake. Nitrogen retained as percentage intake was higher in diets with groundnut cake, followed by diets with *Moringa* leave while lower (P<0.05) nitrogen retained as percentage intake was obtained in diets with groundnut haulms which is at par with diet containing cowpea husk. This might be as a result of the amino acid profile of groundnut cake and *Moringa oleifera*.

Table 4: Nitrogen retention in rabbits fed diets containing different plant protein sources

Parameters	Groundnut cake	Moringa leaves	Cowpea husk	Groundnuthaulms	SEM
N intake (g)	1.01^{c}	1.28^{b}	1.29^{ab}	1.35^{a}	0.03*
FeacalNloss (g)	0.12^{c}	0.11^{c}	0.18^{b}	0.24^{a}	0.01*
Urinary N loss (g)	0.07^{b}	0.18^{a}	0.18^{a}	0.16^{a}	0.02*
Total N loss (g)	0.19^{d}	0.29^{c}	0.35^{b}	0.40^{a}	0.02*
N retained (g)	0.82^{b}	0.99^{a}	0.93^{a}	0.95^{a}	0.04*
N retained as % intake	80.98^{a}	77.38^{b}	72.22^{c}	70.37^{c}	1.69*

^{abcd}Means with different superscript within rows differed significantly (P<0.05), SEM = Standard error of mean

CONCLUSION/ RECOMMENDATION

It was concluded that diets containing different plant protein sources results in positive nitrogen balance. It was then recommended that different plant protein sources can be fed to rabbits for positive nitrogen balance.

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IMPACT OF PUMPKINLEAF (CUCURBITA MAXIMA) MEAL ON THE GROWTH PERFORMANCE OF FINISHER JAPANESE MALE QUAILS (COTURNIX JAPONICA)

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ABSTRACT

The high and continuous prices of soybeans have prompted livestock farmers and nutritionists to search for affordable alternative protein sources. This study sought to analyze the impact of pumpkin leaf (*Cucurbita maxima*) meal on the growth performance of finisher Japanese male quails (*Coturnix japonica*). Five diets of similar protein and energy values were formulated the design is as follows: control: soybean meal-based basal diet, PLM15: basal diet added with 15% pumpkin leaf meal, PLM30: basal diet added with 30% pumpkin leaf meal, PLM45: basal diet added with 45% pumpkin leaf meal and PLM60: basal diet added with 60% pumpkin leaf meal. 200 male quails at 4 weeks of age were selected from females on the bases of their plumage and behavioral characteristics. They were divided into five groups of 4 replicates and 10 quails per replicate and reared in a completely randomized design with feed and water given *ad libitum*. The results showed that growth performance was significantly ($p<0.05$) better with 15-30% pumpkin leaf meal, with lower mortality rates. However, higher levels of pumpkin leaves (45-60%) significantly ($p<0.05$) led to negative performance. In conclusion, it is recommended to include pumpkin leaf meal at levels between 15-30%for adult Japanese male quails.

Keyword: Japanese male's quails, pumpkin leaf, nutritional composition, performance, soybeans

DESCRIPTION OF THE PROBLEM

Soybean is considered a top plant-based protein source due to its high content of protein, fat, minerals, fiber, carbohydrates, and moisture (1). However, using it as the sole protein ingredient in poultry feeds can lead to increased costs because of its high market price. The addition of other inexpensive protein sources can help reduce feed (2).Pumpkin leaves, a low-cost vegetable packed with essential nutrients, are one such option (3). While globally, pumpkin flesh and seeds are usually valued, the leaves are also rich in nutrients such as ash, protein, ether extract, crude fiber, and nitrogen-free extract (4, 5). To make the most of this valuable part of the plant, a detailed study is needed to determine its potential as a feed ingredient. This study focuses on analyzing the impact of pumpkin leaf (*Cucurbita maxima*) meal on the growth performance of finisher Japanese male quails (*Coturnix japonica*).

MATERIALS AND METHODS

This study was conducted in the teaching and research farms of the Department of Animal Science, Federal University Gashua, Yobe State, Nigeria. It involves gathering fresh pumpkin leaves in Gashua daily market, sun-drying them for five days, and analyzing their nutritional composition in a laboratory. Various methods and instruments were used to determine the proximate composition, minerals, amino acids, and other components (6, 7, 8). The results were presented in table 1. Five different diets were prepared with varying levels of pumpkin leaf meal added to a soybean meal-based basal diet as follows: Control: soybean meal-based basal diet, PLM15: basal diet added with 15% pumpkin leaf meal, PLM30: basal diet added with 30% pumpkin leaf meal, PLM45: basal diet added with 45% pumpkin leaf meal and PLM60: basal diet added with 60% pumpkin leaf meal (Table 2). 200 male quails at 4 weeks old were bought from the Animal Science Department at Federal University, Gashua, distinguishing the males from the females by their physical

features like plumage patterns. Males have specific markings like a black throat patch, white stripe above the eye, and reddish-brown chest. They are more aggressive, territorial, and possess a distinct loud call. These quails were then split into 20 groups and weighed using a precise scale. The 20 groups were randomly distributed into the five dietary treatments with 4 replicates of 10 quails each in a completely randomized design. They were housed in cages measuring 45 x 30 cm, provided water and feed *ad libitum* for 4 weeks, with daily cleaning. Weekly measurements of live weight and feed intake were taken to calculate weight gain and feed conversion ratio. Finally, the data was analyzed using SPSS (IBM version 25) from 2018 for further evaluation.

Table 1: Chemical analyses of pumpkin leaf

Proximate composition	**%**
Moisture content	11.84
Crude protein	18.21
Ash	7.08
Nitrogen free extract	50.19
Ether extract	2.43
Crude fiber	10.25
Energy (kcal)	365.85
Calcium (mg/kg)	3.17
Phosphorus (mg/kg)	4.26
Lysine (g/16gN)	6.34
Methionine (g/16gN)	1.81

Table 2: Ingredients and composition of diets with various levels of pumpkin leaves meal

Ingredients	**Control**	**PL15**	**PL30**	**PL45**	**PL60**
Maize	15.67	14.89	14.44	15.11	15.73
Wheat offal	6.18	5.25	4.33	4.17	2.47
Soybean meal	0.00	0.93	1.85	2.78	3.71
Pumpkin leaves meal	4.94	5.70	5.61	4.53	4.63
Groundnut cake	2.06	2.06	2.47	2.27	2.18
Fish meal	2.06	2.06	2.17	2.06	2.2
Limestone	1.48	1.48	1.48	1.48	1.48
Bone meal	1.04	1.04	1.04	1.04	1.04
Premix	0.08	0.08	0.08	0.08	0.08
Lysine	0.08	0.08	0.08	0.08	0.08
Methionine	0.08	0.08	0.08	0.08	0.08
Salt	0.08	0.08	0.08	0.08	0.08
Oil	1.24	1.26	1.28	1.24	1.24
Total	**35.00**	**35.00**	**35.00**	35.00	**35.00**
Crude protein %	18.04	18.14	18.11	18.10	18.21
Energy (kcal)	2905	2908	2910	2910	2909

Control: soybean meal-based basal diet, PLM15: basal diet added with 15% pumpkin leaf meal, PLM30: basal diet added with 30% pumpkin leaf meal, PLM45: basal diet added with 45% pumpkin leaf meal and PLM60: basal diet added with 60% pumpkin leaf meal.

RESULTS AND DISCUSSION

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Table 3 displays the growth performance of Japanese male quail from 4-8 weeks of age. The final weight, total weight gain, and daily weight gain significantly ($p<0.05$) increased from the control group to PLM30, but decreased in PLM45 and PLM60. On the other hand, total feed intake and daily feed intake showed a different trend, fluctuating in the control, PLM15, and PLM30 groups, and significantly ($p<0.05$) increased in PLM45 and PLM60. Feed conversion ratio was significantly ($p<0.05$) better from control group to PLM30

and poor in PLM45 and PLM60. Mortality % decreased from control to PLM30, but increased in PLM45 and PLM60. It is suggested that PLM15-30 can be a suitable replacement for soybean meal in Japanese male quail production due to its comparable feed intake, gains, efficient feed utilization, and low mortality rates. This study supports previous research (9, 10) indicating that quails fed a diet high in leaf protein, like pumpkin leaves, show faster growth rates compared to those fed a soybean diet. Pumpkin leaves are rich in vitamins, minerals, and antioxidants (4), which complement the nutritional deficiencies of soybeans, maintaining bone health, blood circulation, and muscle function for optimal growth. The higher crude fiber content in pumpkin leaves (Table 1) allows for their use at lower levels to promote digestive health, prevent constipation, and lower cholesterol levels in quails (3). Overall, male quails aged4-8 weeks showed growth rates between the reference values 200-250grams (11, 12) when fed PLM15-30, highlighting the potential of creating a balanced diet using this alternative protein source.

Table 3: Growth performance of Japanese male quail from4-8 weeks of age

Parameters	Control	PLM15	PLM30	PLM45	PLM60	±SEM	*P*-value
Initial weight (g)	98.38	91.24	94.35	94.11	97.07	2.79	-
Final weight (g)	201.44^{a}	210.95^{a}	219.01^{a}	189.34^{b}	180.51^{b}	15.62	0.018
Total weight gain (g)	103.06^{a}	119.71^{a}	124.66^{a}	95.23^{b}	83.44^{b}	17.08	0.089
Weight gain (g)	3.68^{ab}	4.28^{a}	4.45^{a}	3.40^{b}	2.98^{c}	0.61	0.010
Total feed intake (g)	560.28^{b}	556.64^{b}	563.08^{b}	604.52^{a}	628.60^{a}	32.21	0.022
Daily feed intake (g)	20.01^{b}	19.88^{b}	20.11^{b}	21.59^{a}	22.45^{a}	1.15	0.021
Feed conversion ratio	5.44^{b}	4.65^{b}	4.52^{b}	6.35^{a}	7.53^{a}	1.26	0.039
Mortality %	5.25	5.00	5.00	6.00	6.25	-	-

Control: soybean meal-based basal diet, PLM15: basal diet added with 15% pumpkin leaf meal, PLM30: basal diet added with 30% pumpkin leaf meal, PLM45: basal diet added with 45% pumpkin leaf meal and PLM60: basal diet added with 60% pumpkin leaf meal.

CONCLUSION

The growth matric were superior between control and PLM15-30 as well as lower mortality rate whereas higher levels of pumpkin leaves (45-60%) show negative performance. Therefore, pumpkin leaves is recommended at levels between 15-30% for adult Japanese male quail

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Monogastric Animal Production: MGP 017

INFLUENCE OF COMBINING LEMON GRASS AND BLACK PLUM LEAF MEAL ON HAEMATOLOGICAL AND SERUM BIOCHEMICAL INDICES OF BROILER FINISHER BIRDS

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ABSTRACT

The effect of combining lemon grass and black plum leaf meal on haematological and serum biochemical indices of broiler finisher birds was conducted at the poultry unit of Federal College of Agriculture, Ishiagu in Ebonyi state. One hundred and twenty (120), four weeks old broiler (ROSS 308) birds were used for the research work. The birds were distributed on weight equalisation into five treatment groups. Each treatment was replicated three times in a completely randomized design (CRD) with eight (8) birds per replicate. Five experimental diets were compounded with treatment 1 containing 0% lemon grass leaf meal and black plum leaf meal, which served as the control. Treatments 2, 3, 4 and 5 contained lemon grass leaf meal and black plum leaf meal at the levels and ratio of 1:4, 2:3, 3:2 and 4:1 respectively. Effect of diet on haematological values namely packed cell volume, haemoglobin, red blood cell and white blood cell were all significantly ($P<0.05$) influenced across the treatment groups. Superior values for packed cell volume, red blood cell and white blood were observed in treatment 5 with 35.97%, $3.81x10^{12}$/l and $260.11x10^{3}$/l respectively. Serum biochemical indices differ ($P<0.05$) significantly in total protein, globulin, urea and cholesterol, but was similar ($P>0.05$) in albumin. Cholesterol values showed a descending order with treatment 1 having a higher value of 169.37mg/dl, while the least value of 153.09mg/dl was observed in treatment 5. Thus, the combination of lemon grass and black plum leaf meal is viable in broiler birds at finisher stage.

Keywords: Serum biochemical, haematological indices, broiler finisher birds, lemon grass leaf meal and black plum leaf meal

DESCRIPTION OF PROBLEM

One of the basic concerns in poultry production in Nigeria is disease outbreak. Although, antibiotic growth promoters have been used to promote growth, prevent infection and control disease, the use of antibiotic growth promoters is presently facing serious criticism and has raised global concern as some reports revealed their ill effects among which is development of microbial resistance to the products and their potential harmful effects on human health[1].In most developing countries, the use of leaves, seeds, fruits, barks and roots of some plants to improve the performance of farm animals is common[2]. The interest in plant feed additives (which include, neem leaf, lemon grass, bitter leaf etc) grew over the last decade as the usage continues to increase across the nation. These plant feed additives have a high attention as feed supplements for various purposes in poultry production during the recent years. Some of the beneficial effects of these bioactive plant substances in animal nutrition may include reduction of microbial threat and promoting intestinal health, which is imperative for optimal well-being of the birds.

Blood provides a valuable medium for clinical investigation of nutritional status of birds because the ingestion of numerous dietary components has been found to have measurable effort on the blood constituents of animals[3]. Therefore, with increasing interest in foliage plant as feed ingredient, several plants have been assessed with respect to their effects on blood parameters in poultry.

Lemongrass *(Cymbopogon citratus)* belongs to the family *Poaceae.* The plant is a tropical grass resistant to different temperatures and can grow in warm, semi-warm and temperate climates, it is an aromatic perennial

tropical plant that can grow as high as 3.5 meters with long thin leaves. Lemon grass was originally found growing wild in India. It produces a network of roots and rootless that rapidly exhausts the soil. Lemon grass is rich in various phytochemicals and is used in traditional system and folk medicine to treat malaria, pneumonia, gastrointestinal infections, anxiety and diabetes. This grass contains flavonoids, phenolic compounds, terpenoid, such as citral α, citral β, nerolgeraniol, citronellal, terpinolene, geranyl methyl heptenone) which may be responsible for its different biological activities such as antibacterial, antidiarrheal, antifungal, antioxidants, and act as a growth promoter for animals[4].

Vitex doniana is commonly known as Black plum (English), Dinya' (Hausa), 'Oriri' (Yoruba) and 'Uchakoro' (lgbo) where the bark, leaves and roots of the plant are used in ethno-medicine for the management and treatment of numerous diseases[5]. Vegetables like *Vitex doniana* are important sources of protective foods, which are highly beneficial for the maintenance of good health and prevention of diseases in broilers[6]. The inclusion of leaves in diet of poultry is becoming adaptable due to its availability and phytochemical constituents responsible for medicinal or organoleptic properties of the plant.

MATERIALS AND METHODS

The experiment was conducted at the Poultry unit of Animal Production Department, Federal College of Agriculture, Ishiagu, Ebonyi state. The lemon grass and black plum leaves were sourced within the college environment. The leaflets were strip from the petioles and sorted out to remove dirt. Then-after was shade-dry until they became dried, after which they were sundried for two hours to make them crispy and then ground to powder using hammer mill machine. One hundred and twenty (120), four weeks old 'Agrited' broiler birds were used for the experiment. The birds were distributed on weight equalisation into four treatments. Each treatment was replicated three times in a completely randomized design (CRD) with eight (8) birds per replicate. The birds were purchased from Cosin farm in Enugu, Enugu state. Feeders and drinkers for the research work were thoroughly wash and clean. The birds were raised on a deep litter system with wood shavings which served as a source of litter. The birds were distributed on weight equalisation to their different pens. Feed and water were given *ad-libitum*. All due vaccination and medication necessary for the bird's welfare during the entire growth cycle from five weeks old to the end of the experiment were strictly adhered to according to laid down standards.

Blood samples of 5mls per bird from each replicate were collected. 2mls was placed in specimen bottles without ethylene diamine tetra-acetic acid (EDTA) to determine the serum biochemistry parameters, while the remaining 3mls was placed in a sample bottle with EDTA accordingly to determine the haematological parameters. Data collected were subjected to analysis of variance (ANOVA) and significant difference mean were separated according to the method of Duncan multiple range test as outlined by[7].

Table 1: Composition of diet for finisher broilers fed graded levels and ratio of lemon grass and black plum leaf meal

	Treatments				
Ingredients	**T1**	**T2**	**T3**	**T4**	**T5**
Wheat offal	6.90	3.90	3.90	3.90	3.90
Palm kernel cake	6.00	4.00	4.00	4.00	4.00
Lemon grass leaf meal	0.00	1.00	2.00	3.00	4.00
Black plum leaf meal	0.00	4.00	3.00	2.00	1.00
Total	**100**	**100**	**100**	**100**	**100**

Other feed ingredient had same value across treatment group: Maize-58.00; Full fat soya-5.00; Groundnut cake-14.00; Fishmeal-1.50; Blood meal-3.50; Bonemeal-2.50; Limestone-1.50; Salt-0.25; Finisher premix-0.35; Lysine-0.20; Methionine-0.30.

RESULTS AND DISCUSSION

Haematological and serum biochemical indices of finisher broiler birds fed diets containing a combination of lemon grass and black plum leaf meal were displayed in Table 2. Birds in treatment 5 had the highest packed cell volume value of 35.97% which was similar to the values of 34.66%, 33.34% and 34.50% observed in treatments 4, 3 and 2 respectively. The least value of 28.86% was obtained for birds in treatment 1. The result showed that there was increase in the values of packed cell volume in treatments fortified with lemon grass and black plum leaf meal. These connotes that plant materials used in the present research had the ability to increase blood count of finisher birds leading to better activation of body antigens and antibodies. The values obtained were within the recommended normal range of 22 to 37.50% as given by[3], which suggest that there was no toxic substance released from the plant source as a result of antinutritional factor to the birds by the addition of lemon grass and black plum leaf meal in their diet. Haemoglobin was superior (P<0.05) in treatment 2 with a value of 12.05g/dl followed by 11.98g/dl and 10.02g/dl obtained for birds in treatments 4 and 5. While the lowest value of 9.82g/dl obtained in treatment 1 was similar (P>0.05) to the value of 9.85g/dl observed in treatment 3 respectively. The values of haemoglobin obtained in this study falls within the recommended range of 9.20 to 13.00g/dl as reported by[8]. Which describes the quality of protein in the diet of the birds with the ability to contribute to a positive state of the birds' haemoglobin level? Birds in treatment 5 had a superior (P<0.05) value of 3.81$\mathbf{x}10^{12}$/l for red blood cell, followed closely by those in treatment 2 (3.46x10^{12}/l), which differ from the least value of 2.79$\mathbf{x}10^{12}$/l in treatment 1. Treatments 3 and 4 had values of 3.19 $\mathbf{x}10^{12}$/land 3.30 $\mathbf{x}10^{12}$/l which are by themselves similar (P>0.05) to each other. Results showed that treatment diets containing the test ingredients had higher red blood cell value when compared to the control. These suggest that the active ingredients in the lemon grass and black plum leaf namely; geraniol, myrcene, limonene, cineole and flavonoids and the other active bio-nutrients enables better and easy flow of blood in the birds and also established a better quantity and quality of blood needed for the birds to thrive and perform optimally without weakness and morbidity all through the experiment, especially in the treatments where they were used to fortify the diets, as they help the birds develop better immunity.

Table 2: Haematological and serum biochemical indices of finisher broiler birds fed supplemental levels of Lemon grass and Black plum leaf meal

	Treatments					
Parameters	T1	T2	T3	T4	T5	SEM
Packed Cell Volume (%)	28.86^{b}	34.50^{a}	33.34^{a}	34.66^{a}	35.97^{a}	0.74
Haemoglobin (g/dl)	9.82^{b}	12.05^{a}	9.85^{b}	11.98^{a}	10.02^{b}	0.38
Red Blood Cell (x10^{12}/l)	2.79^{c}	3.46^{a}	3.19^{b}	3.30^{b}	3.81^{a}	0.08
White Blood (x10^{3}/l)	235.34^{b}	257.47^{a}	252.44^{a}	257.32^{a}	260.11^{a}	2.92
Total protein (g/dl)	3.25^{b}	3.45^{a}	3.41^{a}	3.44^{a}	3.45^{a}	0.03
Albumin (g/dl)	2.65	2.73	2.63	2.70	2.67	0.03
Globulin (g/dl)	0.60^{b}	0.72^{a}	0.78^{a}	0.74^{a}	0.78	0.02
Urea (mg/dl)	7.85^{b}	8.75^{a}	7.78^{b}	8.90^{a}	8.85^{a}	0.16
Cholesterol (mg/dl)	169.37^{a}	156.87^{b}	156.63^{b}	153.35^{b}	153.09^{b}	11.76

^{abc}Means on the same row with different superscripts are significantly (p<0.05) different.
SEM = Standard Error of Mean

Dietary treatments on total protein was superior (P<0.05) with a value of 3.45g/dl observed in treatments 2 and 5, which did not differ (P>0.05) from the values obtained for treatment 3 and 4 with 3.41g/dl and 3.44 g/dl respectively. The least value of 3.25g/dl was observed in treatment 1. The value obtained for total protein in this study falls within the recommended range of 3.3 to 5.5g/dl for total protein as given by[9] , except for those in treatment 1. [3]had earlier stated that the quality of protein in the diet of the birds usually determines the quality and quantity of protein made available to the birds, which usually reflects in the total protein in the blood factor. Superior (P<0.05) urea value of 8.90mg/dl was obtained for birds in treatment 4, which was closely followed by those in treatment 5 and 2 with 8.85mg/dl and 8.75mg/dl respectively. While the lowest

value of 7.78mg/dl was obtained in treatment 3, which was similar (P>0.05) to those observed in treatment 1 with 7.85mg/dl. The high level of urea in treatments fortified with the test ingredients above the control (except treatment 3) could suggest an increase in the release of serum urea which could be as a result of good quality and quantity of protein available to the birds from the diet given. Thus, the value obtained for urea in this study was within the recommended value range of 2.50 to 10.50mg/dl as reported by[10]. Result revealed that there was progressive decrease in the serum cholesterol level from the control to the treatments fortified with the test ingredients. It shows that birds on the control diet had the highest (P<0.05) serum cholesterol value of 169.37mg/dl. Birds in treatment 5 had the least value of serum cholesterol with 153.09mg/dl, which did not differ (P>0.05) from those in treatment 2, 3 and 4 with 156.87mg/dl, 156.63mg/dl and153.35mg/dl respectively. The results for serum cholesterol showed that the value obtained for birds were within the recommended range of 86 – 211mg/dl[8]. This finding agrees with the results obtained by[11] who worked with leaf meals in farm animals and observed corresponding decreased in serum cholesterol values as the levels of leaf meals increased in the diets of the animals.

CONCLUSION

Vital inferences can be drawn from the results obtained in the present study; this includes the following;

1. That lemon grass leaf meal and black plum leaf meal can be used as phytogenic plant materials in broiler finisher birds
2. That finisher broiler chickens can tolerate a combination of lemon grass and black plum leaf meals in their diets and by this taking advantage of the natural active ingredients in them to build stronger antibodies that can help the birds fight germs and diseases at this stage of growth.

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Monogastric Animal Production: MGP 018

EFFECT OF DIFFERENT REGIME OF *Moringa Oleifera* LEAF MEAL ON PERFORMANCE OF BROILER CHICKENS AT STARTER PHASE

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ABSTRACT

The study was conducted in the teaching and research farm of Federal Polytechnic Bali Taraba State to investigate the effect of Moringa oleifera leaf meal (MoLM) supplemented diets on the performance of broiler Chickens. Three different graded levels of Moringa oleifera leaf meal were used to formulate poultry feed. Ration was formulated using soybean, maize and MoLM as ingredient for broiler starter (23% Crude Protein) using Pearson Squire Method. A total Sixty-day old broiler chicks were randomly allocated to three treatment diets as T1(0%), T2 (0.75%) and T3 (1.50%) MOLM in a Completely Randomized Design. The birds were distributed into 3 treatments comprising 3 chickens per replicate and managed under dip litter system for a period of 4 weeks. Feed consumption, weight gain and feed conversion ratio were evaluated for the individual replicate. At the end of the study, it was observed that significant differences ($p<0.05$) existed in weight gain, daily body weight gain and feed. furthermoer feed conversion ratio shows difference ($p<0.05$). It was therefore concluded that the use of MoLM in the broiler diet at 1.5% inclusion supplementing soybean affects the performance of broiler bird at starter phase. The study also reveals that MoLM can be used to complement and supplement sources of protein in broiler diet.

Keywords: Moringa oleifera, Leaf Meal, Broiler, Growth, livestocks and chickens.

INTRODUCTION

Broiler chicken production is one of the easy alternative family incomes provider. This is due to its shorter rearing period which provides a quick return on investment. In recent times, the poultry industry has gained recognition with many farmers venturing in to it. It is a fast growing sector of the agriculture, that present a protein to man and livestock at affordable price. However feeds and feeding are an important component of a successful poultry industry but the competition between man and livestock as well as cost of feed has posed a threat to the industry. Animal scientist has since been on their toes in search of alternative feeding material with little or no human competition and which is readily available and affordable. *Moringa oleifera* is one of the plants that can be used to compound livestock feed due to its rich nutrient contents. The plant in addition to being a good source of vitamins and amino acids, it has wide range of medicinal value including growth promotion and antimicrobial effect [6,5].

Moringa oleifera tree is considered one of the world most useful plants known for its nutritional, medicinal and significant economic importance. *Moringa oleifera* possess multiple advantages, because different parts of the tree (leaves, fruits, immature pods and flowers) are edibles and forms part of the traditional diets in many tropical and sub-tropical countries [4,7].
Regarding chemical composition, [3] have reported that Moringa oleifera seeds are good source of fats, proteins and minerals.

Statement of the problem The age long competition for feed material between man and livestock has been a cause for concern among animal scientist. In search for the less competitive and affordable feed material has qualified *Moringa oleifera* as a convenient substitute.

MATERIALS AND METHODS

The study was carried out at the poultry unit of the teachings and research farm, department of Animal health and Production, School Agricultural Technology, Federal Polytechnic Bali, Taraba State. A total of (60) day old broiler chicks (mixed sexes) purchased from a reputable hatchery were randomly allocated into tree experimental treatment with three replicates One of the groups T1 was fed basal diet only (control) while T2 and T3 were fed diets containing 0.75% and 1.5% of *Moringa oleifera* leaf meal supplementing soybean respectively. The experiment was arranged as a complete randomized design using deep liter system of housing. All the necessary vaccines were administered during the brooding period. The experimental diets were made iso-caloric and iso-nitrogenous and formulated to meet or exceed the National Research Council, (1994) requirements of broiler chicks. Feed and water was provided *ad libitum.*

Table 1: Ingredient composition of broiler starter diets formulated with inclusion of Moringa leaf meal

Broiler starter Ingredient	T1(0% control)	T2 (0.75% MoLM)	T3 (1.5% MoLM)
Maize	39.50	39.50	39.50
Maize bran	18.80	18.80	18.80
Soybean	34.20	32.00	29.80
MOLM	-	2.20	4.40
Fish meal	2.20	2.20	2.20
Bone meal	2.50	2.50	2.50
Palm oil	0.80	0.80	0.80
Methionine	0.25	0.25	0.25
Lysine	0.25	0.25	0.25
Sodium chloride	0.50	0.50	0.50
Premix	1.00	1.00	1.00
TOTAL	100	100	100

Table 2: Performance of broiler chickens fed diet with MoLM at starter phase

Parameters	T1	T2	T3	Sings
Initialweight/(g/bird)	30.75	31.60	30.77	NS
Final weight/(g/bird)	635.37^{ab}	620.15^{ab}	617.75^{a}	*
Weight gain/(g/bird)	606.43^{ab}	585.53^{ab}	620.54^{a}	*
Feed intake/g	2429.03^{ab}	2341.41^{ab}	3253.3^{a}	*
FCR	4.01	4.00	5.24	*

ab= means with the same superscript within the same row are not significantly ($p>0.05$) different NS= Not significant *= Significant at $p<0.05$, T(1,2,and 3,) = Treatments, MoLM = Moringa oleifera leaves meal.

RESULTS AND DISCUSSION

The results from Table 2 indicates that, feeding *Moringa oleifera* leaf meal supplemented diet has effect on growth performance of broiler during (starter phase) . The results indicate that difference exist in the final body weight, weight gain as well as feed intake at the starter phase of the study. Furthermore, there was significant differences ($p<0.05$) in feed conversion in response to the feeding of the birds with diet containing *Moringa oleifera* leaf meal inclusion of 1.50% MoLM.

The performance of broiler fed with Moringa supplemented diets over the control diet in terms of final body weight, weight gain and feed intake in this experiment during the Starter phase could be attributed to nutritional content of the *Moringa oleifera* leaf. The higher body weight and the consequence FCR in this study might be related to the presence of different bioactive components in moringa leaf meal that may

play a role in improved nutrient utilization in supplemented birds. The high FCR recorded in this study could be attributed a possible feed wastage by the birds. Similarly, higher body weight was also recorded by [1], who used moringa leaf powder as dietary supplement with 1.2% levels in broilers [3] reported that *Moringa oleifera* leaves are good source of fats, proteins and minerals. These observation runs contrary to the findings of [2] , who observed that antibiotics or plant extract supplementation in a broiler experiment did not influence body weight gain, feed intake and feed.

Conclusively, supplementation of *Moringa oleifera* leaf meal in broiler diet at the starter phase should be encouraged as it increases the performance of the birds through improved weight gain, feed intake as well as daily weight gain. it can conviniently be used to supplement plant protein source without compromising performance.

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Monogastric Animal Production: MGP 019

IMPACT OF DIETARY REPLACEMENT OF MAIZE WITH TOASTED BAMBARA NUT SIEVATE-YAM PEEL COMPOSITE WITH OR WITHOUT LACTIC DRY® ON BONE MORPHOMETRY OF NOILER CHICKENS

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ABSTRACT

A study to assess bone morphometry of noiler chicken was conducted using 180 56-day old noiler chickens. The birds were divided into two groups of 90 birds. Each group was sub-divided into 3 sub-groups of 30 birds and then replicated thrice with 10 birds. The experiment was a 2 x 3 factorial arrangement. One of the two groups was offered diets; T1: control, T2:20 and T3:40% of TBNS-YPMC replacing maize, respectively without Lactic Dry® (LD) while the other group was offered same diets with LD. Data were collected on fresh bone weight, defatted bone weight, ash weight, organic matter, Ca, P, Mg, Zn and I then anaylsed using SAS. Results revealed Ca, P, Mg, Zn and Fe differed significantly ($P<0.05$). Birds fed diet containing 40% TBNS-YPMC replacing maize without LD and control diet with LD had highest and similar (4.25±0.14 ppm) Ca while birds fed other treatment diets had least and similar (3.82±0.11 ppm) Ca. P was highest and similar ((2.23±0.03 ppm)) in birds fed diet containing 40% TBNS-YPMC replacing maize without LD and diets containing 0 and 40% TBNS-YPMC with LD while birds fed diet containing 20% TBNS-YPMC replacing maize without LD had least (2.00±0.06 ppm) P. Mg, Zn and Fe of birds fed all treatment diets had highest and similar values of 1.11±0.03, 0.09±0.0 and 0.35±0.03 ppm, respectively while birds on control diet without LD had their least values. It was concluded that Ca and P were improved on diets containing 0 and 40% TBNS-YPMC without and with LD, respectively while experimental diets improved Mg, Zn and Fe except control with LD.

Key words: Bone, noiler, morphometry, sievate and peels

DESCRIPTION OF THE PROBLEM

Global unfavourable climate change, insecurity among other factors are responsible for low animal production occasioned by insufficient output from the crop farmers in the country [1] which requires urgent attention through use of crop by-products as potential replacement for exorbitant conventional feed stuff. These crop by –products are low in mineral and contain anti-nutritional factors that hamper sufficient absorption of these minerals when consumed by the animal, especially monogastric with attendant consequences on skeletal muscles and productivity [2].

In an attempt to circumvent the present menace, genetic selection of chickens raised for meat yield with greater weight and the development of skeletal muscles do not correspond to the growth of bones leading to bone deformities and fractures [3]. It is therefore, vital to monitored bone mineralization to ensure optimum counterbalance against negative forces associated with the supportive and locomotor function of the skeleton in all animal species hence, 20 to 30% of mineral obtained diet.

Hence, inadequate intake and lower utilization of minerals during fast growth, genetic factors and the internal structure of bones could adversely affect poultry performance [2].

Ca and P are the most common structural elements for skeletons and teeth which constant mobilization is inevitable to maintain the blood levels needed to regulate body functions as their low content in the body lead to bone deformities [4]. P synergizes with Ca to give rigidity to bones and teeth, buffer in the body fluids, responsible for cell division, reproduction and transformation of hereditary traits [4]. Similarly, Zinc is necessary for maintenance of structural and functional integrity of biological membranes, facilitation of gene expression and protein synthesis, enzyme structure and function, appetite regulation, good food utilization and bone metabolism, especially during the stages of rapid growth [2]. Therefore, this study assessed bone morphometry of noiler chickens fed diets containing toasted Bambara nut sievate-yam peel meal composite.

MATERIALS AND METHOD

Location of Study: The study was conducted at the Poultry Unit of the Livestock Teaching and Research Farm, Joseph Sarwuan Tarka University, Makurdi, Nigeria.

Collection and Preparation of Bambara Nut Sievate (BNS) and yam peel (YP)
BNS was purchased at Wannune, Benue State. 5 kg of raw BNS was thoroughly mixed with 500 mls of water and toasted. Fresh YP was collected from local farmers in Makurdi and sun-dried (5-7 days) to a constant weight. The dried yam peel was milled for use

Experimental Diets
6 diets were formulated with TBNS-YPM composite (1:1) contains 89.64% dry matter, 12.25% crude protein, 1.87% ether extract, 12.26% crude fibre and 3.46% ash which replaced maize in the diets at 0, 20 and 40% with or without Lactic Dry® (LD) and denoted as T1, T2 and T3, respectively as shown in Table 1. LD was supplemented in some of the diet at the rate of 25 g/100 Kg diet

Experimental Design and Management of Birds
180 56-day old noiler chickens were divided into 2 main groups of 90 chickens. Each group was further sub-divided into 3 sub-groups of 30 birds and replicated thrice with 10 birds each. One of the 2 main groups was offered diets; T1: control, T2:20 and T3:40% of TBNS-YPMC replacing maize, respectively without LD while the other group had same diets with LD. The experiment was a 2 x 3 factorial in CRD arrangement which lasted 10 weeks while feed and water were offered *ad-libitum* throughout the study period.

Bone Morphometry
At the end of the feeding trial, femur bones were freed of soft tissue, partially defatted with ether for 24 hours. The moisture content (dry matter) was determined gravimetrically as the residue remaining after drying the samples. Ash content was determined by ashing the defatted bones at 550 °C. Calcium, Phosphorous, Magnesium, Iron and Zinc were assessed by extraction and then titration according to procedures outline by AOAC (2005). Organic matter was calculated by subtracting the quantity of ash from the dry matter content. Mathematically, Organic matter (OM) = Dry matter (DM) – Ash content

Statistical Analysis
Data generated were subjected to analysis of variance (ANOVA) in a 2 x 3 factorial arrangement. Duncan Multiple Range Test (DMRT) was used to separate means that differed significantly ($P<0.05$) as contained in Statistical Analysis Software (SAS) package (version 9.1.3).

RESULTS AND DISCUSSION

Main effect of experimental diets with or without LD on bone morphometry of finisher noiler chickens is presented in Table 2. Results on effect of LD on bone morphometry of finisher noiler chickens fed diets containing replacement levels of TBNS-YP revealed no significant ($P>0.05$) influenced on all morphometry indices. Similarly, effect of dietary replacement of maize with TBNS-YP revealed no significant ($P>0.05$) influenced on all morphometry indices. This implies that experimental diets offered noiler birds did not

negatively interfere with mineral absorption mechanism. Hence, there was similar values of morphometry indices among the experimental birds.

Interaction effect of experimental diets with or without LD on bone morphometry of finisher noiler chickens is presented in Table 3. Results revealed that Ca, P, Mg, Zn and Fe content of noilers bone differed significantly ($p<0.05$). Birds fed diet containing 40% TBNS-YPMC replacing maize without LD and control diet with LD recorded highest and similar (4.25±0.14 ppm) values for Ca while birds fed other treatment diets recorded least and similar (3.82±0.11 ppm) Ca. Okwunodulu *et al*. (2022) reported higher Ca content of 30.42±0.00, 49.01±0.23 and 42.45±0.00 mg/100 g for local, old layer and broiler chickens, respectively compared with the values of Ca for noiler chicken bone in the present study. Similarly, Noilers birds on diet containing 40% TBNS-YPMC replacing maize without LD and diets containing 0 and 40% TBNS-YPMC with LD had highest and similar ((2.23±0.03 ppm) bone P values while those on diet containing 20% TBNS-YPMC replacing maize without LD recorded least (2.00±0.06 ppm) P values. Okwunodulu *et al*. (2022) reported higher P values of 18.57±0.03, 19.23±0.23 and 17.67±0.03 mg/100 g for local, old layer and broiler chickens compared to the values of P of noiler bones in the present study.

Noiler chicken fed experimental diets recorded highest and similar values of 1.11±0.03, 0.09±0.0 and 0.35±0.03 ppm for Magnesium, Zinc and Iron bone content, respectively while least values for Magnesium (0.78±0.13 ppm), Zinc (0.06±0.01 ppm) and Iron (0.28±0.02 ppm) were recorded for birds on control diet without LD. Suchý *et al*. (2009) reported higher Mg values in the range of 2.4 ± 0.23 to 2.4 ± 0.24 g/Kg on 100% DM compared to values in the present study. It is concluded that 40% TBNS-YPMC and control diet without and with LD improve Ca and P while Mg, Zn and Fe were improved on all experimental diets aside the control diet without LD. Application; poultry farmers can incorporate up to 40% TBNS-YPMC in noiler diet to improve mineral content of bone.

Table 1: Ingredients and Proximate Nutrient Composition of Noiler Chickens Finisher Diets Containing Graded Replacement of Maize with BNS-YPM Composite

Ingredients (Kg)	Dietary replacement levels of Maize with TBNS-YPM Composite (%)					
	No Lactic Dry®			Lactic Dry® (25 g/100 kg)		
	0	20	40	0	20	40
Maize	51.49	41.19	30.89	51.49	41.19	30.89
BNS-YPMC	00.00	10.30	20.60	00.00	10.30	20.60
FFSB	28.96	30.03	30.03	30.03	30.03	30.03
Maize Offal	15.00	15.00	15.00	15.00	15.00	15.00
Bone ash	3.50	3.50	3.50	3.50	3.50	3.50
Salt	0.30	0.30	0.30	0.30	0.30	0.30
Methionine	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25	0.25
Vit. Premix	0.25	0.25	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100**	**100**	**100**	**100**
Calculated Composition						
Crude protein	17.00	17.34	17.67	17.00	17.34	17.67
Crude fibre	4.28	5.33	6.40	4.28	5.33	6.40
EE	3.02	2.80	2.59	3.02	2.80	2.59
Ash	1.79	2.02	2.23	1.79	2.02	2.23
ME (Kcal/Kg)	3,097.82	3,025.26	2,952.71	3,097.82	3,025.26	2,952.71

*TBNS-YPMC= Toasted Bambara nut sievate-Yam Peel Meal Composite, FFSB= Full Fat soybeans, Ca= Calcium, P=Phosporus, ME= Metabolisabel Energy, Kcal= Kilocalories, Kg= Kilogramme.

***Vitamin premix contains B1, 1g; B2,6g; B12,0.02g; K3,3g; E,3g; Biotin,0.05g; Folic acid,1.5g; Cholinechloride,250g; Nicotineacid,30g; Ca- pantothenate,15g; Co,0.4g; Cu,8g; Fe,32g; I,0.8g; Zn,40g; Mn,64g; Se,0.16g, BHT,5g*

Table 2: Main Effect of Diets Containing Replacement Levels of Maize with TBNS-YPMC Supplemented with or without Lactic Dry® Bone Morphometry of Finisher Noilers

			Replacement levels of maize with TBNS-YPMC			
Parameters	No Lacti Dry®	Lactic Dry®	0	20	40	p-values
Fresh bone weight (g)	53.44 ±4.30	54.67 ±5.31	52.50 ±5.98	54.33 ±5.46	55.33 ±6.78	0.3295
Defatted bone weight (g)	31.56 ±1.95	34.44 ±3.17	31.83 ±2.91	33.33 ±3.17	33.83 ±3.94	0.2536
Ash weight (g)	8.89 ±0.39	9.89 ±0.59	9.50 ±0.34	9.50 ±0.85	9.17 ±0.70	0.7939
Organic matter weight (g)	22.44 ±1.82	24.56 ±2.69	22.33 ±2.79	23.50 ±2.55	24.67 ±3.33	0.1820
Calcium (ppm)	3.91 0.07	3.93 0.10	4.01 ±0.13	3.81 ±0.05	3.92 ±0.11	0.0022
Phosphorous (ppm)	2.08 ±0.04	2.11 ±0.04	2.13 ±0.06	2.02 ±0.12	3.33 ±0.08	0.0313
Magnesium (ppm)	0.91 ±0.06	0.98 ±0.05	0.89 ±0.08	1.07 ±0.06	0.89 ±0.05	0.2437
Zinc (ppm)	0.07 ±0.01	0.08 ±0.00	0.07 ±0.01	0.08 ±0.04	0.07 ±0.00	0.2431

Table 3: Interaction Effect of Diets Containing Replacement Levels of Maize with TBNS-YPMC Supplemented with or without Lactic Dry® Bone Morphometry of Finisher Noiler Chickens

	No Lactic Dry supplementation			Lactic Dry supplementation			
Parameters	0	20	40	0	20	40	p-value
Fresh bone wt (g)	59.33 ±11.46	47.67 ±3.18	53.33 ±6.84	45.67 ±0.88	61.00 ±9.71	57.33 ±13.38	0.7603
D-fat bone wt (g)	35.00 ±5.57	28.67 ±1.45	31.00 ±1.53	28.67 ±1.20	38.00 ±5.13	36.67 ±8.21	0.5882
Ash wt (g)	9.33 ±0.33	8.67 ±0.88	8.67 ±0.88	9.67 ±0.67	10.33 ±1.45	9.67 ±1.20	0.8102
Organic M. (g)	25.67 ±5.23	19.33 ±1.20	22.33 ±0.88	19.00 ±0.58	27.67 ±3.71	27.00 ±7.02	0.4874
Ca (ppm)	3.78 $\pm0.10^{b}$	3.81 $\pm0.02^{b}$	4.14 $\pm0.12^{a}$	4.25 $\pm0.14^{a}$	3.82 $\pm0.11^{b}$	3.70 $\pm0.03^{b}$	0.0197
P (ppm)	2.03 $\pm0.07^{bc}$	2.00 $\pm0.06^{c}$	2.20 $\pm0.00^{ab}$	2.23 $\pm0.03^{a}$	2.03 $\pm0.09^{bc}$	2.07 $\pm0.03^{abc}$	0.0453
Mg (ppm)	0.78 $\pm0.13^{b}$	1.02 $\pm0.12^{ab}$	0.93 $\pm0.08^{ab}$	1.00 $\pm0.03^{ab}$	1.11 $\pm0.03^{a}$	0.84 $\pm0.07^{ab}$	0.0394
Zn (ppm)	0.06 $\pm0.01^{b}$	0.08 $\pm0.01^{ab}$	0.0 7 ± 0.01^{ab}	0.08 $\pm0.00^{ab}$	0.09 $\pm0.00^{a}$	0.07 $\pm0.01^{ab}$	0.0139
Fe (ppm)	0.28 $\pm0.02^{b}$	0.31 $\pm0.02^{ab}$	0.31 $\pm0.02^{ab}$	0.31 $\pm0.01^{ab}$	0.35 $\pm0.03^{a}$	0.33 $\pm0.01^{ab}$	0.0275

^{a,b,c} = Means in the same row with different superscripts are significantly different ($p<0.05$). M= matter, ppm= Part per million, D-fat= defatted and weight, Ca = Calcium, P = Phosphorous, Mg = Magnesium, Zn = Zinc and Fe = Iron

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ASSESSMENT OF DIETARY REPLACEMENT VALUE OF MAIZE WITH TOASTED BAMBARA NUT SIEVATE-YAM PEEL MEAL COMPOSITE WITH OR WITHOUT LACTIC DRY® ON GROWTH PERFORMANCE OF NOILERS

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ABSTRACT

A study to evaluate growth performance of noiler chicks was conducted using 180 14-day old noiler chicks. The birds were in 2 groups of 90 birds. Each group had 3 sub-groups of 30 birds with 3 replicates of 10 birds each. The experiment was laid in 2 x 3 factorial arrangement with one of the 2 groups fed diets: T_1: control, T_2:20 and T_3:40% of TBNS-YPMC replacing maize without Lactic Dry® (LD) while the other group was fed same diets with LD. Results revealed that daily feed intake (DFI) and FCR were significantly ($P<0.05$) influenced. Birds on all treatment diets had the highest and similar values (57.10±1.58 g/bird) for DFI while birds fed diet containing 40% TBNS-YPMC as replacement for maize without LD had least DFI (48.26±3.90 g/bird). Birds fed diets containing 20 and 40% TBNS-YPMC as replacement for maize without LD, control diet with LD and diet containing 20% TBNS-YPMC as replacement for maize with LD had best and similar FCR (3.69±0.34) values while birds fed control diet without LD and diets containing 40% TBNS-YPMC as replacement for maize with LD had poorest and similar FCR (4.38±0.05). Final body weight, total body weight gain and daily body weight gain of noiler chicks ranged from 733.89±8.73 to 799.56±12.59, 546.89±8.73 to 609.56±12.59 and 13.02±0.21 to 14.51±0.30 g/bird, respectively with zero mortality. In conclusion, TBNS-YPMC can replace maize in noiler chicks' diets up to 40% without adverse effect on their growth.

Key words: noiler, growth, yam, peel and sievate

DESCRIPTION OF THE PROBLEM

Average protein per capita daily consumption of most Nigerians is 45.4 g and below compared with the global average of 64 g while the value recommended by Food and Agricultural Organization (FAO) is 53.8 g per day per person [1]. According to Ramani [2], almost half of the 206 million Nigerians do not consume protein daily as against recommended consumption. Protein deficiency in Nigeria requires continuous intervention efforts to combat while reducing malnutrition crisis. Poverty, high cost of protein based food stuff, unemployment and lack of awareness have been proven as the major factors responsible for protein deficiency in diets of most Nigerians as well as inhabitants of the developing countries [1]. Skyrocketing prices of conventional feed stuff lead to increase in cost of animal production which subsequently translates to high cost of animal protein sources such as meat, egg among others in the country [3].

There is an urgent need for interventions to drive down the cost of feed input in Nigeria and make animal protein affordable to households thus, increasing the daily protein intake of the populace. Therefore, Animal nutritionist in Nigeria has embarked on researches geared towards the deployment of breeds of animals with high meat, egg production, genetic potential for utilization of poor quality feed, hardy, resistant to most diseases and adaption to our local environmental conditions.

One of such breeds of animal is the noiler chickens which is affordable, cheaper to maintain and capable of scavenging for feed and water similar to our local chickens. To popularize Noiler chicken production, a feeding protocol that is less dependent on conventional feeding stuffs (maize and soyabean) will go a long way to ensuring the adaptation of Noiler chicken production by Poultry farmers. It is in this regard that the use of agricultural wastes such as Bambara nut sievate (BNS) and yam peels (YP) become indispensable in livestock prodution. BNS is a product obtained after milling Bambara nut and sieving it using 2 mm sieve. It can be incorporated in the diets of livestock to boast their performance and reduce cost of their edible products. It has been revealed that anti-nutritional factors contents of Bambara nut waste can be successfully reduced by heat treatment among others. Nutritive value of Toasted Bambara nut waste is negatively affected by its high fibre content and thus, made it unsuitable for incorporation in monogastric diets [3]. Similarly, yam peel is a by-product of yam processing obtained after peeling yam tubers. Adegun [4] reported that yam peel meal has good proximate nutrients composition. The aim of the study was to assess dietary replacement value of maize with toasted Bambara nut sievate-yam peel meal composite on growth performance of noiler chicks.

MATERIALS AND METHOD

Location of Study: The study was conducted at the Poultry Unit of the Livestock Teaching and Research Farm, Joseph Sarwuan Tarka University, Makurdi, Nigeria.

Collection and Preparation of Bambara Nut Sievate (BNS) and yam peel (YP)
BNS was purchased at Wannune, Benue State. 5 kg of raw BNS was thoroughly mixed with 500 mls of water and toasted. Fresh YP was collected from local farmers in Makurdi and sun-dried (5-7 days) to a constant weight. The dried yam peel was milled for use

Experimental Diets: Six diets were formulated with TBNS-YPM composite (1:1) replacing maize in the diets at 0, 20 and 40% with or without Lactic Dry® (LD) and denoted as T1, T2 and T3, respectively as shown in Table 1. LD was supplemented at the rate of 25 g/100 Kg diet

Experimental Design and Management of Birds
180 14-day old noiler chicks were divided into 2 main groups of 90 chickens. Each group was further sub-divided into 3 sub-groups of 30 birds and replicated thrice with 10 birds each. One of the 2 main groups was offered diets; T1: control, T2:20 and T3:40% of TBNS-YPMC replacing maize, respectively without LD while the other group had same diets with LD. The experiment layout was a 2 x 3 factorial arrangement lasting for 10 weeks while feed and water were offered *ad-libitum* throughout the study period.

Data collection
Growth performance Growth indices considered were;
Feed intake was determined as the difference between quantity of feed offered and quantity of feed leftover.
Body weight gain was calculated as the difference between initial body weight and final body weight.
FCR was calculated as the ratio of feed intake to body weight gained in a specified period of time.

$$\text{FCR} = \frac{Total\ feed\ intake}{Total\ weight\ gained}$$

Mortality rate was calculated as the ratio of number of dead birds to the number of birds housed per treatment, expressed as percentage.

Statistical Analysis
Data generated were subjected to one-way analysis of variance (ANOVA) in a 2 x 3 factorial arrangement. Duncan Multiple Range Test was used to separate means that differed significantly ($p<0.5$) as contained in (SAS) Statistical software package (version 9.1.3).

Table 1: Ingredients and Proximate Nutrients Composition of Noiler Chicks' Starter Diets Containing Graded Replacement of Maize with BNS-YPM Composite

	Dietary replacement levels of Maize with TBNS-YPM Composite (%)					
	No Lactic Dry®			Lactic Dry® (25 g/100 kg)		
Ingredients	0	20	40	0	20	40
Maize	31.33	25.06	18.80	31.33	25.06	18.80
BNS-YPMC	00.00	6.27	12.53	00.00	6.27	12.53
FFSB	54.27	54.27	54.27	54.27	54.27	54.27
Maize Offal	10.00	10.00	10.00	10.00	10.00	10.00
Bone ash	3.50	3.50	3.50	3.50	3.50	3.50
Salt	0.30	0.30	0.30	0.30	0.30	0.30
Lysine	0.10	0.10	0.10	0.10	0.10	0.10
`Methionine	0.25	0.25	0.25	0.25	0.25	0.25
Vit. Premix	0.25	0.25	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100**	**100**	**100**	**100**
	Calculated Proximate Composition					
Crude protein	24.00	24.21	24.40	24.00	24.21	24.40
Crude fibre	4.54	5.18	5.83	4.54	5.18	5.83
Ether extract	2.51	2.38	2.24	2.51	2.38	2.24
Ash	2.99	3.13	3.25	2.99	3.13	3.25
ME (kcal/kg)	3116.16	3071.99	3027.90	3116.16	3071.99	3027.90

TBNS-YPMC= Toasted Bambara nut sievate-Yam Peel Meal Composite, FFSB= Full Fat soybeans, ME= Metabolisable Energy.
**Vitamin premix contains B1, 1g; B2,6g; B12,0.02g; K3,3g; E,3g; Biotin,0.05g; Folic acid,1.5g; Cholinechloride,250g; Nicotineacid,30g; Ca-pantothenate,15g; Co,0.4g; Cu,8g; Fe,32g; I,0.8g; Zn,40g; Mn,64g; Se,0.16g, BHT,5g*

RESULTS AND DISCUSSION

Main effect of diets containing replacement levels of maize with TBNS-YPMC supplemented with or without Lactic Dry® (LD) on growth performance of noiler chicks is presented in Table 2. Main effect of LD supplementation showed no significant (P>0.05) influenced on growth indices of noiler chicks. Main effect of dietary replacement levels of maize with TBNS-YPMC showed that FCR was significant (P>0.05) influenced among growth indices of noiler chicks. This showed that supplementation of LD had no positive impact on the growth of noiler birds. Improved FCR of birds on diet containing 20% TBNS-YPMC as replacement for maize in noiler diets could not be imputed to low or high dietary fibre in the present study. It may be imputed to the ability of birds to utilize efficiently this diet.

Interaction effect of diets containing replacement levels of maize with TBNS-YPMC supplemented with or without LD on growth performance of noiler chicks is presented in Table 3. Daily feed intake (DFI) and FCR were significantly influenced (P<0.05). Noiler chicks on other treatment diets had highest and similar values (57.10±1.58 g/bird) for DFI while birds fed diet containing 40% TBNS-YPMC as replacement for maize without LD had least DFI (48.26±3.90 g/bird) value. Low feed intake of birds fed diet containing 40% TBNS-YPMC replacing maize without LD may be due to high fibre content of the diet which could not be handled efficiently by the young birds, possibly due to secretion of insufficient endogenous enzymes that could not facilitate breaking down of complex and macro feed molecule for subsequent digestion by the birds. These results are in harmony with the finding of Magee *et al.* [5] who reported that inclusion of probiotics in livestock diets improves digestive enzymes secretion thus boasting feed intake.

Birds fed diets containing 20 and 40% TBNS-YPMC as replacement for maize without LD, control diet with LD and diet containing 20% TBNS-YPMC as replacement for maize with LD had the best and similar FCR (3.69±0.34) values. Meanwhile, birds fed control diet without LD and diets containing 40% TBNS-YPMC

as replacement for maize with LD had poorest and similar FCR (4.38±0.05) values. Poor FCR for birds on control diet without LD may be due to lower crude fibre content which was easily digestible with attendant short transit time in the digestive tract that enable the birds to consume large quantities of feed. Similarly, poor FCR of birds on diet containing 40% TBNS-YPMC replacing maize with LD could be imputed to ability of the beneficial bacteria in the LD to displace and dislodge harmful bacteria which subsequently improved the birds' gastro-intestinal tract and general health thus, encouraging feed intake as well possible production of enzymes the aid in the breakdown of fibrous feed component. This could imply that probiotics work better to an extend on high fibre diet. Body weight gain of noiler chick fed diets with LD is in harmony with the findings of Sirovnik *et al.* [6] who reported no effect of probiotic on broiler body weight gain. However, zero mortality in this study buttresses the findings of Magee *et al.* [5] who found out that inclusion of beneficial microbes regulates the immune reaction and anti-oxidative status to boost the host's immunity to infections. In conclusion, TBNS-YPMC with or without LD can replace maize up to 40% without adverse effect on growth of noiler birds.

Main Effect of Diets Containing Replacement Levels of Maize with TBNS-YPMC Supplemented with or without Lactic Dry® on Growth Performance of Noiler Chicks (2-8 weeks)

			Replacement levels of maize with TBNS-YPMC			
Parameters	No Lactic Dry®	Lactic Dry®	0	20	40	p-values
IBW (g/b)	188.33 ±0.44	190.00 ±0.00	188.50 ±0.67	190.00 ±0.00	189.00 ±0.45	0.0752
FBW (g/b)	758.37 ±13.82	774.38 ±13.01	758.61 ±18.92	788.76 ±11.48	751.76 ±16.06	0.3046
DBWG (g/b)	13.50 ±0.32	13.01 ±0.31	13.58 ±0.44	14.26 ±0.27	13.40 ±0.38	0.3330
DFI (g/b)	52.35 ±1.52	52.25 0.94	54.39 ±1.77	51.59 ±0.72	50.92 ±1.63	0.5320
FCR	3.87 ±0.14	3.77 ±0.12	4.04 ±0.22^{a}	3.63 ±0.11^{b}	3.81 ±0.08^{ab}	0.0394
Mort. (%)	0.00 ±0.00	0.00 ±0.00	0.00 ±0.00	0.00 ±0.00	0.00 ±0.00	

a,b = Means in the same row with different superscripts are significantly different ($p<0.05$).

Table 3: Interaction Effect of Diets Containing Replacement Levels of Maize with TBNS-YPMC Supplemented with or without Lactic Dry® on Growth Performance of Noiler Chicks

	No Lactic Dry® supplementation			Lactic Dry® supplementation			
Parameters	0	20	40	0	20	40	p-Values
IBW (g/b)	187.00 ±0.00	190.00 ±0.00	188.00 ±0.00	190.00 ±0.00	190.00 ±0.00	190.00 ±0.00	0.0756
FBW (g/b)	733.89 ±8.73	799.56 ±12.59	741.67 ±27.74	783.33 ±33.21	777.96 ±19.59	761.85 ±20.45	0.3183
DBWG (g/b)	13.02 ±0.21	14.51 ±0.30	13.18 ±0.66	14.13 ±0.79	14.00 ±0.47	13.62 ±0.48	0.3622
DFI (g/b)	57.10 ±1.58^{a}	51.69 ±0.55^{ab}	48.26 ±3.90^{b}	51.67 ±2.40^{ab}	51.48 ±1.51^{ab}	53.59 ±1.06^{ab}	0.0428
FCR	4.38 ±0.05^{a}	3.57 ±0.09^{b}	3.67 ±0.11^{b}	3.69 ±0.34^{b}	3.69 ±0.22^{b}	3.94 ±0.06^{ab}	0.0443
Mortality (%)	0.00 ±0.00	0.00 ±0.00	0.00 ±0.00	0.00 ±0.00	0.00 ±0.00	0.00 ±0.00	-

a,b = Means in the same row with different superscripts are significantly different ($p<0.05$).
TBNS-YPMC =toasted Bambara nut sievate - yam peel meal composite, IBW= Initial body weight, FBW= final Body weight, TBWG= Tota body weight gain, DBWG=Daily body weight gain, TFI=Total feed intake, DFI=Daily feed intake, FCR=Feed conversion ratio and b = bird

Application, poultry farmers can use up to 40% TBNS-YPMC as replacement for maize with or without LD in noilers diets.

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Monogastric Animal Production: MGP 021

COST-BENEFIT OF FEEDING NOILER CHICKS' DIETS CONTAINING REPLACEMENT LEVELS OF MAIZE WITH TOASTED BAMBARA NUT SIEVATE-YAM PEEL MEAL COMPOSITE.

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ABSTRACT

A study to evaluate cost-benefit analysis of noiler chicks was conducted using one hundred and eighty 14-day old noiler chicks. Ninety birds were allotted to each of the two main groups offered diets supplemented with or without Lactic Dry. Each of the main groups were sub-divided into 3 groups of 30 birds and replicated thrice with 10 birds. Each group of birds was fed diets; T1: control, T2:20 and T3:40% of TBNS-YPMC replacing maize. The experiment was a 2 x 3 factorial in CRD arrangement. Results revealed that Cost per Kg diet was highest (₦369.56) and least (₦331.74) for control diet LD and diet containing 40% TBNS-YPMC without LD, respectively. Cost per kg of weight was highest (₦1,618.59) and least (₦1,217.49) for birds on control diet without LD and diet containing 40% TBNS-YPMC replacing maize without LD. respectively. Cost of feed consumed by noiler chick was highest (₦886.59) and least (₦673.43) for noilers on control diet without LD and diet containing 40% TBNS-YPMC replacing maize without LD. Total cost of production highest (₦1,288.16) and least (₦1,074.68) for chicks fed control diet without LD and diet containing 40% TBNS-YPMC replacing maize without LD. Gross profit for birds fed diet containing 40% TBNS-YPMC replacing maize without LD had highest (₦425.32) and least (₦211.84) for birds on control diet without LD. Conclusively, noilers can be fed diet containing40% TBNS-YPMC as replacement for maize to boost farmers income.

Key words: Sievate, noiler, benefit, cost and peel.

DESCRIPTION OF THE PROBLEM

High cost of consumable animal products in developing countries such as Nigeria is responsible for widespread malnutrition. This is due to exorbitant prices of conventional feed ingredients which invariably translates to high cost of production which subsequently impact negatively on the income of poultry producers [1]. Similarly, a drastic reduction of profit margin of average livestock producer is one of the menace in the industry due to heavy insecurity that deterred crop farmers from recording high yield hence, the need to use even the crop by-products [2]. Thus, providing Nigerians with adequate and balanced food supply to alleviate many health issues is our priority [3].

Therefore, the use of less expensive agricultural wastes such as Bambara nut sievate (BNS); a product obtained after milling Bambara nut and sieving it using 2 mm sieve and yam peels (YP); obtained after peeling of yam tubers are indispensable for producing affordable poultry meat and eggs. Similarly, Noiler; a dual purpose breed of chickens has been reported to reduce the cost of production leading to low cost of animal protein and at a sustainable level [4]. However, high fibre and anti-nutritional factor content of unconventional feed stuffs demands supplementation of exogenous enzymes and heat treatment, respectively to breakdown the macro-nutrient and deactivate the anti-nutritional factors for the birds to efficiently handle It has been reported that broiler chickens fed diets containing graded levels of YPM (0, 15 and 30%) with or without enzymes (50g/100Kg diet) as replacement for maize improved farmers profit due to reduction in the

cost of production [5]. Therefore, this study evaluated the cost-benefit of feeding noiler chickens' diets containing replacement levels of maize with toasted Bambara nut sievate-yam peel meal composite.

MATERIALS AND METHOD

Location of Study: The study was conducted at the Poultry Unit of the Livestock Teaching and Research Farm, Joseph Sarwuan Tarka University, Makurdi, Nigeria.

Collection and Preparation of Bambara Nut Sievate (BNS) and yam peel (YP)
BNS was purchased at Wannune, Benue State. 5 kg of raw BNS was thoroughly mixed with 500 mls of water and toasted. Fresh YP was collected from local farmers in Makurdi and sun-dried (5-7 days) to a constant weight. The dried yam peel was milled for use

Experimental Diets: Six diets were formulated with TBNS-YPM composite mixed in the ratio of 1:1 replacing maize in the diets at 0, 20 and 40% with or without Lactic Dry® (LD) and denoted as T1, T2 and T3, respectively as shown in Table 1. LD was supplemented in some of the diet at the rate of 25 g/100 Kg diet

Experimental Design and Management of Birds
A total of one hundred and eighty 14-day old noiler chicks were divided into 2 main groups of 90 chicks placed on diets supplemented with or without Lactic Dry. Each group was sub-divided into 3 sub-groups of 30 birds and replicated thrice with 10 birds each. Each of the 2 main groups were offered diets; T1: control, T2:20 and T3:40% of TBNS-YPMC replacing maize. The experiment was a 2 x 3 factorial in CRD arrangement which lasted 6 weeks while feed and water were offered *ad-libitum* throughout the study period.

Table 1: Ingredients and Proximate Nutrients Composition of Noiler Chicks' Starter Diets Containing Graded Replacement of Maize with BNS-YPM Composite

	Dietary replacement levels of Maize with TBNS-YPM Composite (%)					
	No Lactic Dry®			Lactic Dry® (25 g/100 kg)		
IngredIngredients (Kg)	0	20	40	0	20	40
Maize	31.33	25.06	18.80	31.33	25.06	18.80
BNS-YPMC	00.00	6.27	12.53	00.00	6.27	12.53
FFSB	54.27	54.27	54.27	54.27	54.27	54.27
Maize Offal	10.00	10.00	10.00	10.00	10.00	10.00
Bone ash	3.50	3.50	3.50	3.50	3.50	3.50
Salt	0.30	0.30	0.30	0.30	0.30	0.30
Lysine	0.10	0.10	0.10	0.10	0.10	0.10
`Methionine	0.25	0.25	0.25	0.25	0.25	0.25
Vit. Premix	0.25	0.25	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100**	**100**	**100**	**100**
	Calculated Proximate Nutrients Composition					
Crude protein	24.00	24.21	24.40	24.00	24.21	24.40
Crude fibre	4.54	5.18	5.83	4.54	5.18	5.83
Ether extract	2.51	2.38	2.24	2.51	2.38	2.24
Ash	2.99	3.13	3.25	2.99	3.13	3.25
ME (Kcal/Kg)	3116.16	3071.99	3027.90	3116.16	3071.99	3027.90

TBNS-YPMC= Toasted Bambara nut sievate-Yam Peel Meal Composite, FFSB= Full Fat soybeans, ME= Metabolisable Energy, Kcal= Kilocalories, Kg= Kilogramme.
**Vitamin premix contains B1, 1g; B2,6g; B12,0.02g; K3,3g; E,3g; Biotin,0.05g; Folic acid,1.5g; Cholinechloride,250g; Nicotineacid,30g; Ca- pantothenate,15g; Co,0.4g; Cu,8g; Fe,32g; I,0.8g; Zn,40g; Mn,64g; Se,0.16g, BHT,5g*

Data collection

Cost- benefit Analysis

Cost (₦) per kg diet was calculated as the aggregate of the individual cost contribution of feed ingredients used to formulate 100kg diet divide by 100.

Cost (₦) of feed consumed was calculated as total feed consumed multiply by their respective cost per kg diet. Feed Cost per Kg Gain was calculated as the product of the Feed Conversion Ratio and Feed cost per kilogramme Total production cost (₦) was calculated as the summation of the cost (₦) of birds, drugs/vaccine and the Cost (₦) of feed consumed and of birds. Gross profit was calculated as the difference between price per bird and total production cost per bird.

RESULTS AND DISCUSSION

Cost-benefit analysis of production of noiler chicks fed diets containing replacement levels of maize with TBNS-YPMC with or without Lactic Dry® (LD) is presented in Table 2. Cost per Kg diet was highest (₦369.56) and least (₦331.74) for control diet with LD and diet containing 40% TBNS-YPMC without LD respectively which buttresses the report of [6] who observed a reduction in feed cost due to inclusion of Bambara groundnut offal (BGO) that subsequently increased farmers' income. Cost per kg of weight of noiler chick was highest (₦1,618.59) for control diet without LD while diet containing 40% TBNS-YPMC replacing maize without LD had least (₦1,217.49) cost per kg weight gain which corroborates the findings of [7] who reported that inclusion of 30% BGO in enzymes supplemented broiler chickens' diets reduce feed cost per kg weight gain of broiler chickens. Cost of feed consumed by noiler chick was highest (₦886.59) for control diet without LD while diet containing 40% TBNS-YPMC replacing maize without LD had least (₦673.43) cost of feed consumed. Total cost of production was highest (₦1,288.16) and least (₦1,074.68) for noiler chick on control diet without LD and diet containing 40% TBNS-YPMC replacing maize without LD, respectively which is in harmony with the findings of [8] who reported a reduction in the cost of production when 50% YPM replace maize in broiler chickens' diets at both starter and finisher phases. Birds fed diet containing 40% TBNS-YPMC replacing maize without LD had highest gross profit (₦425.32) while birds on control diet without LD had least (₦211.84) gross profit which confirms the earlier assertion of [6] who observed that inclusion of BGO increased farmers' income. **Conclusively**, replacement of maize with TBNS-YPMC in noiler chicks' diets, reduced cost per kg diet and improved farmer's income. **Application;** Farmer can use 40% TBNS-YPMC as replacement for maize in noiler chicks' diets to improve their income.

Table 2: Cost-benefit Analysis of Production of Noiler Chicks Fed Diets Containing Replacement Levels of Maize with TBNS-YPMC Supplemented with or without Lactic Dry®

	Dietary replacement levels of Maize with TBNS-YPM Composite (%)					
	No Lactic Dry® Supplementation			Lactic Dry® Supplementation		
Parameters	0	20	40	0	20	40
14-day old chicks (₦)	300.00	300.00	300.00	300.00	300.00	300.00
Vaccine/Drug (₦)	101.25	101.25	101.25	101.25	101.25	101.25
Cost/Kg diet (₦)	369.54	358.26	331.74	369.56	358.28	331.76
Total feed intake (kg)	2.40	2.17	2.03	2.17	2.16	2.25
FCR	4.38	3.57	3.67	3.69	3.69	3.94
Cost/Kg weight gain (₦)	1,618.59	1,278.99	1,217.49	1,363.68	1,322.05	1,307.13
Cost of feed cons. (₦)	886.90	777.42	673.43	801.95	773.88	746.76
Cost of production (₦)	1,288.15	1,178.67	1,074.68	1,203.20	1,175.13	1,148.01
Gross profit (₦)	211.85	321.33	425.32	296.80	324.87	351.99

Cons.= consumed. NOTE: Each post-brooded noiler bird was sold at ₦1,500.00

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CARCASS AND INTERNAL ORGANS OF MONGREL WEANER RABBITS FED DIETARY INCLUSION OF BAMBARA NUT SIEVATE TOASTED AT DIFFERENT DURATIONS

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ABSTRACT

A study was carried out to evaluate carcass traits and internal organ relative weight of weaner rabbits fed dietary inclusion of bambara nut sievate (TBN) toasted at different duration in a 90-day trial. 30 mongrel weaner rabbits weighing between 550.00-555.50 g were acclimatized for 10 days and allotted to 5 treatments of 6 rabbits each with a rabbit per replicate in a Complete Randomized Design. The rabbits were intensively managed, housed individually in hutches (0.6 x 0.6 x 0.6 m) with drinkers and feeders firmly fixed. Routine management were observed. Five experimental diets were formulated to contain 0% BNS (Control) and 20% each of raw and different durations of toasted BNS, and coded as T1: control, T2: 20 raw BNS, T3:20, T4:30 and T5:40 minutes of toasted BNS, respectively. Feed and water were supplied to the experimental rabbits' *ad libitum*. Each rabbit was offered 200 g of *Tridax procumben* daily. Results revealed that carcass and internal organs weight of rabbits were not significantly influenced ($p>0.05$) except gall bladder weight. Rabbits on control and diet containing toasted Bambara nut sievate toasted for 40 minutes had highest and similar (0.08 %LW) relative gall bladder weight while those on other experimental diets had least and similar (0.04 %LW) relative gall bladder weight. It is concluded that raw and toasted Bambara nut at 20 to 40 minutes can be included in rabbits' diets without adverse effect on carcass and internal organs.

Key words: organ, sievate, carcass, Bambara and weight

DESCRIPTION OF THE PROBLEM

Drastic and persistent drop in animal protein daily intake of most Nigerians below the previous existed figure of 45.4 g and below recommended value of 53.8 g by Food and Agricultural Organization (FAO) per day per person remains a major worry to animal scientist [1]. The need to overcome this perennial menace becomes pertinent especially in the face of insecurity and economic hardship in the country. The need to use crop wastes such Bambara nut sievate; a product obtained after milling Bambara nut and sieving it using 2 mm sieve which can be incorporated in the diets of livestock to boast their performance and reduce cost of their edible products is the way forward. Although, raw Bambara nut waste contain anti-nutritional factors that hamper growth performance of livestock which can be successfully deactivated using heat treatment [2]. Similarly, nutritive value of toasted Bambara nut sievate is negatively affected by its high fibre content and thus, made it unsuitable for incorporation in monogastric diets [2]. Ahamefule *et al*. [3] reported that in recent times, a case has been made for rabbit production as a realistic approach to counter the animal protein deficit in the diet of Nigerians. Prolificacy of rabbit and its potential to strive on low quality diets under intensive production is currently considered as one of the alternatives means of bridging animal protein gap among Nigerians [4]. This principally feasible as a results of its large caecum that harbor variety of microbes for fermentation of high dietary fibre has contributed to make rabbit an animal of choice for the present study. This study evaluated the impact of feeding dietary inclusion of bambara nut sievate toasted at different duration on carcass and internal organs of mongrel weaner rabbits.

MATERIALS AND METHOD

Experimental Site: The study was conducted at the Rabbitary Unit of the Livestock Teaching and Research Farm, College of Animal Science, Federal University of Agriculture, Makurdi, Benue State-Nigeria,

Collection and processing of Bambara ground nut Sievate (BNS)
The Bambara nut sievate was purchased from Wannune, Benue State. Five kilograme of raw BNS was thoroughly mixed with 500 mls of water and toasted thrice at different durations (20,30 and 40 minutes) at a temperature of between 50 -60 ^{0}C. The toasted BNS was cautiously done to avoid charring. Laboratory thermometer was used to monitor the toasting temperature at two (2) minutes interval to ensure that the toasting temperature remained within the specified ranged. Thereafter, the toasted material was allowed to cool (25˚C) before putting in the respective marked sacks for use. Other feed ingredients were bought at the Market and Livestock shop within Makurdi.

Experimental Animal, design and Management
A total of 30 mongrel weaner rabbits weighing between 550.00-555.50 g were dewormed using Ivomec at 0.2 ml per rabbit subcutaneously, embazin Forte and neomycin were administered to take care of coccidiosis and other bacterial infections, respectively. They were acclimatized for 10 days and allotted to 5 treatments of 6 rabbits each with a rabbit per replicate in a Complete Randomized Design. The rabbits were intensively managed, housed individually in hutches (0.6 x 0.6 x 0.6 m) with drinkers and feeders firmly fixed. Routine management were observed.

Experimental diets and feeding
Five experimental diets were formulated to contain 20% each of raw and different durations of toasted Bambara nut sievate (BNS) and coded as T1: control, T2: 0, T3:20, T4:30 and T5:40 minutes of toasting, respectively. Feed and water were supplied to the experimental rabbits' *ad libitum*. Each rabbit was offered 200 g of *Tridax procumben* daily.

Data Collection
Carcass Evaluation
At the end of the 90-day feeding trial, three rabbits whose weights were closest to the average weight of rabbits in that treatment group were selected, starved overnight to clear their guts of digesta and subjected to carcass evaluation as described by Uza *et al.* [4]. Each animal was weighed before slaughter, after slaughter and after dressing. Dressing percentage was calculated as the weight of dressed carcass in relation to live weight at slaughter multiplied by 100. Dressed carcass is the weight of the rabbit after removal of the head, fur, contents of the thoracic and abdominal cavities (including the diaphragm and kidney). Internal organs were expressed as percentage of live weig**ht.**

Statistical Analysis: Data obtained were subjected to one-way analysis of variance (ANOVA) using SPSS [5] and means were separated ($P<0.05$) using Duncan Multiple Range Test [6].

RESULTS AND DISCUSSION

Results revealed that carcass and internal organs weight of rabbits were not significantly influenced ($p>0.05$) except gall bladder weight (Table 2). Rabbits on control and diet containing toasted Bambara nut sievate toasted for 40 minutes had highest and similar (0.08 %LW) relative gall bladder weight while those on other experimental diets had least and similar (0.04 %LW) relative gall bladder weight. Gall bladder secrets bile that aids digestion of fats in small intestine. The increase relative weight of gall bladder among rabbits on control diet and diets containing Bambara nut sievate toasted for 40 minutes could be due to low fats contents of these diets that made the body system to demand less bile for fat digestion leading to large amount of bile been retained in the gall bladder. Slaughtered, eviscerated, dressed weight and dressing percentage of rabbis in the present study are favuorably comparable with the values of 1.50 to 1.77, 1.17 to 143, 1.03 to 1.23 kg and 67.13 to 69.81%, respectively reported by Uza *et al.* [4] when rabbits were fed diet containing grass

meal. This implies that BNS did not pose problem to the rabbits. Similarly, Salroo *et al*. [8] also reported average slaughter weight of 1.72 kg in soviet fryer at 12 weeks of age which compared favourably with the present result. The dressed weights in this study are in consonance with result (1.00 – 1.01 kg) reported by Ahamefule *et al*. [3] for weaner rabbits fed cassava peel-based diets. The values of 68.51 to 71.69% obtained in the present study suggests that the optimum levels of raw and toasted BNS inclusion in the rabbit diets may not have been attained. The relative liver, kidney, spleen, heart of rabbits in the present study are lower compared with the range of values of 13.91 to 14.45, 6.37 to 8.38, 1.57 to2.68 and 4.35 to 6.63% LW, respectively reported by Ironkwe and Amaefule [9] when rabbits were fed graded levels of BGO diets. **In conclusion**, raw and toasted Bambara nut at 20 to 40 minutes can be included in rabbits' diets without adverse effect on carcass and internal organs. **Application**; rabbit farmers can include raw and toasted Bambara nut sievate in rabbits' diets without adverse effect on carcass traits and organ weight.

Table 1: Ingredient and Proximate Nutrient Composition of Diets containing Raw and Varied duration of toasted Bambara nut sievate (BNS).

	Duration (Minutes) of toasting BNS included in the diets				
Ingredients	Control	0	20	30	40
Maize	31.33	14.28	14.28	14.28	14.28
Full fat soybean	19.67	16.72	16.72	16.72	16.72
Bambara nut sievate	0.00	20.00	20.00	20.00	20.00
Brewer's Dried Grains	30.00	30.00	30.00	30.00	30.00
Rice Offal	15.00	15.00	15.00	15.00	15.00
Bone Ash	3.00	3.00	3.00	3.00	3.00
Salt	0.30	0.30	0.30	0.30	0.30
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.20	0.20	0.20	0.20	0.20
Vitamin Premix	0.25	0.25	0.25	0.25	0.25
TOTAL	**100**	**100**	**100**	**100**	**100**
	Determined Nutrient Composition (%)				
ME Kcal / Kg	2,245.72	2,203.73	2,220.89	2,427.24	2,390.21
Crude protein	16.63	17.50	17.06	17.50	17.50
Crude fiber	23.16	27.32	24.43	19.39	15.23
NFE	36.96	31.06	33.37	38.36	37.91
Ether extract	3.93	5.60	5.00	5.16	4.90
Ash	8.98	7.99	9.09	8.39	14.45

NFE = Nitrogen free extract, ME = Matabolisable energy = (37 x %CP + 81X % EE + 35.55 X NFE). ME as calculated using Puazenga [7] **I Kg of Vitamin premix contained vitamin B1, 1g; vitamin B2,6g; vitamin B12,0.02g; vitamin K3,3g; vitamin E,3g;Biotin,0.05g;Folicacid,1.5g;cholinechloride,250g;Nicotineacid,30g;Capantothenate,15g;Co,0.4g;Cu ,8g;Fe,32g;I0.8g;Zn,40g;Mn,64g ;Se,0.16g,BHT,5g.*T1= Control, T2= 20 % raw Bambara nut sievate, T3= 20 % Bambara nut sievate toasted for 20 minutes, T4= 20 % Bambara nut sievate toasted for 30 minutes and T5= 20 % Bambara nut sievate toasted for 4S0 minutes

Table 2: Carcass traits and organ weight evaluation of mixed breeds of rabbits fed dietary inclusion of raw and different duration of toasted Bambara nut sievate.

	Duration (Minutes) of toasting BNS included in the diets					
Parameters	Control	0	20	30	40	SEM
Fasted weight (Kg)	1.61	1.69	1.60	1.58	1.61	0.04
Evisc. weight (Kg)	1.23	1.29	1.22	1.23	1.23	0.02
Sieging weight (Kg)	1.10	1.11	1.05	1.08	1.08	0.02
Carcass weight (Kg)	1.15	1.10	1.10	1.13	1.13	0.02
Dressing %	71.69	68.90	68.51	71.33	70.08	0.78
Organs expressed as % live weight						
Liver	2.51	2.18	2.03	2.26	2.19	0.07
Lung	0.54	0.45	0.50	0.53	0.61	0.03
Heart	0.27	0.24	0.23	0.24	0.24	0.01
Kidney	0.52	0.51	0.46	0.51	0.58	0.02
Spleen	0.06	0.05	0.04	0.04	0.06	0.00
Abdominal fat	2.31	2.36	2.48	1.01	1.64	0.28
Gall bladder	0.08^{a}	0.04^{b}	0.04^{b}	0.04^{b}	0.05^{ab}	0.01

a,b,= Means with different superscripts in the same row are significantly different (P<0.05). % LW= Percentage Live weight, Evisc. =Eviscerated and %= Percentage.

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Monogastric Animal Production: MGP 023

INFLUENCE OF CRUDE ONION EXTRACT ON SERUM BIOCHEMICAL INDICES OF BROILER CHICKENS

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ABSTRACT

The study investigated the influence of onion extract on serum biochemistry of broiler chickens. A total of one hundred and fifty (150) day-old Abor acre broiler chicks (mixed sex) was reared up to eight (8) weeks of age and used for the study. The chickens were randomly assigned to five dietary treatment groups with thirty (30) birds per treatment. Each group was further sub-divided into three replicates of 10 birds per replicate in a Complete Randomized Design (CRD). The onion extract were squeezed out with sieve into a container, the extract were prepared daily and administered to the birds at graded levels of 0.00%,2.5%, 5.0%, 7.5% and 10% in a litre of drinking water for T_1, T_2,T_3,T_4 and T_5 respectively and were fed to the bird ad-libitum. The result of serum biochemistry revealed that there were significant ($P<0.05$) difference among all parameters examined except total protein, globulin, alanine amino transferase and urea which were not significantly ($P>0.05$) different among treatment groups.Serum biochemical indices of broiler chickens revealed that onion extract has no adverse effect on the birdsbut reduced blood cholesterol level. Birds fed 1% onion extract showed best performance and reduced blood cholesterol level. The cholesterol values ranged from 2.6 to 6.9mmol/l and were significantly ($P<0.05$) higher (6.9 mmol/l) in T1 (control) and T2 compared to other treatment groups, while the least was observed (2.5 mmol/l) in T5. The serum glucose levels of broiler chickens fed crude onion extract ranged from 5.30 to 6.67mmol/l indicated that treatment 5 recorded the highest value (6.67 mmol/l) than other treatment groups. However, the values obtained in this study were in lined with the values (6.20 to 19.40 mmol/l) for healthy broiler chickens.Therefore it is conclude that 1% level is recommended for broiler chicken.

Key words: broilers, onion extract and serum biochemistry

DESCRIPTION OF PROBLEM

In Nigeria, the impact of inadequate animal protein intake is felt more by a large proportion of the populace especially in the rural areas. Poultry meat is a good source of animal protein and can contribute immensely in boosting the consumption level of animal protein. The increase in the cost of input especially that of feed is among the constraints in commercial broiler production (1). Ensuring more net return and minimizing high expenditure for feed are the main challenges, for which many research strategies have been trying to address through the inclusion of feed supplements and feed additives in the diets of broiler chicken.

The major feed additive that has been extensively used is antibiotics-based growth promoters. Incidentally, their use in animal feed has shown several side effects such as resistance of pathogens towards the drug and evidence of resistant strains that become zoonotic (2). The emergence of antibiotic resistance by pathogenic bacteria has led to international restriction on the use of antibiotics in animal feeds. Consequently, the poultry industry is under great pressure to minimize their use in animal feed and seek alternatives. These alternatives can be found in the use of herbs and spices materials as supplements. According to(3) natural alternatives to antibiotics, such as herbs and medicinal plants, have attracted attention due to their wide range of potential beneficial effects and availability. One of such is the onion.

Onion ***(Allium cepa)*** belongs to the *Allium* genus as reported by(4). This plant contains numerous health benefits which have been attributed to the vegetable include antibacterial, antiviral, anti-parasitic and

antifungal properties. In addition to use of onion for nutrition it is used for treatment of some illness as herbal medicine. The objective of study is to determine serum biochemical indices of broiler chickens supplemented with Onion extracts.

Objective

The objective of study is to determine serum biochemical indices of broiler chickens fed diets supplemented with Onion extracts.

METHODOLOGY

Location of the study

The research was carried out at the Poultry Unit of the Teaching and Research Farm, Department of Animal Science, Faculty of Agriculture, University of Maiduguri Borno State, Nigeria. Maiduguri is positioned between latitude 11027'30 N and 11033'30 N, longitude 1302'30'' and 1309'1''E, and has an elevation of 354m above sea level. The area is recognized for its diverse climate and seasonal changes, with a brief period of 3-4 months. It characterized by short period of rainfall and long dry season of about 8-9 months Encarta (5).

Animals and Experimental Design

A total of one hundred and fifty (150) day old Abor acre broiler chicks were randomly assigned to five dietary treatment groups with thirty (30) birds per treatment. Each group was further sub-divided into three replicates of 10 birds per replicate in a completely randomized design (CRD). Prior to arrival of the chicks, the rearing pens were thoroughly swept, washed with detergent and then disinfected with a suitable disinfectant (IZAL) so as to eliminate any disease causing organism present that may be a source of infection to the chicks. All brooding equipment were cleaned, washed and disinfected. On arrival, clean drinking water with anti-stress (glucose) and feed were supplied to the chicks. Blue-flamed heating kerosene stove were used as a source of heat during brooding. Brown papers were used for the first seven days of brooding on the cemented floor, thereafter, wood shaving were spread on the cemented floor to a depth of about two centimetres (2 cm) to serve as an insulator and also absorb moisture from droppings.

The chicks were vaccinated according to the recommended schedule for the North East zones. The bird diets were changed from the broiler starter to finisher at 5th week of age and the study lasted for eight (8) weeks.

Procurement and Preparation of onion extract

The test material onion (*Allium cepa*) was purchased from Gamboru Market in Maiduguri Metropolis. The onion was carefully selected to ensure that they are disease free before extraction. After which the outer layer was removed and washed, bulb were weighed, 25% of clean water by weight of the onion bulb was added and blended into paste using electrical blender. The paste was then squeezed out with sieve into a container to obtained the extract. The extract were prepared daily and administered to the birds at graded levels of 0.00%, 0.25%, 0.50%, 0.75% and 1.00% in a litre of drinking water for T1, T2, T3, T4 and T5 respectively and were fed to the birds *ad-libitum.*

Chemical Analyses

The serum biochemical analysis carryout include total protein, albumin, globulin, serum urea, serum cholesterol, serum glucose, Aspartate aminotransferase and Alanine aminotransferase.

Statistical Analysis

All data obtained were subjected to one way analysis of variance (ANOVA) using completely randomized design (6). Differences between the means were separated using least significant difference (LSD) at 95% confidence level ($p<0.05$) with the aid of Statistix 10.0.

Broiler Starter and Finisher diets

The Broiler Starter and Finisher diets are shown in Table 1 below

Table 1: Ingredients Composition and Calculated Analysis of Broiler Starter and Finisher Diets (%)

Ingredients	Starter	Finisher
Maize	54.00	58.00
Groundnut Cake	20.00	5.00
Soy Bean Meal	10.00	20.50
Wheat offal	7.50	8.50
Fish meal	5.00	4.00
Bone ash	2.00	2.50
Limestone	0.50	0.50
Min-vit premix*	0.40	0.40
Methionine	0.30	0.30
Lysine	0.10	0.10
Salt	0.20	0.20
TOTAL	**100.00**	**100.00**
Calculated Analysis (%)		
Crude protein	22.46	20.19
Crude fibre	3.69	3.97
Ash	2.58	3.06
Ether extract	5.11	4.23
Nitrogen-free extract	66.16	68.57
Calcium	1.00	1.10
Phosphorus	0.44	0.50
ME (Kcal/kg)	2839.58	2955.18

RESULTS AND DISCUSSION

Proximate Composition of the Broiler Starter and Finisher Diets

The Proximate composition of the broiler starter and finisher diets is presented in Table 2 below.

Table 2: Proximate Composition of the Broiler Starter and Finisher Diets

Nutrients (%)	Broiler Starter	Broiler finisher
Crude protein	23.02	19.55
Crude fibre	5.85	7.92
Ether extract	5.96	5.58
Ash	6.47	5.52
Nitrogen-free extract	58.70	61.43
ME (Kcal/Kg)	3209.00	3325.38

Nitrogen-free extract was calculated by difference: NFE = 100- (%CP+%EE+%CF+%Ash), while ME = Metabolisable energy was calculated according to (7) as follows; ME = 37x %CP + 81 x %EE +35 x %NFE.

The serum glucose levels indicated that treatment 5 recorded the highest value (6.67 mmol/l) than other treatment groups. However, the values obtained in this study were in lined with the values (6.20 to 19.40 mmol/l) reported by (8) and (9) for healthy broiler chickens.

Table 3: Serum Biochemical Component of Broiler Chickens fed Graded Level of Onion Extracts

Parameters	T1 (0%)	T2 (0.25%)	T3 (0.50%)	T4 (0.75%)	T5 (1.00%)	SEM
Total Protein (g/dl)	59.67	56.33	49.00	59.33	59.67	2.48^{NS}
Albumin (g/dl)	39.33^{a}	24.67^{bc}	20.00^{c}	31.67^{ab}	34.00^{ab}	3.35*
Globulin (g/dl)	20.33	31.67	29.00	27.67	25.67	3.09^{NS}
Aspartase Amino Transferase (iu/l)	59.33^{b}	115.33^{a}	113.33^{a}	55.67^{b}	49.00^{b}	7.15*
Alanine Amino Transfarase (iu/l)	55.00	62.33	60.33	65.67	61.33	4.61^{NS}
Urea (mmol/l)	5.73	5.87	6.13	6.03	7.60	0.66^{NS}
Glucose (mmol/dl)	5.63^{b}	5.67^{b}	5.53^{b}	5.30^{b}	6.67^{a}	0.27*
Cholesterol (mmol/dl)	6.9^{a}	6.5^{a}	3.4^{b}	2.9^{c}	2.5^{c}	1.30*

SEM = Standard Error of Means., NS = Not significant (P>0.05), * = Significant (P<0.05) difference, a, b, c, = Mean in the same row bearing different superscripts differ significantly (P<0.05)

The cholesterol values ranged from 2.6 to 6.9mmol/l and were significantly (P<0.05) higher (6.9 mmol/l) in T1 (control) and T2 compared to other treatment groups, while the least was observed (2.5 mmol/l) in T5. The values obtained in the study were similar to the range of 4.5 to 7.0mmol/l as reported by(10). The cholesterol level decreased as the level of onion extract increases; this is an indication that onion extract reduces blood cholesterol level of broiler chickens. The total protein values obtained are within the ranged 49.66 to 62.33 g/dl as outlined by (11). (12) reported that serum total proteins of chickens are indirect indices for measuring nutritional protein adequacy in farm animals. However, this implies that the protein is adequate for broiler chickens.

The level for alanine amino transferase ranged from 55.00 to 65.67 iu/l. The values obtained in the study were similar to the level 62 iu/l reported by (7) for domestic chickens. Increased levels also cause liver damage, kidney infection and myocardial infection (13). Alanine amino transferase is released in the blood when the liver or heart is damaged (14).Therefore the value obtained in this study is within the normal range for broiler chicken.

CONCLUSION AND APPLICATION

The study concluded that serum biochemical indices of broiler chickens onion extract has no adverse effect on the birds at all level of inclusion. The cholesterol level decreased as the level of onion extract increases. 1 % inclusion showed better performance on reduced blood cholesterol level.

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EFFECT OF *CARICA PAPAYA* LEAF MEAL, *Ocimum Gratissium* LEAF MEAL AND *Bryophyllum Pinnatum* LEAF MEAL ON GROWTH PERFORMANCE OF BROILER CHICKENS

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ABSTRACT

This study assessed the effect of *Carica papaya* leafmeal (CLM), *Ocimum gratissimum* leaf meal (OLM) and *Bryphylhum pinnatum* leaf meal (BLM) on growth performance of broiler chicken**.** A basal diet was divided into four portions, designated as diet 1 (control) and diets 2, 3 and 4 supplemented into 0.2% *Carica papaya* leaf meal (CLM), 0.2% *Ocimum gratissimum* leaf meal (OLM) and 0.2% *Bryohylhum pinnatum* leaf meal (BLM). One hundred and twenty-eight (128) day old broiler chicks were randomly assigned to the four experimental diets; 8 birds per replicate using a Completely Randomized Design. The body weight gain of birds on control diet and diet 2 were similar ($P<0.05$) but significantly higher than the values recorded for birds fed diets 3 and 4. The feed conversion ratio of birds fed diet 2 were significantly lower than the values recorded for birds fed control diet, diets 3 and 4. The final live weight, feed intake were not significantly ($P < 0.05$) influenced by the Phytogenic supplemented diet. The pawpaw leaf meal at 0.2% dietary supplementations improved the body weight gain and feed conversion ratio without any deleterious effect on the birds. The PLM at 0.2% dietary supplementation is hereby recommended in this study. It enhanced the growth performance of the birds and improved the feed conversion ratio of the birds.

Keywords: *Ocimum gratissimum, Bryophyllum pinnatum,* broilers, growth performance, antibiotics

DESCRIPTION of Problem

The rapid rise and increase in intensity of broiler chicken production have increased the challenge of searching for alternatives capable of providing improvement in the productive parameters of performance, carcass yield, benefits to animal health, and improvements in the quality of meat. Consumers' pressure and worries regarding the harmful effects of antibiotic growth promoters (AGP) use and the ban of antibiotics in the European Union have prompted researchers to think about alternatives to antibiotics (1). The aim of these alternatives is to maintain a low mortality rate and a good level of animal yield, while preserving the environment and consumer health. Plant extracts have been studied as an interesting strategy for the replacement of AGP, since they do not have market restrictions, are considered natural products without risk of residues in the final product, bring health benefits, such as antimicrobial (2), anti-oxidant (3) and digestive (4) effects.

Phytogenic feed supplements are a large group of compounds having diversified chemical bioavailability and structure (5). These phytogenic bioactive compounds in the plants vary, depending on some factors, such as the specific part of the plant, the harvest season, production techniques or methods and geographical location (6). Phytochemicals have some biological properties (antioxidant, anti-stress, antimicrobial and immunomodulatory) that prompt their consideration for use as growth promoters in livestock production (7). Phytogenic feed additives are usually defined as products derived from plants and added to animal feed for fattening to increase productivity, improving the quality of feed and animal hygiene conditions and not least to improve the quality of produced food.

Feed additives produced from plants have a significant antibacterial effect capable of suppressing pathogenic microflora in the gastrointestinal tract of animals and thus reducing mortality during the fattening period, especially in stress period (8). Plant additives are often added into feedstuff as they improve the taste and smell of feed and thus improve intake and growth of animals (9). Several herbal additives contain substances

which increase the production of digestive juices (saliva, gastric juices, pancreatic and intestinal secretion) and thereby enhance appetite and digestion (10). The aim of the study was to determine the effect of *Carica papaya* leaf meal, *Ocimum gratissimum, Bryophyllum pinnatum* on growth performance of broiler chickens.

METHODOLOGY

Location of Experimental site: The study was carried out at the Poultry Unit of Teaching and Research Farm, Department of Agricultural Technology, The Federal Polytechnic Ado Ekiti, Ekiti state, Nigeria. The state is located in South Western part of the country, Ekiti state covers a land area of 6353km square (2453sqmi) with a population estimated in 2005 to be 2737,186. It enjoys tropical climates with two distinct seasons, there are rainy season (April to October) and dry season (November to March). Ado Ekiti has a temperature ranges between 21^{o}C to 28^{o}C.

Site Preparation: The poultry house was thoroughly washed, fumigated with disinfectant. The poultry house was allowed to stay and dried for two weeks before the arrival of the experimental birds, proper weeding of the surrounding was carried out to prevent predators and pests.

Test ingredients: The test ingredients *Carica papaya*, *Ocimum gratissimum*, *Bryophyllum pinnatum* leaf meals used were harvested within the premises of The Federal Polytechnic Ado Ekiti. They were air-dried for 13 days in order to reduce their moisture content. They were milled into fine particles and used to formulate the diets.

Management of Experimental Birds: A total number of one hundred and twenty-eight birds of Cobb-500 breeds were used for the experiment. The chicks were brooded for two weeks for acclimatization using electric bulb as source of light and heat in the pen. In the brooder house, enough provision were made for space and Ventilation. Polythenes were also used to cover the pen to provide warmth, and protection against predators and cold extreme weather. Proper and adequate management practice were undertaken. Vaccinations and medications were given appropriately throughout the durations of the experiment. Feed and water were given *ad-libitum.*

Experimental diets: The composition of experimental diets were presented in table below. The basal diets were formulated for broiler starter (0-28) days and finisher phase (29-56) days. The basal diets were divided into 4 diets: Diet 1: Control diet (without supplements) , Diet 2: Contained 0.2% of *Carica papaya* leaf meal, Diet 3: Contained 0.2% of *Ocimum gratissimum*, Diet 4: Contained 0.2% of *Bryophyllum pinnatum* leaf meal.

Experimental design: The experimental design used was Completely Randomized design (CRD). There are 4 treatments replicated 4 times with 8 birds per replicates. The total number of birds used in this study was one hundred and twenty-eight (128) broiler chickens for duration of eight weeks

Data collection: The birds in each treatment were weighed on weekly basis and feed intake was recorded on daily basis for the growth performance. The following parameter were assessed initial body weight, final live weight, feed intake, average daily feed intake, average daily weight gain. Weight gain was obtained by subtracting the initial weight from the final live-weight. The feed conversion ratio (FCR) was calculated by dividing feed intake by body weight gain of the birds.

Statistical analysis: All data collected in this study were subjected to Analysis of Variance using SPSS. Duncan's Multiple Range Test of one way ANOVA was used to analyze the mean differences of the same parameter. Significant differences was considered where necessary at a level of ($P>0.05$).

Table 1 Composition of experimental diet (%) for broiler starter and finisher

Ingredients	Broiler starter	Broiler finisher
Maize	48.00	62.00
Soybean cake	22.00	15.00
Groundnut cake	14.00	14.00
Fish meal	2.00	2.00
Bone meal	4.00	3.00
Limestone	2.00	2.00
Broiler premix	0.25	0.25
Methionine	0.25	0.25
Lysine	0.25	0.25
Common salt	0.25	0.25
Vegetable oil	1.00	1.00
Total	100.00	100.00
Calculated composition		
Metabolizable Energy	2938.00	3035.00
Crude protein	24.62	19.28
Calcium	2.35	1.99
Phosphorus	0.84	0.65
Lysine	1.33	1.27
Methionine	0.60	0.58

RESULTS

The effects of phytogenic supplementations on the final live weight, feed intake (FI), body weight gain (BWG) and feed conversion ratio (FCR) are presented in Table 3. The body weight gain of birds fed control diet, *Ocimum gratissimum* leaf meal (OLM) and *Bryophyllum pinantum* leaf meal (BLM) are 50.95g, 49.89g and 49.99g, respectively were similar ($P > 0.05$) but significantly ($P < 0.05$) lower than those birds fed *Carica papaya* leaf meal (CLM) supplemented diet (58.39g). The feed conversion ratio (FCR) of the birds on CLM supplemented diet was significantly lower (1.52). The final live weight, feed intake were not significantly ($P>0.05$) influenced by the phytogenic supplemented diet.

Table 3. Effect of phytogenic feed additives on growth performance of broiler chickens

Parameters	T1	T2	T3	T4	SEM	*p- value*
	Control	CLM	OLM	BLM		
Initial weight (g)	38.80	38.88	38.97	38.97	0.04	0.60
Final liveweight (g)	2905.38	2865.31	2841.13	2914.68	13.32	0.17
Feed intake/b/d (g)	87.46	86.96	89.90	88.61	0.50	0.16
Body weight gain (g)	50.95^{a}	58.39^{a}	49.89^{b}	49.99^{b}	0.94	0.02
Feed conversion ratio	1.72^{b}	1.52^{c}	1.80^{a}	1.77^{ab}	0.03	0.01

^{a,b,c} means in the same row with different superscripts are significantly ($p<0.05$) different; sem: Standard Error of Mean, Carica papaya leaf meal(CLM), Ocimum gratissimum leaf meal (OLM), Bryophyllum pinnatum leaf meal, BLM

DISCUSSION

In this study, the observed improved BWG and FCR of the experimental animals fed CLM supplemented diets could be due to the activities of the constituents of the phytogenics. The bioactive (antimicrobial, antioxidant) of phytochemicals were reported (11), (12) and could have contributed to the improved BWG

and FCR recorded for the birds fed CLM. Besides, phytochemicals were reported to exert anabolic effects and modulate the animals' metabolism to influence the increase of the muscle tissue (13), (14). The present study clearly shows the effects of the tested phytogenic feed additives (PFA) on growth performance of broiler chickens. Previous studies carried out on the effect of PFA on growth performance of broilers showed conflicting results, and do not allow a generalized conclusion on the efficacy of such feed additives. The present study result contradicted the result of (9) who reported that feeding PFA diets to birds reduced feed intake at negligible changes in BW gain, leading to an improved FCR. The inclusion of the phytogenic additive may have influenced the diet's taste; for instance, by the pungency of the phytogenic compounds, and as a result, the feed intake of animals decreased (15). In the current study, Our PFA had no noticeable effect on BW or feed intake.

Results of the present study revealed that PFAs supplementation to broiler chickens' feeds resulted in no significant body weight gain, and CLM improved FCR supporting the findings of (9) revealing that PFAs reduced feed intake at largely unchanged BWG or final body weight, thereby can improve FCR. This study was in accordance with earlier reports (16) which indicated an improvement in final liveweight and FCR due to PFA supplementation without any effect on the daily weight gain or FI.

CONCLUSION AND APPLICATION

In this study, the *Carica papaya* leaf meal at 0.2% dietary supplementations improved the body weight gain, feed conversion ratio without any deleterious effect on the birds.

The CLM at 0.2% dietary supplementation is hereby recommended for use in diets of broiler chicken at both phases of growth. It will enhance the growth performance and improve the feed conversion ratio of the birds.

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Monogastric Animal Production: MGP 025

DIGESTA TRANSIT TIME OF FINISHER BROILER CHICKENS FED TWO VARIETIES OF SORGHUM BASED DIETS SUPPLEMENTED WITH OR WITHOUT TANNASE

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ABSTRACT

A feeding trial was carried out to evaluate the digesta transit time of finisher broiler chickens (28-56 days) fed red sorghum (RS) and white sorghum (WS) based diets with or without tannase supplementation. Two hundred and forty Arbor Acre broiler chickens aged 28 days were assigned to eight (8) dietary treatments of 30 birds and each treatment divided into 3 replicates of 10 bids each to have a 4x2 factorial arrangement in a completely randomized design. Eight diets were formulated to replace maize with sorghum (red and white sorghum) at 4 levels (0, 100RS, 100WS and 50RS:50WS %) supplemented with or without tannase. The birds were fed ad-libitum until they were 56 days when the digesta transit time was evaluated. Birds fed the control (maize based diet) recorded the highest ($p < 0.05$) content of marker in excreta (54.983, 4.806, 28.721, 10.855, 15.605, 16.475 and 15.416 mg/kg) at 1, 2 , 3, 4 , 8 , 10 and 12 hours respectively, while birds fed 100RS had the highest marker content in excreta (21.978, 19.740 and 13.813mg/kg) at 5, 36 and 48 hours respectively. Birds fed 100WS and those fed 50RS:50WS had the highest marker content in excreta (8.628, 26.255mg/kg) at 6 and 24 hours respectively. The marker content (Chromium) in excreta were significantly ($p < 0.05$) influenced by the interaction of sorghum type and tannase supplementation across all the dietary treatments but there was no particular pattern followed. It was concluded from the study that maize based diets (control diet) had shorter retention time within the digestive tract compared to the sorghum based diets. Therefore, longer retention time of digesta within the digestive tract and better absorption of nutrients was achieved with total replacement of maize with red or white sorghum or 50 % red :50 % white sorghum.

keywords: Sorghum, tannase, broiler finisher , digesta transit time, Chromium

DESCRIPTION OF PROBLEM

The increase in population especially across large parts of Africa has influenced the higher demand for food, but consumption of animal protein such as eggs and poultry meat is low (**1**). One of the major factors responsible for low protein intake is reduced level of livestock production resulting from high cost of feed (**2**) due to high cost of maize which constitute about 60-70% component of poultry feed (**3**). The pressure on maize as food, feed and for industrial use is high leading to scarcity and elevated price of maize (**4**) There is need to minimize the over dependence on maize by sourcing other feed stuffs that can supply the energy requirement of poultry especially broiler chickens (**5**). The similarities in the nutritional composition of sorghum and maize made sorghum to be considered as a possible replacement for maize in poultry diets (**6**). (**7**) estimated the metabolizable energy contents of maize and sorghum as 3432 and 3256 kcal/kg and crude protein as 9.0 and 11.0 % respectively. The use of sorghum grain by poultry is however limited by the presence of anti-nutrients such as high tannin and phytates (**8**). Different treatments which can be used to reduce or eliminate tannin in sorghum include fermentation, use of activated charcoal, alkali, microbial phytase and tannase to catalyse the hydrolysis of tannins (**9**).This study was conducted to determine the effects of replacing maize with red and white sorghum supplemented with or without tannase on the digesta transit time of finisher broiler chickens.

MATERIALS AND METHODS

Preparation of test ingredients and diets

The red and white sorghum were sourced from the open market and were crushed using the mechanical crusher and enriched with the tannase enzyme during the formulation of the diets. Tannase enzymes were prepared at the department of Animal Nutrition Laboratory, Federal University of Agriculture Abeokuta by obtaining cultured *Aspergillus niger* which were screened to select the best clear zone producing isolates for tannase production using methods described by (**10, 11**). Sorghum was dehulled to obtain sorghum bran, which was prepared into a medium and autoclaved. The mouldy bran was broken, dried at 40-50^{0}C and then crushed, milled and stored for usage (Solid tannase). Eight experimental broiler finisher diets were formulated as shown in Table 1 in which maize was replaced with sorghum (red sorghum (RS) and/or white sorghum (WS) at 0% , 100% RS , 100% WS and 50RS: 50WS% without supplementation of tannase constituting diets 1, 2, 3 and 4 while diets 5, 6, 7 and 8 had the same composition as diets l, 2, 3 and 4 but supplemented with tannase 0.5g/kg feed. The birds were fed with the formulated diets ad-libitum.

Experimental Design

Two hundred and forty unsexed arbor-acre broiler chickens aged 28 days were randomly allotted into 8 dietary treatments of 30 birds and each treatment replicated 3 times with 10 birds each in a 4x2 factorial arrangement using completely randomized design.

Data collection

Two (2) birds per replicate at the end of the 56- day feeding trial were fasted for 12 hours, but water was made available to enable emptying of the gastrointestinal tract, after which feed was supplied along with gelatin capsule containing 50mg Chromium oxide (marker) administered orally. Excreta samples were collected from the birds for 48 hours at intervals of 1,2,3,4,5,6,8,10, 12,24,36,48 hours and oven dried at 65^{o}C before analysing the Chromium concentration in the excreta using methods described by (**12**). Data obtained were subjected to one-way analysis of variance in a 4x2 factorial arrangement using Minitab statistical package (**13**) and significant ($p<0.05$) difference among treatment means were separated by Tukey's procedure of the same package.

The experimental model is: $Y_{ijk} = \mu + S_i + T_j + (ST)_{ij} + \sum_{ijk}$

Y_{ijk} = observed value of dependent variable
μ= population mean (overall mean)
Si= Effect of main energy sources (Maize, RS, WS and RS+WS)
T_J = Effect of tannase supplementation
$(ST)_{ij}$ = Interaction effects of sorghum and tannase supplementation
$\sum_{ijk}$ = Random residual error

Table 1: Gross composition of experimental broiler finisher diets (5-8weeks)

	Without Tannase				With Tannase			
Ingredients	**Diet1**	**Diet 2**	**Diet 3**	**Diet 4**	**Diet 5**	**Diet 6**	**Diet 7**	**Diet 8**
Maize	57.00	-	-	-	57.00	-	-	-
Red sorghum	-	57.00	-	28.50	-	57.00	-	28.50
White sorghum	-	-	57.00	28.50	-	-	57.00	28.50
Fish meal	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Soyabean meal	31.00	31.00	31.00	31.00	31.00	31.00	31.00	31.00
Palm oil	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Wheat offal	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40
Limestone	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Bonemeal	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Lysine	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Methionine	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Toxin binder	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Tannase	-	-	-	-	+	+	+	+
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated nutrient values								
ME (kcal/kg)	2936.50	2873.81	2816.80	2845.31	2936.50	2873.81	2816.80	2845.31
C. Protein (%)	21.64	22.21	21.81	22.01	21.64	22.21	21.81	22.01
C. Fat (%)	3.65	2.97	3.08	3.03	3.65	2.97	3.08	3.03
C. Fibre (%)	3.24	3.13	3.21	3.19	3.24	3.13	3.21	3.19
Calcium%	1.16	1.15	1.18	1.17	1.16	1.15	1.18	1.17
A. phosphorus%	0.44	0.39	0.57	0.48	0.44	0.39	0.57	0.48

1kg of broiler premix contains*: Vitamin A 10,000,000 IU; Vitamin E 20,000 IU; Vitamin K 2,250mg; Thiamine 1750mg; Riboflavin 5000mg; Pyridoxine 2,750mg; Niacin 27,500mg; Vitamin B12 15mg ; Pantothenic acid 7500mg; Biotin 50mg; Choline chloride 400g; Antioxidant 125g; Magnesium 80g; Zinc 50mg; Iron 20g; Copper 5g; Iodine 1.2g; Selenium 200mg; Cobalt 200mg* C : Crude A : Available

RESULTS AND DISCUSSION

The main effect showed that the highest ($p < 0.05$) Chromium contents in excreta (54.983, 4.806, 28.721, 10.855, 15.605, 16.475 and 15.416 mg/kg) were recorded for broiler chickens fed the maize based diet (control) at the early hours of 1, 2, 3, 4, 8, 10 and 12 hours respectively compared to the highest ($p < 0.05$) Chromium content (21.978, 19.740 and 13.813mg/kg) in excreta recorded for broiler chickens fed the 100RS based diets at 5 hours then latter at 36 and 48 hours respectively. Similarly, birds fed 100WS and those fed 50RS: 50WS had the highest value (8.628, 26.255mg/kg) of marker in excreta at 6 and 24 hours respectively. The marker contents (Chromium) in excreta were significantly ($p < 0.05$) influenced by the interaction of sorghum type and tannase supplementation across all the dietary treatments but there was no particular pattern followed. The results indicated that the control diet had shorter retention time within the digestive tract compared to the sorghum based diets. This implies that the sorghum based diets was exposed to the digestive enzymes for a longer period and the nutrients may be well absorbed. This is in tandem with the submission of (**14**) that maize may be more easily digestible than sorghum probably due to the resistant

starch in sorghum which may cause it to have a longer retention time within the digestive tract. (**15**) stated that during digesta passage, each section of the gastro-intestinal tract allows for mixing with gastro-intestinal secretions, hydrolysis by digestive enzymes, absorption of the resulting products, fermentation of resistant material by gut bacteria and absorption of nutrients. Longer retention times of the digesta are mostly associated with increased digestibility, microbial activity and absorption of water from the gut (**16**). The marker (Chromium) content in excreta of birds fed either tannase supplemented or unsupplemented diets was significantly influenced, although did not follow a particular pattern.

Table 2: Main effects of sorghum type with or without tannase supplementation on digesta transit time of finisher broiler chickens (28 - 56 days)

Sorghum level %	T	Cr 1hr mg/kg	Cr 2hrs mg/kg	Cr 3hrs mg/kg	Cr 4hrs mg/kg	Cr 5hrs mg/kg	Cr 6hrs mg/kg	Cr 8hrs mg/kg	Cr10hrs mg/kg	Cr12 hrs mg/kg	Cr24 hrs mg/kg	Cr36 hrs mg/kg	Cr48 hrs mg/kg
Interaction													
0	+	4.777^{c}	3.210^{a}	26.663^{b}	10.270^{d}	3.093^{e}	3.730^{e}	13.720^{d}	20.170^{a}	10.790^{c}	9.210^{e}	3.117^{f}	3.120^{h}
100RS	+	3.383^{d}	0.273^{a}	12.540^{c}	2.076^{g}	22.580^{a}	2.403^{f}	18.173^{a}	19.936^{b}	5.080g	6.423^{f}	20.937^{a}	6.306^{d}
100WS	+	0.037^{e}	2.136^{f}	11.683^{d}	0.030^{h}	2.716^{g}	15.390^{a}	5.096^{h}	12.776^{c}	10.170^{d}	6.420^{f}	15.167^{c}	11.030^{b}
50R:50W	+	0.037^{e}	0.043^{h}	5.860^{f}	6.956^{e}	4.270^{d}	2.213^{g}	10.390^{e}	7.816^{g}	5.923^{f}	12.526^{d}	0.017^{g}	8.940^{c}
0	-	11.190^{a}	6.403^{a}	30.780^{a}	11.440^{c}	0.610^{h}	4.093^{d}	17.490^{b}	12.780^{c}	20.043^{a}	18.520^{c}	11.847^{d}	4.936^{f}
100RS	-	3.620^{d}	4.026^{c}	11.650^{d}	14.250^{b}	21.376^{b}	8.950^{b}	6.513^{f}	10.726^{d}	9.856^{e}	4.210^{g}	18.543^{b}	21.320^{a}
100WS	-	8.110^{b}	3.433^{d}	6.263^{e}	20.853^{a}	12.623^{c}	1.866^{h}	6.263^{g}	10.636^{e}	2.730^{h}	25.400^{b}	7.440^{e}	4.980^{e}
50R:50W	-	4.483^{c}	4.206^{b}	1.720^{a}	6.273^{f}	2.983^{f}	7.943^{c}	14.403^{f}	8.763^{f}	11.573^{b}	39.983^{a}	15.630^{c}	4.116^{g}
Pooled SEM		0.111	0.007	0.010	0.015	0.011	0.008	0.014	0.011	0.017	0.008	0.234	0.009
Main													
0		59.983^{a}	4.806^{a}	28.721^{a}	10.855^{a}	1.852^{d}	3.912^{d}	15.605^{a}	16.475^{a}	15.416^{a}	13.866^{c}	7.482^{d}	4.038^{d}
100RS		3.502^{c}	2.150^{c}	12.095^{b}	8.163^{c}	21.978^{a}	5.676^{b}	12.343^{c}	15.331^{b}	7.468^{c}	5.316^{d}	19.740^{a}	13.813^{a}
100WS		4.073^{b}	2.785^{b}	8.973^{c}	10.441^{b}	7.670^{b}	8.628^{a}	5.680^{d}	11.706^{c}	6.450^{d}	15.910^{b}	11.303^{b}	8.005^{b}
50R:50W		2.260^{d}	2.125^{d}	3.790^{d}	6.615^{d}	3.626^{c}	5.078^{c}	12.396^{b}	8.290^{d}	8.748^{b}	26.255^{a}	7.823^{c}	6.528^{c}
SEM		0.078	0.005	0.007	0.010	0.008	0.006	0.009	0.008	0.012	0.006	0.166	0.006
level													
-	+	2.058^{b}	1.416^{b}	14.186^{a}	4.833^{b}	8.165^{b}	5.934^{a}	11.845^{a}	15.175^{a}	7.990^{b}	8.645^{b}	9.809^{b}	7.349^{b}
-	-	32.850^{a}	4.517^{a}	12.603^{b}	13.204^{a}	9.398^{a}	5.713^{b}	11.167^{b}	10.726^{b}	11.050^{a}	22.029^{a}	13.365^{a}	8.838^{a}
SEM		0.055	0.003	0.005	0.007	0.006	0.004	0.007	0.006	0.009	0.004	0.117	0.004
Tannase													

[ab] mean values on the same row having different superscripts are significantly ($p < 0.05$) different. Cr: Chromium RS : Red sorghum, WS : White sorghum, T : Tannase supplementation

CONCLUSION AND RECOMMENDATION

It can be concluded that longer retention time of digesta within the digestive tract and better absorption of nutrients was achieved with total replacement of maize with red or white sorghum or 50RS:50WS % in the diet of finisher broiler chickens.Therefore recommended for optimum performance of broiler chickens.

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Monogastric Animal Production: MGP 026

INFLUENCE OF FEED RESTRICTION, WITH OR WITHOUT ASCORBIC ACID AND TOCOPHEROL SUPPLEMENTATION ON GROWTH PERFORMANCE AND ORGAN CHARACTERISTICS OF BROILER CHICKENS

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ABSTRACT

A total number of 120 Arbor Acre strain broiler was used to study the effect of feed restriction with vitamin C (ascorbic acid) and vitamin E (tocopherol) supplementation on growth performance and organ characteristics of broiler chickens. The birds were randomly allocated into four treatments of 30 birds per treatment at three replicates of 10 birds per replicate in a completely randomized design (CRD). Treatment1 has no Vitamin with no restriction, Treatment 2 diet containing Vitamin E and C with no restriction, Treatment 3 diet has no Vitamin with 2 hours feed restriction daily and Treatment 4 diets has inclusion of Vitamin E and C with 2 hours feed restriction on daily bases. Data were collected on growth performance and organ characteristics. They were analyzed using one way ANOVA of SPSS software package. Highest ($P < 0.05$) average weight gain (1711.12g) was recorded for broiler fed diet containing Vitamin E and C with no restriction while broiler chickens fed diet with no Vitamin but feed restriction for 2 hours daily had the least value (1570.21g). Highest ($P < 0.05$) liver proportion (2.58%) was recorded for broiler fed diets with no vitamin and no restriction while broiler chickens fed diet with vitamin supplementation and feed restriction had least value (2.19%). Highest ($P < 0.05$) gizzard proportion (3.15%) was recorded for broiler fed diet without vitamins but with restriction of feed for 2 hours daily while broiler chickens fed diet containing vitamin E and C with no restriction had least value (2.66%). It was concluded that supplementation of vitamin C and E in the diet of broiler chickens had positive effect on the growth performance and organ characteristics. The diets of broiler chickens should be supplemented with these vitamins to help prevent weight loss during feed restriction. and a will help to maintain or help bird to recover weight or nutrient lost during feed restrictions.

Keyword: Broiler chicken, Growth performance, vitamin C and E

DESCRIPTION OF PROBLEM

Broiler chickens are important source of protein rich in essential amino acids that are required for human body growth. They have been intensively selected for efficient and rapid weight gain and currently reach their slaughter weight at five weeks of age (1). Inadequacy and inconsistency of feed supply is a major bottleneck to efficient animal production in tropical farming system (2). (3) attributed these short – fall in feed supply to two major factors viz: scarcity and high cost of conventional protein and energy feedstuff, and competition for these products by man, livestock and agro – industrial sectors. Quantitative feed restriction programme has been successfully applied in managing these scare feedstuffs. However, improper use of this approach can lead to considerable weight loss and poor production. Thus, the application of the knowledge of feed management in nutrition must interact with economic consideration that influences the amount of feed supplied as ration.

Vitamin C, also known as ascorbic acid, is presented as a natural antioxidant that can be used to reduce the oxidative stress imposed by heat stress. Vitamin C ameliorates production and immunity problems induced by heat stress such as suppressing immunity, lowering feed consumption, inducing oxidative stress, increasing rectal temperature and increasing mortality in birds (4).

Vitamn E (α-tocopherol) is a hydrophobic antioxidant that scavenges the free radicals hydroxyl, alkoxyl, peroxyl and superoxide anion through non enzymatic defense (5). Vitamin E has been reported to be an excellent biological antioxidant and its administration reduces the physiological response of organisms to stress through enzymatic and non-enzymatic defense mechanisms against free radicals (6). The supplementation of vitamin E to broilers is also an important factor for the health of humans consuming chicken meat (7) as it is known to improve meat quality by up regulating the expression of antioxidant enzyme genes in broilers (8). The present study aimed to investigate the consequential application of vitamin C and E on growth performance and organ characteristics of broiler chickens placed on feed restriction.

MATERIALS AND METHOD

Experimental site and test ingredient

The experiment was conducted at the Poultry Unit of the Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria. The test ingredients used (Vitamin C and E) were purchased from a reputable feed mill at Ibadan, Oyo State Nigeria.

Animals and Experimental Design

A total number of 120 Arbor Acre strain broiler chicks were used. The birds were randomly and equally allocated into four treatments at thirty birds per treatment, this was further divided into three sub-groups of ten (10) birds per group and each serve as replicate in a completely randomized design. The treatments were tagged as: The Control (T1) of which the diet contained no vitamin with no feed restriction. Treatment 2 was given diets containing Vitamin E and C with no feed restriction. Treatment 3 was fed diet without vitamin E and C at 2 hours feed restriction daily while treatment 4 was fed diets containing vitamin E and C with restriction of feed for 2 hours daily.

Data Collection and Analysis

During the feeding trial, feed intake and body weight gain were recorded weekly. The feed conversion ratio was calculated as the amount of feed (g) required to gain 1g of body weight. At the end of 6 weeks, 3 birds per replicate were randomly selected, fasted for 12 hours in the presence of abundant water and slaughtered. Weights of their internal organs were measured and expressed as percentage of live weight. All data were subjected to analysis of variance (ANOVA) using SPSS 2006 software package. Duncan multiple range test of the same package was used to separate the means that were significant.

RESULT AND DISCUSSION

Table 1 Shows the effect of feed restriction with or without inclusion of vitamin C (ascorbic acid) and vitamin E (tocopherol) on growth performance characteristics of broiler chickens. Significant ($P<0.05$) difference was recorded on average weight gain. Highest average weight gain (1711.12g) was recorded for birds fed diet containing Vitamin E and C with no restriction while birds fed diet with no Vitamin E and C with restriction of feed for 2 hours daily had the least value (1570.21g). This result shows that inclusion of vitamin C and E in the diet of broiler chickens significantly enhanced weight gain and also helps to improve the weight gain of the birds on feed restriction. This result is in line with the report of (11) who recorded a significant increase on weight gain of birds fed diet containing vitamin C. Supplementation of vitamin C and E in the diet of birds has been used to alleviate the negative consequences of heat stress (9) and also an important factor for the health of humans consuming chicken meat (7) as it is known to improve meat quality by up regulating the expression of antioxidant enzyme genes in broilers (8). Vitamin C can positively influence intestinal health by enhancing tensile strength, epithelial formation, and internal protein flow. It also helps to prevent oxidative stress (10). It has been proven that the inclusion of vitamin C and E in the diets of broiler chickens helps to maintain or help bird to recover weight or nutrient lost during feed restrictions (10).

Table 1 performance characteristics of broiler chickens

Parameters	T1	T2	T3	T4	SEM
AWG (g)	1693.24[a]	1711.12[a]	1570.21[c]	1638.15[ab]	20.18
TF1	3895.20	3938.72	3865.39	3898.43	29.91
ADWG	34.56[a]	34.92[a]	32.05[b]	33.43[b]	0.41
ADFI	79.49	80.38	78.88	79.56	0.61
FCR	2.31	2.30	2.47	2.39	0.03

[ab] means on the same row with different superscript are significantly different

AWG – Average Weight Gain
TFI – Total Feed Intake
ADWG - Average Daily Weight Gain
ADFI - Average Daily Feed Intake
FCR – Feed Conversion Ratio
SEM – Standard Error of Mean

Table 2 Shows the effect of feed restriction together with vitamin C (ascorbic acid) and vitamin E (tocopherol) supplementation on organ characteristics of broiler chickens. Significant ($P<0.05$) difference was recorded liver, gizzard, proventiculus and kidney proportions. Highest ($P<0.05$) liver proportion (2.58%) was recorded for birds fed diet with no vitamin E and C with no restriction while bird fed diet with inclusion of vitamin C and E and feed restriction for 2 hours daily had least value (2.19%). Highest ($P<0.05$) percentage gizzard (3.15%) was recorded for birds fed diet without Vitamin E and C with restriction of feed for 2 hours daily while birds fed diet containing Vitamin E and C with no feed restriction had least value (2.66%). Highest ($P<0.05$) proventriculus (0.72%) was recorded from broiler fed diets with inclusion of Vitamin E and C with restriction of feed for 2 hours daily while broiler chicken fed diet without Vitamin E and C with no restriction had least value (0.44%). Highest ($P<0.05$) kidney proportion (0.51%) was recorded from broiler fed diets with inclusion of Vitamins and two hours feed restriction while broiler chicken fed diet without Vitamin E and C with no restriction had least value (0.31%). This result shows an increase in the weights of internal organs (liver, gizzard, proventriculus and kidney) and did alter substantially ($P>0.05$) after adding vitamins. However, the treatment group, which received the vitamin C and E combination, had considerably larger weights of the liver, gizzard, proventriculus and kidney compared to the control diet. This result is expected since Vitamin C and E is a hydrophobic antioxidant that scavenges the free radical's hydroxyl, alkoxyl, peroxyl and superoxide anion through non enzymatic defense (5). Vitamin E has been reported to be an excellent biological antioxidant and its administration reduces the physiological response of organisms to stress through enzymatic and non-enzymatic defense mechanisms against free radicals and protect the internal organ of chicken according to (6). They are also known to improve meat quality by up-regulating the expression of antioxidant enzyme genes in broilers (8).

Table2 Organ Characteristics of Broiler Chickens

Parameters	T1	T2	T3	T4	SEM
Liver (%)	2.41[ab]	2.48[a]	2.42[ab]	2.19[b]	0.05
Gizzard (%)	3.09[ab]	2.66[b]	3.15[a]	2.94[ab]	0.08
Spleen (%)	0.10	0.11	0.11	0.99	0.01
Pancrease (%)	0.24	0.24	0.19	0.24	0.01
Heart (%)	0.45	0.49	0.51	0.44	0.01
Lung (%)	0.51	0.53	0.59	0.51	0.24
Proventriculus (%)	0.44[b]	0.48[b]	0.58[ab]	0.72[a]	0.04
Kidney (%)	0.31[b]	0.33[b]	0.37[ab]	0.51[a]	0.02

[ab] means on the same row with different superscript are significantly different
SEM – Standard Error of Mean

CONCLUSION AND APPLICATION

It was concluded that the inclusion Vitamin C and E in the diet had positive effect on the growth performance and organ characteristics of broiler chickens and helps birds placed on feed restriction to meet their nutritional needs.

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Monogastric Animal Production: MGP 027

INFLUENCE OF DIETARY *PICRALIMA NITIDA* POWDER ON GUT MORPHOLOGY OF BROILER CHICKENS

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ABSTRACT

The utilization of herbal plants with diverse applications as growth stimulants has been beneficial in broiler production. Hence, a 6-week trial was conducted to evaluate the effect of dietary *Picralima nitida* seed meal, (PNSM) on the gut morphology of broiler chicken. A total of 256 -day-old, unsexed Arbor-Acre Plus broiler chicks were randomly allotted into four treatment groups of eight replicates, with eight birds per replicate in a completely randomized design. *Picralima nitida* was incorporated at 0, 0.25, 0.50 and 1.0g/100g to formulate four (4) experimental diets. At the end of the study, 8 birds per treatment were randomly selected and slaughtered for intestinal morphology examinations according to the Standard procedure. Data collected on gut morphology were subjected to one-way analysis of variance at 5% level of probability. Results indicated that dietary PNSM significantly ($P<0.05$) influenced the gut morphology of broiler chicken. *P. nitida* supplementation at 0.5 and 1% was observed to reduce villus height, deepen crypts and increase the thickness of the muscular wall of the intestine. This study concludes that dietary inclusion of *Picralima nitida* powder improved the gut morphology of broiler chicken. In addition, no negative effect ($P>0.05$) of the various levels of *P. nitida* were observed on liver and kidney function, however, alterations were observed in the morphology of the intestinal tract of broilers.

Keywords: *Picralima nitida* seed meal, Arbor-Acre Plus, diets, gut morphology and villus.

PROBLEM DESCRIPTION

Nigeria is the second-largest chicken producer in Africa after South Africa (1). According to (2), Nigeria's consumption of poultry meat has risen by 200% between 2010 and 2020. In addition, between 2020 and 2025, it is anticipated to increase by between 6 and 10% annually. The importance of poultry production thus, cannot be overemphasized eliciting the need to continually find ways to increase and improve quality meat production. Feeding antibiotics as growth promoters has had a substantial role in poultry industry (3). Currently, the global paradigm is shifting from an emphasis on productive day efficiency to one of the public securities issues. The World Health Organization (WHO) has recently identified antibiotic resistance as a major problem for public health on a global scale (4). For this reason, an overflow of studies is triggered to introduce suitable alternatives for antibiotics (5). The use of plant materials as a replacement of conventional growth promoters in broilers has given results in all aspects of the meat production chain, such as improvements in product performance, carcass, and meat quality (6; 7). *Picralima nitida* is an herbal plant with numerous applications in West African unconventional medicine. *P. nitida* is a member of the Apocynaceae family and is used extensively in traditional medicine. It has historically been used to treat infectious diseases in general as well as fevers (8), coughs (9), diabetes (10), malaria (11) and other infectious diseases. Leaves of *P. nitida* have been reported to possess both antidiabetic and antioxidant properties (12; 13; 14). Research has shown that *P. nitida* seed is a good source of phytochemicals, contains various

biochemical and proffer physiological effects (15). Furthermore, *Picralima nitida* has been utilized extensively in the field of pharmacology and is very rich in alkaloids with fungicidal, bactericidal, acaricidal, and insecticidal characteristics (16). Despite the effectiveness of the species' antimicrobial activity, there is little or no documented study on the efficacy of dietary inclusion of *Picralima nitida* powder on the performance of broiler chickens. Hence, the basis of this study.

MATERIALS AND METHODS

Experimental site and duration: The research was carried out for six weeks at the Teaching and Research Farm, Faculty of Agriculture, University of Ibadan, Oyo State. Nigeria.

Experimental Animals and their management: A total of 256 day-old (Arbor-Acre Plus) broilers were purchased from Federal College of Animal Health and Production Technology, Ibadan, Oyo State. Nigeria. They were randomly allotted into four dietary treatments of sixty-four birds each with eight replicates of eight birds each in a completely randomized design. Birds were reared in a well-ventilated and illuminated open side poultry building on a deep litter system. Feeds and water were supplied *ad-libitum.* Routine Vaccination and other health management were carried out. The birds were vaccinated against Mareks disease at the hatchery and against Newcastle and Infectious Bursal diseases.

Source and Preparation of the test ingredients: *Picralima nitida* matured fruits were obtained from traditional medicine material market at Ojoo, situated in Ibadan, Oyo State, Nigeria. The fruits were identified and authenticated by a taxonomist at the Botany Department, faculty of Science, University of Ibadan while other feed ingredients were purchased from a reputable feed mill in Ibadan. The test ingredient was subjected to both quantitative and qualitative phytochemical analyses

Formulation of Experimental Diets: Four diets were formulated in starter, grower and finisher phases and each contains recommended protein and energy also each diet was supplemented with *Pricalima nitida*. The starter diet contained 23.28% crude protein and 2970kcalME/kg, grower diet contain 21.75% crude protein and 2990kcalME/kg while the finisher diets contain 19.37% crude protein and 3070kcalME/kg.
Dietary Treatment 1 (T1): Control diet, without *Picralima nitida*.
Dietary Treatment 2 (T2): Diet + 0.25g *Picralima nitida*
Dietary Treatment 3 (T3): Diet + 0.5g *Picralima nitida*
Dietary Treatment 4 (T4): Diet + 0.1g *Picralima nitida*
The diets used for the experimental period was compounded and were in a mashed form while the feeding trial lasted for six (6) weeks.

Data collection: On day 42, eight (8) birds were randomly selected per treatment and slaughtered. Examinations of intestinal morphology were carried out according to the method of (17). After slaughter, segments of the digestive tract (small intestine) were removed. The ileum segment of the small intestine was removed (from Meekel's diverticulum to the ileocaecal junction) and samples were fixed in a prepared 10% formalin solution. First, they were washed with distilled water to remove any adherent intestinal content, then fixed in 10% buffered formalin until analyzed. Morphometric measurements were performed on the cut segments. The included morphometric indices measured were villus height from the tip of the villus to the crypt, crypt depth from the base of the villi to the submucosa, villus width and the muscular width. The readings were performed per replicates in each treatment and per intestinal segment. Villus height was measured from the apical to the basal region, which corresponded to the superior portion of the crypts. Crypts were measured from the basis until the region of transition between the crypt and the villus and then the ratio of villus height to crypt depth were calculated.

Statistical Analysis: All data collected were subjected to one-way analysis of variance (ANOVA) using(18) and significant means were separated using Duncan's multiple range test (DMRT) of the same statistical package.

RESULTS AND DISCUSSION

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Presented in Table 2 is the effect of dietary *Picralima nitida* on the morphology of the duodenum, ileum and jejunum of broiler chicken. Dietary *Picralima nitida* significantly ($P < 0.05$) influenced the gut morphology of broiler chickens. Results of the present study revealed that P. *nitida* seed powder inclusion in the diet resulted in shortening and thinning of the villus of the duodenum, this was also accompanied with deepening of crypts. In the jejunum, villus were significantly shortened and thinned at 1% PNSM inclusion. It is noteworthy that dietary *P. nitida* seed powder mediated the thickening of the muscular wall of the duodenum, jejunum and ileum. Long villi and shallow crypts provide a larger surface area for the absorption of nutrients and low renewal rate, allowing efficient enzyme production and nal cells (19). More so, the villus height and crypt depth in the small intestine are related to nutrient adsorption (20). The highest villus length, villus width and muscularies wall thickness of the epithelium of the jejunum of the intestine were recorded in birds fed dietary 0.5g/100g *Picralima nitida*. The results of the present study agree with the findings of (21), and they reported in separate studies that the supplementation of rosemary leaf meal in the diet improved the villus length and crypt depth in the jejunum at different stages of broiler growth. More so, the increased villus length and surface area could predict the gain in weight (22). The highest crypt depth of the ileum while the highest crypt depth and muscularies wall thickness of the epithelium of the duodenum of the intestine were recorded in birds fed dietary 0.5g/100g *Picralima nitida* Dietary *Picralima nitida* leave meal improved the crypt depth in the ileum thereby making the crypts deeper and this suggests that improved digestive tract maintenance could be the reason for the improved growth performance recorded in this study. The improved digestive tract has a direct stimulating effect on the gastro-intestinal cell proliferation, as reported by (23).

Table 1: Effect of dietary *Picralima nitida* on gut morphology of broiler chickens

Parameters		Inclusion levels of *Picralima nitida* (g/100g)				
	Parts (µm)	(T1) 0	(T2) 0.25	(T3) 0.5	(T4) 1.0	SEM
Duodenum	VH	1110.70^{a}	812.00^{b}	539.00^{c}	664.20^{bc}	47.96
	CD	131.17^{b}	304.81^{ab}	380.91^{a}	124.79^{b}	35.13
	MWT	129.41^{b}	133.00^{b}	203.25^{a}	101.75^{b}	8.70
	VW	236.95^{a}	163.64^{b}	172.70^{b}	179.40^{b}	7.83
Ileum	VH	454.74^{b}	654.43^{a}	434.64^{b}	488.03^{ab}	30.92
	CD	120.74^{ab}	107.35^{ab}	124.39^{a}	83.43^{b}	6.73
	MWT	73.40^{b}	184.00^{a}	50.68^{b}	92.17^{b}	10.52
	VW	308.12^{a}	92.67^{b}	117.78^{b}	130.75^{b}	15.01
Jejunum	VH	714.39^{a}	674.89^{a}	624.20^{a}	446.74^{b}	28.33
	CD	166.98^{ab}	214.02^{a}	139.80^{b}	83.51^{c}	11.44
	MWT	111.27^{b}	142.74^{a}	150.76^{a}	93.86^{b}	5.50
	VW	253.17^{a}	301.99^{a}	200.02^{a}	97.00^{b}	20.20

^{a,b,c} Means along the same row with different superscripts are significantly different ($P<0.05$).
VH: Villus Height, CD: Crypt depth, MWT: Muscular wall thickness, VW: Villous width

CONCLUSION:

The inclusion of *Picralima nitida* seed meal at 1% of the diet proved to have positive effect on the gut morphology of the experimental birds, especially with respect to muscular wall thickness. In addition, feeding *Picralima nitida* seed meal diet did not have any negative effect any part of the broiler chicken's gut.

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Monogastric Animal Production: MGP 028

GROWTH PERFORMANCE OF BROILERS ON IN-FEED INCLUSION OF BIOCHAR FROM MIXTURE OF WOOD AND EMPTY PALM FRUIT BUNCH

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ABSTRACT

A total of 45, four weeks (28 days) old, unsexed *Arbor acre* (broiler) chickens were used to determine the growth performance of broiler chickens on feed supplemented with biochar produced from pyrolysis of wood and empty palm fruit bunch mixture at the finisher phase (29 – 56 days). The birds were assigned on weight equalization to three feed substitution levels (0, 3 and 6% biochar Kg^{-1}) of the whole diet with fifteen (15) birds per treatment (three replicates of five birds each), in a completely randomized design for four weeks. Data collected were subjected to analysis of variance using Genstat, 2009 (12th Edition) package, and significant means separated using Duncan`s Multiple Range Tests at 5 % level of probability. The final body weight (FBW) and average daily feed intake (ADFI) of the birds showed no significant ($P>0.05$) differences among the treatments (T1, T2 and T3). However, the average feed intake in the biochar supplemented treatments (T2; 164.30 g and T3; 165.80 g) were higher than the control (T1; 160.40 g). Conversely**,** the average daily weight gain of broilers on the 3 and 6% biochar kg^{-1} supplemented diets recorded significant decrease compared with the control group. The FCR significantly increased from 2.27 (T1) to 2.40 and 2.50 in T2 and T3 respectively. On cumulative feed intake, the 3% (T2) biochar Kg^{-1} was significantly ($P < 0.05$) higher than T1 and T3. Conclusively, supplementation of biochar beyond 3% depressed growth performance.

Keywords: Biochar, wood, empty palm fruit bunch, Broiler chicken, Performance

DESCRIPTION OF PROBLEM

Notable residues deposited in poultry meat and eggs due to constant use of chemical feed additives to improve production parameters have rendered man and the environment vulnerable to the harmful effects of these residues when poultry products are consumed or carelessly deposited in the environment. Therefore, cost-effective, users and environmentally friendly alternatives to the use of these chemical feed additives are advocated. One such alternative in-feed inclusion is biochar.

The International Biochar Initiative defined biochar as "the solid material obtained from the thermochemical conversion of biomass in an oxygen-limited environment". (1) and (2) indicated that the process of biochar production from biomass yield two main products, carbon (50%) and biofuel, often syngas which can be employed in several energy application processes. The physicochemical properties of biochar depend on feedstock materials and the thermochemical process (3). (4), also indicated that depending on the feed materials and pyrolysis condition, biochar contains (on a w/w basis) 40 – 80% carbon, 0.1 – 0.8% nitrogen, 1 – 2% potassium, 5 – 6% calcium and can have an ion exchange capacity between 25 and 150 $cmol^{+}/kg$. Biochar are often used for carbon sequestration and as a soil ameliorant for improving soil water holding capacity and/or ion exchange capacity and as a recalcitrant carbon, mineral fertilizer, (4); (5); (6); (7).

Biochar is not per se a nutrient but added to feeds to enhance the quality of the nutrients in the feeds thereby promoting digestion, improve animal health, increased feed efficiency, energy absorption through the feed and thus the productivity of the bird, fish and other animals. Biochar has been produced from different materials and utilized as feed substitute, such as coconut shell (8), Maize cobs and *Canarium schweinfurthii* Engl. Fruit seeds (9); as well as locally available wood (10).

The study was conducted to determine the growth performance of broiler chickens fed diet containing biochar produced from pyrolysis of a mixture of wood and empty palm fruit bunch (EPFB). These seemly biological wastes could be utilized as cost-effective, users and environmentally friendly in-feed inclusion in the form of biochar.

MATERIALS AND METHODS

Experimental Location

The study was carried out at the Poultry Unit of the Department of Animal Production, Leventis Foundation, Kano State Agricultural Training School, Panda, Kano State, Nigeria. Kano State is located in the Northern part of Nigeria. Panda is in the Sahel Savannah Vegetation bounded by Latitude 12^0N and 14^0N

Source of Birds, Housing and Experimental Design

Forty-five (45), four weeks (28 days) old unsexed arbor Acre (broiler) chickens that were reared from day-old assigned to three treatments on weight equalization basis with 15 birds each, and replicated three times in a completely randomized design. Each replicate contained 5 birds. The duration of the experiment was four weeks (29 – 56 days). The birds were moved a week prior to the commencement of the experiment from the brooding/starter house to the experimental pens for acclimation. The birds were housed on a wood shavings littered floor pens of 1.5 m^2 (1.5 m × 1.0 m) per 5 birds. Standard management practices were employed in the management of the chickens. Water and feed were provided *ad libitum*.

Experimental Diets and Feed Supplementation

The biochar used for the supplementation was produced from incomplete pyrolysis of a mixture of wood and empty palm fruit bunch (EPFB) in a pyrolytic kiln. Dietary treatments included a control group with diet having 0% biochar kg^{-1} (T1), and two groups with diets supplemented with 3% (T2) and 6% biochar kg^{-1} (T3). The control group (0% biochar) was fed only the standard commercial broiler finisher crumble ration (Livestock Feeds, Nigeria) with the nutrient composition presented in Table 1, while T2 and T3 were replaced accordingly.

Evaluation of Production Parameters

The initial weights of the birds were taken at the beginning of the experiment, and thereafter on a weekly basis to determine their growth response and average body weight (ABW) together with average weight gain and feed conversion ratio (FCR) were estimated on a weekly basis. These were also evaluated at the end of the study. Feeds were weighed on daily basis, and leftover of feeds were also weighed on daily basis to obtain the feed intake.

Statistical Analysis

All data collected during the entire experiment was subjected to analysis of variance using Genstat, 2009 (12th Edition) package. The separation of means were carried out using Duncan`s Multiple Range Tests at 5 % level of probability.

RESULTS

Effects of Different Dietary Levels of Biochar on Growth Performance of Finisher Broiler Chickens (29-56 days)

The initial liveweight of birds indicated statistical similarity ($P>0.05$) as shown in Table 2. Within the experimental period, the final body weight (FBW) and average daily feed intake (ADFI) of the birds showed no significant ($P>0.05$) differences among the treatments (T1, T2 and T3). Numerically however, the average daily feed intake in T2 (164.30 g) and T3 (165.80 g) was higher than the T1 (160 g).

The average daily weight gain of broilers on the 6% biochar supplemented diets (T3) recorded significant decrease compared with the 0% biochar (T1) group (Table 2). T2 (68.33 g) neither differ statistically with

T1 (70.48 g) nor T3 (66.33 g). The FCR significantly increased from 2.27 (T1) to 2.40 and 2.50 in T2 and T3 respectively.

Table 2: Effects of diets containing different Dietary biochar on growth performance of finisher broiler chickens (29-56 days)

PARAMETERS	BIOCHAR REPLACEMENT LEVELS			P-Value	±SEM
	T1 (0%)	T2 (3%)	T3 6%		
Initial Body Weight (g)	1186	1208	1171	0.70	30.40
Final Body Weight (g)	3160	3121	3028	0.14	40.20
Ave Daily Feed Intake (g)	160.40	164.30	165.80	0.28	2.18
Ave Daily Weight Gain (g)	70.48[a]	68.33[ab]	66.33[b]	0.08	1.05
Feed Conversion Ratio	2.27[b]	2.40[a]	2.50[a]	0.01	0.03

[ab]Means with different superscripts differ significantly (P<0.05)

The effect of diets containing different dietary biochar on weekly growth performance parameters such as average weight gain (AWG), average daily weight gain (ADWG), average feed intake (AFI) and feed conversion ratio (FCR) of finisher broiler chickens is shown in Table 3. AWG of the birds showed no significant (P>0.05) differences among treatments at weeks 5, 6 and 7. It however indicated statistical difference at week 8 with significant decline of the 6% supplementation group (T3) by 5.88% of the control group (T1). Apart from the week 5, the Average Feed Intake (AFI) reflected no significant differences among treatments. T2 and T3 (with comparable values) indicated significantly higher feed conversion ratio (FCR) at week 8 of the feeding trial.

DISCUSSION

The result of the current investigation (at 3 and 6 % supplementation of Biochar) did not increase weight gain or improved feed conversion as reported by some previous workers. The findings contradict the report of (11) who used wood (oak) charcoal on broiler chicks and laying hens, (8) using activated coconut shell charcoal meal on broiler chickens and (9) using charcoal from maize cob in broiler diet. These authors reported increased daily weight gain and higher final body weight for broilers fed diets amended with 20g/kg – 60g/kg. Nevertheless, the outcomes of the study were in agreement with those of (12) who had reported that from 2% and higher levels of inclusion of dietary biochar is capable of depressing growth rates and final body weights of broiler chickens. The result observed in the current study also corroborates that of (13) who reported that inclusion of poultry litter biochar (PLB) at rate of 6.2 – 6.9% resulted in decreased broiler (Cobb 500) liveweight gain.

Biochar is not per se a nutrient but added to feeds to enhance the quality of the nutrients in the feeds thereby promoting digestion, improve animal health etc. This could result in diminished nutrient value by dilution of the feed in terms of energy and protein content, if applied at a high dose. This can be substantiated by the numerically higher feed intake observed in the biochar included treatment groups; as birds tend to eat to satisfy their energy need. Therefore the dose of inclusion could have accounted for the divergent reports among workers with biochar in-feed. For example, (9) reported that the broilers fed activated coconut shell charcoal (unspecified pyrolysis conditions) had significant improvements in feed conversion ratio (FCR), particularly at an inclusion dose of 0.5% w/w, but effects were reversed with inclusion of 2% w/w or higher levels.

Another factor of consideration is the compositional differences of the biochar in terms of its physical and chemical properties depending on the type of feedstock and/or materials used, the ionic charge, the pyrolysis condition (complete or incomplete, and/or the temperature).
Nevertheless, other positive responses that could be compensatory to the reversed growth performance to biochar in-feed substitution could include improved blood profiles, egg yield, ability to resist pathogens

including gut pathogenic bacteria and a reduction in litter ammonia and methane production (14); (15) and (10).

Table 3: Effects of diets containing different levels of dietary biochar on weekly growth performance of finisher broiler chickens (29-56 days)

PARAMETERS	WEEK	BIOCHAR LEVELS			P-Value	±SEM
		T1 (0%)	T2 (3%)	T3 6%		
AWG (g)	5	469.30	447.30	420.70	0.16	15.48
	6	916.10	906.70	860.70	0.41	29.10
	7	1451.00	1400.00	1384.00	0.46	37.40
	8	1973.00[a]	1913.00[ab]	1857.00[b]	0.08	29.30
ADWG (g)	5	67.05	63.91	60.09	0.16	2.21
	6	65.44	64.76	61.48	0.41	2.08
	7	69.09	66.68	65.89	0.46	1.78
	8	70.48[a]	68.33[ab]	66.33[b]	0.08	1.05
AFI (g/bird)	5	933.70[b]	956.00[a]	939.70[b]	0.004	2.94
	6	1058.00	1095.00	1095.00	0.25	16.10
	7	1254.00	1243.00	1250.00	0.80	10.86
	8	1374.00	1370.00	1356.00	0.41	9.00
AFIC (g/bird)	5	933.70[b]	956.00[a]	939.70[b]	0.004	2.94
	6	1992.00	2051.00	2035.00	0.11	16.93
	7	3246.00	3295.00	3285.00	0.39	24.50
	8	4492.00	4597.00	4642.00	0.28	60.60
ADFI (g/bird/day)	5	133.40[b]	136.60[a]	134.20[b]	0.004	0.42
	6	142.30	146.50	145.40	0.11	1.21
	7	154.60	156.90	156.40	0.38	1.17
	8	160.40	164.20	165.80	0.28	2.16
FCR	5	1.99	2.15	2.24	0.17	0.08
	6	2.18	2.26	2.37	0.23	0.07
	7	2.24	2.35	2.38	0.30	0.06
	8	2.27[b]	2.40[a]	2.50[a]	0.01	0.03

[ab]Means with different superscripts differ significantly ($P<0.05$)
AWG = average weight gain; ADWG = average daily weight gain; AFI = average feed intake; AFIC = average feed intake cumulative; ADFI = average daily feed intake; FCR = feed conversion ratio; T1 = 0% biochar; T2 = 3% biochar; T3 = 6% biochar

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Monogastric Animal Production: MGP 029

EFFECTS OF ROSEMARY LEAF MEAL AND SODIUM BENTONITE ON THE GROWTH PERFORMANCE AND ECONOMICS OF BROILER CHICKEN STRAIN

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ABSTRACT

The study was conducted to determine the effect of rosemary leaf meal and sodium bentonite on the growth performance and economics of broiler chickens. A total of 180 day-old broiler chicks of Cobb 500 strain were used for the study. The birds were randomly divided into 6 groups and allotted into 6 dietary treatments, each treatment was replicated 3 times, with 30 birds per treatment and 10 birds per replicate in a 2×3 factorial arrangement in a completely randomized design (CRD). Sodium bentonite (SB) and rosemary leaf meal (RLM) were incorporated into their diets at different levels, Treatment (T1) contained 0gSB+0gRLM/kg diet), T2 (0gSB+3gRLM/kg diet), T3 (0gSB+6gRLM/kg diet), T4 (15gSB+0gRLM**),** T5 (15gSB+3gRLM), T6 (15gSB+6gRLM), respectively. Feed and water were provided *ad libitum*. Routine management practices were applied as at when due. Body weight was measured and recorded on weekly basis, while, feed intake was determined through weigh-back technique, on daily basis. The experiment lasted for 8 weeks. The results showed that interaction effect of rosemary leaf meal and sodium bentonite significantly ($p<0.05$) increased final body weight (3163.91 to 4624.89g), total weight gain (3121.85 to 3583.06g), and reduced feed intake (6197.82 to 4939.06g), average daily feed intake (110.68 to 88.19g), feed cost per kg gain (₦869.40 to ₦630.20) and mortality (8.33 to 1.48%), at inclusion level of 15g SB+3g RLM/kg feed. It was concluded that sodium bentonite and rosemary leaf meal should be included at 15g SB+3g RLM/kg feed for improved broiler growth performance at a reduced cost of production.

Keywords: Rosemary, sodium bentonite, growth performance, economics, broilers

INTRODUCTION

Many synthetic feed additives have been used to improve feed efficiency, productive performance and health of broiler chickens. Antibiotics have been used as growth stimulating agent long time ago due to its role in the modulation of the gut ecosystem [1]. Currently, the use of antibiotics as growth promoters has been restricted due to its residues in animal products and resistance in humans [2]. In addition, antibiotics growth promoters (AGP) has a number of negative effects on animals which results to significant financial losses. As a result, researchers have been looking for antibiotic substitute.

Consequently, efforts have been directed towards the identification and use of healthy natural alternatives to antibiotics in animal production. Some of these ground breaking efforts include the use of: probiotics [3], herbal products [4], phytogenics, natural spices and polyphenols [5]; [6]. Phytogenics are substances of plant origin added to animal diet to improve production and health. One of such phytogenics is rosemary. Rosemary (*Rosmarinus officinalis*) is a natural aromatic plant that has high antioxidant activity which improves bird performance. It contains polyphenolics which have antimicrobial, antioxidant and anti-inflammatory properties [7]. Rosemary leaf meal has been reported to significantly improved production performance and digestibility of crude protein in broiler chickens [8].

Another natural product of significant importance in poultry production is sodium bentonite. Sodium bentonite is a type of natural clay that is produced by the devitrification of volcanic ash and has high absorption capacity [9]. Sodium Bentonite as a feed additive has been used successfully in poultry feed

without any harmful effects [10]. Bentonite is composed mainly of 75% or more clay minerals and is a complex material with SiO_2 53.788%, Al_2O_3 22.378%, Fe_2O_3 3.90%, CaO 1.65%, MgO 2.123%, Na_2O 1.96%, K_2O 0.693% and organic matter 13.43% [11]. Several studies proved that sodium bentonite improved the growth performance of broiler chickens [12], and as a toxin binder, decreased the adverse effect of aflatoxin [13]. These natural products have been independently employed in broiler production with significant improvements, however, the combined effect of these natural additives have not been fully explored. Thus, the aim of the study was to determine the effect of rosemary leaf meal and sodium bentonite on the growth performance and economics of broiler chickens.

MATERIALS AND METHODS

Location of the study

The experiment was carried out at the Poultry Unit of the Department of Animal Science Teaching and Research Farm, University of Nigeria, Nsukka.

Experimental Materials

Rosemary leaves and sodium bentonite were sourced from Ogige Market in Nsukka, Enugu state, Nigeria, processed and included in the experimental diets.

Experimental Animals and Management

A total of 180 day-old broiler chicks of Cobb 500 strain were used for the experiment. The chicks were randomly assigned to six (6) treatment groups. Each treatment contained 30 birds and was replicated (3) times. Each replicate was assigned 10 birds in a 2×3 factorial arrangement in completely randomized design (CRD). The treatments comprised of T1 = 0g SB+0g RLM/kg feed, T2 = 0g SB+3g RLM/kg feed, T3 = 0g SB+6g RLM/kg feed, T4 = 15g SB+0g RLM/kg feed, T5 = 15g SB+3g RLM/kg feed and T6 = 15g SB+6g RLM/kg feed. The birds were managed in a deep litter system. Prior to the arrival of the day-old chicks, the pens were thoroughly washed, dried and wood shavings spread as litter materials. On arrival, the chicks were weighed individually using an Electronic digital weighing scale. Feed and water were provided *ad libitum*. Vaccination and medications were employed as at when due.

Experimental Diet

The birds were fed formulated broiler starter and finisher diets fortified with the test ingredients. The starter ration contained 20% CP and 2950 kcal/ME, while, finisher ration contained 17% CP and 3000 kcal/ME.

Data analysis

Data collected were subjected to a two-way analysis of variance (ANOVA), in a completely randomized design (CRD), using statistical package of social science (SPSS version 26). Significant different means were separated using Duncan New Multiple Range Test [14].

RESULTS AND DISCUSSION

The results of the effect of rosemary leaf meal and sodium bentonite on the growth performance and cost implications are presented in Table 1. The result showed that rosemary leaf meal significantly ($p<0.05$) increased final body weight, total weight gain, average daily weight gain, and reduced total feed intake, feed conversion ratio, feed cost per kg gain and mortality at 3g RLM/kg feed. Meanwhile, RLM did not ($p>0.05$) affect initial body weight and feed cost per kg feed. The result was in agreement with the study of [15] who reported significant increase on broiler performance at inclusion of 5-15g/kg of dried rosemary leaf meal. Similarly, [16], observed significant improvements in average daily weight gain and feed conversion ratio when broiler diets were supplemented with rosemary oil extract.

The effect of sodium bentonite significantly ($p<0.05$) increased final body weight, total weight gain and average daily weight gain. Total feed, average daily feed intake and percentage mortality were reduced at 15g SB/kg feed inclusion level, compared to the control. This result is in agreement with [16] who reported significance improvement in performance of broiler birds fed sodium bentonite. Similarly, it is in agreement with the findings of [17] who showed that the use of phyllosilicate clay had significant effects on broiler weight gain, feed efficiency and final body weight.

Table 1: The effect of Rosemary leaf meal (*Rosmarinus officinalis*) and Sodium bentonite on Growth performance of broiler chickens

Treatments/ Parameters	IBW (g)	FBW (g)	TWG (g)	ADWG (g)	TFI (g)	ADFI (g)	FCR	FC/kg (₦)	FC/day (₦)	FC/kg gain (₦)	Mortality (%)
Effect of RLM											
0g/kg	41.85	3411.17^{b}	3369.54^{b}	60.17^{a}	6093.83^{a}	108.82^{a}	1.81^{a}	460.00	893.96^{a}	832.60^{a}	8.58^{a}
3g/kg	41.74	3503.35^{a}	3461.62^{a}	61.81^{a}	5926.24^{ab}	105.83^{ab}	1.71^{ab}	460.00	869.32^{ab}	786.60^{c}	0.00^{c}
6g/kg	41.98	3317.14^{b}	3275.20^{b}	58.49^{b}	5692.93^{b}	101.66^{b}	1.74^{b}	460.00	835.06^{b}	800.40^{b}	5.33^{b}
SEM	0.49	74.36	77.24	1.33	77.72	1.39	0.04	41.00	3.75	11.13	0.34
P-Value	0.15	0.01	0.02	0.03	0.03	0.02	0.01	0.23	0.04	0.27	0.03
Effect of SB											
0g/kg	41.85	3067.45^{b}	3325.61^{b}	59.39^{b}	5925.81^{a}	105.82^{a}	1.78^{a}	460.00	869.24^{NS}	818.80^{a}	5.56^{a}
15g/kg	41.85	3753.66^{a}	3411.97^{a}	61.93^{a}	5782.8^{b}	103.26^{b}	1.69^{b}	460.00	848.21^{NS}	777.40^{b}	4.72^{b}
SEM	0.40	59.87	61.47	1.08	65.35	1.17	0.04	12.00	3.06	10.77	0.54
P-Value	0.21	0.02	0.01	0.01	0.02	0.00	0.04	0.23	0.42	0.08	0.02
Interaction of RLM+SB											
0gRLM+ 0gSB/kg	41.49	3197.45^{c}	3156.02^{ab}	56.36^{ab}	5848.60^{ab}	104.44^{b}	1.89^{a}	460.00	857.90^{b}	869.40^{a}	8.33^{a}
0gRLM+ 15gSB/kg	42.29	3434.54^{a} ^{b}	3392.25^{ab}	60.58^{ab}	5940.78^{b}	106.09^{b}	1.79^{b}	460.00	871.45^{b}	823.40^{ab}	1.78^{c}
3gRLM+ 0gSB/kg	41.78	3470.36^{a} ^{b}	3428.56^{ab}	61.22^{ab}	5688.04^{ab}	101.57^{ab}	1.81^{a}	460.00	834.33^{ab}	832.60^{b}	5.33^{b}
3gRLM+ 15gSB/kg	42.20	4624.89^{a}	3583.06^{a}	63.98^{a}	4939.06^{c}	88.19^{c}	1.37^{b}	460.00	724.42^{c}	630.20^{ab}	1.48^{c}
6gRLM+ 0gSB/kg	41.18	3572.17^{b}	3530.99^{ab}	63.05^{ab}	5911.71^{b}	105.57^{b}	1.67^{c}	460.00	867.18^{b}	768.20^{c}	3.83^{ab}
6gRLM+ 15gSB/kg	42.18	3163.91^{c}	3121.85^{b}	55.75^{b}	6197.82^{a}	110.68^{a}	1.88^{a}	460.00	909.16^{a}	864.80^{a}	4.33
SEM	0.69	105.16	100.69	1.88	109.91	7.57	0.06	6.00	50.56	8.21	0.13
P-Value	0.31	0.02	0.04	0.01	0.00	0.01	0.03	0.61	0.02	0.00	0.00

^{abc} Means on the same column with different superscripts are significantly different ($p<0.05$), SEM = Standard error of mean, IBW = Initial body weight, FBW = Final body weight, TWG = Total weight gain, ADWG = Average daily weight gain, TFI = Total feed intake, ADFI = Average daily feed intake, FCR = Feed conversion ratio, FC/kg = Feed cost per kilogram, FC/day = Feed cost per day, FC/kgG = Feed cost/kilogram gain.

The result of the interaction between RLM and SB showed significant improvements in the final body weight, total weight gain, average daily weight gain, feed conversion ratio and percentage mortality at inclusion level of 3gRLM+15gSB/kg. This result is in agreement with the result of [18] who reported that the inclusion of Algerian Sodium Bentonite in diets of broilers chickens improved weight gain. Also, this study is in agreement with the findings of [19], who reported that dietary inclusion of phyllosilicate clay minerals such as kaolin improved the performance of broiler birds. The reason for this improvement could be attributed to the action of the silicate minerals enhancing the digestibility and absorption of nutrient in the broilers' diets [12]. Improvement in weight gain could be due to the reduction of digestion transition rate, which increases the time of exposure to digestive enzymes [20]. The results toe the path of the findings of [21] and [5] who reported a positive increase in body weight gain and performance of broilers by the dietary inclusion of rosemary leaf meal.

CONCLUSION

It was concluded that inclusion of 15g SB and 3g RLM per kg feed improved growth performance and cost of production, it is therefore, recommended that 15g SB and 3g RLM should be used by farmers to improve broiler performance at reduced cost.

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HAEMATOLOGICAL AND SERUM BIOCHEMICAL INDICES OF BROILER FINISHER BIRDS FED DIETS SUPPLEMENTED WITH SWEET POTATO (*Ipomoea batatas*) LEAF MEAL

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ABSTRACT

The study was conducted to determine the effect of sweet potato (*Ipomoea batatas)* leaf meal on haematological and serum biochemical indices of broiler finisher chickens. One hundred and twenty (120) Abor acre broiler chickens aged four weeks were used for the study. They were randomly allotted to four (4) dietary treatment groups. Each treatment group consisted of thirty (30) birds replicated three (3) times with ten birds per replicate in a Completely Randomized Design (CRD) with supplementation levels of sweet potato leaf meal at 0.00, 5.00, 10.00 and 15.00 g/kg designated as T_1, T_2, T_3 and T_4 respectively. Feed and water were given to the birds *ad libitum.* The results showed that the monocytes, heterophils, platelets, and red blood cell counts (RBC) were significantly ($P< 0.05$) different between dietary treatments. The basophils, lymphocytes, mean corpuscular volume (MCV), esosinophils, mean corpuscular haemoglobin concentration (MCHC), mean corpuscular haemoglobin (MCH), packed cell volume (PCV), white blood cell (WBC) count, haemoglobin concentration recorded no significant ($P> 0.05$) effect among the treatment groups. The results of serum biochemical parameters indicated that there were significant ($P< 0.05$) differences among the treatment groups in all the serum biochemical parameters measured except Aspartate transaminase which was similar ($P >0.05$) among the dietary treatment groups. It could be concluded that supplementation of sweet potato leaf meal up to 15g/kg in the diet of broiler finisher chicken had no toxic effect on the haematological and serum metabolites since it was within the normal ranges.

Keywords: Broiler Finisher, Haematology, Serum Biochemistry, Sweet Potato leaf,

INTRODUCTION

Broiler chicken production is the fastest means of providing animal protein to the teeming world population due to the birds' efficient feed utilization, rapid weight gain, and short generation interval (1). Broiler chickens are important source of protein, rich in essential amino acids that are required for human body growth, maintenance and repairs (2). The demand for animal protein is on the increase as the population of the world is increasing geometrically. Another factor that favours the demand of broiler meat is its low level of cholesterol after processing (2). However, high cost of conventional feed ingredients has sent lot of poultry farmers out of business as cost of feeding alone account for 60-75% of the total production cost in Nigeria. Therefore, it is necessary to introduce an alternative, cheap and available feed material to substitute the existing broiler feed (1). One of such is Sweet potato leaf meal. The study of blood indices is useful in health and physiological stautus of animals, and it is majorly influenced by nutrition, pathology and the environmental factors the birds are subjected to (3). This study therefore investigated the haematological and serum biochemical indices of finisher broiler chicken fed diets supplemented with sweet potato (*Ipomoea batatas*) leaf meal.

MATERIAL AND METHODS

Location of the study

The study was carried out at the Poultry Unit of the Teaching and Research Farm, University of Calabar, Calabar, Cross River State, Nigeria. The annual temperature and rainfall ranges between 25º and 30ºC and 1260 to 3500mm, respectively (4).

Collection and processing of test material

Fresh leaves of sweet potato (*Ipomea batata*) leaf of white variety were sourced within the farm locality where it was planted as a cover crop. The leaves were rinsed with clean flowing tap water to remove dirt and sand, and air dried for three (3) days then milled using 2mm sieve size to form the meal.

Experimental diets preparation

The finisher diets were formulated to supply 20.22% crude protein and 3100.05kcal/kg of metabolizable energy. The diets were divided into four (4) treatments groups designated as T_1, T_2, T_3 and T_4 with supplementation level of potato leaf meal at 0.00g/kg, 5g/kg, 10g/kg and 15g/kg respectively. The composition of the experimental diet is shown in Table 1.

Experimental birds and management

A total of 120 four (4 weeks old) arbor acres strain of broiler chicks were used for this experiment. There were randomly allotted to four dietary treatments in a Completely Randomized Design (CRD). Each treatment had thirty (30) birds with three (3) replicates of ten (10) birds each. The birds were managed for 28 days (4 weeks) in a deep liter system. Proper routine management procedures were adopted to ensure maximum health and productivity.

Blood collection and analysis

At the end of the feeding trial, blood samples (5ml) each was collected from the vein of the wing web of three birds per replicate by vein puncture of the wings. The samples were put into a well labeled Ethylene Diamine Tetra-acetic Acid (EDTA) anticoagulant bottles for hematological studies, while the blood sample were put in another set of bottles without EDTA for serum biochemistry assay.

Statistical analysis

All data collected from blood assay were subjected to One Way Analysis of Variance (ANOVA) for Completely Randomized Design (CRD) using Genstat Release 8.1 (5) statistical package. Significance difference were separated using the Least Significance Difference (LSD).

RESULTS AND DISCUSSION

Haematological characteristics of broiler birds fed sweet potato leaf meal

The haematological characteristics of broiler finisher birds fed sweet potato leaf meal as supplement in the diet is presented in Table 2. There was no significant ($P>0.05$) differences in the parameters measured except for platelets, red blood cell counts (RBCs), heterophils and monocytes. The platelets count in T_3 and T_4 are significantly ($P<0.05$) higher than (53.38×10^9/L) in T_1 and (59.66×10^9/L) in T_2 with similar values. The red blood cell (RBC) counts was significantly ($P<0.05$) higher in T_4 (3.96×10^{12}/L) and T_2 (3.89×10^{12}/L) compared to T_1 and T_3 with lower values. The heterophils values were significantly ($P<0.05$) higher in T_2, T_3 and T_4 compared to T_1 with least value. Birds fed T_1, T_3 and T_4 diets recorded significantly ($P<0.05$) higher monocyte values compared to those in T_2 with lower values. The values obtained in all the parameters measured fall within the normal for clinically healthy birds reported by Mitruka *et al*. (6). The similarities in most of the haematological indices across the treatments indicate the wellness of the birds throughout the period of the experiment as normal haematological parameters of an animal are direct indication of absence of disease (7). These results were similar with those observed by Olugbemi *et al*. (8) that packed cell volume was not affected due to the supplementation of sweet potato leaf meal in the diet.

Serum biochemical indices of broiler birds fed sweet potato leaf meal

The result of feeding sweet potato leaf meal on serum biochemical parameters of broiler chickens is shown in Table 3. There were significant ($P<0.05$) differences among the treatment groups in urea, cholesterol, glucose, calcium and alkaline phosphate values. However, there were no significant ($P>0.05$) differences in Alanine transaminase and Aspartate transaminase values among the dietary treatments. Serum urea was significantly ($P<0.05$) higher in birds fed T_1, T_2 and T_3 compared to those fed T_4. Highest values of serum urea was observed in T_1 with T_4 having the lowest. The serum urea values obtained in this study were within the normal range of 4.80 – 29.74 mg/dl reported by Kaneko *et al*. (9) and (10) in Harco cocks. However, the values were lower than the range of 30.46 ± 2.51 – 54.08 ± 0.11 mg/dl reported by Iheukwumere *et al*. (11) in chickens. This disparity in urea values may be attributed to differences in breed and nutritional status of the birds. Serum cholesterol was significantly ($P<0.05$) higher in birds fed control diet (T_1) than those fed T_4 but similar to those fed T_2 and T_3. The cholesterol values obtained in this experiment were within the

normal range of 52 – 143 mg/u reported by Banerjee (12) for birds and also within the range of 109 – 128 mg/dl reported by Egu (10) for Harco cocks. Serum glucose content was significantly (P<0.05) higher in birds fed control diet compared to those fed other dietary treatments which had statistically similar (P>0.05) values. The serum glucose values obtained in this study were lower than the range of 132.60 – 176.40 mg/dl reported by Egu (10) in Harco cocks but were however, within the range of 75.80 – 100.50 mg/100 ml reported by Egu (13) in broilers. This implies that the birds were fed diets containing adequate energy to carter for their physiological processes. Serum Alkaline phosphatase content was significantly (P<0.05) higher in birds fed T_1, T_2 and T_4 compared to those fed T_3 dietary treatment. Serum Alkaline phosphatase values obtained in this research were within the normal values reported by Kaneko *et al*. (9) for chicken. Alkaline phosphatase assays is useful in the diagnosis of obstructive liver disease (14). The liver function enzymes measured were within the normal range reported by Kaneko *et al*. (9) for clinically healthy chicken. This implied that the liver was not affected due to the levels of supplementation.

Table 1: Ingredients composition of experimental broiler diets

Ingredients (%)	
Maize	50.00
Soybean	27.50
Wheat offal	9.90
Di-calcium phosphate	2.50
Oyster shell	1.50
Lysine	0.25
Methionine	0.25
Salt	0.25
Vitamin premix	0.25
Total	**100.00**
Calculated nutrient composition	
Crude protein	20.22
Crude fibre	5.03
Ether extract	2.73
Metabolizable Energy (Kcal/kg)	**3100.05**
Determined Analysis	
Crude protein	19.89
Crude fibre	5.81
Ether Extract	2.73
Ash	0.53

Table 2: Haematological characteristics of broiler bird fed diet supplemented with sweet potato (*Ipomoea batatas*) leaf meal

	Dietary level of leaf of sweep potato leaf meal (g/kg)					
Parameter	**T1 (0.00)**	**T2 (5.00)**	**T3(10.00)**	**T4 (15.00)**	**SEM**	**Normal Ranges**
PCV (%)	28.64	29.96	29.96	30.00	0.70	30-50(%)
WBC ($x10^9$/L)	7.44	7.71	8.22	8.54	0.56	5.2-12.5($x10^9$/L)
PLAT ($x10^9$/L)	53.38^b	59.66^b	83.34^a	93.63^a	8.87	200-650($x10^9$/L)
RBC ($x10^{12}$/L)	3.76^b	3.89^a	3.83^b	3.96^a	0.11	5.2-12.5($x10^{12}$/L)
HB (g/dl)	9.91	9.66	9.34	9.72	0.36	10-17.4(g/dl)
MCH (pg)	27.69	25.68	24.66	25.68	0.77	17.1-23.9(pg)
MCHC (g/dl)	35.31	34.31	34.00	34.00	0.52	28.2-40(g/dl)
MCV (fl)	74.63	74.33	76.00	74.33	1.61	57.5-75(fl)
HET (%)	10.00^b	10.34^{ab}	11.61^a	13.66^a	1.05	NA (%)
LYM (%)	86.65	86.65	82.00	82.00	1.02	43-80(%)
EOS (%)	0.00	0.00	0.33	0.66	0.27	NA (%)
MON (%)	3.31^a	2.33^b	3.31^a	3.31^a	0.40	NA (%)
BAS (%)	0.00	0.00	0.00	0.33	0.20	NA (%)

^{a,b,} means along the same row with different superscript are significantly (0<0.05) different. PCV = Packed Cell Volume, WBC = White Blood Cell, PLAT = Platelets, RBC = Red Blood Cell, HB = Haemoglobin,

MCH = Mean Corpuscular Haemaglobin, HET = Heterophils, LYM = Lymphocytes, EOS = Eosinophils, MON = Monocytes, BAS = Basophils.

Table 3: Serum biochemical parameters of broiler birds fed diet supplemented with sweet potato (*Ipomoea batatas*) leaf meal

	Dietary supplementation levels of sweet potato leaf meal (g/kg)				
Parameters	**T1 (0.00)**	**T2 (5.00)**	**T3 (10.00)**	**T4 (15.00)**	**SEM**
Urea (mg/dl)	13.50[a]	10.50[a]	11.50[a]	5.00[b]	1.82
Cholesterol (mg/dl)	164.00[a]	122.50[ab]	116.50[ab]	63.50[b]	20.62
Glucose (mmol/L)	142.50[a]	101.00[b]	93.00[b]	84.50[b]	12.87
Calcium (mmol/L)	7.40[b]	7.70[ab]	7.75[a]	7.85[a]	0.10
Alkaline phosphatase (iμ/L)	161.00[a]	162.00[a]	132.50[b]	157.00[a]	9.19
Alanine transaminase (iμ/L)	0.00	0.00	0.00	0.00	0.00
Aspartate transaminase (iμ/L)	89.00	89.00	89.00	89.00	0.00

[ab] means in the same row with different superscript are significantly (P<0.05) different, SEM = Standard error of mean

CONCLUSION

It can be concluded that the supplementation levels of sweet potato leaf meal did not have any detrimental effects on the birds as both the haematological and serum biochemical parameters were within the normal range. Hence, sweet potato leaf meal can be used in the diets of broilers birds.

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Monogastric Animal Production: MGP 031

GROWTH PERFORMANCE AND CARCASS CHARACTERISTICS OF BROILER FINISHER BIRDS FED DIET SUPPLEMENTED WITH SWEET POTATO (*Ipomoea batatas*) LEAF MEAL

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ABSTRACT

A feeding trial was conducted to determine the effect of supplementation levels of sweet potato (*Ipomoea batata*) leaf meal on the growth performance and carcass characteristics of broiler finisher birds. A total of 120 (4 weeks old) Abor acre strain of broiler birds were used for the experiment in a Completely Randomized Design (CRD). The birds were randomly allotted into four (4) treatment groups with three (3) replicates having ten (10) birds. Sweet potato leaf meal was supplemented in the broiler finisher diet as additive at 0g/kg, 5g/kg, 10g/kg, and 15g/kg and designated as T_1, T_2, T_3, and T_4, respectively. The result of performance showed that feed intake (99.07, 94.91, 92.29, and 90.03 g for T_1, T_2, T_3 and T_4 respectively) and feed conversion ratio (FCR) of 3.14, 3.03, 2.87, and 2.82g decreases significantly ($P<0.05$) across the treatment as the level of inclusion of sweet potato leaf meal increased. There was no significant ($P>0.05$) difference in total weight gain daily, average weight gain and final weight gain. The result of carcass parameters showed that there was no significant ($P>0.05$) across the treatment in all the carcass parameters measured except that of the liver which was significantly ($P<0.05$) higher in T_4. The liver enlarged to be able to detoxify the anti-nutrients that was be present in the leaf meal. It could be concluded that sweet potato leaf meal can be supplemented up to 15g/kg in the diet of broiler finisher in order to improve the growth performance and carcass characteristics.

Key words: Performance, Carcass, Sweet potato leaf meal, Broiler, Supplementation

INTRODUCTION

It is an established fact that feed constitutes the greatest and most costly input in livestock farming, especially poultry. Feed is a major component of total poultry venture as more than 70% of the total expenditure is on procurement of feeds (1). Thus, any significant reduction in the cost of feeds will significantly reduce the overall production cost and increase the profit margin of the farm (2). The trust of nutritional research is now towards identifying non-conventional feed sources that are locally available with low human demands (3). One of such non-conventional feed additives that could be used to reduce the high cost of conventional feed sources in poultry is the sweet potato leaf meal.

Feed additives are ingredients added to animal diets to enhance production efficiency, improve health and reduce morbidity (4). Hence, feed additives are added to diets for reasons other than supply of nutrients to animals. According to (4), they are added in order to improve feed utilization. As a result of replacing them without affecting the performance of birds; growth promoter or leaf meal can be used to feed Broiler's (5). The economic benefits of plant-based feed additives has been lowering production cost as a result of their affordability in our natural ecosystem and their availability. This plant material like sweet potato leaf with bioactive ingredients could be used.

Several reports on the phytochemical properties of the leaf has recorded significant increases in the performance of livestock and generally reduced production cost (6). This study evaluated the nutritive potential of sweet potato leaf meal at various inclusion levels in the diets of broiler finisher chicken.

MATRIALS AND METHOD

Location of the study

The study was carried out at the Poultry Unit of the Teaching and Research Farm, University of Calabar, Calabar, Cross River State, Nigeria. Calabar is geographically located within the tropical rain forest zone of Nigeria, with a land mass of 233.2 square mile (604km^2) and lies between latitude 4^{o}50N to 415^{o}39 and longitude 8^{o}17E to 10^{o}43E of the equator. The relative humidity is 55-85% with an elevation above sea level of 28 meters. The annual temperature and rainfall ranges between 25^o and 30^{o}C and 1260 to 3500mm, respectively (7).

Collection and processing of test material

Fresh leaves of sweet potato (*Ipomoea batata*) of white variety were sourced within the farm locality where it was planted after two months as a cover crop. The leaves were rinsed with clean flowing tap water to remove dirt and sand, and air dried for three (3) days to reduce the moisture content while retaining the green colouration, it was milled using 2mm sieve size to form the meal before incorporating in the diet.

Experimental diets

Birds were fed formulated broiler starter diet for four (4) weeks, followed by finisher diet (Table 1) for another four (4) weeks. The sweet potato leaf meal was incorporated in the feed during the finisher phase at 0g/kg, 5g/kg, 10g/kg and 15g/kg designated as T_1, T_2, T_3 and T_4, respectively, with T_1 serving as the control diet

Experimental Birds and Management

A total of 120 four weeks old Abor acre strain of broiler birds were used for this experiment. The birds were randomly allotted into four (4) treatments groups with three (3) replicates per treatment and each replicate with ten (10) birds in a Completely Randomized Design (CRD). The birds were managed in a deep liter system, adequate spacing, ventilation, protection against predators and proper routine management procedures were adopted to ensure maximum health and productivity.

Growth Performance Indices

Feed intake, weight gain, feed conversion ratio (FCR) and carcass yield were the parameters measured. Feed intake was estimated by subtracting the weight of the left over from the weight of feed served the previous day, Weight gain was determined by the difference between the current weight and previous weight while feed conversion ratio was determined by dividing the total feed intake by the total weight gain.

Carcass yield determination

At the end of the feeding trial, twenty four (24) birds, six (6) birds per treatment whose weight were equal or close to the mean weight per treatment i.e two (2) per replicate were selected, starved for twelve (12) hours but had access to drinking water prior to slaughter. The birds were weighed for life weight and thereafter slaughtered by severing the jugular vein. The carcasses were dissected into primal cuts and the internal organs removed. The primal cuts measured are shown in table 3.

Statistical analysis of data

All data obtained were analyzed using one-way ANOVA for CRD. Significant means were separated using the Duncan Multiple Range Test (8)

The model used was as follows:

$Y_{ij} = \mu + T_i + E_{ij}$

Y_{ij} = Observed value;

μ = Overall mean value

T_i = Random effect of the levels of sweet potato leaf meal

E_{ij} = Random residual error

Growth Performance Characteristics

The result of the growth performance of broiler birds (4-8 weeks) fed diet containing varying levels of sweet potato (*Ipomoea batatas*) leaf meal is summarized in Table 2. The growth parameters were not significantly ($p>0.05$) affected by the inclusion levels of sweet potato leaf meal in the diet except the feed conversion ratio and the daily feed intake which decrease at varying levels of inclusion of the leaf meal in the diet This result is in agreement with that of *Kiozya et al.* (9) who reported non- significant ($p<0.05$) differences among treatments on the daily weight gain, final weight gain and total weight gain. The findings however, does not support the observation by *An et al.* (10) who reported that feed intake was not significantly ($P >0.05$) affected by 15g/kg level of sweet potato leaf meal in broilers diet. The significant difference ($P <0.05$) in feed conversion ratio among the dietary treatments in line with the finding of *An et al.* (10) who reported significant ($P<0.05$) differences among treatments on feed conversion ratio as the level of sweet potato leaf meal increases in the diet. This implies that the birds were able to convert the feed into flesh as levels of sweet potato leaf meal inclusion increases in the feed.

Carcass Characteristics of Broiler Birds Fed Sweet Potato (*Ipomoea batatas*) Leaf Meal

The result of the carcass characteristics of broiler birds fed diet containing sweet potato leaf meal is presented in Table 3. The carcass characteristics and internal organs were not significantly ($P>0.05$) affected by the dietary inclusion of sweet potato leaf meal except the liver of broiler birds which differed significantly ($P<0.05$) as the level of supplementation increased. This shows that the experimental diet did not exert any significant influence on most of the carcass parameters. This result is similar to that of (6) who reported no change in primal cuts of broiler birds fed diet containing sweet potato (*Ipomoea batatas*) leaf meal in broiler finisher diet. However, there was significant ($P<0.05$) differences in liver weight which tended to increase as the proportion of sweet potato leaf meal increased in the diet. This result disagrees with that of *Kiozya et al.* (9) who reported no significant differences in liver weight at higher level of inclusion of sweet potato leaf meal. But the result is in conformity with the findings of *Grunberg et al.* (3) who observed a high value for liver weight in broiler birds as the inclusion levels of sweet potato leaf meal increased in the diets due to the presence of anti-nutrients in the leaf meals. In their opinion, they attributed it to the variety, age of the plant, and the content of anti- nutritional factors, where the liver had to be enlarged in order to detoxify the toxins found in the leaf meal.

Table 1: Ingredients Composition of experimental broiler diets

Ingredients (%)	
Maize	50.00
Soybean	27.50
Wheat offal	9.90
Di-calcium phosphate	2.50
Oyster shell	1.50
Lysine	0.25
Methionine	0.25
Salt	0.25
Vitamin premix	0.25
Total	100.00
Calculated nutrient composition	
Crude protein	20.22
Crude fibre	5.03
Ether extract	2.73
Metabolizable Energy (Kcal/kg)	3100.05

Table 2: Growth performance Characteristics of Broiler Finisher Birds Fed Sweet Potato (*Ipomoea batatas*) Leaf Meal (4-8 weeks) as supplement

Parameters	T_1 (0g/kg)	T_2 (5g/kg)	T_3 (10g/kg)	T_4 (15g/kg)	SEM
Initial weight (g/bird)	446.50	436.50	436.00	439.50	4.21
Finial weight (g/bird)	1820.00	1703.50	1780.00	1780.00	2.96
Total weight gain (g/bird)	1373.50	1267.00	1344.00	1340.50	8.82
Average weight gain (g/bird)	32.70	30.17	32.00	31.92	0.96
Daily feed intake (g)	99.07[a]	94.41[b]	92.29[c]	90.03[d]	1.53
Feed conservation ratio	3.14[a]	3.03[b]	2.87[c]	2.82[d]	0.04

[a, b, c, d,] Means on the same row with different supper script differ significantly (P<0.05).

Table 3: Carcass Characteristics of Broiler Finisher Birds Fed Sweet Potato (*Ipomoea batatas)* Leaf Meal as supplements

Parameters	T_1 (0g/kg)	T_2 (5g/kg)	T_3(10g/kg)	T_4(15g/kg)	SEM
Live weight (g/bird)	1890.00	1890.32	1890.50	1890.58	8.11
Dressed weight (g/bird)	1483.67	1488.06	1474.45	1467.47	11.84
Dressing %	78.50	78.72	77.91	77.62	6.09
PRIME CUTS (%)					
Breast	17.89	17.63	17.80	17.69	1.35
Backcut	13.66	13.60	13.61	13.61	0.99
Drumsticks	10.36	10.34	10.33	10.32	1.18
Thighs	12.41	12.40	12.41	12.43	1.97
Head	2.60	2.60	2.60	2.55	0.06
Wings	9.41	9.38	9.41	9.39	0.67
Shanks	4.33	4.32	4.31	4.30	0.16
Neck	5.13	5.11	5.10	1.14	0.17
ORGANS (%)					
Intestine (full content)	7.80	7.82	7.82	7.85	1.05
Liver	2.66[b]	2.68[b]	2.78[a]	2.72[a]	0.11
Kidney	0.19	0.19	0.19	0.16	0.03
Heart	0.60	0.60	0.59	0.58	0.03
Gizzard	1.90	1.90	1.89	1.90	0.07
Lungs	0.50	0.49	0.49	0 .50	0.02

[a, b, c, d,] Means on the same row with different supper script differ significantly (P<0.05)

CONCLUSION

It is concluded the inclusion levels of *Ipomoea batatas* (up to 15g/kg) did not have any adverse effect on the growth and carcass characteristics of broiler finisher chicken.

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PERFORMANCE AND NUTRIENT DIGESTIBILITY OF WEANED RABBITS FED BIODEGRADED *PROSOPIS AFRICANA* SEED COAT

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ABSTRACT

The study was conducted to evaluate the performance and nutrient digestibility of rabbits fed diets containing varying levels of biodegraded *Prosopis africana* pod for a period of 84days. A total of 25 weaned rabbits of about 4-5 weeks of age with similar weights were randomly assigned to 5 treatments consisting of 1 rabbit in a replicate. The design used was Completely Randomized Design (CRD). Control experiment (T_1) had no *Prosopis* (0% *Prosopis)*, whereas, other feed served to rabbits contained 25%, 50%, 75%, and 100% of *Prosopis africana* pod, representing T_2, T_3, T_4 and T_5, respectively. Feed and water were given *ad libitum.* Performance indices such as weight gain, feed efficiency, protein efficiency ratio, and nutrient digestibility indices were measured. Results revealed that all the performance indices measured were not significantly ($P>0.05$) affected except average daily weight gain and final weight. Also, nutrient digestibility parameters were not affected by treatments except for nitrogen free extract that significantly decreased across treatments. The study concluded that, *Prosopis africana* pod meal could replace maize in rabbits' diets upto100% without compromising their performances.

Key words: Performance, Nutrient, Digestibility, Rabbits, *Prosopis africana,*

INTRODUCTION

Production of feed that is cost effective is the focal point of attention in recent times. The reason is that cost of production accounts for about 70-75% of the total cost of production (1). Conventional feedstuffs are responsible for this high cost; millet, maize, soybean, groundnut because they are highly competed for by man, animal and industries (2). This quest has drawn the attention of researchers to non- conventional feedstuffs that are not faced with the issue of seasonality nor competing with man for food (3). In the light of the foregoing, *Prosopis* seed coat is considered potential feedstuffs for rabbit production.

Prosopis africana seeds, pods and seed coat are rich in protein, fibre and carbohydrates, respectively. However, the setback of using *Prosopis* is high content of anti-nutritional factor such as haemagglutinin, tannins, *prosopine* and toxic amino acid which are capable of hindering the bio-availability of nutrients when consumed without adequate processing (such as boiling, fermentation, sun drying, grounding) (4; 5). Abang *et al.* (6) asserted that, adequate scientific data on direct or processed use of *Prosopis* seed coat and its nutritive value is lacking, available information deals mainly with the use of *Prosopis* leaves, seed and pods. *Prosopis* seed is use in making "Dawa Dawa" seasoning- Maggi in Nigeria after going through process of production. Hence, the study investigated effect of feeding varying levels of fermented *Prosopis* seed coat to weaned rabbits. The objective of this study is to evaluate the growth performance and nutrient digestibility of weaned rabbits fed diet containing different levels of *Prosopis africana* seeds coat meal.

MATERIALS AND METHODS

Location of the Study

The study was carried out in the Rabbitary Unit of the Livestock Teaching and Research farm of the University of Agriculture Makurdi, Benue State, Nigeria. The experiment was conducted in the same location as described by Abang *et al.* (7)

Processing of *Prosopis africana* Seed coat

Prosopis africana seed coats were obtained around Makurdi metropolis. The seed coats were collected and fermented with fresh rumen content for three days. Forty (40) kg of *Prosopis africana* seed coat mixed with twenty-five (25) kg of fresh rumen content was collected in black poly bags and allowed to ferment for 72 hours in an anaerobic condition. The fresh rumen content was obtained in the early hours of the morning in the Month of March. The fermented seed coats were then spread to dry before being winnowed to remove the chaff then ground and incorporated into the feed as required per treatment.

Experimental diets

Five dietary treatments with crude protein ranging from 17.24 – 17.78% and metabolizable energy from 2491.00 – 2542.57Kcal/kg designated as T_1, T_2, T_3, T_4 and T_5 representing 0%, 25%, 50% 75% and 100% inclusion of fermented *Prosopis africana* seed coat in the diets of the rabbits were formulated. The diets were formulated using the following ingredients as shown in Table 1.

Proximate analysis

Proximate analysis of the test ingredient as well as the experimental diets was determined by AOAC (8). Metabolizable energy (ME) was calculated using the methods outlined by Pauzenga, (9). The analysis was done at the Nutrition Laboratory University of Agriculture, Makurdi.

Experimental Design and Management of Rabbits

A total of twenty- five (25) rabbits of mixed sexes and breeds (Chinchilla and Newzealand White) aged between 4 – 5 weeks were obtained from Dagwam farm NVRI, Vom Plateau State, Nigeria, were used for the study. The rabbits were weighed and randomly assigned to five treatments with five rabbits each (four New Zealand white and one chinchilla) for each treatment, with similar mean live weight in a Completely Randomized Design (CRD). Rabbits were housed in three-tier hutch system. All routine management practices were strictly observed throughout the study period. Feed and water were provided *ad-libitum.* They were allowed to acclimatize for 7days before starting the experiment. Parameters mensured were feed intake, weight gain, feed conversion ratio, protein efficiency.

Digestibility trial

At the end of twelve (12) weeks feeding trial, 3 rabbits each from the treatment groups with similar mean live weights were selected from each replicate and transferred into metabolic cages for individual feeding and feacal collection. The rabbits were then fasted overnight but water given to them. Feacal samples were collected for seven days bulked for each replicate and oven dried at 60^{o}C to constant weight. The feacal samples for each diet was bulked, finely ground and analyzed for chemical composition according to the method outlined by AOAC (6).

Statistical analysis

Data collected during the experiment were statistically analyzed using the general linear model procedure of software package, SPSS (10), while the differences between treatments means were separated by Duncan Multiple Range Test (11)

RESULTS AND DISCUSSION

Growth performance of weaned rabbit

The recorded average final weight ranged from 1455.30 to 1892.30g in T_1 and T_4 and were significantly different ($P<0.05$) across the dietary treatments. The final weight range of 936.67 to 1211.12g in T_1 agrees with the result of Adamu *et al.* (12) for rabbits fed *Prosopis africana* pulp. The results indicated that the inclusion level of *Prosopis africana* across the dietary treatments did not affect the performance of the animals. The average daily weight gain reported in this study ranged from 8.22g to 14.23g which differed statistically ($P<0.05$) across the dietary treatments. This range was higher than the range of 6.54 to 10.36g reported by Adamu *et al.* (13) on rabbits fed *Prosopis africana* pulp. This shows that the anti-nutritional factor like tannins, trypsin inhibitors, protease inhibitors were reduced to a tolerable level by the processing

method adopted. The average daily feed intake recorded in this study ranged from 77.68 to 83.96g, the result did not significantly differ (P>0.05) across the five dietary treatments. These values were higher than the values of 41.86g to 47.37g reported by Adamu *et al*. (13) on rabbits fed *Prosopis africana pulp.* Although, the high feed intake had no negative effect on the experimental animals during the trial period. The result of efficiency of feed utilization obtained in this study (4.60 to 6.34) with no significant differences (P>0.05) across the treatments were comparable with the values of 5.95 to 6.83 reported by Adamu *et al.* (12) on rabbits fed *Prosopis Africana.* Protein efficiency ratio (1.34 to 2.11) was equally not significantly (P>0.05) affected across the dietary treatments. These results were comparable with 0.83 to 1.19 recorded by Adamu *et al.* (12) on rabbits fed *Prosopis africana pulp.* This result indicated that the rabbits utilized the dietary protein well during the experiment.

Effect of Replacing Maize with *Prosopis africana* on Coefficient Digestibility of Weaned Rabbits

There was no significant (P>0.05) difference in all the parameters measured except for nitrogen free extract (NFE). The values of dry matter digestibility varied from 83.22 to 94.10 and were higher than 74.14 to 83.35 reported by Omole *et al.* (14) and 61.64 to 64.97% recorded by Sarhan, (15) who replaced clover hay with dietary pea vines hay and pea pods hulls partially or completely. The high coefficient of digestibility of crude protein of the diet in this study (88.42 to 96.37%) could be attributed to better utilization of nutrients by rabbits. This result agrees with the result of Cheeke *et al.* (16). The nitrogen free extract digestibility in this study ranged from 82.90% to 96.37% with significant differences (P<0.05) across the treatments, rabbits that fed T1 diet had significantly higher NFE digestibility compared to those fed other dietary treatments. This result is in agreement with that of Onifade and Tewe (17) who noted that the high digestibility of maize -based diet was due to the high availability of their carbohydrates. Also, NFE decreases across the treatments because the energy of maize is higher than that of *Prosopis africana* and so the nitrogen free extract decreases as the quantity of Prosopis increases across the treatments. The decrease in nitrogen free extract was also observed by Adamu *et al.* (2010) when he replaced *Prosopis africana* pulp with maize.

Table 1. Composition of experimental diet with varying levels of fermented *Prosopis africana* seed coat meal for weaned rabbits

Ingredients	**T_1 (0%)**	**T_2 (Pa25%)**	**T_3 (Pa50%)**	**T_4 (Pa75%)**	**T_5 (Pa100%)**
Maize	36.00	27.00	18.00	9.00	0
Prosopis Africana	-	9.00	18.00	27.00	36.00
Soya bean meal	15.00	15.00	15.00	15.00	15.00
Brewer Dry Grain	35.00	35.00	35.00	35.00	35.00
Maize Offal	10.00	10.00	10.00	10.00	10.00
Bone meal	2.25	2.25	2.25	2.25	2.25
Salt	1.00	1.00	1.00	1.00	1.00
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Vitamin/Premix	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated nutrients:					
ME (kcal/kg)	2542.57	2529.57	2515.80	2504.00	2491.00
Crude Protein	17.24	17.38	17.51	17.65	17.78
Crude fiber	10.00	10.93	11.91	13.00	14.04

Table 2: Effect of Replacing Maize with *Prosopis africana* on Growth Performance of Weaned Rabbits

Treatment (%)	T_1 (Pa 0%)	T_2 (Pa25%)	T_3 (Pa50%)	T_4 (Pa75%)	T_5 (Pa100%)	SEM
Initial weight (g)	724.86	768.33	760.50	721.83	740.83	38.15^{NS}
Final weight (g)	1455.30^{d}	1890.30^{ab}	1881.00^{ab}	1892.30^{a}	1858.30^{c}	90.92*
ADWG (g)	8.62^{c}	12.34^{b}	14.05^{a}	14.23^{a}	13.76^{ab}	1.07*
ADFI (g)	83.96	78.27	77.68	80.17	79.36	1.95^{NS}
FE (g)	4.60	4.52	4.45	4.36	4.32	0.09^{NS}
PER (g)	2.11	1.45	1.34	1.35	1.34	0.02^{NS}
Mortality	1.00	0.00	1.00	0.00	1.00	0.01^{NS}

^{abcd}= mean in the row with different superscript are significantly different (P<0.05), Pa = *Prosopis Africana,* SEM = Standard Error Mean, ADWG= Average daily weight gain, ADFI = Average daily feed intake, FE= Feed efficiency, PER =Protein efficiency ratio, NS= Not significantly different (P>0.05), * = Significantly different (P<0.05).

Table 3: Effect of replacing maize with *Prosopis africana* on nutrient digestibility coefficient of weaned rabbits

Treatment (%)	T_1 (Pa 0%)	T_2 (Pa25%)	T_3 (Pa50%)	T_4 (Pa75%)	T_5 (Pa100%)	SEM
Dry matter	94.10	90.1	86.24	85.74	83.22	2.65^{NS}
Ether extract	94.94	94.16	92.08	89.74	90.14	2.31^{NS}
Crude protein	96.37	94.03	91.07	91.08	88.42	1.60^{NS}
Crude fibre	75.80	69.05	56.82	67.86	62.21	7.14^{NS}
Nitrogen free Extract	96.37^{a}	94.03^{ab}	87.51^{b}	86.60^{b}	82.90^{c}	2.15*

abc= mean in the row with different superscript are significantly different (P<0.05), Pa = *Prosopis african,* SEM = Standard Error Mean, NS = Not significantly different (P>0.05) * = Significantly different (P<0.05)

CONCLUSION

This study concluded that *Prosopis africana* fermented with rumen content could replace maize in weaned rabbit diet up to 100%.

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THE INFLUENCE OF DIETARY TIGER NUT LEVELS ON BLOOD INDICES OF THREE RABBIT BREEDS

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ABSTRACT

This study investigated the impact of dietary *Cyperus esculentus* (tiger nut) as feed additive fed to three rabbit breeds at different inclusion levels on the blood indices of the rabbits. Sixty (60) rabbits comprising of 30 males and 30 female's rabbits consisting of Dutch Belted, Hyla Max and New Zealand White breed were randomly assigned to diets containing 0, 10, 20, 30g/kg feed respectively. Each treatment was replicated 4 times with 15 rabbit per treatment The rabbits were fed *ad – libitum* and provided with clean water for 8 weeks (56 days) after which blood samples were collected from 2 rabbits per replicate. Diet and breed had significant impact on some of the blood indices parameters examined in this study. sex also showed significant influence on the blood profile of the rabbits, this could be as a result of hormonal difference. It was observed that tiger nut within the tested range showed no deleterious effect on the health of the animals and the animals were not anaemic, suggesting tiger nut could be used as feed additive in feed production.

Key words: Blood, tiger nut, rabbit, breed, serum

INTRODUCTION

Haematological study is vital because blood is the major transport system of the body and the study involves the numbers of the cellular elements of the blood which are red cells (erythrocytes), white cells (leucocytes), and the platelets (thrombocytes) and the use of these results in the diagnosis and monitoring of disease (1). Haematological components consist of packed cell volume, red blood cell, hemoglobin, white blood cell, mean corpuscular hemoglobin, mean corpuscular volume and mean corpuscular hemoglobin concentration. They are valuable in measuring toxicity especially with feed constituents that affects the blood as well as the health status of animal (2).

Blood serum biochemical parameters provide valuable information on nutrient utilization by animals and are often helpful in revealing health disorders (3). According to (4), examining blood for their constituents can provide important information for the diagnosis and prognosis of diseases in animals. Blood constituents change in relation to the physiological conditions like feed stress and health (4). Some serum biochemical components consist of serum aspartate aminotransferase (AST), Alanine amino transferase (ALT), Total protein (TP), Albumin, Globulin and Creatinine. It has been reported by (5) that tiger nut (*Cyperus esculentus*) was also cultivated for its nutritive edible nuts and it is rich in vitamin E and C. It has excellent nutritional values with a higher fat content, also rich in minerals like phosphorus, potassium, calcium, magnesium and iron necessary for bones, tissue repair, muscles, the blood stream and for body growth and development but lower in sodium (6). This study is therefore aimed at evaluating the impact of tiger nut on the health of rabbits by examining their blood profile.

MATERIALS AND METHODS

Location of study

The study was carried out in the Rabbitry Section of the Teaching and Research Farm of The Federal University of Technology Akure, Ondo State, located on 350.52m above the sea level at latitude 7^0 15'N and

5^0 12'E (7). The temperature is 26.2^0C and the relative humidity is 78%. The vegetation of the area is that of the rainforest characterized by hot and humid climate. (7).

Experimental Animals and Management

Sixty (60) physically matured rabbits of 6 weeks of age were purchased from a reputable rabbitry in Ondo State and its environs. The sixty rabbits consist of forty-eight (30) does and twelve (30) bucks of three different breeds namely New Zealand White (10 does and 10 bucks), Hyla Max (10 does and 10 bucks) and Dutch Belted (10 does and 10 bucks).

Experimental formula

A tiger nut supplemented diet was formulated to meet the nutrient requirement of the rabbits. The tiger nut (*Cyperus esculentus*) was mixed with other feed ingredients to form four (4) experimental diets; Treatment 1(control). Treatment 2 = 10g of tigernut to 1kg of feed. Treatment 3 = 20g of tigernut to 1kg of feed. Treatment 4 = 30g of tigernut to 1kg of feed.

Experimental Diets

A basal diet used for the study was formulated for matured does. Matured does and bucks feed formulation was made to contain 15% CP and 2600Kcal/kg ME. The feed composition for matured does and bucks are presented in Table 1. The proximate feed analysis for mature rabbits.

Blood Analysis

Two (2) rabbits per replicate from each breed were randomly selected at the end of 8 weeks feeding trial for the blood profile analysis. About 2 mls of blood samples were collected from the ear vein of each rabbit into well labeled bijou bottles containing a speck of Ethylenediamine tetraacetic acid (EDTA) for haematological studies. The EDTA bottles were gently rocked to prevent coagulation and the blood samples were immediate analyzed according to the method described by (8). The haematological parameters studied were: Packed cell volume (PCV), Erythrocyte sedimentation (ESR), haemoglobin concentration (HB), white blood cells variants (WBC), Red blood cells (RBC) and white blood cell differential count: Lymphocytes, Heterophils, Eosinophil, Monocytes and Basophils were determined as described by Lamb (9). Similarly, a volume of 10mls of blood samples collected from the rabbits were emptied into a set of samples bottles without EDTA and allowed to stand in slanting position for about 12 hours till it clotted. Serum analysis was carried out using the Randox Laboratories Ltd, UK, test kits. The serum parameters studied include: Alanine aminotransferase (ALT), aspartate aminotransferase (AST), creatinine, glucose and cholesterol.

Table 1: Percentage composition of experimental diets fed to matured does and bucks

Ingredients	Compositions
Maize	8.00
Wheat offal	18.00
Rice bran	42.00
Groundnut cake	5.00
Palm kernel cake	25.50
Limestone	1.00
Grower's Premix	0.10
Salt	0.20
Lysine	0.10
Methionine	0.10
Total	100
Calculated Composition	
Metabolisable energy (Kcal/kg)	2586.41
Crude protein	14.86
Crude fibre	13.29
Calcium	0.48
Available phosphorus	0.66
Lysine	1.17
Methionine	0.73

RESULTS AND DISCUSSION

The values obtained for PCV as shown in Table 2 were higher than that reported (10). In addition, (11) reported that high PCV haematocit reading insinuated an increase in the number of circulating RBC. In this current finding, ESR values were moderate, and it had been reported by (12) and (13) that the frictional resistance of the surrounding plasma which holds the cells in suspension and gravitational pull on the erythrocyte was believed to determine ESR. There were significant sex differences in the blood parameters as it was observed that male had higher value. Hence the result from this experiment was contrary to the findings (14) that concluded that there was no sex difference in the blood parameters of examined breeds of rabbit. (15) concluded that males generally had higher mean values than their female counterpart. In this present study, most of the haematological parameters affected by sex were higher in females which agreed with (16) and (17) that it could be as a result of hormonal difference. However, apart from the factors considered in this research, the differences in haematological parameters may be caused by environmental and nutritional factors.

Results obtained from Table 3 shows that blood biochemical parameters could be used to access the health status of rabbits and the serum indices are important measure of protein adequacy. The biochemical values obtained in the study among the three breeds for total protein, Alb, Glo, Chol, Urea, ALT, AST, Creat and Gluc were recoded. The blood concentration protein average under this study was between the range of 6.34±0.08 to 6.86±0.10g/dl which agreed with (18) and (19) who reported 5-7, 6.63- 8.33 and 7.25, respectively but higher than the results reported (20), (21) and (22) who reported between 5.03 and 6.86. Urea blood concentration of the rabbits was between 15.63±1.61 and 20.96± 1.11mg/dl which was lower than values of (19), (21) and (23). It was observed that sex had significant influence on the biochemical parameters which was in accordance with (24) and (25) who reported sex differences in broiler chicken. The sex affected protein and cholesterol concentrations in blood. The protein concentrations were lower in males compared to females and this result agreed with (26). Cholesterol level was high in the male rabbits than the female rabbits in various ages which was in consonance with (27) that reported higher cholesterol concentration in males compared to females. Hence, the results from this study agree with the findings of (28) in their study of the growth performance, haematology and serum biochemical of female rabbits fed dietary fumonism. (29) reported a range of 31.37 – 38.00 mg/dL urea in their study of the effect of processing methods of *Leptadenia hastata* leaves on haematology and serum biochemistry of weaner rabbits. A range of 30.96 – 35.40 mg/dL urea was also reported (30) for weaner rabbits fed varying levels of dried *Gmelina arborea* leaf meal. Urea values obtained in this study (15.63±1.61 to 20.11±1.80) for the effect of diet were lower than reported values. The low serum urea content of rabbits in this study suggests that the diets were rich in protein and the protein was of high quality, as high urea level was an indication of low protein quality (31). A low urea level also insinuated that the protein rich diet enhanced the proper functioning of the kidneys (32). Cholesterol values (33.96±1.79 to 38.19±1.04mg/dl) obtained were within the normal physiological range for rabbits (5 – 44 mg/dl) reported by (33). The least cholesterol value which might suggest that the diet would assist in reducing the deposition of cholesterol in the muscle, consequently producing lean meat. The serum biochemistry of the rabbits used for this study revealed that total protein, albumin and globulin concentrations remained constant as the dietary levels of tiger nut increased in the diets which was in contrary with (34) that observed reduction in the mean value of total protein, albumin and globulin as the dietary levels of tiger nut increased in the diets of broiler finisher. These showed that tiger nut meals were moderately utilized by the rabbits at relatively higher dietary inclusion. Also, the effect of feeding high dosage of tiger nut which contained relatively high fibre, perhaps, was the reflection of high creatinine values and according to (35) high creatinine values in the serum indicated poor utilization of nutrient due to muscles wastage (35).

Table 2: Least Square Means for the Effects of Breed, Sex, and Diet on Haematological Indices of Rabbits (Does and Buck)

Factor	ESR (mm/hr)	PCV (%)	RBC ($x10^6$ mm)	WBC ($x10^3$ mm)	HB (g/100 ml)	LYM (%)	NEU (%)	MON (%)	EOS (%)	MCHC (%)	MCV (%)	MCH (pg)	BAS (%)
Breed													
DUT	2.43±0.58	31.05±0.92	3.97±1.2[a]	13.2±2.37	10.27±0.31[ab]	60.45±0.38	30.6±0.48	6.8±0.28	2.1±0.22	33.09±0.16[b]	78.31±0.93[b]	25.9±0.29	0.05±0.05
HYLA	2.35±0.4	31.95±0.89	4.14±1.4[a]	13.4±2.45	10.65±0.3[a]	60.45±0.35	30.8±0.53	6.35±0.28	2.4±0.24	33.32±0.09[a]	77.43±0.9[b]	25.8±0.29	0±0
NZW	6.03±2.08	29.4±1	3.58±1.2[b]	13.7±2.82	9.41±0.3[b]	61.2±0.33	30.25±0.35	6.05±0.23	2.5±0.2	32.18±0.61[c]	82.09±1.27[a]	26.32±0.41	0±0
Sex													
M	4.06±0.93	30.33±0.66	3.87±0.92	13.2±1.67[b]	10.1±0.22	60.63±0.23	30.52±0.29	6.44±0.16	2.4±0.15	33.29±0.02[a]	78.66±0.63[b]	26.19±0.21[a]	0.02±0.02
F	1.75±0.33	32.67±0.64	4.00±0.94	14.2±2.09[a]	10.13±0.27	61±0.48	30.67±0.63	6.25±0.45	2.08±0.23	31.14±0.97[b]	81.74±1.95[a]	25.27±0.41[b]	0±0
Diet													
10g	5.63±2.35	30.2±1.34	3.93±0.2	13.4±1.25	9.9±0.45	60.87±0.54	30.33±0.53	6.4±0.36	2.33±0.3	32.82±0.43[b]	77.54±1.49	25.41±0.47[b]	0.07±0.07
20g	2.23±0.64	31.53±0.6	3.93±0.08	13.3±2.06	10.43±0.19	60.5±0.27	30.93±0.38	6.33±0.29	2.2±0.24	33.08±0.17[a]	80.35±0.74	26.57±0.21[a]	0±0
30g	1.93±0.44	31.47±1.15	3.97±0.18	13.4±3.1	10.33±0.39	60.4±0.45	30.8±0.7	6.33±0.35	2.47±0.26	32.85±0.46[b]	79.8±1.07	26.19±0.43[ab]	0±0
Control	4.6±1.66	30±1.23	3.79±0.17	13.6±3.41	9.77±0.39	61±0.37	30.13±0.47	6.53±0.27	2.33±0.23	32.7±0.61[c]	79.41±1.71	25.85±0.35[ab]	0±0

Means with different superscripts in the same column are significantly difference (P<0.05).
*PCV- packed cell volume; RBC – red blood cell; ESR - erythrocyte; WBC – white blood cell; HB- haemoglobin; LYM- **lymphocytes**; NEU- neutrophils; EOS – eosinophils; MCHC – mean corpuscular haemoglobin concentration; MCV- mean corpuscular volume; MCH - mean corpuscular haemoglobin concentration ; BAS – basophils*

CONCLUSION

Evaluation of the experimental animals' physiological and health status, conducted through blood indices throughout the study duration, revealed the absence of diseases or clinical infections, as all values fell within normal ranges. Regarding hematological mean values. Rabbits fed diets containing tiger nut demonstrated significantly improved performance compared to those on the control diet. This improvement was reflected in blood profiles, with increasing concentrations of tiger nut in the diet correlating with higher red blood cell count, white blood cell count, and PCV levels. Importantly, elevated ESR levels did not indicate acute infection, suggesting efficient utilization of tiger nut by rabbits.

Table 3: Least Squares Means for the Effects of Breed, Sex, Diet on Serum Biochemical Indices of Rabbits (Does and Buck)

Factor	T.Prot (g/dl)	Alb (g/dl)	Glo (g/dl)	Chol (mg/dl)	Urea (mg/dl)	ALT (U/L)	AST (U/L)	Creat (mg/dl)	Gluc (mg/dl)
Breed									
DUT	6.52 ±0.12^{b}	3.16 ±0.08^{b}	3.42 ±0.07^{b}	34.93 ±1.18	20.96 ± 1.11^{a}	55.88 ±0.77^{c}	64.11 ±0.84^{a}	1.05 ±0.02	117.15 ±2.11
HYLA	6.67 ±0.08^{ab}	3.19 ±0.07^{b}	3.50 ±0.05^{a}	34.85 ±0.81	16.09 ±1.30^{b}	56.82 ±0.36^{b}	62.88 ±0.68^{ab}	1.08 ±0.06	121.86 ±5.86
NZW	6.83 ±0.08^{a}	3.41 ±0.07^{a}	3.41 ±0.03^{b}	37.48 ±1.62	18.11 ±1.26^{ab}	57.70 ± 0.39^{a}	61.45 ±0.52^{b}	1.02 ±0.05	117.15 ±1.71
Sex									
	6.75 ±0.07^{a}	3.31 ±0.05^{a}	3.46 ±0.04	35.37 ±0.89	17.77 ±0.84	57.24 ±0.31^{a}	63.10 ±0.53	1.04 ±0.03	122.73 ±2.86^{a}
	6.53 ±0.09^{b}	3.14 ±0.09^{b}	3.42 ±0.05	36.52 ±1.29	19.63 ±1.57	55.93 ±0.72^{b}	62.24 ±0.73	1.07 ±0.03	110.71 ±0.30^{b}
Diet									
10g	6.34 ±0.08^{c}	3.05 ±0.07^{c}	3.28 ±0.05^{c}	35.51 ±1.17	20.11 ±1.80	56.08 ±0.56^{b}	61.58 ±0.50^{b}	1.10 ±0.03	127.11 ±7.32^{a}
20g	6.83 ±O.11^{a}	3.39 ±0.08^{a}	3.56 ±0.06^{a}	38.19 ±1.04	18.81 ±1.31	58.47 ±0.68^{a}	62.13 ±0.64^{ab}	1.01 ±0.07	113.97 ±2.29^{b}
30g	6.86 ±0.10^{a}	3.37 ±0.10^{a}	3.54 ±0.05^{a}	35.35 ±1.58	19.00 ±1.14	56.22 ±0.52^{b}	63.38 ±0.98^{ab}	1.06 ±0.03	117.80 ±1.87^{ab}
Control	6.67 ±0.09^{b}	3.22 ±0.09^{b}	3.40 ±0.04^{b}	33.96 ±1.79	15.63 ±1.61	56.43 ±0.60^{b}	64.17 ±1.05^{a}	1.03 ±0.06	116.00 ±1.97^{ab}

Means with different superscripts in the same column are significantly difference (P<0.05).
T. prot = Total protein; Alb = Albumin; Glo = Globulin; Chol = Cholesterol; Creat = Creatinine; Gluc = Glucose; AST = Aspartate aminotransferase; ALT = Alanine aminotransferase

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Monogastric Animal Production: MGP 034

GROWTH PERFORMANCE OF WEANER RABBITS FED GRADED LEVELS OF MILLET OFFAL DIETS AS REPLACEMENT FOR WHEAT OFFAL IN THE DIET

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ABSTRACT

The aim of this study is to determine the Growth Performance of Weaner Rabbits Fed Graded Levels of Millet Offal Diets as Replacement for Wheat Offa in the dietl. A total of 60 cross bred weaner rabbits aged 5- 6 comprising of New Zealand white, Californian white, Dutch Belted, American checkered, Chinchilla and English Spotted of both sexes were purchased from reputable rabbit farmers in Vom Jos South where used in 8 weeks feeding trial. In this experiment, five iso-nitrogenous diets were formulated to meet 16% crude protein nutritional requirements of the weaner rabbits and similar levels of crude fibre by replacing wheat offal with graded levels of millet offal respectively in which groundnut haulms constituted 20% of each diet. The diets were designated 1, 2, 3, 4 and 5. Diet 1 contained wheat offal which served as the control (0%) while treatments (2-5) contained millet offal at graded levels at 25, 50, 75, and 100% respectively. Data on daily Feed intake was determined, weight gains, Feed conversion ratio (FCR) were calculated. Mortality records were kept when they occurred throughout the experimental period. There were no significant differences in all parameters measured. Conclusion, the inclusion of millet offal was best at 75 - 100% with improved the growth performance of rabbits without any deleterious effect.

Keywords: Growth Performance, Weaner Rabbits, Millet Offal Groundnut Haulms and Wheat Offal.

INTRODUCTION

The problem of feed supply and availability on a sustainable basis has been the major concern of the livestock industry in Nigeria (Ajimohun *et al.*, 2022). Faced with the competition between humans and livestock for grains and the need to bridge the gap of animal protein consumption, Nigeria must look in wards for her feed resources. The livestock sector is required to shift emphasis from the usual conventional to non-conventional feed materials that are locally available and cheap (Ajimohun *et al.*, 2022).
Among monogastric animals, rabbit has been reported to utilize fibrous materials for production of meat (Wafar *et al.*, 2019). Studies showed that chemical composition of forages could serve as a potential source of nutrients for animals (Wafar *et al.*, 2019).

Forages can be fed in the dry form as hay or fresh. This is of importance to rabbit farmer in the northern part of Nigeria, characterized by long period of dry season. Forage haulms are abundant in northern Nigeria especially during the peak of harvest (Wafar *et al.*, 2019).

Millet offal contained higher crude protein, crude fibre and ash concentrations than wheat offal. Millet offal is one of the industrial by-products which could substitute for maize as energy as well as wheat offal in rabbit diet. Ezieshi and Olomu (2008) reported the chemical composition of millet offal obtained from two sources, one from pap manufacture and the other from brewery. The millet offal from pap contains 20.65% CP, 3.12%CF, 3.01% EE, 3.36% ash and 2506 kcal/kg ME while the one from brewery contained 14.60% CP, 4.5% CF, 2.25% EE, 2.90%AS and 2148.0 kcal/kg ME respectively. Ogundipe and Agbede (2012) reported 15.08% CP, 15.9% CF and 6.36% ASH for millet offal. They reported that millet offal can be included in rabbit diets at up to 75% level without adverse effect on performance, carcass characteristics, organ weight and haematological responses of and at a lower cost.

Therefore, this study seeks to evaluate the growth performance of weaner rabbits fed graded levels of millet offal diets with groundnut haulms as replacement for wheat offal.

MATERIALS AND METHODS

Experimental Site
The research was conducted in the Rabbitry section Dagwom Farm, National Veterinary Research Institute, Vom, Plateau State in the Sudan savanna zone of North Central Nigeria.

Experimental animals and management
The rabbits were managed according to the provisions of International Guideline principles of Biomedical Research involving animals (CIOMS, 1985). A total of 60 cross bred weaner rabbits aged 5- 6 comprising of New Zealand white, Californian white, Dutch Belted, American checkered, Chinchilla and English Spotted of both sexes were purchased from reputable rabbit farmers in Vom Jos South. In this experiment, sixty (60) aged 5- 6 weeks with an average mean weight value of 529 - 574g where used in 8 weeks feeding trial. The hutches were provided with suitable facilities for drinking, feeding and faecal collection. Management practices, health and sanitation programme were strictly followed. At the end of the acclimatisation week the weaners were randomly allocated to five dietary treatments in a Completely Randomised Design (CRD). Feed was given at 7.00am- 9.00am in the morning and the left over from previous day were collected and weighed in order to determine feed intake. Each experiment lasted for eight weeks (56 days).

Experimental diets
In this experiment, five iso-nitrogenous diets were formulated to meet 16% crude protein nutritional requirements of the weaner rabbits and similar levels of crude fibre by replacing l wheat offal with graded levels of millet offal respectively in which groundnut haulms constituted 20% of each diet. The diets were designated 1, 2, 3, 4 and 5. Diet 1 contained wheat offal which served as the control (0%) while treatments (2-5) contained millet offal graded levels at 25, 50, 75, and 100% respectively. The test ingredients and five diets were analysed for their proximate composition. The composition and proximate composition of the diet is shown in table 1.

Experimental design
After the 7 days acclimation period, the rabbits were randomly distributed into 5 groups of 12 rabbits, divided into three replicates of 4 rabbits per replicate in a Complete Randomise Design (CRD).

Data collection
Data on daily Feed intake was determined by subtracting the leftovers (orts) from the feed offered to each rabbit. The weight gains were calculated as the difference in the weight from the previous week. Feed conversion ratio (FCR). This was calculated as the ratio of feed intake to weight gain. Mortality records were kept when they occurred throughout the experimental period.

$$FCR = \frac{\text{Feed Intake (g)}}{\text{Weight gain (g)}}$$

RESULTS

The results of growth performance of weaner rabbits fed graded levels of millet offal diets as replacement for wheat offal are presented in Table 2. There were no significant differences in all parameters measured. The initial weights of the weaner rabbits varied from (498.47 – 531g) diet 3 (50%) and diet 2 (25%) were similar.The final weight values varied between (1488.4 – 1670.33g) on diets 1 and 2 were similar.The weight gain values ranged from (989.93 – 1150.93g) in weaner rabbits fed diets 3 and 1. The highest weight gain value (1150.93g) obtained on diet 1 (control) and lowest value (989.93g) on diet 3 (50%) were similar. Feed conversion ratio values varied between (3.62 – 4.14) best value (3.62) observed on diet 4 followed by (4.14)

on diet 5 were comparable to 3.71, 3.70 and 4.13 on diets 1, 2, and 3 respectively, similarly values obtained on FCR across dietary groups were all within the range recommended for rabbits.

Table 1: Ingredients and Percentage Composition of Graded Levels of Millet Offal in Weaner Rabbits Diets with Groundnut as Replacement for Wheat offal

Ingredients	Diets				
	I	**2**	**3**	**4**	**5**
	0%	**25%**	**50%**	**75%**	**100%**
Maize	31.87	31.13	30.39	29.65	28.92
Soya beans cake	14.88	15.62	16.36	17.11	17.83
Wheat Offal	30	22.5	15	7.5	0
Millet offal	0	7.5	15	22.5	30
Groundnut haulms	20	20	20	20	20
Bone meal	1.5	1.5	1.5	1.5	1.5
Limestone	1.0	1.0	1.0	1.0	1.0
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.13	0.130	0.13	0.13	0.13
Methionine	0.12	0.12	0.12	0.12	0.12
Total (%)	100	100	100	100	100
Calculated Analysis (%)					
Crude Protein (CP)	16.00	16.00	16.00	16.00	16.00
MetabolisableEnergy(ME Kcal/Kg)	2619.71	2661.97	2704.24	2746.78	2788.85
Crude fibre (CF)	9.00	9.04	9.00	9.35	9.19
Either Extract (EE)	4.63	4.74	5.44	4.97	5.12
Calcium	1.12	1.20	1.20	1.36	1.27
Phosphorus	0.42	0.45	0.39	0.51	0.36
Lysine	1.39	1.30	1.31	1.33	1.39
Methionine	0.54	0.67	0.79	0.87	1.05
Ash	4.76	4.7	4.70	4.67	4.65

Bio-premix supplied per kg of diet: Vitamin A, 12500I.U; Vit. D3, 2500 I.U; Vit E, 50mg; Vit. K3, 2.5mg; Vit. B3.0mg; VitB6 6.0mg; Niacin, 40.0mg; Calcium pantothenate 10.0mg; Biotin 0.8mg; VitB 12 0.25mg; Folic acid 1.0mg; Choline chloride 300mg; Manganese 100mg; Iron 100mg; Zinc,50mg;Iodine 1.55I.U; Selenium 0.1mg

DISCUSSION

The results revealed no significant differences in the growth performance parameters measured. However rabbits on millet offal diets, had higher numerical values compared to those on control diet. The final weight obtained ranged from 1488.4 - 1670.33g this study was higher than 82.23 – 1332.25g and 813.75 – 1283.50g reported by Ojebiyi *et al*. (2006) and Egbo *et al*. (2005), lower than 2098.9g and 1723.10 – 1814.50g reported by Uko *et al*. (1999) and reports by Ogunsipe and Agbede (2012) but was comparable to 1350.00 – 1666.67g and 1420.00 – 1620g reported by Adejinmi *et al*. (2013) and Deli and Preston (1991). The values for feed intake ranged from 72.95 – 75.35g observed in this study were higher than 59.05 – 62.18g, 30 - 32g and 34.59 – 71.71g reported by Makinde *et al*. (2017), Denli *et al*. (1991) for rabbits of the same age, also by Bassey Okon and Oluwatosin Olawoyin (2008). The values within 59.09 to 71.70 g/day reported by Ogunsipe and Agbede (2012), 40.3 to 71.19g/day reported by Taiwo et al. (2005), Amaefule *et al.* (2005) were comparable. The daily weight gain values ranged from 17.68 – 20.55g observed in this study were higher than 16.90g, 12.93g and 9 - 15.2g reported by Uko et al. (1999), Egbo *et al*. 2005, Muir and Massaete (1996) comparable to 17.69 – 18.53g and 18.3 – 22g reported by Ogunsipe and Agbede (2012) and Deli and Preston (1991).This thus, confirms the nutritive adequacy of the millet offal vis-à-vis the test diets and

by implication, any of the diets could be used for rabbit production in areas where shortage of one abounds. The non significant influence of the dietary treatments on weight gain confirms the earlier reports by Bassey *et al.* (2008) that millet bran could replace wheat bran in rabbit diets. The variations in results could be associated with the age of the rabbits, type of ration, breed and the climatic conditions where the experiment was conducted. The results of the feed conversion ratio (FCR) values ranged from 3.70 – 4.14 rabbits on the control diet were not significantly different from those fed the various test diets were comparable to 3.26 – 3.99 reported by Ogunsipe and Agbede (2012). Feed conversion ratio obtained is still within the normal range for rabbits. This shows that though the effect of dietary treatments were not statistically different rabbits fed on the test diets better utilized their diets than those fed the control diets.

Table 2: Growth Performance of Weaner Rabbits fed Graded Levels of Millet Offal Diets as Replacement for Wheat Offal

Parameters	Diets					SEM
	1 (0%)	**2 (25%)**	**3 (50%)**	**4 (75%)**	**5 (100%)**	
Initial weight (g)	499.80	531.50	498.47	509.47	519.40	10.14 ^{NS}
Final weight (g)	1650.73	1670.33	1488.4	1641.4	1517.53	41.94 ^{NS}
Weight gain (g)	1150.93	1138.83	989.93	1131.93	998.13	34.77 ^{NS}
Total feed intake (g)	4219.60	4211.20	4085.20	4042.64	4117.12	55.44 ^{NS}
Daily Feed intake (g)	75.35	75.2	72.95	72.19	73.52	0.99 ^{NS}
Daily weight gain (g)	20.55	20.34	17.68	20.21	17.82	0.62 ^{NS}
FCR	3.71	3.70	4.13	3.62	4.14	0.09 ^{NS}
Mortality (No)	0.00	0.00	0.00	0.00	0.00	0.00 ^{NS}

$^{a, b, c}$ means with different superscripts on the same row differ significantly, SEM = Standard Error of Means, NS = Not significant, FCR = Feed conversion ratio

CONCLUSION

Conclusion, the inclusion of millet offal was best at 25 -50% with improved the growth performance of rabbits without any deleterious effect.

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Monogastric Animal Production: MGP 035

HAEMATOLOGICAL INDICES AND SERUM BIOCHEMISTRY OF WEANED PIGS FED DIETARY TURMERIC (*CURCUMA LONGA L.*) MEAL AS ADDITIVE

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ABSTRACT

The objective of the study was to evaluate the effect of dietary Turmeric (*Curcuma longa L.*) on haematological and serum biochemical indices of weaned pigs. Fifteen (15) pigs were used for the study. The weaned pigs were assigned to five different treatments with 3 pigs per treatment, replicated 3 times in a completely randomized design for fifty-six (56) days. The pigs were allowed one week of acclimatization period before the commencement of the study. They were fed commercial grower diets and forages during this period. After acclimation, the pigs were assigned a formulated ration supplemented with turmeric at 0, 100, 200, 300 and 400g respectively and were coded T1, T2, T3, T4 and T5 respectively. T1served as control. Haematological and serum biochemistry indices were measured in the course of the study. The data collected were subjected to analysis of variance (ANOVA) using SPSS version 21. This result revealed that turmeric affected ($p<0.05$) the haematological indices, white blood cells (WBC), haemoglobin, neutrophils, lymphocytes and MCH in the pigs but did not have significant effect ($p>0.05$) in the PCV, red blood cell, platelets, MCV and MCHC of pigs in the study as all the treatments had similar ($P>0.05$) PCV values of 37.00 - 38.50. *Curcuma longa* influenced ($P<0.05$) serum enzymes but did not have significant effect ($P>0.05$) on glucose and cholesterol. In conclusion, dietary supplementation of *Curcuma longa* at 100g did not have significant effect on most haematological and serum biochemical indices, hence the health of the weaned pigs was not compromised.

Keywords: Turmeric, weaned pigs, haematology, serum biochemistry

DESCRIPTION OF PROBLEM

Several factors are known to affect the physiology of farm animals, one of which is nutrition [1]. The dietary intake of an individual animal reflects the nutritional status of such individual and the effectiveness of metabolic processes, which according to [2], can be determined by either or combinations of chemical, anthropometric, biochemical, or dietary methods.

The ban on the use of antibiotics as growth promoters in animal production has led to investigating different natural feed additives to replace these dietary antibiotics [3]. This has however, necessitated and intensified the search for possible alternatives as growth promoter that are safer to health improvement and disease control in animals. Probiotics [4], are non-pathogenic microbial adjuncts, which have been used as feed supplements and also as growth promoters, improving the immune system of animals by promoting the composition and microbial balance in their guts.

The potentials of *Curcuma longa* as a probiotic has been identified by several authors [5] and [6]. *Curcuma longa* is rich in proteins, vitamins, and minerals. The aim of this study were to evaluate the effect of *Curcuma longa* on haematological profile and serum biochemistry of weaned pigs at 56 days (8 weeks).

MATERIALS AND METHODS

Experimental site

The experiment was carried out in the piggery unit, Dagwom Farm Division of National Veterinary Research Institute, Vom, Jos, Plateau State, Nigeria. Vom lies on longitude 8º45 East and latitude 9º48 North and has an altitude of about 1280m above sea level. The average temperature is between 19ºC to 22ºC, mean annual rainfall of 131.75cm to 146cm with the highest rainfall usually recorded during the wet months of July and August. [7]

Fifteen (15) mixed breeds of weaned pigs were used and the pigs dewormed and other routine vaccination were carried out according to their treatments and managed under standard husbandry conditions with *ad libitum* supply of feed and water. They were fed commercial grower diets and forages during acclimatization period. Routine management practices were well observed in the best of animal welfare principles. They were weighed and randomly distributed into three pigs per treatment and one pigs per pen as replicate in a Completely Randomized Design (CRD). The experimental diets comprised of 5 treatments were formulated as shown in T1.

Table 1: Percentage composition of diets for weaned pigs

	Dietary levels of turmeric				
Ingredients %	T1(0g)	T2(100g)	T3(200g)	T4(300g)	T5(400g)
Maize	40.00	40.00	40.00	40.00	40.00
Maize offal	24.12	24.12	24.12	24.12	24.12
PKC	17.03	17.03	17.03	17.03	17.03
Soybean meal	13.55	13.55	13.55	13.55	13.55
Fish meal	2.00	2.00	2.00	2.00	2.00
Bone meal	2.50	2.50	2.50	2.50	2.50
V/premix[x]	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
L-lysine	0.20	0.20	0.20	0.20	0.20
DL-Methionine	0.10	0.10	0.10	0.10	0.10

At the end of the 56 days feeding trial, blood samples for serum biochemical and haematological analysis (4 ml each) were collected through the jugular vein of fifteen (15) pigs from each replicate using well sterilized hypodermic needles and syringes. The blood samples were shared into 2 ml each for haematological and serological analysis, respectively using the methods as described by [8]. from each replicated. The data contained were subjected to analysis of variance (ANOVA) using [9], and means were separated using Duncan of same software to determine significant differences.

RESULTS AND DISCUSSION

The dietary inclusion of *Curcuma longa* in the diets of weaned pigs in this study as shown in Table 2, significantly affected (P<0.05) white blood cells (WBC), neutrophils and lymphocytes in the weaned pigs. However, other haematological parameters were not influenced by dietary levels of *Curcuma longa.* This study revealed that *Curcuma longa* did not have significant effect (P>0.05) in the PCV of pigs in the study as T1, T2, T3, T4 and T5 all had similar (P>0.05) PCV values of 36.97 - 38.50% respectively. The results obtained from this study is in agreement with that of [10] who reported variation in the blood indices of pigs fed dietary *Saccharomyces cerevisiae*. Higher (P<0.05) WBC was observed with inclusion of *Curcuma longa* in the diets of the pigs when compared with those without *Curcuma longa* in their diets (T1). Pigs fed T2 and T4 had WBC values 45.29 and 42.31×10^9/dL respectively while pigs on T1 diet had WBC value of 27.25×10^9/dL. Significantly higher (P<0.05) platelet was observed in pigs fed T2 in the study while similar (P>0.05) lower values were recorded in T3 and T5 respectively. In the same vein [10] recorded similar results in buck fed *Saccharomyces cerevisiae* supplementation. *Curcuma longa* did not have effect on RBC as values recorded were statistically similar (p>0.05). MCV, MCH and MCHC were all similar (P>0.05)

across dietary treatment groups. Haemoglobin was not also affected by *Curcuma longa* in the study as values observed were similar across dietary treatment except T3 that had 137g/L lower value. This was in agreement with [11] who reported variation, that number of haemoglobins in pigs is not attribute to varying inclusion levels. Similarly, neutrophils and lymphocytes all showed significant alteration ($p<0.05$) with inclusion of *Curcuma longa* in the diets of the pigs in the study.

Table 2: Haemtological parameters of weaned pigs fed Turmeric (*Curcuma longa L.)* in varying supplementation

	Treatments (g)					
Parameters	1 (0)	2 (100)	3 (200)	4 (300)	5 (400)	SEM
PCV (%)	38.50	37.78	37.58	36.97	38.02	0.62
WBC (10^9/L)	27.25^{d}	45.29^{b}	30.80^{e}	42.31^{a}	30.02^{c}	11.85
RBC (10^{12}/L)	8.25	8.45	6.88	8.31	8.57	0.69
HGB (g/L)	155.00^{c}	159.67^{b}	137.00^{d}	167.67^{a}	159.67^{a}	22.10
PLT (10^9/L)	515.30	574.00	332.30	568.70	394.30	180.30
Neut (%)	32.33^{b}	34.67^{b}	29.50^{c}	46.33^{a}	33.37^{b}	4.41
Lymp (%)	66.33^{a}	59.00^{ab}	64.67^{a}	54.00^{b}	63.67^{a}	4.62
MCV (f/L)	52.33	52.00	51.00	52.00	53.00	1.36
MCH (g/L)	18.27^{ab}	18.20^{ab}	16.40^{b}	19.60^{a}	18.57^{ab}	1.53
MCHC (g/L)	353.33	369.33	369.33	372.67	355.00	20.64

PCV= ;WBC=White blood cell; HGB=Haemoglobin; RBC=Red blood cells; PLT=Platelet; Lymph=Lymphocyte percentage; MCV=Mean corpuscular (erythrocyte) volume; Lymph=Lymphocyte; HCT=Haematocrit; MCHC=Mean cell (erythrocyte) haemoglobin concentration.

Serum biochemical Parameters of Weaned pigs fed Turmeric (*Curcuma longa L.)* in varying supplementation

Table 3 below shows the serum biochemical parameters of Weaned pigs fed Tumeric (*Curcuma longa)* in varying composition significantly the serum biochemical parameters were higher than in treatment group (Treatment 1). Highest value of total protein was recorded in treatment 2 (27.70).

Table 3: Serum biochemical Parameters of Weaner pigs fed Tumeric (*Curcuma longa.)* in varying supplementation

Parameters	**Treatments (mg)**					
	1 (0g)	**2 (100g)**	**3 (200g)**	**4 (300g)**	**5 (400g)**	**SEM**
TP (g/dL)	21.69^{c}	19.89^{c}	27.70^{a}	22.48^{bc}	26.61^{ab}	2.54
GLUB (g/dL)	1.95^{bc}	3.25^{a}	1.46^{d}	2.31^{b}	1.61^{cd}	0.21
ALB (g/dL)	19.74^{b}	16.64^{b}	26.23^{a}	20.17^{b}	25.00^{a}	2.63
GLUC (g/dL)	4.30	3.24	4.41	4.37	3.97	0.48
AST (U/L)	31.41^{b}	31.87^{b}	41.25^{a}	36.66^{ab}	32.81^{b}	3.47
CHOL (mg/dL)	2.39	2.17	2.52	2.67	2.90	0.28

T.P = Total protain; Glub= Globulin; Alb= Albumin; Gluc= Glucose; Ast= Aspartate; chol= Cholesterol

Results in this study showed that *Curcuma longa* influenced ($P<0.05$) serum enzymes on total protein, globulin and albumin. Values of total protein observed in the study were from 19.89 - 27.70 g/dL for T1, T2, T3, T4and T5 respectively. Lower ($P<0.05$) glucose and cholesterol were observed with supplemented *Curcuma longa* in the pig diets. Aspartate aminotransferase (AST) was higher (41.25 µ/L) in the diet 3 while pigs on diet T1 had the lowest value. [12], revealed that TP, globulin, albumin and AST were higher in chickens fed ginger supplemented diets. Glucose and Cholesterol did not showed ($P>0.05$) any significant with dietary inclusion of *Curcuma longa* in the pig diets. The results confirm the findings of [10]; [11] and [12] who reported same findings when ginger root was incorporated into weaned pigs.

CONCLUSION AND APPLICATION

The importance of haematology and serum biochemistry in the evaluation of the health status of pigs cannot be overemphasized especially when there is a test ingredient introduced into the experimental diet. Turmeric improved the blood profile in the diet especially at 100g as additive with no deleterious effects on the blood profile of pigs. Therefore, pig farmers are advice to include turmeric as additive to improve health status of their pigs.

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Monogastric Animal Production: MGP 036

GROWTH PERFORMANCE AND COST BENEFITS OF USING DRIED WATERMELON RINDS IN RABBIT DIETS

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ABSTRACT

The competition between humans and livestock animals for maize has brought about the recent researches on the use of unconventional feed ingredients such as dried watermelon rinds in livestock feed. This experiment was conducted using dried watermelon rinds (DWMR) as an energy source to test the growth performance of weaner rabbits and the cost benefits. Eighty (80) crossbreed, unsexed weaner rabbits with mean weight of 630 g were used for this study. They were allocated on weight equalisation basis into 4 treatments (0%, 5%, 10% and 15% of DWMR inclusion levels, representing T1, T2, T3 and T4, respectively) and further divided into 5 replicates of 4 rabbits. The study lasted for 8 weeks, and data generated were subjected to one-way analysis of variance. The results showed that rabbits fed diet containing 5% DWMR had the highest ($p<0.05$) final body weight and total weight gain (1391.25 g and 762.31 g, respectively). Feed cost (₦/kg) declined from ₦559.00 on diet 1 to ₦464.00 on diet 4. Similar trend was also observed with cost of feed in naira (₦) per rabbit; diets 1(0% DWMR) had ₦1377.20 and 4(15% DWMR) (₦1056.91). The highest cost saving (₦) of ₦292.75 was obtained on diet 2 (5% DWMR). This study concluded that dried watermelon rinds can be included up to 5% in the diet of weaner rabbits to enhance growth, increase profitability and better economic returns.

Keywords: Rabbit; Dried watermelon rind; Performance; Cost benefit

DESCRIPTION OF PROBLEM

The price of conventional energy feeds resources most especially maize is on the high side and cannot permit profit maximization in livestock ventures. In view of this, current research interest in the livestock industry is aimed at finding alternatives to this elusive feed ingredient for cheaper feed ingredients that are always available and have no competition with man's dietary demands (1). Some agro-industrial by-products like dried watermelon rinds have been discovered as a convenient non-conventional ingredient that can be used to feed animals like rabbit which can easily utilize waste to produce meat giving it an advantage over other animal species because of its peculiar digestive physiology which permits the use of forages and agro-industrial by products, and low cost of investment (2). Watermelon rind is one of the many unwanted by-products produced by Nigerian eateries, fruit juice manufacturers and food industries, which is mostly thrown off as wastes carelessly into the environment and hence pollutes the environment (3). It possesses significant amounts of moisture (10.61%), ash (13.09%), crude protein (11.17%), fat (2.44%), and carbohydrates (56%) (4), and its potentials in rabbit feeding had been reported in the literature (5, 6 and 7). Most of these authors substituted dried watermelon rind for wheat offal as source of fibre; however, there is paucity of literature on its use to replace maize in rabbits' diet. The study therefore aimed at bridging this gap by investigating the use of dried watermelon rinds as an alternative energy source in rabbits' diet.

MATERIALS AND METHODS

Experimental Site

The experiment was carried out at the Rabbitry unit of the Directorate of University Farms (DUFARMS) College of Animal Science and Livestock Production, Federal University of Agriculture, Abeokuta, Ogun

state, Nigeria. The area lies within the coordinates 70° 15' 59.66" N and 30° 26' 13.64" E. The climate was humid with a mean annual rainfall of 1037mm and mean temperature of 34.7 and 83% relative humidity, respectively (8).

Sourcing and processing of test ingredient

Fresh watermelon rinds were collected from fruit vendors around Alabata axis, Odeda Local Government Area, Abeokuta, Ogun state, Nigeria. The rinds were rinsed thoroughly and scrapped to remove sand particles and watermelon remains that might cause decaying instead of drying. The rinds were then sliced into smaller sizes and sundried for about 3 weeks. After which it was then milled with hammer mill into smaller sizes of 2 mm before incorporation into the diets.

Experimental animals and management

A total of 80 crossbreed, unsexed weaner rabbits of an average weight of 630 g were purchased from a reputable farm at Ogbomosho. They were randomly assigned on weight equalisation basis into four (4) dietary treatments (Table 1: 0%, 5%, 10% and 15% of dried watermelon rinds inclusion levels, and this represents T1, T2, T3 and T4 respectively). Each treatment group containing 20 rabbits, further replicated five (5) times with each replicates containing 4 rabbits. The rabbits were kept in hutches equipped with concrete feeders and drinkers used to supply feed and water *ad-libitum*. Maintenance of strict hygiene like daily sweeping of the pen, washing and refilling of drinkers with fresh clean water, cleaning of feeders and provision of feed was thoroughly ensured throughout the period of experiment (8 weeks).

Table 1: Percentage Composition of Experimental Diets

	T1	T2	T3	T4
	Level of Inclusion of DWMR (%)			
Ingredients	0	5	10	15
Maize	45	40	35	30
Plam kernel cake (PKC)	10	10	10	10
Soya bean meal	10	10	10	10
DWMR	0	5	10	15
Wheat offal	30	30	30	30
Bone meal	3	3	3	3
Oyster shell	1.50	1.50	1.50	1.50
Salt	0.25	0.25	0.25	0.25
Vitamin Premix	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00
Calculated Analysis				
ME (Kcal/kg)	2611.4	2439.8	2268.2	2096.6
Crude protein (%)	15.39	15.55	15.72	15.89
Crude fibre (%)	5.52	6.16	6.80	7.44

DWMR: Dried Water Melon Rind

Data Collection

Growth performance evaluation

The initial body weight was taken at the beginning of the experiment and weekly thereafter. Feed intake was measured using the differences between weight of feed offered and that of left-over; body weight gain was calculated as final weight minus initial weight while feed efficiency was calculated using the relationship of weight gain and feed intake. Mortality was recorded as it occurred.

Feed cost analysis

Costs of feed were calculated using the prevailing market prices of ingredients at the time of the experiment for the economic appraisal of the feeds (cost of dietary ingredients (₦/kg), cost of diet per kg, total feed intake and total weight gain).

Data Analysis

All the data collected were subjected to analysis of variance using (9), and where significant differences in means were indicated, Duncan's Multiple Range Tests of the same statistical package was used to separate them at 5% level of significance.

RESULTS AND DISCUSSION

The growth performance of the weaner rabbits fed the experimental diets is presented in Table 2. Inclusion of dried watermelon rind (DWMR) as an energy source at different levels in weaner rabbits' diets showed no significant (P>0.05) effect on the feed intake, feed efficiency and mortality in the current study; this is similar to the finding of (10). However, the final body weight and total weight gain of the rabbits were significantly (P<0.05) influenced by DWMR on. Rabbits fed diet with 5% DWMR had the highest final body weight and total weight gain (1391.25 g and 762.31 g, respectively), while those fed diets containing 0% and 15% DWMR had similar final body weight (1330.25 g and 1229.69 g, respectively). Increased level of inclusion of DWMR resulted in decreased weight gain as lowest total weight gain was observed in rabbits fed diets containing 10% and 15% DWMR (585.56 g and 600 g, respectively). The improved weight gain and final body weight of rabbits fed diet with 5% DWMR in the present study could be as a result of the effect of the micronutrients such as carotene, vitamin K, ascorbic acid, riboflavin, iron, iodine, and other mineral components especially at 5% DWMR inclusion; this concurs with the observation of (5) who reported that DWMR could be included in the diet of weaner rabbits up to 6% without any deleterious effect on the health and general performance of rabbits. The reduction in weight gain and final weight at higher inclusion levels could be due to the decline in the metabolisable energy (ME) supplied by the diets at 10 and 15% DWMR inclusion levels.

The economic analysis of rabbits fed DWMR as substitute for maize is presented in Table 3. The feed cost in ₦/kg decreased with increasing level of DWMR in the diet; feed cost (₦/kg) declined from N559.00 on diet 1 to N464.00 on diet 4. Similar trend was also observed with cost of feed in naira (₦) per rabbit; diets 1(0% DWMR) had N 1377.20 and 4(15% DWMR) (N 1056.91). The highest cost saving (₦/) of N292.75 was obtained on diet 2 (5% DWMR). The cost ₦/kg and total feed cost (₦) on the control are higher than the cost of DWMR diets and this finding is in agreement with the reports of (11) on rumen contents in rabbit production.

Table 2: Growth performance of rabbits fed diets containing varying levels of dried watermelon rind

	Inclusion level of DWMR (%)					
Parameters	0	5	10	15	SEM	P-value
Initial Weight (g)	625.81	628.94	630.81	629.69	2.02	0.8518
Final Weight (g)	1330.25^{ab}	1391.25^{a}	1216.38^{b}	1229.69^{ab}	28.80	0.0906
Weight Gain (g)	704.44^{ab}	762.31^{a}	585.56^{b}	600.00^{b}	28.50	0.0767
Total Feed Intake (g)	2463.69	2289.94	2212.06	2277.81	55.57	0.4399
Feed Efficiency	0.29	0.33	0.27	0.26	0.01	0.1683
Mortality (%)	0.38	0.38	0.38	0.25	0.08	0.9459

^{ab} means on the same row having different superscripts are significantly (p<0.05) different.
DWMR- Dried Watermelon Rind, SEM- Standard Error of Mean

CONCLUSION AND APPLICATION

The findings of this study shows that 5% inclusion level of DWMR can be incorporated into weaner rabbits' diet without any adverse effect on the growth performance at a lower cost of production. The use of dried watermelon rind up to 5% inclusion level should be encouraged not only to reduce dependent on maize but also to reduce cost of feed for a profitable rabbit production.

Table3: Cost benefit of using dried watermelon rind in the diet of weaner rabbits

	Inclusion Level of DWMR (%)					
Parameters	0	5	10	15	SEM	P-value
TFI	2463.69	2289.94	2212.06	2277.81	55.57	0.4399
Feed Cost (₦/kg)	559.0^{a}	544.0^{b}	499.0^{c}	464.0^{d}	6.74	<.0.001
Cost of feed (₦/rabbit)	1377.20^{a}	1245.73^{ab}	1103.82^{bc}	1056.91^{c}	35.93	0.0025
Total weight Gain	704.44^{ab}	762.31^{a}	585.56^{b}	600.00^{b}	28.50	0.0767
Cost of feed (₦/kg gain)	1984.47	1691.73	1903.20	1882.06	64.02	0.4393
Cost saving (₦)	0.00	292.75	81.28	102.41	82.16	0.6566
Percentage Cost saving	0.00	9.84	1.33	1.04	4.56	0.8736

^{abcd} means on the same row having different superscripts are significantly ($p<0.05$) different.
DWMR- Dried Watermelon Rind Mean, SEM- Standard Error of Mean.

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Monogastric Animal Production: MGP 037

HAEMATOLOGICAL INDICES OF FUNAAB ALPHA BROILER CHICKENS FED DIETS WITH VARYING LEVELS OF ALLIGATOR PEPPER (*Aframomum melegueta*) SEED MEAL

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ABSTRACT

Alligator pepper (*Aframomum melegueta*) seed meal (APSM) was included in the basal diets of 150 day old FUNAAB Alpha broiler chickens as phytogenic feed additives, an alternative to in-feed antibiotics in a 56 days feeding trial. Result at the starter phase reveals significantly (P<0.05) difference in packed cell volume (PCV), haemoglobin, red blood cell (RBC), and white blood cell (WBC). However, birds on T3 diet recording the highest PCV, haemoglobin, RBC and WBC (30.50, 10.15, 4.10 and 11.90%) values while birds on T4 diet had the least (18.00, 6.75, 1.95 and 7.45%) values for PCV, Haemoglobin, RBC and WBC respectively. Basophils, mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were also significantly (P<0.05) different. The result at the finisher phase showed that dietary inclusion of APSM significantly (P<0.05) influenced the PCV, WBC, neutrophils, lymphocytes, eosinophils, monocytes, MCH, and MCHC. Birds on T2 diets were highest at PCV (39.00%) and WBC (16.70%) values while T1 birds were least at PCV (33.50%) and WBC (12.95%) values. Neutrophils was highest (33.00%) for T1 birds and lowest (27.50%) for T4 birds while the reverse was the case for lymphocytes which was lowest (65.50%) for T1 and highest (72.50%) for T4. Monocytes was highest (1.00%) for T1 and T5 but lowest (0.50%) for T3, MCH was highest (40.70%) for T4 and lowest (37.11%) for T1 while MCHC was highest (33.69%) for T5 and lowest (32.17%) for T2. The study therefore concluded that dietary inclusion of APSM at 1g/kg enhanced the haematological parameters of starter FUNAAB Alpha broiler chickens.

Keywords: Alligator pepper, broiler chickens, haematology, seed meals

DESCRIPTION OF PROBLEM

Bacteria are one of the frequent vehicles of pathogenic agents in poultry resulting in poor poultry performance. Antibiotic growth promoters are a term used to describe any medicine that destroys or inhibits bacteria [1]. In-feed antibiotics have been used to suppress and inactivate the activities of bacteria in poultry. However, Synthetic antibiotics as growth promoters are expensive and have adverse effects on the consumer's health due to the survival of the residue of antibiotics in the tissues of birds [2]. Reports on the incidence of resistance due to the use of infeed antibiotics in poultry nutrition have become a public concerns these concerns have fuelled the search for alternative products like phytogenic feed additives. Phytogenic feed additives are plant-derived products used in animal feed to improve the performance of domestic livestock through amelioration of feed properties, promotion of the animals' production performance and improving the quality of food derived from those animals [3]. These plant-derived products have several beneficial effects such as antimicrobial and antioxidant activities, improvement of gut health and growth performance [4].

Blood is an important index of physiological, pathological and nutritional status in an organism [5]. Haematological studies are useful in the diagnosis of many diseases as well as investigation of the extent of damages to blood [6]. As reported by [7], animals with good blood composition are likely to show good performance. Dietary components have also been reported to have measurable effects on blood constituents [8]. Haematological parameters can be used in diagnosis of various pathological and metabolic disorders in chicken. However, Alligator pepper has been consumed and used for medicinal purpose as phytogenics due

to its anti-oxidizing, antimicrobial, aphrodisiac, anti-inflammatory, analgesic, stimulating and digestive properties, and for treating gastrointestinal disorders [9]. Alligator pepper seed meal (APSM) is a naturally occurring substance and its medicinal properties can enhance the immunity of broiler chicken and it is unlikely to have any negative lingering effects unlike in-feed antibiotics which retain its residues in tissues of the birds.

Although several study have focus on the use of APSM as phytogenic feed additives in the diets of other strains of broiler chickens, its specific application in FUNAAB alpha broiler chickens' diets is quite limited. Hence, the study aims to evaluate the haematological indices of FUNAAB alpha broiler chickens to diets containing varying levels of APSM.

MATERIALS AND METHODS

Experimental site and test ingredients

The study was carried out at the Poultry Unit of the Directorate of University Farms (DUFARMS), Federal University of Agriculture, Abeokuta (FUNAAB), Ogun State, Nigeria. The area lies on latitude 7º 13'49.46N and longitude 3º26'11.98E, at 76m above sea level in a tropical rain forest vegetation zone with an average temperature of 27.57ºC [10]. Dried Alligator pepper was purchased from open market within Abeokuta metropolis; the seeds were removed from its pods and blended using a kitchen blender to achieve a fine particle size and included in the basal diets at 0.0, 0.5, 1.0, 1.5 and 2.0 g/kg basal diets to form five dietary treatments, T1, T2, T3, T4 and T5 respectively.

Experimental birds and management

One hundred and fifty (150) day-old FUNAAB Alpha broiler chicks were purchased from a FUNAAB Hatchery at DUFARMS, FUNAAB and randomly allotted to five dietary treatments (T_1, T_2, T_3, T_4 and T_5) in a completely randomized designed of three replicates with ten chicks per replicate. Experimental diets and water were provided *ad libitum* throughout the 56th day feeding trial.

At the end of the feeding trial, records of live weight and feed intake for each replicate were used to calculate the average live weight per bird while feed conversion ratio was calculated as total feed consumed per weight gain.

Data collection and statistical analysis

At the end of the starter and finisher phases of the feeding trial, syringes of 2mls capacity was used to collect blood sample from the brachial vein of birds, randomly selected at two birds per replicate into an Ethylenediamine tetraactic acid (EDTA) bottle to prevent coagulation and labeled for determination of haematology parameters such as red blood cell (RBC), white blood cell (WBC), packed cell volume (PCV), white blood cell differential (haemoglobin, neutrophils, basophils, lymphocytes and eosinophils). Another 2mls was collected into plain sample bottles

Data generated were subjected to Analysis of Variance for a Completely Randomized Design using general linear model [11]. Significant means were separated using the Duncans Multiple Range Test of SPSS software.

RESULTS AND DISCUSSION

The significant increase in PCV, haemoglobin and RBC values of birds fed T2 and T3 diets at the starter phase is an indication that the oxygen carrying capacity of the blood was enhanced, however the significant decrease in WBC observed for birds on T4 and T5 diet could be due to the antimicrobial and antioxidant properties of APSM at those inclusion levels which makes the birds less susceptible to infection and oxidative stress. The significantly high PCV for bird on T2 and T5 at the finisher phase might be due to distortion of the physiological equilibrium of the blood, it has been posited that high PCV reading (polycythemia) is an indication of either an increase in the number of red blood cells or a reduction in the

circulating plasma volume [12]. An increase in WBC values in poultry can be indicative of several factors, including infection, inflammation, or stress, the significant increase of WBC in all the birds on APSM except T4, could therefore be due to stressor arising from other external factors but not APSM. The haemoglobin and RBC at the finisher phase were not significantly influenced by APSM in their diet, which implies that haemoglobin and RBC were intact and the birds were therefore not anaemic. Haemoglobin, MCH and MCHC are important blood parameters whose values are used to determine the presence and severity of anaemia [13]. A decrease in their levels in birds can be an indication that the birds are exposed to, or are poorly dealing with stressors. However, the significant increase in the MCH and MCHC values of birds on T4 might be an indication that the anti-stressor characteristics of gingerol constituent of APSM improved the birds' ability to withstand stress.

Table 1: Gross composition of basal diet

Ingredients (%)	Broiler Starter (0-4 weeks)	Broiler Finisher (5-8 weeks)
Maize	52.00	56.00
Soybean meal	22.00	8.00
Groundnut cake	10.00	16.00
Wheat offal	6.30	3.00
Palm kernel cake	2.00	9.30
Fish meal (72%)	3.00	3.00
Bone meal	2.00	2.00
Limestone	2.00	2.00
*Broiler Premix	0.25	0.25
Salt (NaCl)	0.25	0.25
Lysine	0.10	0.10
Methionine	0.10	0.10
Total	**100.00**	**100**
Determine Nutrients (%)		
ME Kcal/kg)	2933.80	2875.60
Crude Protein	23.22	20.18
Crude Fibre	4.26	5.12
Fat	2.19	4.12
Calcium	1.40	1.65
Phosphorus	0.44	0.82

**Premix provided the following: Vitamin A 12,000,000 I.U; Vitamin D 3,000,000 I.U; Vitamin E 30,000,000; Vitamin K 2,500mg; Folic acids 1,000mg; Niacin 40,000mg; Panthothenic acid 10,000mg; Vitamin B_{12} 20mg; Selenium 250mg; Iodine 200mg; Iron 40,000mg; Manganese 70,000mg; Copper 8,000mg; Zinc 60,000mg; Chlorine 200,000mg*

ME (Kcal/kg) = 37 x % CP + 81.8 x % EE + 35.5 x % NFE (Pauzenga, 1985)

CONCLUSION

The blood quality and health of FUNAAB Alpha broiler chicken fed T3 diets were not compromised at the starter phase and the birds were all not anaemic at the finisher phase.

Table 2: Haematology of starter and finisher FUNAAB Alpha broiler chickens fed diets containing varying levels of APSM

Starter (0 – 28 days)	**T1**	**T2**	**T3**	**T4**	**T5**	**SEM**	**P-value**
PCV (%)	25.50^{ab}	24.50^{ab}	30.50^{a}	18.00^{b}	20.00^{ab}	1.67	0.040
Haemoglobin (g/dl)	8.80^{ab}	9.10^{ab}	10.15^{a}	6.75^{b}	7.00^{b}	0.49	0.038
RBC (x 10^{12}/L)	2.60^{bc}	3.20^{ab}	4.10^{a}	1.95^{c}	3.00^{b}	0.22	0.005
WBC (x ^{9}/L)	10.30^{ab}	9.80^{ab}	11.90^{a}	7.45^{b}	8.20^{ab}	0.64	0.032
Neutrophils (%)	31.50	30.50	31.00	31.00	32.00	0.54	0.957
Lymphocytes (%)	67.00	68.00	68.50	66.50	67.50	0.55	0.846
Eosinophils (%)	0.50	0.50	0.00	0.50	0.00	0.11	0.274
Basophils (%)	0.50^{ab}	0.50^{ab}	0.00^{b}	1.00^{a}	0.00^{b}	0.12	0.015
Monocytes (%)	1.00	0.50	0.50	1.00	0.50	0.11	0.274
MCV (fl)	96.87^{a}	75.78^{ab}	74.40^{ab}	95.19^{ab}	68.78^{b}	4.28	0.030
MCH (pg)	34.69^{a}	28.19^{ab}	24.75^{b}	35.77^{a}	24.08^{b}	1.72	0.025
MCHC (g/dl)	35.92^{ab}	37.38^{a}	33.27^{b}	37.44^{a}	35.00^{ab}	0.55	0.011
Finisher (29 - 56 days)	**T1**	**T2**	**T3**	**T4**	**T5**	**SEM**	**P-value**
PCV (%)	33.50^{b}	39.00^{a}	33.50^{b}	34.00^{b}	36.00^{ab}	0.732	0.028
Haemoglobin (g/dl)	11.15	12.55	11.05	11.35	12.15	0.236	0.164
RBC (x 10^{12}/L)	3.00	3.25	2.85	2.80	3.00	0.072	0.334
WBC (x ^{9}/L)	12.95^{c}	16.70^{a}	14.50^{bc}	12.90^{c}	15.15^{b}	0.433	0.003
Neutrophils (%)	33.00^{a}	30.00^{ab}	30.50^{ab}	27.50^{b}	30.50^{ab}	0.728	0.025
Lymphocytes (%)	65.50^{b}	68.00^{ab}	68.50^{ab}	72.50^{a}	68.00^{ab}	0.889	0.017
Eosinophils (%)	0.00^{b}	0.00^{b}	0.50^{a}	0.00^{b}	0.00^{b}	0.072	0.021
Basophils (%)	0.50	0.50	0.00	0.00	0.500	0.107	0.271
Monocytes (%)	1.00^{ab}	1.50^{a}	0.50^{bc}	0.00^{c}	1.00^{ab}	0.153	0.002
MCV (fl)	111.51	120.11	118.69	121.79	120.81	1.630	0.294
MCH (pg)	37.11^{b}	38.64^{ab}	38.99^{ab}	40.70^{a}	40.66^{a}	0.506	0.023
MCHC (g/dl)	33.28^{ab}	32.17^{b}	32.94^{ab}	33.40^{ab}	33.69^{a}	0.196	0.037

$^{a, b, c}$ Means with different superscripts on the same row are significantly ($P < 0.05$) different, SEM: Standard error of means, PCV: Packed cell volume, RBC: Red blood cell, WBC: White blood, MCV: Mean corpuscular volume, MCH: Mean corpuscular haemoglobin, MCHC: Mean corpuscular haemoglobin concentration

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Monogastric Animal Production: MGP 038

GROWTH RATE OF BROILER CHICKENS IN THE SEMI-ARID REGION OF NIGERIA: A CASE OF GASHUA TOWN

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ABSTRACT

High temperatures pose a significant challenge to poultry production in the semi-arid regions of Nigeria, especially for exotic breeds. This paper examined the growth rates of broilers raised in Gashua to better understand conditions in these areas, aiding farmers in making informed decisions about flock management. The findings revealed that broilers raised from November to January exhibited the fastest growth rates, followed by those raised from August to October, while slower growth was noted for broilers from February to July. It was concluded that specific management strategies are essential for broilers raised during the hotter months of February to July to attain optimal growth rates.

Keywords: Broiler chickens, growth rate, months, hot periods, Gashua

DESCRIPTION OF THE PROBLEM

Broiler chickens are commonly chosen for meat production because they grow quickly and efficiently convert fee [1]. However, in dry regions, extreme environmental conditions can stress the birds, affecting their growth and productivity [2]. Rising temperatures can lead to heat stress in broilers, resulting in reduced feed intake, weight gain, and even death [2]. Monitoring growth patterns and adjusting management practices are crucial to maximize broiler growth potential [3]. Evaluating factors such as growth rate, days to market, mortality, and feed efficiency can help assess flock performance and identify effective management strategies for optimal growth [4]. This paper reviewed the growth rate of broiler chickens in the semi-arid region of Nigeria: a case of Gashua town.

MATERIAL AND METHODS

Gashua is situated in Nigeria's semi-arid region, at latitude of 12° 52.547/12.8758°N and a longitude of 11.0120°/11°00.719E. The area experiences fluctuating temperatures throughout the year, with warmer weather typically occurring from March to June, averaging 40°C, and cooler temperatures from November to January, averaging 21°C [5].

The growth performance of approximately 200 ROSS 308 broiler chickens was evaluated during different seasons (November-January, February-April, May-July, and August-October), each lasting six weeks, during which the chickens were fed experimental diets. The daily weight gain of the broilers was calculated for each period, and growth efficiency was assessed using the formula:

$$\text{Coefficient of growth} = \frac{\text{Average daily weight gain}}{\text{Initial weight}}$$

Data on growth rates in the different periods were analyzed using SPSS to determine any significant different at $p<0.05$ level.

RESULTS AND DISCUSSION

The results presented in Table 1 indicate that broiler chickens significantly ($p<0.05$) grow faster and achieve higher weekly average live weight and daily weight gain when reared from November to January and August to October compared to those raised from February to July. Therefore, special feeding and other management strategies are necessary during hot periods to optimize growth and health. The rate of growth coefficient follows a similar trend with the growth pattern with significant ($p<0.05$) highest coefficient observed in the November-January period. Several researchers reported that growth rate is the function of efficiency of converting feed to meat, and the period between February and July are periods of extreme heat reducing feed intake [3, 6]. Sudik *et al*. [1] claimed that birds grow better when provided with a favorable environment conditions. The higher coefficient of growth of broilers raised in November to January followed those in August to October implies that the periods are favorable than from February to July. The management of heat stress requires a holistic approach that includes improvement and management of housing systems, lighting programs, water system and water quality [4, 7].

Table 1: Weekly growth rate (g) and rate of growth coefficient of broiler chickens at varying seasons

Weeks	November-January	February April	May-July	August-October	±SEM	p-value
Initial weight	47.88	49.26	50.26	46.12	1.80	0.988
1	161.69^{a}	131.92^{bc}	113.15^{c}	143.09^{b}	20.33	0.099
2	397.25^{a}	340.28^{bc}	246.31^{c}	371.55^{b}	65.94	0.016
3	836.32^{a}	727.70^{bc}	563.62^{c}	800.11^{b}	120.96	0.065
4	1255.71^{a}	1031.78^{bc}	998.06^{c}	1087.25^{b}	114.47	0.001
5	1786.44^{a}	1400.23^{c}	137.18^{c}	1660.12^{b}	756.49	0.001
6	2175.13^{a}	1691.54^{c}	1633.29^{c}	1917.50^{b}	246.48	0.002
ADWG	51.79^{a}	40.28^{c}	38.89^{c}	45.66^{b}	5.87	-
RoGC	1.08^{a}	0.82^{c}	0.77^{c}	0.99^{b}	0.14	-

Values under each period are average of 200 broiler chickens; ADWG = average daily weight gain, RoGC = rate of growth coefficient

CONCLUSION

This reviewed showed that broiler chickens in an arid region of Nigeria, specifically in Gashua, Yobe State, had a more favorable temperature for optimal growth rate when reared from November to January and August to October compared to from February to July. Therefore, a holistic approach to reduce heat stress in broilers during hotter months is recommended.

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Monogastric Animal Production: MGP 039

GROWTH PERFORMANCE OF BROILER CHICKENS FED DIETS WITH GRADED LEVELS OF TIGER NUT (CYPERUS ESCULENTUS) WASTE

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ABSTRACT

This study was carried out to evaluate the growth performance of broiler chicken fed diets with graded levels of tiger nut (*Cyperus esculentus*) waste (TNW). A total of 84-day-old Ross 308 broiler chicks were divided into four groups of 21with 3 replicates of 7 birds each in a completely randomized design. The groups were assigned to dietary treatments: basal diet +0.0% TNW (T1), basal diet + 5% (T2) basal diet + 10% TNW (T3) and basal diet + 15% TNW (T4). The study lasted for 8 weeks. Data collected on growth performance and carcass quality was subjected to statistical analysis and significant means were separated using Duncan multiple range test at P<0.05 level of significant. The results show that the highest feed intake was obtained in T1 (3910.80g) and lowest value in T4 (3705.88g), while the highest weight was obtained in T2 (1820.30g), and the lowest value was recorded in T4 (1590.10g). There were no significant (P>0.05) differences in primal cut parts. The highest drumstick value of 10.36% was obtained in T2 and lowest value of 9.00% was obtained in T3. The highest breast weight (as percentage of primal cut) of 26.73% was obtained in T2 and lowest value of 23.88% in T4. There was no significant difference (p>0.05) in organ weight. It was concluded that TNW at 5% inclusion level in the diets of broiler chicken had no detrimental effect on performance and carcass quality.

Keywords: Tiger nut waste, Performance, Carcass characteristics, Broiler

INTRODUCTION

Poultry farmers in developing countries are faced with various problems of feed shortage, caused by high demand for grains and increase in prices of other feed ingredients in the poultry industry (1). The cost of poultry production keeps on rising due to the high cost of feedstuffs, and this has led researchers to focus on non-conventional feeds (2). Agro-industrial by-product and crop residues, which represent a vast animal feed resource, have now been targeted by animal nutritionists because of their cost effectiveness. Research has been, and still being carried out on the potential use of these by-products and crop residues but to date very little effective practical application has been achieved. Tiger nut is a grass-like plant of the family *Cyperaceae*, order *Cyperale*s or *Graminales* (3) is well grown in the middle belt and northern region (5). According to (4), it is often cultivated for its nutritive edible nuts and has 21% soluble glucose. Its prospect as energy source for poultry and livestock production has not been delve into extensively. This study was carried out to evaluate growth performance of broiler chicken fed tiger nut waste (TNW).

MATERIALS AND METHODS

Experimental site: The experiment was carried out in Zaria Kaduna State which is situated on latitude 11.085541 and longitude 7.719945 with average temperature varying between 25℃ and 39℃.

Sourcing of experimental material: The Tiger nut waste (TNW) was obtained from a processing industry in Ikara, kaduna state. The TNW was air dried at room temperature for 1 week and incorporated into the diets of the birds at 0%, 5%, 10%, and 15% inclusion levels, replacing maize.

Experimental design, birds, housing and feeding: A total of 84-day-old Ross 308 broiler chicks were divided into four groups of 21with 3 replicates of 7 birds each in a completely randomized design. The groups were assigned to dietary treatments: basal diet +0.0% TNW (T1), basal diet + 5% (T2) basal diet + 10% TNW (T3) and basal diet + 15% TNW (T4) (Tables 1). The feed and water were supplied ad libitum for an experimental period of 49 days. The experimental birds were vaccinated but not medicated.
Chemical analysis: tiger nut waste was analyzed for moisture, crude fiber, crude protein, either extract, nitrogen free extract and ash according to the methods of Association of Official Analytical Chemists (10).

Table 1: Composition of broiler finisher diets with graded levels of Tiger nut waste

Ingredient	T1(0%)	T2(5%)	T3(10%)	T4(15%)
Maize	53.35	50.09	48.03	45.37
Tiger nut waste	0.00	2.66	5.32	7.58
Bone meal	2.10	2.10	2.10	2.10
Wheat offal	10.00	10.00	10.00	10.00
Soya bean meal	29.00	29.00	29.00	29.00
Limestone	1.60	1.60	1.60	1.60
Soya oil	3.10	3.10	3.10	3.10
Salt	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10
Toxin binder	0.10	0.10	0.10	0.10
Broiler premix	0.25	0.25	0.25	0.25
Calculated Analysis				
Crude Protein (%)	19.15	19.03	18.90	18.78
Crude Fiber (%)	3.06	3.59	4.12	4.66
Metabolizable Energy Kcal/Kg	3138.45	3127.61	3116.56	3105.98

Data Collection and analysis
Data were collected on the performance parameters (Feed intake, Body weight gain, and feed conversion ratio (FCR) and Live ability and carcass characteristics of broiler chicken.

Liveability: This was calculated with the formula
Percentage liveability % = $\frac{\text{Number of live birds x 100}}{\text{Number of birds per treatment}}$
Carcass characteristics: At the end of the eight-week experimental period, 2 birds per replicate were randomly selected from each treatment and slaughtered by bleeding the jugular vein according to (4). They were then processed for carcass analysis. Data collected were subjected to analysis of variance (ANOVA) procedure using (6). Significant differences in means were separated using (7) at $p<0.05$)

RESULTS AND DISCUSSIONS

Results of chemical analysis of tiger nut waste show it is rich in energy (2624.71Kcal/kg), fat (8.70%), 21.45%, protein (4.40%) and ash (2.40%). The relatively low protein obtained in this study was higher than the value reported by (3), but lower than the values reported (9) The continuous decline in protein content with increase in TNW feeds could be attributed to the low protein content of TNW inclusion. A similar finding was reported by (9). The high metabolizable energy of TNW based diets is attributed to high carbohydrate and crude fat content of the tiger nut waste. Thus, TNW is a good source of energy for poultry. The lower crude fibre obtained in this study was lower than 24.0% and 23.3% obtained in raw and roaster tiger nuts respectively (8), but higher than reported by (9). The value obtained for ash in this trial for TNW indicated that it contained an appreciable level of minerals.

The growth performance of broilers is shown in Table 2. There was significant ($p<0.05$) difference in the average feed intake of the birds across treatments with the highest average feed intake recorded in birds fed the control diet (39%) and least in those fed 15% TNW diet. This finding agreed with the conclusion of (9) that the higher the inclusion levels of tiger nut meal in broiler diet, the lower the feed intake. Final weight was significantly ($p<0.05$) higher in birds fed T2 and lower in those fed T3 compared to birds fed other diets. Feed conversion ratio was significantly lowered in the birds fed 5% TNW than in those fed other diets, which were similar. The poor performance of birds on 10 and 15% TNW diets (T3 and T4) may also be traced to the dilution of available nutrients by high fibre tiger nut waste which impairs digestion and consequently availability of nutrients to the birds (monogastric) fed such ration.

Table 2: Growth performance of broiler birds fed graded levels of tiger nut waste diets

Parameters	**T1**	**T2**	**T3**	**T4**	**SEM**
Final weight (g)	1716.67^{b}	1820.30^{a}	1590.10^{c}	1616.67^{c}	52.04
Average feed intake (g/bird)	3910.80^{a}	3896.64^{b}	3751.37^{c}	3705.88^{c}	19.32
Initial weight at 1 week (g)	126.50	127.00	127.25	126.40	1.00
Feed conversion ratio	2.27^{a}	2.13^{b}	2.34^{a}	2.30^{a}	0.04
Mortality %	0.00	0.00	0.00	0.00	0.00

a, b, c means on the same row with different superscripts are significantly different ($P<0.05$).
SEM: Standard Error of Means

The result on carcass characteristics (Table 3) showed that there were significant differences ($P<0.)5$) in the live weight, defeathered weight, eviscerated percentages and dressing out percentages. However, values obtained for primal cuts showed no significant ($p>0.05$) differences for the thigh, drumsticks, wings and the breast percentages. The liver, heart and gizzard also did not exhibit any significant variations among the dietary treatments. The result indicated that the test ingredient had no negative effects on the carcass characteristics of the birds. Therefore this findings agreed to the report of (3) who observed no significant difference ($p>0.05$) in carcass evaluation except the neck weight when the birds were fed graded levels of alkaline treated Tiger nut residue.

Table 3: Carcass characteristics of broiler chickens fed graded levels of Tiger nut waste

Parameters	**T1**	**T2**	**T3**	**T4**	**SEM**
Live weight (g)	1750.00^{b}	1900.00^{a}	1700.00^{b}	1750.00^{b}	43.30
De-feathered weight(g)	1620.00^{c}	1790.00^{a}	1608.00^{c}	1670.00^{b}	65.07
Eviscerated %	82.28^{b}	83.16^{a}	82.05^{b}	82.06^{b}	3.44
Dressed %	76.06^{a}	75.78^{a}	73.70^{b}	64.62^{c}	5.90
Primal cuts %					
Thigh	15.50	17.00	15.00	15.0	1.59
Drumstick	9.90	10.36	9.00	9.10	0.18
Wings	7.00	7.84	7.00	6.90	0.13
Breast	25.40	26.73	25.29	23.88	1.02
Organs					
Liver	1.37	1.64	.135	1.20	0.26
Gizzard	1.97	2.10	1.94	1.93	0.26
Heart	0.50	0.60	0.58	0.46	0.08

a, b, c means on the same row with different superscripts are non-significantly different ($P<0.05$) SEM Standard Error of Means

CONCLUSION

In conclusion, the results obtained from this study indicates that tiger nut waste has relatively good nutritional composition, thus making it fit for animal consumption at 5% inclusion level. It also established

from proximate analysis presented that tiger nut residue which are often regarded as waste materials has relatively good nutritional composition; fat, fiber, ash and energy which can be harnessed for use in monogastric nutrition, although at lower level of inclusion.

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Monogastric Animal Production: MGP 040

EVALUATION OF HAEMATOLOGY OF WEANER PIGS FED PARTIALLY DEFATTED BLACK SOLDIER FLY LARVA MEAL

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ABSTRACT

This study investigated the effects of partially defatted Black Soldier Fly larva (BSFL) meal on the haematology of weaned pigs. Twenty-seven (27) crossbreed pigs (Large White x Landrace) were used and grouped into 3 treatments with 3 replicates containing 3 pigs per replicate. The animals ranged from 9 to 10 weeks in age with an average weight of 8.26 ± 0.43 kg. The treatments consisted of 0%, 5% and 10% of BSFL meal to replace equivalent quantities of Soybean meal. The experiment lasted for 49 days. Blood samples for haematological evaluation were collected from 9 piglets (3 animals per treatment) at day 49. The results showed no significant (P>0.05) differences in haematological parameters such as Packed Cell Volume (PCV), Haemoglobin (Hb) concentrations, Red Blood Cell (RBC) count, White Blood Cell (WBC) count, lymphocyte percentage, and platelet count. The PCV level was highest in pigs fed 10% Black Soldier fly larva (47.67%) but did not significantly (P>0.05) differ from pigs in other treatments. Pigs fed 10% BSFL also recorded the highest haemoglobin level (15.50 g/dL) but did not differ significantly from their counterparts in T1 (12.43g/dL) and T2 (11.93g/dL).The same trend was also observed for the White Blood cells across all treatments as pigs in T3 recorded the highest mean value (10,583 µL**)**. In conclusion, results showed that the inclusion of partially defatted Black Soldier fly larval meal to partially substitute soybean in weaner pig diets had no negative effect on the health status of the experimental animals.

Keywords: Black Soldier Fly Larvae, Pig, Insect, Blood Chemistry.

DESCRIPTION OF PROBLEM

Soybean appears to be the most significant protein-rich feed ingredient worldwide (1). However, the high cost of Soybeans and competition from humans have deprived the livestock industry of this protein rich source. This is essentially due to the limited number of producers and fluctuating climatic conditions. A large percentage of soybean used in livestock feed manufacturing industries are usually imported which has posed a negative impact on the economy (2). As a result, the global search for more sustainable and less land-consuming protein alternatives has been intensified to shift the attention of researchers towards alternative protein sources such as Insect protein meal.

Insect meal such as the Black soldier fly larvae (BSFL) has become a potential alternative to high-value protein sources and has received increased attention in the recent decade (3). BSFL are an excellent protein source and has been reported to contain about 37% to 65% Crude protein (4, 5). They also have high fat content which ranges from 15 to 49% on a dry matter basis (6, 7). Furthermore, the fatty acid composition of BSF larvae is high in the Medium Chain Fatty Acid (MCFA) such as the lauric acid (7). Studies have established the antibacterial effect of lauric acids on Gram positive and gram negative bacterial (8,9), which could represent an alternative for the development of novel antibacterial agents that could be used to modulate gut microbial community and hence improve growth performance of swine.

Therefore, dietary inclusion of insect meal for pigs has aroused the interest of researchers with their attention focusing more on performance (11), nutrient digestibility (11,3), Haematological indices (10,11) and gut antibacterial and morphology (3). Despite these findings, there is insufficient data on the effect of partially

defatted BSF larva meal on Haematology profile of weaned pigs. Therefore, this current study evaluates the dietary implication of partially defatted BSF larva meal on the health status of weaned pigs through assessment of some vital haematological parameters.

MATERIALS AND METHODS

Experimental Site
This experiment was carried out at the Piggery unit, University of Ibadan Teaching and Research Farm in Ibadan, Nigeria.

Experimental animals and management
Twenty seven (27) pigs were used and partitioned into 3 treatments with 3 replicates(each replicate consisted of three pigs). The animals ranged from 9 to 10 weeks in age with average weight of 8.26 ± 0.24 kg. The pigs were assigned to each treatment at random. The breed used for the experiment was a crossbreed (Landrace X Large White). The study lasted six (6) weeks.

BSF larva meal and experimental diets
The BSF larva meal used in this experiment was produced and processed by a breeder in Ogun state, Nigeria. The larvae were fed on fruit waste before being mechanically defatted in an oven without a solvent and then put on a screw press. The proximate composition of the Black Soldier Fly larva was also provided by the breeder. Three different experimental diets were formulated with the same level of crude protein (CP) and metabolizable energy (ME). The diets were designed to contain 0%, 5% and 10% inclusion levels of BSF larva to replace Soybean meal in the diet. The diets were designed to meet the nutritional requirements of the piglets (NRC 2012). The pigs had unlimited access to experimental feed and clean water.

Parameters measured
Haematology:
At the end of the study, nine (9) piglets were randomly selected from each treatment group (3 animals per group). Blood samples were drawn from the anterior vena cava of these pigs using a sterile syringe and heparinized tubes. The blood samples were subsequently transported to the laboratory for haematological analysis. The PCV, RBC, WBC, Hb and platelet counts were assessed using standard procedures described by (12)

Statistical analysis: The data collected were subjected to analysis of variance (ANOVA). Duncan's New Multiple Range Test was used in separating the significant means.

RESULTS AND DISCUSSION

All haematological parameters measured in this study (Table 2) fell within the acceptable physiological reference ranges for swine (13,14). Despite variations in BSFL inclusion levels, no significant differences ($P > 0.05$) were observed in haematological parameters. PCV level was highest in pigs fed 10% Black Soldier fly larva (47.67%) but did not significantly ($P=0.15$) differ from their counterparts in other treatments. Likewise, the Hb concentrations showed no significant differences among treatments, though pigs in T3 exhibited numerically higher Hb counts (Table 2). A similar trend was observed for RBC, with pigs fed T3 having significantly higher RBC counts (7.74 $x10^6/\mu L$) compared to T1 (6.00 $x10^6/\mu L$) and T2 (6.03 $x10^6/\mu L$). The increased PCV and RBC counts in pigs fed T3 suggest improved erythropoiesis, which might be attributed to the higher nutritional value of BSFL, including essential amino acids and vitamins.
The higher haemoglobin levels in pigs fed T3 are likely a direct result of the increased RBC count, as haemoglobin is a component of red blood cells. Also, this observation may be because haemoglobin levels are primarily determined by the availability of iron and protein for haemoglobin synthesis. BSFL is known to have a balanced amino acid profile and sufficient micronutrients, including iron, which are essential for maintaining haemoglobin levels. The similar haemoglobin levels across diet treatments suggest that BSFL provided equivalent nutrients for haemoglobin synthesis as soybean meal (5). The lack of significant

differences in PCV, Hb and RBC among the treatments suggests that the inclusion of BSFL meal did not compromise the oxygen-carrying capacity of the blood.

Table 1: Gross Composition of the Experimental Diet

Ingredients (kg)	T1	T2	T3
Maize	49.90	49.90	49.90
Palm Kernel Cake	15.00	15.00	15.00
Wheat Offal	10.00	10.00	10.00
Soya bean Meal	20.00	15.00	10.00
Black Soldier Fly Larva Meal	0.00	5.00	10.00
Bone Meal	4.00	4.00	4.00
Salt	0.30	0.30	0.30
Premix	0.25	0.25	0.25
Lysine	0.25	0.25	0.25
Methionine	0.15	0.15	0.15
Toxin binder	0.15	0.15	0.15
Total	100	100	100
Calculated Analysis			
Energy (Kcal/Kg)	3103.73	3045.67	3073.74
Crude protein (%)	20.38	20.63	20.88

Table 2: Haematology of Weaned Pigs fed Partially Defatted Black Soldier fly larvae at Different Inclusion level

Treatments					
Parameters	**T1**	**T2**	**T3**	**SEM**	**P-value**
Packed cell volume **(%)**	38.00	37.00	47.67	2.49	0.15
Haemoglobin (g/dL)	12.43	11.93	15.50	0.82	0.16
Red Blood Cell ($x10^6$ /µL)	6.00	6.03	7.74	0.46	0.23
White Blood Cell (µL)	10466.67	8433.33	10583.33	988.51	0.67
Lymphocytes (%)	51.00	49.00	56.33	1.60	0.15
Platelets (µL)	175000.00	142666.67	110000.00	14238.16	0.18

Where T1: Control diet T2: Diet + 5% Defatted Black Soldier Fly Larvae inclusion level T3: Diet + 10% Defatted Black Soldier Fly Larvae inclusion level. SEM: Standard error of mean.

There were no significant differences in WBC counts among the treatments. Pigs in T3 recorded the highest mean value (Table 2). This implies that the immune systems of the animals used in this study were not affected. The immunological condition of an animal is determined by leukocytes (WBC) known to play a primary role in both human and animal immune systems (15). A significantly increased leukocyte count in pig is connected with persistent pneumonia or parasitism (16). If the leukocyte counts are within normal levels, it means that the food source has no negative effect on the immune system. On the other hand, a drop in WBC count could indicate a decrease in the development of a defence mechanism to resist infection (17). The lymphocyte counts also remained stable across treatment groups (Table 2), suggesting that BSFL's bioactive components, such as antimicrobial peptides and chitin, may support immune function without causing suppression or over-activation (6). Chitin and antimicrobial peptides have been shown to modulate the immune system, potentially enhancing the animal's ability to fight off infections (6).

The platelet level recorded in this study also revealed that there was no significant (P=0.18) difference across treatments fed graded levels of BSFL(Table 2). Platelet counts are generally influenced by factors such as bone marrow function, blood loss, or stress. Since BSFL provides a high-quality protein source with adequate amino acids, it likely did not induce any nutritional deficiencies or stress that would lead to changes

in platelet production. This shows that the nutritional content of BSFL is sufficient to maintain normal platelet production, similar to that provided by soybean meal (14).

CONCLUSION AND APPLICATION

1. The results obtained in this study indicated that the inclusion of BSFL meal did not significantly alter key haematological parameters; packed cell volume, haemoglobin concentration, red blood cell count, white blood cell count, lymphocyte percentage, and platelet count.
2. Partially defatted Black Soldier fly larval meal can be used to substitute soybean in weaner pigs diets up to 10% inclusion level without any adverse effect on the haematology.
3. These findings present additional information on the replacement value of Black soldier fly larvae meal to substitute Soybean meal without any adverse effect on the overall health status of the pigs.

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Monogastric Animal Production: MGP 041

COMPARATIVE CHEMICAL COMPOSITION OF OF COCOA BEAN SHELL AND RUMEN FILTRATE FERMENTED COCOA BEAN SHELL

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ABSTRACT

Cocoa Bean Shell (CBS), a byproduct of cocoa bean processing achieved through breaking and winnowing, holds significant nutritional value suitable for animal feed. Hence, Investigations were conducted to evaluate the effects of rumen filtrate fermented cocoa Beans shell on the chemical composition of cocoa beans shell. Fresh cocoa bean shell (FCBS) was obtained from a cocoa bean processing industry, and bovine rumen content was collected from four randomly selected slaughtered cattle at the abattoir. The rumen content was mixed with an equal amount of potable water (1:1 ratio), stirred, and then sieved to obtain rumen filtrate (RF). The RF was mixed with FCBS in a 5:5 ratio. The mixture was thoroughly blended manually, packed into polythene bags, and sealed. The bags were then placed under shade of a tree and allowed to ferment for 24 hours. After fermentation, the contents were sun-dried within 48 hours until they reached a moisture content of less than 10%. Results revealed that fermentation method employed had significant ($P<0.05$) effect on CBS used in this study. The crude protein, ash, nitrogen free extract, flavonoids, tannins, saponin, terpenoides, steroids and theobromine content of CBS reduced (CBS: 8.18% – FCBS: 5.10%), (FCBS: 10.40% - RFCBS: 9.08%), (FCBS: 57.64% - 57.07%) (FCBS: 10.52-RFCBS: 8.52%), (FCBS: 8.03% – RFCBS: 7.97%), (FCBS: 1.73% - RFCBS: 1.61%), (FCBS:4.11% - RFCBS: 2.17%), (FCBS: 1.73 – RFCBS:1.40%) and (FCBS:14.19 – RFCBS: 10.83%) after being fermented but increased the crude fibre content, phytate and oxalate of the test ingredient from 10.27% to 15.26%, 0.10 -0.20% and 1.06 -1.20% respectively. Fermentation method employed had significant influence on the chemical composition of FCBS.

Key words: Theobromine, Unconventional feedstuffs, Environmental pollution and Rumen filtrate

DESCRIPTION OF PROBLEM

Cocoa is a crucial cash crop supporting over 4.5 million families globally (1). It holds promising economic potential due to its high market value and versatility as a source of income. During chocolate production, cocoa beans generate by-products such as cocoa bean shell (CBS), cocoa pod husks, and cocoa pulp. CBS, constituting approximately 14–15% of the bean's weight (2), has recently gained attention among researchers for its functional food applications due to its bioactive compounds, comparable to those found in cocoa nibs. Studies indicate that CBS shares similar bioactive compounds and lipid profiles with cocoa butter, alongside its characteristic chocolate flavor and (3). CBS is rich in beneficial components including dietary fiber (61.18–65.58 g per 100 g), epicatechin (4.56–6.33 mg/g), catechin (2.11–4.56 mg/g), methylxanthines such as theobromine (7.12 to 12.77 mg/g) and caffeine (4.02 to 6.13 mg/g), polyphenols (6.10–42.97 mg GAE/g), and various fatty acids (oleic, stearic, and palmitic acids). These nutritional attributes position CBS as a valuable ingredient in functional foods, particularly in baked goods and beverages (4; 5). Moreover, CBS exhibits anti-inflammatory and potential antitumoral properties, which may mitigate risks associated with inflammatory gut diseases and colorectal cancer (6). The chemical composition and bioactive characteristics of CBS can vary due to differences in cocoa varieties and processing methods (including fermentation, drying, and roasting) employed by different industries (7). However, there remains a gap in research regarding how these factors specifically influence CBS properties. Therefore, this study aims to investigate the comparative proximate composition and bioactive compounds present in fresh CBS and rumen filtrate fermented CBS.

MATERIALS AND METHODS

Experimental site: This study was conducted at the poultry unit of the Teaching and Research Farm of Animal Science Department, Faculty of Agriculture, University of Abuja, and lasted for a period of 56 days.

Collection and Processing of test ingredients and Diets: Fresh cocoa bean shell (FCBS) was obtained from a cocoa bean processing industry in Ondo State, and bovine rumen content was collected from four randomly selected slaughtered cattle at Gwagwalada's abattoir in the Federal Capital Territory, Abuja. The rumen content was mixed with an equal amount of potable water (1:1 ratio)[27], stirred, and then sieved to obtain rumen filtrate (RF). The resulting RF was mixed with FCBS in a 5:5 ratio. The mixture was thoroughly blended manually, packed into polythene bags, and sealed. The bags were then placed under shade of a tree and allowed to ferment for 24 hours according to the procedure of (8)[28]. After fermentation, the contents were sun-dried within 48 hours until they reached a moisture content of less than 10%, following the procedure outlined by previous researchers which was originally described for fermenting sweet orange (*Citrus sinensis*) peels with bovine rumen filtrate for use in broilers, pullets, and rabbits.[29]

Chemical Analysis: Moisture, crude protein, crude fat, ash and crude fiber content were determined as described by (9). The moisture content was determined by hot air oven method at 105^0C. The macro Kjeldahl method was used for crude protein content determination, fat content was examined by extracting 2g of sample with petroleum ether (boiling point of 40^0C to 60^0C) using Soxhlet extraction method. Ash content was determined by weighing samples into a tarred porcelain crucible which was then incinerated at 550^0C in an ash muffle furnace until ash was obtained. Quantitative phytochemical screening analysis was carried out on the fresh CBS and rumen filtrate fermented CBS according to the standard procedures of (10).

Statistical Analysis: Data obtained was subjected to analysis of variance[30] using SAS (11). Significant means among the variables were separated using Duncan multiple range test of the same statistical software.

RESULTS

Chemical Composition of Cocoa Bean Shell and Rumen Filtrate Fermented Cocoa Bean Shell

Table 1 shows the chemical composition of cocoa bean shell (CBS) and Fermented cocoa bean shell (FCBS). Fermentation method employed had significant ($P<0.05$) effect on the cocoa bean shell used in this study. The crude protein, ash, nitrogen free extract, flavonoids, tannins, saponin, terpenoides, steroids and theobromine content of the Cocoa Bean Shell reduced (CBS: 8.18% – FCBS: 5.10%), (CBS: 10.40% - FCBS: 9.08%), (FCBS: 57.64% - 57.07%) (FCBS: 10.52-RFCBS: 8.52%), (FCBS: 8.03% – RFCBS: 7.97%), (FCBS: 1.73% - RFCBS: 1.61%), (FCBS:4.11% - RFCBS: 2.17%), (FCBS: 1.73 – RFCBS:1.40%) and (FCBS:14.19 – RFCBS: 10.83%) after being fermented but increased the crude fibre content, phytate and oxalate of the test ingredient from 10.27% to 15.26%, 0.10 -0.20% and 1.06 -1.20% respectively

Proximate composition and phytochemical analysis of the cocoa bean shell (CBS) and fermented CBS

The crude protein values obtained for both fermented cocoa bean shell and raw cocoa bean shell were lower than the values (15.20 – 19.80%) reported by (12). The variation observed could be attributed to different type or varieties used, climatic or soil condition of the environment, disease and seasonal differences. The chemical composition of CBS is affected by climatic conditions as well as varieties (13). The fermented cocoa bean shell (FCBS) obtained in this study had reduced crude protein content when compared with the raw cocoa bean shell. The reduction observed in crude protein content of FCBS may be due to the conching process which could have denatured some protein in the chocolate (14). This observation was consistent with the result reported by (15). The decrease observed in the crude protein content after fermentation might be due to breakdown of protein content during the curing process, occurred partly due to hydrolysis to amino acids and peptides and partly by conversion to insoluble forms by the action of polyphenols as well as losses by diffusion (11; 16). Contrary to this, was the observation of (17) who reported a significant increase in

cocoa bean shell's protein content by the sixth day of fermentation. The insignificant lower ether extract values obtained might be attributed to the relatively lower sizes of CBS used in this study. This could account for the observed relatively lower fat content. (18) reported that the smaller the CBS resulted in lower fat yield. The crude fiber content was significantly higher in fermented CBS than in unfermented samples. The increase in crude fiber content after being fermented and dried occurs because of the loss of water from the CBS, resulting in a relatively higher content of crude fiber. Furthermore, the result obtained in this study was in line with the observation of (14) who had earlier reported that fiber content of the CBS increased after being fermented and dried. Ash is an indicator of mineral contents of foods and has been shown by (19) to be high in cocoa products. The ash content of the cocoa beans shell decreased significantly with fermentation and this observation was comparable with the findings of (17). The ether extract of samples (CBS and FCBS) were not significantly different from each other and this contradicted the findings of (17) who reported that ether extract of the CBS significantly decreased from 62.9% to 55.7% on the sixth day of fermentation . [31]This disparity observed could be attributed to different fermentation periods used. It was suggested by (17) that the reductions in fat content of the CBS could be avoided by reducing fermentation time. Cocoa fermentation is influenced by many factors such as type of cocoa, disease, climatic and seasonal differences (20). The fermentation methods employed suppressed the adverse effect of the anti-nutritional facts present therefore improving the nutritive of value of the test ingredients. This result obtained in this study supported the assertion of (21).

Table 3: Chemical composition of Cocoa Bean shell and Fermented Cocoa Bean Shell

Parameters (%)	CBS	FCBS	SEM [a,b]
Dry matter	89.10	89.11	0.00
Crude Protein	8.18[a]	5.10[b]	0.69[32]
Ether extract	2.61	2.60	0.00
Crude fibre	10.27[b]	15.26[a]	1.12
Ash	10.40[a]	9.08[b]	0.30
NFE	57.64[a]	57.07[b]	0.13
Phytate	0.10[b]	0.20[a]	0.22
Oxalate	1.06[b]	1.20[a]	0.03
Flavonoids	10.52[a]	8.52[b]	0.44
Tannins	8.03[a]	7.97[b]	0.01
Saponin	1.73[a]	1.61[b]	0.03
Terpenoides	4.11[a]	2.17[b]	0.43
Steroids	1.73[a]	1.40[b]	0.07
Theobromine	14.19[a]	10.83[b]	0.75

Means along the same row with different superscripts are significantly different (P<0.05)

CONCLUSION

Fermentation method employed had significant influence on the chemical composition of cocoa bean shell used in this study as it reduced the phytochemical compounds [33]present and increased the crude fibre content of the Cocoa Bean shell[34]

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SERUM LIPID PROFILE AND LIVER HISTOPATHOLOGY OF BROILER CHICKEN FED MONKEY POD (*Albizia saman*, Jacq. Merr.) LEAF MEAL-BASED DIETS

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ABSTRACT

Choline has been used extensively to mitigate fat imbalance in poultry birds by promoting fatty acid utilization and uptake by the liver. However, its misuse has led to birds' discomfort and low productivity, necessitating a sustainable substitute that is natural, safe, potent and accessible. The effect of *Albizia saman* leaf meal-based diets on serum lipid profile and liver histopathology of broiler chickens was investigated in a 42-day feeding trial. Two hundred one-day old Ross 308 broiler chicks were allocated to five treatment groups with five replicates of eight birds each. Treatments 1 and 2 (low fat diet; high fat diet with no feed additive) respectively. Treatment 3: the basal diet+choline, treatments 4 and 5: basal diets with 1.5 and 3.0% *Albizia saman* leaf meal supplementation. At day 42, blood samples were collected for serum lipid profile assay, and liver samples for histopathology. Data were analyzed using descriptive statistics and ANOVA at α0.05. The results showed that birds fed a high-fat diet with choline (163.33mg/dL) had significantly higher ($P<0.05$) cholesterol levels than those fed 1.5% *Albizia saman* (121.67mg/dL) leaf meal diet. Diets supplemented with 1.5 and 3.0% *Albizia saman* leaf meal resulted in lower triglycerides (100.00mg/dL; 97.30mg/dL) and VLDL (20.00mg/dL 19.46mg/dL) levels and higher HDL (68.45mg/dL; 87.01mg/dL) levels, respectively. The histopathological examination revealed that birds fed a high-fat diet with 1.5% *Albizia saman* showed no observable liver lesions, indicating a hepatoprotective effect. In contrast, birds fed a high-fat diet with choline and 3.0% *Albizia saman* had atrophy and inflammation in centrilobular hepatocytes. In conclusion, 1.5% *Albizia saman* supplementation positively influenced liver function and serum lipid composition in broiler chickens, enhancing hepatic health and lipid metabolism, offering a safe and effective alternative to synthetic choline chloride.

Keywords: Leaf meal, Liver histopathology, Serum metabolites, Broiler chicken

DESCRIPTION OF PROBLEM

The poultry industry relies heavily on maize as a primary energy source and feed grain, making up 70% of production expenses (1). Maize is highly digestible, providing efficient nutrient assimilation and metabolizable energy for growth and maintenance (2). However, the diversion of maize for ethanol production has led to grain supply problems and price increases, impacting the animal feed industry (3).
As a response to high maize costs, nutritionists have explored dietary oil as an alternative energy source. While oil has high energy value, its excessive use can lead to imbalanced fat deposition, fatty liver syndrome, and negative health consequences (4, 5). Choline, an essential micronutrient, has been used to enhance animal performance and alleviate nutritional deficiency symptoms. However, choline chloride supplementation has limitations due to its hygroscopicity, vulnerability to degradation, and potential corrosive effects the on the GIT with its attendant negative impacts (6).

Researchers have sought natural and safe alternatives to choline chloride, exploring herbs and spices as potential sources of antioxidants. *Albizia saman*, a flowering tree, has been recognized for its rich nutrient content, pharmacologically active agents and cytotoxic and anticancer properties. It contains antioxidant compounds that can help protect cells from damage caused by free radicals and reduce oxidative stress, creating a healthy cellular environment (7). This makes it a viable alternative to choline chloride supplementation, as it can provide similar benefits without the potential drawbacks of choline chloride.

Therefore, the objective of this study was to evaluate the effects of *Albizia saman* leaf meal-based diets on the serum lipid and liver histopathology of broiler chickens.

MATERIALS AND METHODS

Experimental site and preparation of test materials

The study was conducted at the Teaching and Research Farm, University of Ibadan, Ibadan, Oyo State. *Albizia saman* leaves were collected from the Department of Animal Science vicinity in October 2023. The leaves were air-dried for one month at 25°C and then pulverized into a fine powder using an electric blender. The powder was stored in a sterile container after botanist authentication to ensure accuracy and validity with a voucher specimen number UIH-23336.

Experimental animals, diets, design, and management

Two hundred one-day old Ross 308 broiler chicks were obtained from a trusted commercial hatchery. The birds were randomly assigned to one of five dietary treatments having five replicates with eight birds each. The compounded feeds were prepared for each feeding phase to meet the birds' nutritional needs. The basal diets consisted of corn-soya bean meal diets with metabolizable energy and crude protein levels of 2951.51 kcal/kg and 23.22% (starter), 3000.25 kcal/kg and 21.12% (grower), and 3095.33 kcal/kg and 19.01% (finisher), respectively.

Experimental layout

Treatment 1: Positive control (Basal diet: low fat diet (4.54%-4.82%); No feed additive)
Treatment 2: Negative control (Basal diet: high fat diet (6.73%-7.33%); No feed additive)
Treatment 3: Basal diet + choline (1500 -1700mg/kg)
Treatment 4: Basal diet + 1.5g/kg *Albizia saman* diet
Treatment 5: Basal diet + 3.0g/kg *Albizia saman* diet

Data collection

Serum biochemical indices

On day 42, blood samples were collected from one bird per replicate using heparinized tubes and venipuncture of the axillary vein. The concentrations of triglycerides, cholesterol, and High Density Lipoprotein (HDL) in blood serum were quantified using spectrophotometry with the AU 400 analyzer. The levels of Low Density Lipoprotein (LDL) and Very Low Density Lipoprotein (VLDL) fractions in the serum were calculated using the Friedewald's equation.

Histopathological indices

At week 6, tissue samples from the liver were collected from three birds per treatment, fixed in formalin, processed for histology, and examined under a light microscope at ×10 magnification, with measurements taken using an oculometer and stage micrometer.

Statistical analysis

Data were subjected to descriptive statistics and analysis of variance (ANOVA) using SAS (8) software package and means separated using Tukey's HSD test at $\alpha 0.05$.

RESULTS AND DISCUSSION

Serum biochemical indices of broiler chickens fed *Albizia saman* leaf meal supplemented diets

Cholesterol concentrations differed significantly ($P<0.05$) across treatments with the highest level (163.33 mg/dL) in birds fed choline and the lowest (121.67 mg/dL) in those fed 1.5% *Albizia saman* leaf meal diets. Triglyceride levels were lowest in birds fed 1.5% (100.00 mg/dL) and 3.0% (97.30 mg/dL) *Albizia saman* diets, and highest in those without choline (170.3mg/dL). The high density lipoprotein (HDL) levels were highest in birds fed 3.0% (87.01 mg/dL) and 1.5% (68.45 mg/dL) *Albizia saman* leaf meal supplemented diets. The very low density lipoprotein (VLDL) levels were lower ($P<0.05$) in birds fed 1.5% (20.00 mg/dL)

and 3.0% (19.46 mg/dL) *Albizia saman* diets compared to those without choline (34.06 mg/dL) supplementation. The low density lipoprotein (LDL) levels were lower (P<0.05) in birds fed 3.0% (45.67 mg/dL) and 1.5% (51.33 mg/dL) *Albizia saman.* Tulsi leaf powder and garlic powder supplementation have been shown to reduce total serum cholesterol, LDL-cholesterol, and triglycerides while increasing HDL-cholesterol (9, 10). The findings of the present study align with these previous studies, demonstrating the efficacy of herbs and natural products in reducing cholesterol levels.

Table 1: **Serum lipid profile of broiler chickens fed diets supplemented with *Albizia saman* leaf meal (29 - 42 days)**

Treatment (mg/dL)	Basal diet	High fat – choline	High fat + choline	High fat + 1.5% AS	High fat + 3.0% AS	SEM	P value
Cholesterol	150.00^{ab}	151.67^{ab}	163.33^{a}	121.67^{b}	125.56^{ab}	8.31	0.0216
Triglyceride	145.31^{b}	170.31^{a}	125.00^{c}	100.00^{d}	97.30^{d}	2.96	<.0001
HDL	45.83^{b}	46.99^{b}	58.59^{ab}	68.45^{ab}	87.01^{a}	6.31	0.0051
VLDL	29.06^{b}	34.06^{a}	25.00^{c}	20.00^{d}	19.46^{d}	0.59	<.0001
LDL	75.11^{a}	70.62^{a}	79.74^{a}	33.22^{ab}	15.60^{b}	10.18	0.0038

$^{a,b,c,d.}$ Means on the same row with different superscripts are significantly (P<0.05) different.

HDL: High Density Lipoprotein, VLDL: Very Low-Density Lipoprotein, LDL: Low Density Lipoprotein. AS- *Albizia saman*

Liver histopathology of broiler chickens fed *Albizia saman* leaf meal supplemented diets

The histopathological examination results of liver tissues from birds on various experimental diets are shown in Plates 1-5. The liver section of birds fed a basal diet (T1) shows random hepatocellular coagulation necrosis and inflammation (Plate 1). Birds fed a high-fat diet without choline (T2) had centrilobular hepatocellular atrophy and inflammation (Plate 2). Similarly, birds fed a high-fat diet with choline (T3) exhibits centrilobular hepatocellular atrophy and inflammation (Plates 3). Birds fed a high-fat diet with 1.5% *Albizia saman* (AS) (T4) had no observable lesions (Plate 4) while those fed a high-fat diet with 3.0% AS (T5) exhibits centrilobular hepatocellular atrophy and inflammation (Plates 5). In line with these results, Odetola *et al*. (11) observed tissue damage in the histopathological photomicrographs of broilers fed graded levels of *Petiveria alliacea* root meal. The necrosis of the villi and tubular epithelium in the intestine and kidney of all treatment groups, except the control group were recorded (11). Additionally, Khanam *et al*. (12) reported dose-dependent liver damage, with mild fatty infiltration in the low-dose treated group. Also, necrosis, and focal collections of lymphocytes in the hepatic plates of the liver in the intermediate and high-dose treated groups of broiler chicks fed different levels of carbaryl, compared to the control group (12).

CONCLUSION AND APPLICATION

The present study shows that incorporating *Albizia saman* leaf meal at 1.5% can enhance liver function and metabolism, particularly in birds fed high-fat diets. The study suggests that diets supplemented with *Albizia saman* leaf meal at 1.5 and 3.0% inclusion levels lowered cholesterol and triglyceride levels with concomitant increase in the high density lipoprotein levels in birds fed high fed diets.

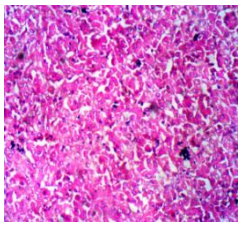

Plate 1. Shows the liver section of birds fed basal diet (T1): there is no observable lesion. H and E x400

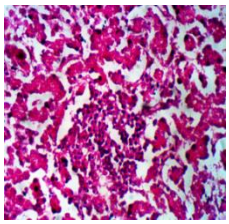

Plate 2. Shows the liver section of birds fed high fat diet without choline (T2): there is centrilobular hepatocellular atrophy and inflammation (A). H and E x400

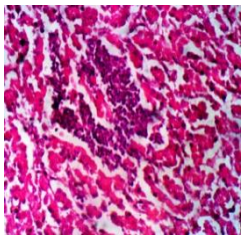

Plate 3. Shows the liver section of birds fed high fat diet with choline (T3): there is centrilobular hepatocellular atrophy and inflammation. H and E x400

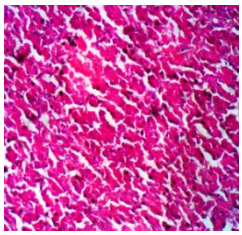

Plate 4. Shows the liver section of birds fed high fat diet with 1.5% AS (T4): there is no observable lesion. H and E x400

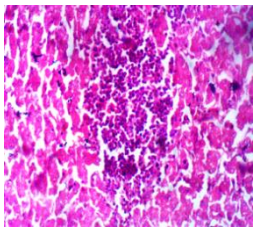

Plate 5. Shows the liver section of birds fed high fat diet with 3.0% AS (T5): there is centrilobular hepatocellular atrophy and inflammation. H and E x400

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Monogastric Animal Production: MGP 043

A META-ANALYSIS OF HATCHABILITY RATE OF *IN OVO* AMINO ACID FED BROILER CHICKENS.

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Abstract

Investigations revealed that i*n ovo* feeding is a cost-effective method to improve hatchability in broiler chickens. Specifically, several studies have shown the impact of essential amino acid. Variations in results hatchability rate across experimental conditions however, necessitated further study. A meta-analysis of 10 published papers of maximum of 120 sample size was conducted to evaluate the potential of *in ovo* feeding of amino acids in broilers. Studies were retrieved by consulting scientific repositories of PubMed, Scopus, Scielo, Web of science and Google scholar. A binary logistic model was used to determine the parameters influencing hatchability and a mixed model analysis of variance was performed to assess variations in hatching weight considering the study as a random effect and amino acids category as fixed effect. The results revealed that for better hatchability, moderate volume ($p = 0.042$) and late injection ($p = 0.002$) of amino acids should be explored. Threonine was associated with higher hatchling weight ($p = 0.005$) and hatchability, while lysine improves post hatch growth parameters. Interactions were observed between period of injection, volume of injection and amino acid concentration in studied birds. The findings suggest that hatchability post *in ovo* feeding may be influenced by technique-related parameters and category of available nutrients. This provokes further investigations into effects of *in ovo* feeding in broilers towards promoting sustainable animal products.

Keywords: *in ovo*, meta-analysis, threonine, hatch, repositories

DESCRIPTION OF PROBLEM

To supply animal protein to meet the demand of ever increasing population toward a sustainable nutritional security, it is essential to improve animal agriculture. Continuous improvement in the genetic strain and nutritional up-gradation has reduced the generation interval and marketable age of broilers from 60 days to 42 days (1). The chicken egg is a closed system with limited availability of nutrients fixed at the time of laying and due to nutritional constraint, almost 5% of the embryos do not survive the last week of the incubation period (2). Therefore, perinatal feeding is important for maintaining a stable and sufficient energy status during the late embryonic and newly hatched periods. Enhanced nutritional knowledge and technical advancements have enabled researchers to manipulate embryos. *In ovo* feeding of various supplements such as amino acids, vitamins, L-carnitine, minerals and glucose have been manipulated for this purpose (3). Significant research has been devoted to exploring the use of *in ovo* injection as a mean of providing supplemental nutrients to broiler chicken embryos. These studies were conducted on the assumptions that embryonic development of commercial strain of broilers could be compromised by a limited availability of essential nutrients in eggs. Fat and moisture levels in eggs are sufficient as embryonic needs but, the levels of available amino acids are lower than required for optimal growth thus, several studies have shown that the *in ovo* injection of amino acids increases chick weight at the time of hatch (2).

Threonine, an essential amino acid serve a critical role in the physiological and biochemical processes of birds and consequently is the third limiting amino acid in commercial poultry diets (3). It's *in ovo* inclusions resulted in rapid growth of embryo, and the synthesis of amylase, mucin and gamma-globulin. It has been proposed that *in ovo* injection of threonine may promote nutrient digestion capacity of embryos and post hatch chicks (4). Growing interest and subsequent research on *in ovo* injection of nutrients into fertile eggs of different species have emerged (4), (5). However, there have been little research on the meta-analysis of

the effect of *in ovo* injection on hatchability of broilers hence, the need for this study. This study aimed at predicting the effect of *in ovo* feeding of threonine and lysine on hatchability rate of broiler chickens.

MATERIALS AND METHODS

Studies evaluated for meta-analysis were selected by consulting scientific repositories (PubMed, Scopus, Scielo, Google Scholar, Semantic, and Web of Science) in March, 2023. The search was made using words such as "*in ovo* feeding", "amino acids", "broilers" and their combinations. The studies obtained were analyzed by their abstract and full text for eligibility before inclusion in database according to the procedure of Ncho *et al*. (6). The response variables extracted from studies were:
i. Hatchability parameters of hatching rate (Hr), hatchling weight (Bwh) and hatchability
ii. Growth parameters
iii. Mean, standard deviation (SD), standard error of mean (SEM) and sample size (n) from the control and treatments.
Parameters that can influence hatchability were computed as binary logH derived from the values of hatch. Such that, if the SMD of hatch ≥ 0 = hatchability of treatment was superior or equal to the control group, and if SMD of hatch < 0 = treatment recorded a lower hatchability compared to the control.

Statistical Analysis

A binary logistic model was used to determine factors influencing hatching rate after *in ovo* feeding of amino acids using a model established by LOGISTIC procedure in SPSS version 10 (6). The logit (Li) model follows the following form –

$$\mathbf{Li\ (Y) = In\ (Pi\ /1\text{-}Pi) = \beta_0 + \beta_k X}$$

(Pi /1-Pi) = odd expressing conditional mean or probability of occurrence of event relative to the likelihood of a non-occurrence given X, Y = binary dependent variable logH (0 or 1), β_0 = unknown constant term, β_k = vector of regression coefficients to be estimated and X = set of independent variables that will determines the probability of the event. Hatchling weight based on amino acid category was analyzed according to mixed model of ANOVA with amino acid category as a fixed effect. Significant differences between amino acid categories were separated with Tukeys test.

RESULTS AND DISCUSSION

The average statistics of the response variables considered from extracted ten studies were presented below. The sample sizes in the hatching parameter dataset were Bwh (n = 38), hatch (n = 35), and logH (n=38). The mean of Bwh recorded was 0.01, while the hatch was estimated at 0.05. Result of logit model as presented in Table 2, also predicted 87.8 % of the values and the rest was misclassified. The analysis revealed that late *in ovo* feeding is likely to increase hatchability ($P<0.05$) by 7 % / day added compared to control group, suggesting that *in ovo* operation improved broiler production efficiency by increasing hatching weight and hatchability. This observation corroborates the findings of Akosile *et al*. (1) and Gupta *et al*. (3) who differently recorded increased hatchability rate in breeder broiler eggs *in ovo* injected with various nutrients via embryo amnion several days prior hatch. The high hatchability rate may also infer better assimilation of injected solution in amnion by the embryo, as the embryo swallows and digest the amnion content through the intestine (4). On the contrary, Retes *et al*. (7) recorded lower hatchability in broilers administered *in ovo* carbohydrate-based solutions before hatch. The disparity in observed results could be due to differences in period of injection, volume of injection, temperature conditions, handling techniques, as well as the size of eggs (3). Literatures have established that heavier eggs, lower volume and late injection preferably, resulted in better hatchability in *in ovo* injected eggs (3), (4) and (5).

Furthermore, our findings revealed that eggs weighing 64 g or over were 43% more likely to experience increased hatchability, compared to smaller ones ($P<0.05$) after late *in ovo* feeding. Thus, each additional 1 ml of diluent added for *in ovo* injected eggs were 76 % less likely to increase or have the same hatchability

as the control. A lower volume of *in ovo* injectable nutrients therefore, is beneficial for increased hatchability in chickens. This correlates with the previous finding in which *in ovo* feeding of 0.05 ml of threonine had better hatchability of quail chick in comparison to 0.1 ml (7).

Similarly, hatchling weight (MD = 0.57) of eggs that received *in ovo* threonine injections were higher (P<0.05) compared to observed values in lysine supplemented embryo (MD = - 0.32) as presented in Table 3. The increase could be due to unlimited availability of nutrients during the late incubation phase. It is expected that *in ovo* supplementation of threonine may help in nurturing the late-term embryo which ultimately resulted in higher hatchability. This assertion conformed to the report of Ncho *et al*. (6), who observed that *in ovo* nutrient feeding is performed to counter the deficiency of nutrients in the late-term embryo. An increase in hatchling weight of *in ovo* threonine supplemented embryos could also be related to anti-stress ability and reduction in lipid peroxidation, as embryo transit from chorio-allantoic to pulmonary respiration during late incubation (7).

Table 1: Variables resp

Qualitative variables

Modalities	Frequency	Proportion
logH 0: if Hatch SMD < 0	20	47.4%
0: if Hatch SMD > 0	18	52.6%

Quantitative variables

Traits	Effect size	N	Mean	SE	Min	Max
Bwh	SMD	40	0.01	0.002	- 0.44	0.758
Hatch	MD	35	0.05	0.005	- 0.53	0.875

SMD = Standardized mean difference; MD = Mean difference; Bwh = hatchling weight; Hatch = Hatchability; logH = hatchability comparison index.

Table 2: Estimated values for hatchability comparison index

Parameters	Coefficient	SE	Ma.eff	Wald	*p*-Value
Intercept	-5.54	3.53	-	-	0.001
Pe-inj	0.54	0.28	0.005	4.834	0.002
EW (60abv)	1.85	0.64	0.430	6.172	0.005
Vol	-5.30	3.42	-0.771	4.231	0.042

EW = Egg weight; Pe-inj = period of injection; Ma.eff = Marginal effect; Vol. = volume of injection; Wald = Wald chi-square; 60abv = egg weight superior or equal to 60. Cases correctly predicted=87.8%, n =38

Table 3: Hatching weight based on amino acid categories

	Amino acids		
Parameter	**Threonine**	**Lysine**	***p*-Value**
Hatchling weight (SMD)	0.57[a]	- 0.32[b]	0.041

Means within the same line with different letters are significantly (P<0.05) different by Tukey test.

CONCLUSION AND APPLICATION

This study quantified egg weight, injection day and volume of injection as major factors that could predict the outcome of *in ovo* feeding of nutrients in broilers, especially hatchability and hatchling body weight. *In ovo* feeding of threonine several days to hatch and at moderate volume increased hatchability and hatchling weight. Therefore, during *in ovo* supply of nutrients in poultry, the concentration and time of injection could be indicators of variation in post hatch body weight gain. This knowledge is necessary to improve the supply of animal products towards sustaining food security.

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MONOGASTRIC ANIMAL PRODUCTION: MGP 044

GROWTH PERFORMANCE AND SERUM ANTIOXIDANT PROPERTIES OF BROILER CHICKENS FED VARIED SUPPLEMENTAL LEVELS OF BAOBAB (*ADANSONIA DIGITATA L.)* LEAF MEAL

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ABSTRACT

The growth performance and serum antioxidant properties of broiler chickens fed Baobab (*Adansonia digitata*) leaf meal (BLM) supplementation were evaluated in a 7-week trial. Forty-five (45) Cobb 500 broiler chickens were used for the experiment. The birds were distributed into five (5) treatment diets in a completely randomized design and replicated three (3) times where three (3) chicks served as a replicate of each treatment diet. The dietary treatments were labeled T_1 (0.00% BLM), T_2 (0.025% BLM), T_3 (0.05% BLM), T_4 (0.075% BLM) and T_5 (0.10% BLM). Growth performance data on initial weight, final weight, feed consumed, weight gain, feed conversion ratio, and mortality were recorded, while blood samples were collected for serum antioxidant analysis. Results showed significant differences ($p<0.05$) in the initial weight, final weight, and weight gain across the dietary group with birds on T_5 (0.10% BLM) ranking the best in these parameters. Significant differences were also observed in the serum antioxidant assay, birds on T_1 (0.00% BLM) and T_5 (0.10%) recorded statistically similar glutathione peroxidase values, birds on T_1 (0.00% BLM) had the lowest (38.484 $M^{-1}Cm^{-1}$) lipid peroxidase value while the highest value (164.33 $M^{-1}Cm^{-1}$) was recorded for birds on T_4 (0.75% BLM). The lowest superoxide dismutase value (27.997%) was recorded for birds on T_3, while no significant differences were observed in the catalase values The study thus concluded that supplementing baobab (*Adansonia digitata*) leaf meal in the diet of broiler chickens up to 0.10% has no deleterious effect on their growth performance and serum antioxidant properties.

Keywords: Baobab, Broiler chickens, Non-conventional feedstuff, Serum, Antioxidants.

DESCRIPTION OF PROBLEM

Numerous non-conventional feedstuffs (NCF) have been investigated; however, research focus is currently, on the possible uses as a source of protein and energy of lesser-known, marginalized, and native African trees and shrubs [1]. One such plant is the baobab (*Adansonia digitata*). Africa is home to the deciduous baobab tree (*Adansonia digitata*), which grows best at low elevations and in both drier and hotter climates. It is so common that a lot of people view it as an icon, representing the continent as a whole. It is extensively distributed in the savannah regions of Nigeria [2].

In the realm of animal nutrition, it is critical to determine practical methods for enhancing the well-being and productivity of broiler chickens owing to the increase in stocking density as a result of increasing production rate. The potential application of compounds derived from plants to improve the antioxidant status of broiler chickens is one area of interest [3]. High stocking densities, quick growth rates, and exposure to pathogens and toxins are just a few of the stresses that intensive broiler chicken production systems frequently subject the birds to [4]. These stressors have the potential to cause oxidative stress, which is defined as an imbalance between the body's antioxidant defenses and the generation of free radicals [5]. Damage to cells and tissues due to oxidative stress can result in diseases, poor meat quality, and decreased growth performance in broiler chickens. It has been demonstrated that the antioxidant qualities of dietary supplements improve broiler chickens' immune systems, improve the quality of their meat, and raise their
According to Adebayo et al. [6], baobab leaf meal is well-known for its high protein content and a variety of bioactive components, including antioxidants like caffeic acid and chlorogenic acid. It has been discovered that these bioactive substances have a variety of health-promoting qualities, such as antibacterial, anti-

inflammatory, antidiabetic, and anticancer effects [7]. This study thus investigated the effects of varied levels of baobab (*Adansonia digitata*) leaf meal supplementation on the growth performance and serum antioxidant properties of Cobb 500 broiler chickens.

MATERIALS AND METHODS

Table 1.0: Gross Composition (g/100g) of the Experimental Diets

Ingredients (%)	T1	T2	T3	T4	T5
Maize	59.35	59.35	59.35	59.35	59.35
Wheat offal	6.00	6.00	6.00	6.00	6.00
Soyabean meal	24.00	24.00	24.00	24.00	24.00
Fish meal	3.00	3.00	3.00	3.00	3.00
Soy oil	3.00	3.00	3.00	3.00	3.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Limestone	0.50	0.50	0.50	0.50	0.50
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.30	0.30	0.30	0.30	0.30
Salt	0.30	0.30	0.30	0.30	0.30
Premix	0.30	0.30	0.30	0.30	0.30
TOTAL	100.00	100.00	100.00	100.00	100.00
BLM	0.00	0.025	0.050	0.075	0.100
Calculated analysis (% DM)					
Metabolizable Energy (kcal/kg)	3108.10				
Crude Protein	20.03				
Crude Fibre	3.17				
Lysine	1.24				
Methionine	0.66				
Calcium	0.99				

Experimental Site

This study was carried out at the Federal College of Agriculture Akure, Ondo State, Nigeria, in the poultry section's experimental unit. The college is situated in the southwest of Nigeria at latitude 7.2704° N and longitude 5.2241° E. The average monthly temperature varied from 22°C in December to 32°C in February, with an average annual relative humidity of approximately 84%. The average annual rainfall was approximately 1200 mm [8].

Experimental Animals and Their Management

Forty-five (45) broiler chickens of Cobb 500 strain were used for the experiment. The birds were assigned to five (5) dietary treatments in a completely randomized design of three (3) replicates consisting of 3 birds each. The treatments were based on five supplemental levels of baobab leaf meal. The experimental birds were fed their respective diets throughout the experiment which spanned 7 weeks. All required routines and occasional management practices were carried out. Parameters on feed consumption and weekly weight gains were recorded.

Data Collection

Performance parameter: Data on weekly feed consumed, weight gain, and feed conversion ratio were recorded.

Antioxidant analysis: Assay of glutathione peroxidase (GPx) Activity, superoxide dismutase (SOD), catalase (CAT), and lipid peroxidase (LPO) were evaluated.

Data Analysis: All data collected were subjected to analysis of variance using the statistical package for social science (SPSS) version 25.0 of the year 2017 and the Duncan Multiple Range Test of the software was used for mean separation.

RESULTS AND DISCUSSION

Table 2.0: Performance of Cobb 500 Broiler Chickens Fed Different Supplemental Levels of Baobab (*Adansonia digitata*) Leaf Meal (BLM)

Treatments	IW (g)	FW (g)	WG (g)	FC (g)	FCR	MORT
T1	524.70^{ab}	6518.00^{b}	5993.30^{b}	5426.00	0.905	0.00
T2	489.30^{b}	5892.70^{b}	5403.30^{c}	6153.60	1.139	0.00
T3	601.30^{ab}	6054.70^{b}	5453.30^{bc}	6358.80	1.166	0.00
T4	533.30^{ab}	6063.00^{b}	5530.00^{bc}	6703.20	1.212	0.00
T5	652.00^{a}	7350.00^{a}	6700.00^{a}	7640.40	1.140	0.00
SEM (±)	21.84	158.32	146.14	628.28	0.145	0.00

a,ab,b,bc,c, = means in the same column but with different superscripts are statistically ($p<0.05$) significant. T_1 = Treatment with 0.00% BLM; T_2 = Treatment with 0.025% BLM; T_3 = Treatment with 0.050% BLM; T_4 = Treatment with 0.075% BLM; T_5= Treatment with 0.10 % BLM; IW= Initial Weight; FW= Final Weight; WG= Weight Gain; FC= Feed consumed; FCR= Feed Conversion Ratio; MORT= Mortality

The performance of Cobb 500 broiler chickens fed different supplemental levels of Baobab (*Adansonia digitata*) leaf meal is presented in Table 2.0. Significant differences were observed in the IW, FW, and WG across the dietary groups. Birds on T_5 (0.10% BLM) recorded the highest IW(652.00g), FW (735.00g), and WG (6700.00g) which are significantly higher ($p<0.05$), Wudil *et al*. [9] reported significantly higher initial weight, final weight, and feed consumed on birds fed 7.5% BLM as a replacement of soya bean meal (SBM). The feed conversion ratio recorded across the dietary groups showed no significant differences ($p>0.05$), of the birds fed BLM, birds on T_2 (0.025% BLM) and T_5 (0.10% BLM) recorded better feed conversion ratio. This may be due to the better feed utilization by broiler chicken at 0.025% and 0.10% respectively, a lower feed conversion ratio is an indicator of better diet utilization in monogastric animals.

Table 3.0: Serum Antioxidant Properties of Cobb 500 Broiler Chickens Fed Varied Supplemental Levels of Baobab (*Adansonia digitata*) Leaf Meal (BLM).

Treatments	GPx (µg/ml)	CAT (KU)	LPO ($M^{-1}Cm^{-1}$)	SOD (%)
T1	235.131^{a}	0.603	38.484^{d}	62.402^{a}
T2	204.493^{ab}	0.607	92.823^{b}	51.515^{b}
T3	203.074^{ab}	0.687	65.672^{c}	27.997^{c}
T4	166.0523^{b}	0.686	164.333^{a}	48.293^{b}
T5	215.556^{a}	0.594	96.534^{b}	54.176^{ab}
SEM (±)	7.189	0.019	11.605	3.223

a,ab,b,c,d = means in the same column but with different superscripts are statistically ($p<0.05$) significant. T_1 = Treatment with 0.00% BLM; T_2 = Treatment with 0.025% BLM; T_3 = Treatment with 0.050% BLM; T_4 = Treatment with 0.075% BLM; T_5 = Treatment with 0.10 % BLM; GPx= Glutathione peroxidase; CAT= Catalase; LPO= Lipid peroxidase; SOD= Superoxide dismutase.

Table 3.0 shows the serum antioxidant properties of Cobb 500 broiler chickens fed baobab leaf meal (BLM). The result showed significant differences in the GPx, LPO, and SOD values across the dietary groups. There is a dearth of information on the effect of baobab leaf meal (BLM) supplementation on the serum antioxidant status of broiler chickens however, Silvia *et al*. [10] reported that products from *Adansonia digitata* are endowed with very interesting antioxidant capacity. Also, Daramola [11] reported that the intake of herbs or medicinal plants or their contents resulted in increased serum antioxidant enzymes such as glutathione

(GSH), catalase (CAT), and superoxide dismutase (SOD) and a decreased lipid peroxidation (LPO) concentration, however, the findings of this research do not follow this trend as fluctuation in values were recorded with increasing BLM supplementation. Birds fed BLM-supplemented diets ($T_2 – T_5$) recorded the highest mean LPO values which indicates that they were more stressed than birds on T_1 (0.00% BLM), which could be a result of anti-nutritional factors (phytic and tannic acids) present in baobab leaves which interferes with some physiological activities.

CONCLUSION AND APPLICATION

From the study, it is observed that BLM supplementation up to 0.10% is capable of improving the growth performance of broiler chickens but interferes the serum antioxidant properties of broiler chickens. Thus, more research should be carried out on the levels of baobab leaf meal that can be supplemented in the diets of broiler chickens to achieve the twin effect of improved growth and antioxidant activity.

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Monogastric Animal Production: MGP 045

EFFECT OF REPLACING MAIZE WITH MAIZE OFFALS ON PERFORMANCE AND EGG LIPID PROFILE OF BROWN EGG-TYPE LAYERS

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ABSTRACT

The study examined the performance and lipid profile of eggs from laying hens fed different levels of maize offal (25, 50 and 70%) in replacement of maize with or without enzyme supplementation. One hundred and twenty-six (126) point of lay (18 weeks old) I*sa Brown* strain of pullets were used in a 12 weeks feeding trial. Data were collected on performance and egg lipid profile. Data were analyzed using One-Way Analysis of Variance and means were separated by Duncan Multiple Range Test of the same software package at $p<0.05$. The results revealed that replacing maize with maize offals at varying levels with or without enzyme supplementation did not negatively affect the performance characteristics and the lipid profile of eggs. Feed cost per kg as well as Feed cost per dozen of egg significantly ($p<0.05$) reduced. It was concluded that maize offal can replace maize up to 75% in layers diet with a significant savings in production cost.

Key words: Maize, Maize offal, Layers, Performance and lipid profile.

DESCRIPTION OF PROBLEM

Feed accounts for about 70 – 80% of total cost of production. Cereal grains make up to 50% of the feed ingredients in poultry feed formulation. The most popularly used cereal in feed is maize which supplies the greater part of the metabolizable energy requirement (1). The demand for maize is increasing at a faster rate daily (2). This may be due to the competition that exists between man and animals (3). In addition, instability and seasonal variability in the production of maize has led to unstable cost of purchasing maize. In Nigeria, the price of maize which was ₦80/kg in the year 2020 has hiked to ₦750 - ₦850/kg in 2024.

Maize offal is the tough outer layer of maize which is very high in fibre and it can be used in a wide variety of ways (4). Industrial maize offal is as good as maize in chicks, growers and layers ration (5). The use of maize offal would reduce feeding cost which is a huge factor in poultry production and its utilization could be improved when supplemented with endogenous enzymes. Enzymes are biological catalyst composed of amino acids with vitamins and minerals that bring about biochemical reactions without themselves undergoing any change. (6) had earlier reported that replacing Maize offals with or without enzyme supplementation did not have negative effects on the external and internal egg qualities of layers. According to (7) enzymes increase egg production, hatchability and also maintain egg quality (7).

Objective

To investigate the effect of replacing maize with maize offals (supplemented with or without enzymes) in the diets of laying chickens on performance and egg lipid profile.

MATERIALS AND METHODS

Location of Experiment: The experiment was carried out at the Poultry Unit of Teaching and Research farm, LAUTECH, Ogbomoso, Oyo State, Nigeria.

Collection and Preparation of Test Ingredients: The maize offal was purchased from Dongo milling industry, Ilorin, Kwara State. The maize offal was sun dried to 12.31% moisture and analyzed for its chemical composition while the enzyme (Multizyme) was purchased from a reputable feed additives vendor.

Experimental Diets: Seven experimental diets were formulated as shown in Table 1, with Treatment one (T1) as the control diet having 100% maize without enzyme supplementation. Treatments 2, 3, 4, 5, 6 and 7

had maize replaced with maize offal at graded levels of 25% with enzyme, 25% without enzyme, 50% with enzyme, 50% without enzyme, 75% with enzyme and 75% without enzyme respectively.

Experimental Animals and Management: 126 point of lay (18 weeks old) "ISA BROWN" layer strain was used. The birds were allocated into seven dietary treatment groups of three replicates per treatment with six (6) birds per replicate in a completely randomized design experiment.

Data Collection and Analysis: Data were collected on performance and egg lipid profile. They were analyzed using one–way analysis of variance (ANOVA) of the General Linear Model of SAS (2003) and means were separated using Duncan's multiple range test of the same package.

Table 1: Composition of Experimental diets

Ingredients	Control	25%+ enzyme	25%- enzyme	50%+ enzyme	50%- enzyme	75%+ enzyme	75%- enzyme
Maize	45.5	34.12	34.12	22.75	22.75	11.38	11.38
Corn bran	-	11.38	11.38	22.75	22.75	34.12	34.12
*Fixed ingredients	53.30	53.30	53.30	53.30	53.30	53.30	53.30
Palm oil	1.20	1.20	1.20	1.25	1.25	4.20	4.20
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Enzyme	-	+ve	-ve	+ve	-ve	+ve	-ve
Determined composition							
Dry matter (%)	87.62	87.50	87.93	87.79	87.30	88.19	87.69
Crude protein (%)	16.04	16.52	16.63	16.44	16.40	16.73	16.15
Crude fat (%)	3.53	3.47	3.58	3.54	3.44	3.63	3.56
Crude fibre (%)	4.10	3.97	4.25	4.16	3.88	4.22	4.12
Ash (%)	6.28	6.36	6.74	6.38	5.86	6.73	6.54
NFE (%)	57.67	57.8	56.73	57.27	58.37	56.88	57.32
Gross energy (Kcal/g)	4.108	4.103	4.137	4.128	4.081	4.143	4.112
M.E (Kcal/kg)	2666.00	2663.00	2694.00	2677.00	2657.00	2686.00	2672.00

**Fixed ingredients - Soyabean Meal 15kg, Wheat offal 19kg, Palm kernel cake 3.80kg, Fish meal 2.50kg, Bone meal 3.75kg, Limestone 8.50kg, Methionine 0.10kg, Lysine 0.15kg, Premix 0.25kg, Salt 0.25kg*

RESULTS AND DISCUSSION

The performance characteristics of layers fed maize offal in replacement of maize with or without enzyme supplementation is presented in Table 2. Inclusion of enzyme did not have significant effect on the hen day egg production (HDEP) of birds fed diets 2 to 6 but there was significant difference in the HDEP of birds fed diets 1 and 7 with a difference of 11.16%, which agreed with the findings of (8) and (9) who reported that enzyme supplementation improve hen day egg production and feed conversion. The daily feed intake of birds fed diets supplemented with enzymes showed no significant difference as opposed to the findings of (10) who replaced maize with wheat offal supplemented with enzymes. The feed cost per dozen eggs was significantly affected by the dietary treatments. The lowest feed cost per kg of egg (₦453.09) was obtained in 75% maize offal without enzyme supplementation. (5) reported that replacing maize with 45% maize bran had no adverse effect on laying performance but led to considerable reduction in feed cost. There was reduction in the feed cost by 9.38% as against the control diet which represent about ₦22.44 per kg of raw materials cost. This is an indication of a favourable cost benefit result and a saving of this magnitude is of great importance to the farmer since feed alone accounts for almost 80% of the total production cost. The egg mass were significantly affected ($P<0.05$) with 25% without enzyme recorded the highest value (42.58) while 75% without enzyme supplementation recorded the lowest (36.54). This result supported the submission of (11) that egg mass were significantly different ($P<0.05$) in hens fed distillers dried grains with soluble and exogenous enzyme mixture.

Table 2: Performance characteristics of Brown egg-type layers fed maize offal in replacement of maize with or without enzyme supplementation

Parameters	T1	T2	T3	T4	T5	T6	T7	SEM	P-value
Initial weight (kg)	1.54	1.54	1.49	1.52	1.52	1.52	1.52	0.01	0.97
Final weight (kg)	1.68	1.67	1.64	1.65	1.65	1.73	1.67	0.02	0.89
Total weight gain (kg)	0.14	0.13	0.14	0.14	0.13	0.20	0.16	0.01	0.53
Daily weight gain (kg)	0.002	0.002	0.002	0.002	0.002	0.003	0.002	0.00	0.50
Daily feed intake (g/bird/day)	108.29^{b}	113.31^{a}	107.53^{b}	115.62^{a}	114.99^{a}	115.18^{a}	107.00^{b}	0.47	0.01
Egg weight (g)	58.23^{a}	56.36^{b}	58.32^{a}	57.61^{ab}	54.35^{c}	57.15^{ab}	57.00^{ab}	0.26	0.01
Hen Day Egg Production (%)	64.93^{b}	75.23^{a}	72.87^{a}	72.64^{a}	72.87^{a}	72.38^{a}	64.07^{b}	0.88	0.01
Egg mass (g)	38.09^{bc}	42.18^{a}	42.58^{a}	41.78^{ab}	39.30^{abc}	41.74^{ab}	36.54^{c}	0.53	0.07
Kg of feed consumed: kg of egg produced	1.86^{c}	2.02^{b}	1.85^{c}	2.01^{b}	2.13^{a}	2.02^{b}	1.91^{c}	0.01	0.01
Cost/kg of feed (₦)	264.00^{a}	248.75^{b}	247.50^{c}	232.69^{f}	231.44^{g}	238.13^{d}	236.88^{e}	1.22	0.01
Feed cost /dozen egg (₦)	105.60^{a}	99.50^{b}	99.00^{c}	93.08^{f}	92.58^{g}	95.25^{d}	94.75^{e}	0.49	0.01

^{abcdefg}Means in the same row with different superscript are significantly different ($p<0.05$)
SEM=Standard error of mean

The egg lipid profile of layers fed diets containing maize offals as replacement for maize with or without enzyme is presented in Table 3. Dietary treatments had no significant effect on the lipid profile of the eggs. This is in line with the reports of (12, 7, 5, 6) who reported no significant effect on the egg quality of laying hens fed diets supplemented with enzymes.

Table 3: Lipid profile of eggs from Brown egg-type layers fed maize offal in replacement of maize with or without enzyme supplementation

Parameters	T1	T2	T3	T4	T5	T6	T7	SEM	P-value
Egg weight (g)	60.19	54.93	56.44	61.12	51.89	57.31	56.58	1.03	0.30
Total Cholesterol (mg/dL)	422.10	404.43	407.06	418.60	395.40	402.96	401.66	3.02	0.20
HDL (mg/dL)	121.76	112.13	114.06	119.63	108.46	110.63	111.56	1.74	0.40
LDL (mg/dL)	230.76	214.00	217.30	229.53	206.66	217.43	219.60	2.68	0.20
VLDL (mg/dL)	14.36	12.69	13.24	14.32	12.37	13.55	13.79	0.33	0.70
Gross Energy (kcal/g)	1.47	1.45	1.46	1.48	1.44	1.46	1.47	0.00	0.20
Lipid Peroxidation (ngMDA/g)	3.19	4.19	3.86	3.79	4.10	4.15	4.33	0.09	0.72

T1= Control, T2= 25% with enzyme, T3= 25% without enzyme, T4= 50% with enzyme, T5= 50% without enzyme, T6= 75% with enzyme, T7=
75% without enzyme, HDL=High density lipoprotein LDL= Low density lipoprotein VLDL= Very low density lipoprotein

CONCLUSION AND APPLICATION

The results of this study showed that 75% replacement value without enzyme supplementation had a reduced feed intake to produce a kg of egg, high hen day egg production, high egg weight and 6.25% savings on feed cost. This will be reasonable to local poultry farmers whose targets are to increase hen day production, egg weight and savings on cost. It could be concluded that maize offal up to 75% with or without enzyme supplementation is a good agro-industrial by-product that is suitable as alternative feed source. It is thereby recommended for farmers to adopt any of the dietary treatments as there was no adverse effect on any of the parameters measured.

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Monogastric Animal Production: MGP 046

GROWTH PERFORMANCE AND GUT MORPHOLOGY OF BROILER CHICKS FED L-THREONINE SUPPLEMENTED DIETS

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ABSTRACT

This study was carried out to evaluate the effects of dietary L-threonine levels beyond the NRC recommendation on the growth performance and gut morphology of broiler chicks during a 14-day feeding trial. Two hundred one-day-old Ross 308 broiler chicks were allocated into four treatment groups with five replicates of ten birds each. Treatment 1: (Basal diet + 0% threonine), treatment 2: (Basal diet + NRC threonine recommendation), treatment 3: (Basal diet + 15% > NRC threonine recommendation), treatment 4: (Basal diet + 30% > NRC threonine recommendation). At day 14, growth response was measured and jejunal segments were collected for histomorphology. Data were analysed using descriptive statistics and ANOVA at α0.05. The result showed no significant differences ($p>0.05$) across the experimental groups for both growth performance and gut morphology. However, the presence of elongated villi and shortened crypts indicates optimal gut health and functionality observed across the experimental groups. In conclusion, threonine supplementation above the NRC (1994) recommendations had no significant impact on growth performance or gut morphology of broiler chicks, suggesting sufficient threonine in the basal diet.

Keywords: Threonine, Growth performance, Gut morphology, Broiler chicks

DESCRIPTION OF PROBLEM

Genetic advancements, physiological knowledge, management innovations, and nutritional optimizations have collectively contributed to enhanced production efficiency in the poultry industry. Threonine is an essential amino acid in animals, especially poultry, necessitating dietary provision with special significance in animals since it impacts intestinal homeostasis, macromolecular biosynthesis, and nutrient messtabolism (1). Studies have shown that adequate inclusion of threonine in the diet can optimise animal growth, enhance immune function, and maintain intestinal integrity (2). However, despite the established importance of threonine in broiler nutrition, there exists a knowledge gap regarding the effects of supplementing threonine beyond the recommended levels set by the National Research Council (3). Therefore, this study investigated the impact of dietary L-threonine supplementation above the NRC recommendation on growth performance and gut morphology of broiler chicks, with the objective of providing valuable insights to optimize threonine nutrition and further enhance production efficiency.

MATERIALS AND METHODS

Experimental site

The study was conducted at the Poultry Unit of the Teaching and Research Farm, University of Ibadan.

Experimental animals, diets, design, and management

A total of 200 Ross-308 strain broiler chicks were weighed and randomly assigned to four dietary treatment groups, with five replicate pens of 10 chicks each, and resulting in 40 birds per treatment. The compounded feeds were prepared for each feeding phase to meet the bird's nutritional requirement. The basal diets consisted of metabolisable energy and crude protein levels of 2963.98 kcal/kg and 23.39% respectively.

Experimental layout

Treatment 1: Basal diet + 0% threonine
Treatment 2: Basal diet + NRC threonine recommendation
Treatment 3: Basal diet + 15% > NRC threonine recommendation
Treatment 4: Basal diet + 30% > NRC threonine recommendation.

Data collection

Growth performance

Feed intakes (FI), body weights gain (BWG), and feed conversion ratio (FCR) were calculated on weekly intervals from day 0 to day 14. The FI was obtained by subtracting leftover feed from total feed offered, BWG was obtained by subtracting initial weight from final weight and FCR was calculated by dividing feed intake by weight gain while mortality was appropriately documented.

Gut morphology

Gut morphology was evaluated at day 14 by excising the jejunal segments from two birds per replicate. The intestinal samples were fixed, embedded in paraffin wax, and stained with hematoxylin-eosin. Morphometric indices measured included villus height, villus length, cryptal depth, cryptal width and muscle thickness.

Statistical analysis

The data were analyzed using descriptive statistics and ANOVA (P=0.05) in JMP (2017). Treatment means were compared using Tukey's HSD test to determine significant differences.

RESULTS AND DISCUSSION

Growth performance of broiler chicks fed L-threonine supplemented diet

The growth parameters of broiler chicks fed L-threonine supplemented diets are shown in Table 1. The growth performance of broiler chicks indicated that threonine supplementation above NRC (1994) recommendation had no significant difference ($p>0.05$) on growth performance, as evidenced by similar weight gain, total feed intake, and feed conversion ratio across all treatment groups. The results of the current study are consistent with findings of Chee *et al*. (4), who similarly observed no effects of dietary threonine variation on feed intake, body weight gain, or feed conversion ratio in broilers during a 21-day study. These results are also in accordance with the findings of Dozier *et al*. (5) and Rama-Rao *et al*. (6), who reported no improvement in performance with crystalline threonine supplementation in broilers. The non-significant differences observed across treatments may be attributed to the sufficient levels of threonine already present in the basal diet, which likely rendered additional L-threonine supplementation unnecessary and devoid of further benefits.

Table 1: Growth performance of broiler chickens fed L-threonine supplemented diets

Parameters	0%L-Thr	NRC	15%>NRC	30%>NRC	SEM	P-value
IW (g/b)	44.05	44.00	44.72	43.72	0.23	0.46
FW (g/b)	211.15	208.82	207.46	214.85	1.93	0.56
WG (g/b)	167.46	164.82	162.74	171.13	1.91	0.45
TFI (g/b)	305.84	286.89	304.25	294.97	3.69	0.16
FCR	1.83	1.74	1.87	1.73	0.03	0.16

Means on the same row with different superscripts are significantly ($P<0.05$) different. T1=0%L-Thr, T2=NRC, T3=15%>NRC, T4=30%>NRC. IW: Initial Weight; FW: Final Weight; WG: Weight Gain; TFI: Total Feed Intake; FCR: Feed Conversion Ratio; SEM: Standard Error of Mean.

Gut morphology of broiler chicks fed L-threonine supplemented diets

The gut morphological indices of broiler chicks fed L-threonine supplemented diets (Table 2) showed no significant differences ($p>0.05$) in morphological parameters across treatments. The presence of elongated villi and shortened crypts indicates optimal gut health and functionality (7), suggesting that all experimental diets supported optimal gut health. Result of the finding contradicts Moghaddam *et al*. (8) who found that Ross 308 broilers require 0.87% synthetic threonine in starter feed, exceeding the 0.80% recommendation by the National Research Council (NRC). Zaghari *et al*. (9) also reported significant influences of threonine

supplementation on villus height, muscular thickness, goblet cell number, and crypt depth in the duodenum, jejunum, and ileum of broilers from 1 to 21 days of age. However, the present result suggests that additional threonine supplementation did not provide further benefits in gut health and development, and indicating efficient utilization of threonine from the basal diet by the birds. In contrast, result of current findings align with Law *et al*. (10), who reported that supplementing with synthetic threonine up to 0.97% had no significant effect on the length of various intestinal segments.

Table 2: Gut morphology (µm) of broiler chickens fed L-threonine supplemented diets

Parameters	0%L-Thr	NRC	15%>NRC	30%>NRC	SEM	P-value
Villi height	3303.36	3275.59	3205.27	3147.18	44.99	0.67
Villi width	340.57	336.24	331.66	306.45	16.34	0.91
Cryptal depth	745.24	755.79	663.51	683.46	37.75	0.83
Cryptal width	342.29	337.35	323.78	304.86	16.04	0.88
Muscle thickness	271.49	317.34	296.56	297.80	8.88	0.37

SEM= Standard Error of Mean, T1=0%L-Thr, T2=NRC, T3=15%NRC, T4=30%NRC

CONCLUSION AND APPLICATION

The study shows that L-threonine supplementation above NRC (1994) recommendations had no significant impact on growth performance or gut morphology of broiler chicks, suggesting sufficient threonine in the basal diet which was below the NRC recommendation. Optimisation of broiler chicks' diet by ensuring adequate threonine levels in the basal diet is very essential. However, the levels above the NRC recommendation used in this study did not compromise the birds' overall performance

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Monogastric Animal Production: MGP 047

INFLUENCE OF DIETARY PHYTOGENICS ON HAEMATOLOGICAL AND SERUM BIOCHEMICAL PARAMETERS OF WEANLING PIGS

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ABSTRACT

The overuse and misuse of antibiotics could contribute to antimicrobial resistance which is detrimental to both livestock and humans, thereby posing great risks to public health. In view of this, there is need to explore antibiotics alternatives for sustainable livestock production. In a six-week study, 48 Large white x Landrace growing male pigs of initial weight (7.50±0.50 kg) were randomly assigned to eight dietary treatments to examine the influence of *Justicia secunda* (JS), scent leaf (SL), and bamboo charcoal (BC) on blood parameters of pigs. Treatment 1 had No supplementation (T1, Control); while treatments 2, 3, 4, 5, 6, 7 and 8 contained 30g/kg *Justicia secunda* (T2); 50g/kg scent leaf (T3); 10g/kg bamboo charcoal (T4); 10g/kg bamboo charcoal + 30g/kg *J. secunda* (T5); 10g/kg bamboo charcoal + 50g/kg scent leaf (T6); 30g/kg *J. secunda* + 50g/kg scent leaf (T7) and 10g/kg bamboo charcoal + 30g/kg *J. secunda* + 50g/kg scent leaf (T8) respectively. At $\alpha_{0.05}$, significant differences were observed among the treatments for blood parameters analysed. Pigs fed 3%JS+1%BC diet had the higher PCV (46.5%) than other treatments, while pigs fed control diet had the least (30.0%), which was similar to that of pigs fed 5% SL diet (32.5%). Pigs fed 3%JS+5%SL+1%BC diet had the least WBC (5.20 $x10^9$/L) compared to other treatments. Pigs fed 3%JS+5%SL+1%BC diet had the lower globulin (3.45 g/dl), AST (39.50 µ/L), ALT (34.50 µ/L) and ALP (188.50 µ/L) values compared to other treatments. In conclusion, dietary inclusion of *Justicia secunda*, scent leaf, and bamboo charcoal singly or their combinations improved blood parameters of weanling pigs.

Keywords: Phytogenics, Haematology, Serum biochemistry, Weanling pigs

DESCRIPTION OF PROBLEM

The discontinuous use of antibiotics in swine production may have serious negative consequences on animals' health and performance. This is due to impaired immunological response to pathogenic microbes, especially on newly weaned pigs and warrants changes in nutritional and management strategies (1). The use of phytogenics, bacteriophages, prebiotics, probiotics, eubiotics and organic minerals have been suggested by some researchers as potential alternatives to antibiotics in livestock production (2). Phytogenic compounds are secondary plant metabolites, which are responsible for the colour and odour of plants (1). They contain various bio-active substances such as thymol, eugenol, carvacrol, cineole, capsaicin and several others which are known for their antifungal, antibacterial, antioxidant and antiviral effects (3). Phytogenic feed additives (PFAs) have been reported to exhibit anti-inflammatory, antioxidative, and immunomodulatory effects in livestock (4). The aim of this study was to evaluate the influence of *Justicia secunda*, scent leaf, and bamboo charcoal on blood characteristics of pigs.

MATERIALS AND METHODS

Experimental Location

The feeding trial was carried out at the Pig Unit, Teaching and Research Farm, University of Ibadan, Ibadan, Nigeria (GPS Coordinates: 7.4432ºN, 3.9003ºE). University of Ibadan Animal Care and Use Research Ethics Committee approved experimental procedures before the commencement of the study (Approval ID: 23/067).

Preparation of Test Ingredients

The fresh plant materials of *Justicia secunda* V. and *Ocimum gratissimum* were sourced from Atisbo Local Government, Tede, Oyo State, Nigeria. Identification and authentication of the plant was carried out at

Department of Botany, University of Ibadan. The leaves were dried under room temperature (air-dry) for 30 days until constant weights were maintained, and milled using a hammer mill. The milled leaves were stored in clean air-tight bags until use. Bamboo charcoal was prepared through the following process. Bamboo (*Bambusa vulgaris* S.) chips of 1 cm (width) x 2 cm (length) were sourced from Atisbo Local Government, Tede, Oyo State, Nigeria, and subjected to heat at 400^{o}C in a muffle furnace for 72 hours and then allowed to cool to room temperature. The charcoal was ground using a hammer mill and sieved, then stored in clean air-tight bags until use.

Animal, Experimental Design and Diets

A total of forty-eight Large white x Landrace weanling male pigs (7.50±0.50 kg initial body weight) were sourced from the Pig Unit, Teaching and Research Farm, University of Ibadan, Ibadan, Nigeria for a 6-week study. The pigs were randomly assigned to eight dietary treatments. Each treatment was replicated three times, with two pigs per replicate. A completely randomised design was used for the study. Diets were formulated to meet the nutrient requirements recommended by (5), and the treatments were: No supplementation (T1, Control); 30g/kg *Justicia secunda* (T2); 50g/kg scent leaf (T3); 10g/kg bamboo charcoal (T4); 10g/kg bamboo charcoal + 30g/kg *J. secunda* (T5); 10g/kg bamboo charcoal + 50g/kg scent leaf (T6); 30g/kg *J. secunda* + 50g/kg scent leaf (T7); 10g/kg bamboo charcoal + 30g/kg *J. secunda* + 50g/kg scent leaf (T8). The pigs were allowed to access feed and water *ad libitum.* All other routine management practices were carried out in accordance with general practices.

Blood Analyses

At day 42, blood samples were obtained from the jugular vein by vena cava puncture from all the pigs after an overnight fast, and collected into non-heparinised tubes and vacuum tubes containing K_3EDTA to obtain serum and whole blood, respectively. Serum samples were centrifuged at 3000 rpm for 15 min at 24°C and the blood samples were stored at −20°C for later analysis. Blood samples were analysed for haematological parameters using a haemocytometer, and serum biochemical parameters using an automatic biochemical analyser (Shimadzu CL-7200, Shimadzu, Kyoto, Japan).

RESULTS

Haematological responses of weanling pigs fed phytogenic-supplemented diets

The haematological responses and serum biochemistry of weanling pigs fed phytogenic-supplemented diets are presented in Table 1. Significant (P<0.05) differences were observed among the treatments for all the haematological parameters. Pigs fed 3%JS+1%BC diet had higher packed cell (46.5%) compared to other treatments, while pigs fed control diet had the least (30.0%), which was similar to that of pigs fed 5%SL diet (32.5%). Pigs fed 3%JS+5%SL+1%BC diet had lower white blood cells (5.20 x10^{9}/L) than other treatments. Higher lymphocyte values were recorded for pigs fed 3%JS+1%BC (58.0%), 3%JS (57.5%), 5%SL+1%BC (55.5%) diets compared to other treatments, which were similar to that of pigs fed 1%BC diet (53.5%). Significant (P<0.05) differences were observed among the treatments for all the serum biochemical parameters. Pigs fed 3%JS+5%SL+1%BC diet had lower globulin (3.45 g/dl), aspartate transaminase (AST) (39.50 µ/L), alanine transaminase (ALT) (34.50 µ/L) and alkaline phosphatase (188.50 µ/L) values compared to other treatments. Pigs fed control diet had higher AST value (60.00 µ/L) compared to other treatments, which was similar to those of pigs fed 1% BC (55.50 µ/L), 3% JS + 5% SL (53.50 µ/L), and 5% SL (53.00 µ/L) diets.

DISCUSSION

Haematological and serum biochemical parameters are used by researchers and veterinarians in evaluating the conditions of animals' health (6). Elevated red blood cells levels were observed with dietary supplementation of *Justicia secunda*, scent leaf, and bamboo charcoal in the present study. (7) documented similar observation when *Coptis chinesis* was supplemented at 1.0 g/kg in the diets of pigs. The increased RBC production observed in pigs fed 3%JS could be attributed to the presence of flavonoid and alkaloid in *J. secunda* which could have enhanced erythropoietin synthesis in the kidney. Erythropoietin is a

glycoprotein produced by the endothelial cells of the kidney's peritubular capillary which regulates erythropoiesis (7).

Table 1: Haematological responses and serum biochemistry of weanling pigs fed phytogenic-supplemented diets

Parameters	CON	3%JS	5%SL	1%BC	3%JS+ 1%BC	5%SL+ 1%BC	3%JS+ 5%SL	3%JS+ 5%SL+ 1%BC	SEM	P-value
PCV (%)	30.00^{d}	37.00^{bc}	32.50^{cd}	35.50^{bc}	46.50^{a}	40.00^{b}	37.00^{bc}	37.50^{bc}	0.88	0.000
Hb (g/dl)	9.60^{d}	11.90^{bc}	10.45^{cd}	11.30^{bcd}	15.20^{a}	13.00^{b}	12.10^{bc}	12.05^{bc}	0.32	0.000
RBC ($x10^{12}$/L)	4.77^{c}	5.81^{bc}	4.79^{c}	5.74^{bc}	7.91^{a}	6.42^{b}	5.87^{bc}	6.27^{b}	0.18	0.000
WBC ($x10^{9}$/L)	10.28^{b}	7.65^{c}	9.28^{b}	9.50^{b}	10.43^{b}	9.75^{b}	12.13^{a}	5.20^{d}	0.33	0.000
LYM (%)	47.00^{c}	57.50^{a}	42.00^{d}	53.50^{ab}	58.00^{a}	55.50^{a}	47.00^{c}	49.50^{bc}	0.95	0.000
NEUT (%)	46.00^{ab}	38.50^{cd}	49.50^{a}	38.50^{cd}	34.50^{d}	34.00^{d}	45.50^{ab}	43.00^{bc}	0.97	0.000
TP (g/dl)	7.25^{a}	6.90^{a}	7.30^{a}	7.35^{a}	7.00^{a}	7.05^{a}	7.30^{a}	6.20^{b}	0.09	0.016
ALB (g/dl)	2.95^{abc}	2.60^{c}	2.90^{abc}	3.20^{a}	2.85^{abc}	3.05^{ab}	3.00^{ab}	2.75^{bc}	0.05	0.033
GLO (g/dl)	4.30^{ab}	4.30^{ab}	4.40^{a}	4.15^{ab}	4.15^{ab}	4.00^{b}	4.30^{ab}	3.45^{c}	0.05	0.000
AST (µ/L)	60.00^{a}	50.50^{b}	53.00^{ab}	55.50^{ab}	50.50^{b}	39.50^{c}	53.50^{ab}	39.50^{c}	1.37	0.000
ALT (µ/L)	47.50^{a}	40.50^{b}	40.50^{b}	42.00^{b}	40.00^{b}	41.00^{b}	41.50^{b}	34.50^{c}	0.76	0.002
ALP (µ/L)	210.50^{abc}	205.00^{c}	220.00^{ab}	215.00^{abc}	206.00^{bc}	221.50^{a}	213.00^{abc}	188.50^{d}	2.04	0.000
BUN (mg/dl)	12.60^{a}	12.15^{a}	12.20^{a}	12.55^{a}	12.75^{a}	12.90^{a}	12.25^{a}	10.65^{b}	0.15	0.002
CRT (mg/dl)	1.50^{a}	1.10^{bc}	1.25^{abc}	1.25^{abc}	1.10^{bc}	1.10^{bc}	1.40^{ab}	1.05^{c}	0.04	0.017

^{a,b,c,d} Means in the same row with different superscripts differ (P<0.05); CON = control diet; JS = *Justicia secunda* leaf; SL = scent leaf; BC = bamboo charcoal; SEM = standard error of mean; PCV = packed cell volume; Hb = haemoglobin; RBC = red blood cells; WBC = white blood cells; LYM = lymphocyte; NEUT = neutrophil; TP = total protein; ALB = albumin; GLO = globulin; AST = aspartate aminotransferase; ALT = alanine aminotransferase; ALP = alkaline phosphatase; BUN = blood urea nitrogen; CRT = creatinine.

Aspartate aminotransferase and alanine aminotransferase levels provide information tissue injury and are estimated to diagnose liver damage (8). Stress arising from inflammation and oxidation of cells could damage liver cells. This could cause the enzymes of the cytoplasm to leak into the blood, thereby increasing the activities of plasma enzymes. Dietary supplementation of *J. secunda*, scent leaf, and bamboo charcoal reduced the ALT and AST levels of the pigs in comparison with pigs fed control diet. This could be attributed to the phenols in *J. secunda*, scent leaf, which exhibited antioxidative effect against damage of tissue by reactive oxygen species, and ability of bamboo charcoal to bind to free radicals, thereby preventing cellular damage.

Blood creatinine and urea levels are determined to evaluate the functioning of the kidney; higher levels suggest reduced ability of the kidney to excrete waste products, implying kidney damage (9). Synergistic effect was observed with the combination of *J. secunda*, scent leaf, and bamboo charcoal in the diet of the pigs as blood creatinine and urea levels were decreased. The observed nephroprotective activity could have been brought about by the interactions among the bioactive substances in *J. secunda* and scent leaf and toxin-

binding activity of bamboo charcoal. Polyphenols of plants have been reported to exhibit chemoprotective activity against damage of the kidney (10).

CONCLUSION AND APPLICATION

In conclusion, dietary inclusion of *Justicia secunda*, scent leaf, and bamboo charcoal singly or their combinations improved blood parameters of weanling pigs. Therefore, it is recommended that *J. secunda*, scent leaf, and bamboo charcoal could be included in the diets of weanling pigs to enhance the health status of the animals.

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Monogastric Animal Production: MGP 048

BLOOD INDICATORS OF FINISHER BROILER CHICKENS ADMINISTERED NEEM (*Azadirachta indica*) AND MORINGA (*Moringa oleifera*) LEAF EXTRACTS

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ABSTRACT

This study evaluated the effects of neem and moringa leaf extracts on blood indicators of 120 Ross 308 finisher broiler chickens (4 weeks old). Neem and moringa leaves were harvested, sorted, washed, air-dried (5days), ground, and stored in air-tight polythene bags. Equal quantities were mixed: 5g Neem + 5g Moringa, 10g Neem + 10g Moringa, and 15g Neem + 15g Moringa, soaked in 1l of boiled water for 12 hours, sieved to obtain the mixed extracts: NM5, NM10, and NM15, respectively; refrigerated in plastic bottles, and renewed every three days. Using a completely randomized design, four broiler chicken groups of 30 chickens each, replicated thrice (10 per replicate) were randomly assigned to 10mls of extracts per litre of water as follows: T1 (Control), T2 (NM5), T3 (NM10), and T4 (NM15). Feed and water containing the extracts were given *ad libitum* for 3 weeks. Blood samples were collected in EDTA and Bijou bottles for haematoserological assays: haemoglobin, RBC, WBC, PCV, platelets, lymphocytes, heterophils, eosinophils, monocytes, AST and ALT. All the parameters showed significant ($p<0.05$) differences among the groups, except eosinophils and monocytes. The highest values of these parameters, which were within the normal range, were from birds in T2 and T3, but heterophils were significantly lower ($p>0.05$) in the treated groups, pointing to the possibility of impaired immunity. In conclusion, 10ml/l of the mixed extracts could impair the immunity of finisher broiler chickens.

Key words: Haematological indices, Serum enzymes, Neem, Moringa, Mixed extracts

DESCRIPTION OF PROBLEM

There is a global move to remove antibiotic growth promoters (AGP's) from animal production, leading to the exploration of other measures to sustain production and reduce the incidence of diseases in the post-AGP era [1]. One of such measures is the use of natural and safe alternatives such as phytogenics, containing natural bioactive compounds derived from plants [2]. The integration of herbal plants and their extracts into the ration of farm animals have been reported to enhance their productivity, welfare, and general well-being [3]. Consequently, plant derived products such as leaf extracts, have been used to improve the performance and overall health of broiler chickens [4].

Moringa (*Moringa oleifera*) and Neem (*Azadirachta indica*) are among the plants commonly used in poultry production as feed supplements to improve growth performance and health [5, 6]. Their leaves are rich in nutrients, including protein, amino acids, and antioxidants, which can enhance growth and egg production in poultry [7]. Moringa leaves contain appreciable amount of crude protein (17.01%), carbohydrates, crude fibre and fatty acids, and minerals such as K, Na, Fe, Mn, Zn, P, Mg and Cu [8]. Neem has been refered to as as a wonder plant due to its versatile applications [9]. Its leaves also have nutritional and medicinal properties that can benefit poultry health and performance [10]. The synergistic effects of some phytobiotics on the growth and health of broiler chickens have been demonstrated [11]. Some reports have shown that some constituents of phytobiotics have synergistic effects [12, 13]. However, Nyeleka [14] posited that research on plant-derived feed additives, which is ongoing, is mainly focused on production parameters such as weight gain and portion sizes where broilers are reared in ideal or optimum environmental conditions. Therefore, there is the need to explore their effects on blood indicators, which suggests the physiological disposition of the animals to their nutrition [15]. According to [16] moringa and neem have the potential to enhance the haematological parameters in broiler chickens, which this study explores further.

MATERIALS AND METHODS

Neem and moringa leaves, harvested from the Teaching and Research Farm of the Rivers State University, Port Harcourt, were separated from the stems, sorted, spread in a shade and allowed to dry for 3 - 5 days without direct exposure to sunlight. Regular turning was done to hinder the growth of fungi until they became crispy to touch, but still remain green. The leaves were ground into powdered form with a GX390 grinding machine, weighed in 5, 10 and 15g units with an electronic scale, and stored in air-tight polythene bags. Equal proportions were mixed (5g Neem + 5g Moringa, 10g Neem + 10g Moringa, and 15g Neem + 15g Moringa), soaked in 1l of boiled water each for 12 hours, and sieved to obtain the mixed extracts: NM5, NM10, and NM15, respectively. The extracts were stored in labelled plastic bottles in a refrigerator, and renewed every 3 days.120 unsexed 4 weeks old Ross 308 finisher broiler chickens were allotted, in a completely Randomized Design, to four groups of 30 chickens each, divided into 3 replicates of 10 each. Each treatment, except the control, was assigned to 10mls per litre of extracts as follows: T1 (Control), T2 (NM5), T3 (NM10), and T4 (NM15). Water containing the extracts, and feed were offered to the chicks *ad libitum* for three weeks (5^{th} -7^{th} weeks). Other routine management practices were strictly observed. Blood samples (5ml) were collected, from 3 chickens per replicate (starved overnight and slaughtered) into EDTA and Bijou bottles for haematological (haemoglobin, red blood cells, white blood cells, packed cell volume, platelets, lymphocytes, heterophils, eosinophils, monocytes), and serum enzymes (Aspartate Aminotransferase -AST and Alanine Aminotransferase - ALT) assays, respectively. Data collected were subjected to analysis of variance and significant means were separated by Duncan New Multiple Range Test with a statistical software [17].

RESULTS AND DISCUSSION

Blood indicators suggest the physiological disposition of the animals to their nutrition [15]. There were significant differences ($p<0.05$) in all parameters except eosinophils and monocytes (Table 1). The highest values of PCV, Haemoglobin, RBC and platelets: 11.93±0.12, 5.77±0.06, 33.00±3.00, and 258.00±1.73, respectively, were recorded in T3. However, they were within the normal ranges for broiler chickens [18], indicating that the extracts were not toxic. The results agree with [19, 6] using mixtures of different extracts including neem and moringa. This indicates adequacy of nutrients, absence of toxicity, and a better immune status in the broiler chickens [20]. Heterophils, the first defenders during infections, together with lymphocytes and macrophages, boost immunity in animals (21). The values of lymphocytes were within the normal range while heterophils were reduced, indicating immunological stress (22).

Table 1 Haematological responses of finisher broiler chickens to Neem and Moringa leaf extracts

Parameters	T1 (Control)	T2 (10ml NM5/l of water)	T3 (10ml NM10/l of water)	T4 (10ml NM15/l of water)
Hb (g/dl)	$10.67±0.65^{b}$	$8.93±0.32^{c}$	$11.93±0.12^{a}$	$9.87±0.70^{bc}$
RBC (10^3/ul)	$5.53±0.70^{ab}$	$4.33±0.15^{c}$	$5.77±0.06^{a}$	$4.83±0.21^{bc}$
WBC(10^3/ul)	$6.00±0.44^{d}$	$9.03±0.42^{a}$	$7.60±0.17^{b}$	$6.83±0.35^{c}$
PCV (%)	$32.00±2.00^{a}$	$26.33±1.53^{b}$	$33.00±3.00^{a}$	$29.67±2.08^{ab}$
Platelets (10^3/ul)	$178.33±3.51^{c}$	$225.00±13.23^{b}$	$258.00±1.73^{a}$	$221.67±4.16^{b}$
Heterophils (%)	$43.33±1.53^{a}$	$32.67±2.52^{b}$	$35.67±2.52^{b}$	$34.33±3.06^{b}$
Lymphocytes (%)	$46.67±1.53^{b}$	$61.00±2.65^{a}$	$58.67±1.53^{a}$	$60.33±4.73^{a}$
Eosinophils (%)	3.33±0.58	2.67±0.58	2.33±0.58	2.67±0.58
Monocytes (10^3µl)	5.33±0.58	5.67±0.58	4.00±1.00	4.00±1.00

^{abcd} Means with diff=erent superscripts across each row are significantly different ($p<0.05$)
Key: NM5- Extract from 5g neem+5g moringa leaf meal; NM10- Extract from 10g neem+10g moringa leaf meal; NM15- Extract from 15g neem+15g moringa leaf meal; PCV- Packed cell volume; Hb – Haemoglobin; RBC – Red blood cells; WBC – White blood cells.

Table 2 Serum Enzymes Indices of Finisher Broiler Chickens to Neem and Moringa leaf extracts

Parameters	T1 (Control)	T2 (10ml NM5/l of water)	T3 (10ml NM10/l of water)	T4 (10ml NM15/l of water)
Aspartate Amino-tansferase U/l	27.67±4.73[b]	47.67±4.51[a]	27.67±7.51[b]	36.00±5.57[b]
Alanine Amino transferase U/l	7.33±0.58[b]	20.00±1.00[a]	18.00±1.00[a]	19.00±1.73[a]

[abc] Means with different superscripts across each row are significantly different ($p < 0.05$)
Key: NM5: Extract from 5g neem+5g moringa leaf meal; NM10; Extract from 10g neem+10g moringa leaf meal; NM15: Extract from 15g neem+15g moringa leaf meal.

Significant differences ($p<0.05$) were observed in Aspartate Aminotransferase (AST) and Alanine Aminotransferase (ALT). T2 recorded the highest values of AST (47.67±4.51) and ALT (20.00±1.00) (Table 2). However, the values were within the normal ranges of 8-48 U/L, and 7-55 U/L, for AST and ALT, respectively [22]. Serum enzyme levels are used as diagnostic tools to evaluate hepatotoxicity of exogenous substances [20]. According to [23], high AST levels, along with Alanine Aminotransferase (ALT) and lactate dehydrogenase (LDH) levels, could be a sign of toxicity in broiler chickens, which are also indicators of hepatocellular damage and oxidative stress. Considering the increased levels of AST and ALT, there are indications that higher doses of the extracts could be hepatptoxic, since such levels are associated with liver injury or impaired function [24].

CONCLUSION AND APPLICATIONS

It was concluded that 10ml/l of the combined extracts could cause impaired immunity in finisher broiler chickens, and higher doses may potentially injure the liver and impair its function.

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Monogastric Animal Production: MGP 049

HAEMATOLOGICAL INDICES OF BROILERS ADMINISTERED BAMBOO (*BAMBUSA VULGARIS*) LEAF EXTRACT

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ABSTRACT

The experiment was carried out for a period of 8weeks to evaluate the effect of inclusion of aqueous bamboo leaf extract (BLE) in drinking water of broiler on haematological parameters. A total of ninety-six (96) day old chicks (Ross) were used for the experiment. The birds were randomly grouped into four treatments consisting of four replicates with six birds per replicate in a completely randomized design. The treatment used were labeled T1 (Control), T2 (Antibiotics), T3 (50ml BLE), T4 (100ml BLE). On the 56th day, blood samples were collected for haematological analysis into a bottle containing ethylene diamine tetra acetic acid (EDTA). The data obtained were subjected to one way analysis of variance SAS (2009). Results showed significant ($P<0.05$) effect of aqueous BLE on PCV and Hb. The inclusion of aqueous BLE at 100ml increased the level of PCV and Hb values. No significant ($P>0.05$) difference in heterophil (HT), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) across all treatments. Inclusion of aqueous BLE at 100ml/L increased the level of RBC values. It was concluded that inclusion of aqueous bamboo leaf extract at 100ml/L in drinking water of broiler is recommended for increase in level of PCV and Hb.

Keywords: Broilers, phytogenic plants, bamboo leaf extract, haematology

INTRODUCTION

Broiler (*Gallus gallus domesticus*) are chickens that are bred and raised specifically for meat production and its production has increased due to consumer demand for affordable poultry meat (1). Poultry diseases are considerable obstacles and disease outbreaks can cause severe impact on the general health and productivity of birds leading to economic losses (2). Antibiotics like tetracycline, bacitracin and tylosin, are frequently used in intensive chicken husbandry to promote growth (3). The widespread and indiscriminate usage has resulted in antimicrobial resistance (4) which necessitated the search for sustainable alternatives without adverse effect.

Bamboo leaves have been reported to contain active ingredients such as flavonoids, vitamin C, polyphenols, and active polysaccharides (5) which qualifies it as suitable alternative to antibiotics. The potency of bamboo may be attributed to the presence of bioactive compounds that exhibits antimicrobial and immunomodulatory effects, which can positively influence the immune response (6). The investigation by Zhang *et al*. (7) suggest that bamboo leaf extract may have potential health benefits for broilers, including its impact on blood parameters.

Haematological tests are important in detecting and diagnosing diseases such as anaemia, hemophilia and several infections (8). Haematological parameters are useful to veterinarians and researchers in monitoring the health and well-being of broiler chickens. Therefore, this study is designed to investigate the effect of bamboo leaf extract inclusion in water on haematological parameters of broilers.

MATERIALS AND METHODS

Experimental site

The experiment was carried out at the Poultry Unit, Teaching and Research Farm, School of Agriculture, Epe Campus, Lagos State University. The climate of Epe is classified as the tropical climate. It has an average temperature of 26.30ºC and precipitation or rainfall of about 1990mm per annum (9). Epe also has its latitude and longitude as 6º 35'2.83"N and 3º 59'0.10"E respectively (10).

Collection and preparation of bamboo leaf extracts

The bamboo extracts were prepared from fresh bamboo leaves collected from the bamboo (*Bambusa vulgaris*) plants within the premises of Lagos State University, Epe Campus. They were air-dried at room temperature and chopped into pieces. Water was boiled and the chopped bamboo leaves were poured into the boiled water at the quantity of 15 grams to 1litres. It was allowed to cool and macerate for about 48 hours after which the extracts were filtered and the leaves particles removed. Then, the extracts were stored in bottles at room temperature prior to usage.

Animal management, treatments and design

The day-old chicks were procured from a reputable hatchery and prior to the arrival of the birds, the brooding pens were cleaned, disinfected and heated to regulate the temperature of the day-old chicks. Wood shavings were provided as beddings on the floor, the feeders and drinkers were cleaned, disinfected and made available for feeding and providing water. The recommended vaccination schedules were also adhered to. A total of 96-day old broiler chicks were purchased and grouped into 4 treatments using a completely randomized design. Each treatment had 24 birds consisting of 4 replicates of 6 birds per replicate. The birds were raised for 8 weeks consisting of starter and finisher phases (4 weeks each). Diets were formulated at each phase (Table1) to meet the nutrient requirements of the birds according to NRC (11) and the treatments are: bamboo leaf extracts free (ordinary water), antibiotics (Tetranor 5% at 5g per litre of water), 50ml of bamboo leaf extracts per litre of water and 100ml of bamboo leaf extracts per litre of water

Blood collection for haematological parameters

On 56th day, blood was collected into bottles containing ethylene diamine tetra-acetic acid (EDTA) for the determination of haematology parameters. Packed cell volume (PCV), Hemoglobin (Hb), white blood cell (WBC) and red blood cell (RBC) were determined according to Lamb (12) while mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC) were calculated according to Bush (13)

Statistical analysis

All data collected were subjected to one-way analysis of variance using SAS (14). The significant means were separated using Tukey's test of the same software. Significant difference was considered at $P<0.05$

RESULTS AND DISCUSSION

Haematological parameters of broilers given aqueous bamboo leaf extract in drinking water

Table 2 shows the haematological parameters of broilers given aqueous bamboo leaf extract (BLE) in drinking water. The result shows that PCV of broilers given 100ml BLE is significantly higher ($p<0.05$) compared to those in the control group but statistically similar to the group of broilers given antibiotics and 50ml BLE. The increase in PCV suggests adequate nutrient availability and utilization by the birds. The range of PCV found in this study is 34.33- 43.33% which is higher than the range (28-35%) reported by Onyishi *et al*. (15) for broiler chickens aged five to seven weeks. Hemoglobin of broilers given 100ml BLE and those given antibiotics is significantly higher ($p<0.05$) compared to those given 50ml BLE but the broilers in the control group had intermediate hemoglobin content. This observation indicates that the inclusion of 100ml/l of BLE in drinking water of broilers could promote the well-being of the birds like that of antibiotics. It has been reported that the use of medicinal plants as feed supplements for both nutritional and therapeutic purposes to improve health status (16). Red blood cell of broilers in control group is

significantly higher ($p<0.05$) than those given 50ml BLE but RBC was intermediate for the group of broilers given antibiotics and 100ml BLE. This suggest that the constituents of the 100ml/l of BLE does not impair the health status of the birds since it is similar to those in the control group. The assessment of circulating red blood cells is crucial in the identification of anemia (17) and the result obtained in this study indicates that the broilers in the control, antibiotics, and 100ml/l BLE group are not suffering from anaemia.

Table 1: Composition of experimental diet

Ingredients (%)	Starter (0-28 days)	Finisher (29-56 days)
Maize	51	60
Soya bean meal	19	19
Groundnut cake	14	10
Fish meal	2	1
Wheat offal	10	6
Oyster	1	1
Bone	2	2
Lysine	0.25	0.25
Methionine	0.25	0.25
*Vitamin/Mineral Premix	0.25	0.25
Salt	0.25	0.25
Total	**100**	**100**
Calculated nutrients (%)		
**Metabolizable energy (Kcal/Kg)	2965.21	3067.24
Crude protein	22.65	19.42
Fat	4.10	3.89
Fiber	3.84	3.33
Calcium	1.30	1.22
Phosphorus	0.51	0.47
Lysine	1.29	1.13
Methionine	0.59	0.54
Ash	3.02	2.57

*Starter premix: vit. A10,000,000 IU, vit. D 32,500,000 IU, vit. E 23,000 mg, vit. K3 2,000 (mg), vit. B1 1,800(mg), vit. B2 5,500(mg), niacin 27,500 (mg), pantothenic acid 7,500 (mg), vit. D6 3,000(mg), vit. B12 (15mg), folic acid (750mg), biotin H2 60mg, chlorine chloride 300,000mg, cobalt 200mg, copper 3,000mg, iodine 1,000mg, iron 20,000mg, manganese 40,000mg, selenium 200mg, zinc 30,000mg.
*Finisher phase: vit. 8,500,000 IU, vit. D3 1,500,000 IU, vit. E 10,000 mg, vit K3 1,500 mg, vit. B1 1,600 mg, vit. B2 4,000 mg, niacin 20,000 mg, pantothenic acid 5,000 mg, vit. D6 1,500 mg, vit. B12 10mg, folic acid 500mg, biotin H2 750mg, chlorine chloride 175,000mg, cobalt 200mg, copper 3,000mg, iodine 1,000mg, iron 20,000mg, manganese 40,000 mg, selenium 200 mg, zinc 30,000 mg.
**Estimated using the Nutrient Requirement of Poultry, NRC (11) formulae, ME = 26.7 (%Dry matter) + 77 (%Ether extract) − 51.22 (%Crude fibre)

Broilers in the control group had higher ($P<0.05$) WBC count than those given antibiotics and 50ml BLE but statistically similar to those given 100ml BLE while the WBC count of broilers given antibiotics is statistically similar to those given 50ml BLE. The reduced WBC observed for the group of broilers given 50ml BLE could be due to the presence of phytochemicals in BLE while the increased WBC count observed in the control group could be due to the presence of foreign organisms such as bacteria, virus. Leucocytes are cells of the immune system involved in defending the body against both infections, and disease (18). Lymphocyte reduced ($p<0.05$) for group of broilers given 50ml/L and 100ml/L of BLE. The reduced lymphocyte observed for these group of broilers suggests that the broilers may not be facing health challenges because rise in circulating lymphocyte could be triggered in response to invading antibodies.

There was no significant (P>0.05) difference in Heterophil, MCV, MCH and MCHC across the four treatments. The values of MCH and MCHC obtained were within the normal range as reported by Bounous and Stedman (19) which suggests good health status of the birds.

Table 2: Haematological parameters of broilers given aqueous bamboo leaf extract in drinking water

Parameters	Control	Antibiotics	50ml (BLE)	100ml (BLE)	SEM	P-value
Packed cell volume (%)	34.33^{b}	41.00^{ab}	38.33^{ab}	43.33^{a}	1.23	0.023
Hemoglobin (g/dl)	13.87^{ab}	14.93^{a}	11.47^{b}	15.27^{a}	0.53	0.014
Red blood cell ($x10^{12}$/L)	3.50^{a}	3.03^{ab}	2.93^{b}	3.10^{ab}	0.79	0.025
White blood cell ($x10^{9}$/L)	19.43^{a}	13.73^{c}	15.73^{bc}	16.93^{ab}	0.68	0.001
Heterophil (%)	32.67	32.67	37.00	34.00	0.96	0.369
Lymphocytes (%)	70.00^{ab}	71.33^{a}	60.33^{c}	62.67^{bc}	1.58	0.004
Mean corpuscular volume (fl)	120.29	130.80	116.90	124.13	2.74	0.347
MCH (pg)	39.69	44.84	39.40	40.81	1.15	0.300
MCHC (g/dl)	33.03	34.28	33.40	32.81	0.32	0.433

^{ab}Means on the same row having different superscript are significantly different (P<0.05)
SEM= Standard error mean, BLE=Bamboo leaf extract, MCH= Mean corpuscular hemoglobin, MCHC= Mean corpuscular hemoglobin concentration

CONCLUSION

The inclusion of aqueous BLE in drinking water at 100ml/L increased the PCV and Hb compared to the control group. The WBC count reduced with oral administration of 50 and 100ml/L aqueous BLE compared to the control group while heterophil, MCV, MCHC and MCH were not significantly influenced across treatment. Therefore, aqueous BLE can be included in the drinking water of broilers at100ml/L for good health status.

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CARCASS AND ORGAN CHARACTERISTICS OF BROILER CHICKENS FED DIFFERENT VARIETIES OF MILLET

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ABSTRACT

This study assessed the effects of pearl millet, foxtail millet, and sorghum millet on the carcass and organ characteristics of broiler birds. Treatments were: maize (T1/control), pearl millet (T2), foxtail millet (T3), and sorghum millet (T4). 120-day-old broiler chicks were randomly divided into four groups of 30 birds each, assigned to the four diets in a completely randomized design, replicated three times for 10 birds per replicate. Data collected for carcass characteristics included live weight, bled weight, defeathered weight, eviscerated weight, carcass weight, carcass yield, head, neck, breast meat, wing, thigh, shank, back, and relative organ weights. Data were analyzed by one-way ANOVA. Results showed that live weight, bled weight, eviscerated weight, drumstick weight, abdominal fat, proventriculus, and eviscerated gizzard were significantly affected ($P<0.05$) by the dietary energy sources. Defeathered weight, carcass yield, and the weight of the head, neck, breast muscle, wing, thigh, shank, back, and internal organs were not significantly affected ($P>0.05$). Birds fed other cereals (pearl millet, foxtail millet, and sorghum millet) were similar to the control in terms of live weight, bled weight, eviscerated weight, carcass weight, and drumstick weight. Abdominal fat was lower ($P<0.05$) in birds fed pearl millet and foxtail millet compared to those given maize. In conclusion, maize can be replaced with pearl millet, foxtail millet, or sorghum millet in broiler diets without adverse effects on carcass characteristics.

Keywords: Carcass Characteristics, Broiler Birds, Millet, Dietary Energy Source, Abdominal Fat

DESCRIPTION OF PROBLEM

Maize is frequently used as a significant nutritional energy source in poultry and human nutrition, as well as for industrial purposes thereby creating intense competition for its supply (Kumaravel, 2014). Due to this intense competition, its price in the market has become unpredictable and is no longer viable for small- and medium-scale poultry producers (Dhillon & Moncur, 2023), hence threatening the sustainability and profitability of their operations (Sogue, 2019). The poultry industry faces potential collapse due to lack of affordable feed sources, leading to reduced production, higher prices, and financial losses; sorghum, containing anti-nutritional factors, can negatively impact birds' performance (Moses et al., 2024). Pearl millet and foxtail millet are potential alternatives to sorghum due to their high nutritional content and health benefits, making them promising for poultry feed (Raju et al., 2024). Therefore, this study aims to evaluate the impact of alternative millets on carcass and organ characteristics, aiming to stabilize feed costs and promote poultry industry sustainability by identifying viable alternatives.

MATERIALS AND METHODS

Experimental Site

The experiment was carried out at the poultry unit of Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso, Oyo state, Nigeria.

Experimental animals, Diets, design, and management

A total of 120 day old mixed sexes of Ross 308 broilers were individually weighed and randomly allocated to four dietary treatments, with 30 birds divided into three replicates of 10 birds each in a completely randomized design. The diets were formulated to meet the birds' nutritional requirements. Four experimental diets were formulated using diet 1 as the control with maize as the energy source. Diet 2 contained pearl millet as the energy source, diet 3 contained foxtail millet as the energy source, and diet 4 contained sorghum millet as the energy source of the diet. The birds were reared on a deep litter. Feed and water were given ad-libitum. Routine medication and vaccination program were strictly adhered to as required. The experiment lasted for eight (8) weeks.

Data collection and Analysis

At the end of the experiment, two birds per replicate (6 birds per treatment) were randomly selected for carcass and relative organ weight evaluation. For carcass and organ evaluation, feed was withdrawn from the birds for 12 hours (overnight) and weighed the following morning. The birds were slaughtered and the bled weights were determined after the birds were drained of blood. Thereafter, they were de-feathered and eviscerated of all internal organs, and the respective weights were documented. The head and the shanks were removed to determine the carcass weight and this was used in evaluating the dressing percentage. The carcass was separated into different prime cuts. The following carcass cut and organs were weighed and expressed as a relative value of the carcass weight.

Carcass cuts: Head, Neck, Back, Breast, Drumstick, Thing and Shank.

Organs: Heart, Kidney, Proventriculus, Gizzard, Spleen, and Liver.

Further, the dressing percentage was calculated as carcass weight/live weight

Statistical analysis

Data collected were subjected to a One-way analysis of variance (ANOVA) using statistical packages of SAS (1999) and means with significant differences were separated using Duncan's multiple Range Test.

RESULTS AND DISCUSSION

Carcass Characteristics

Live weight, bled weight, eviscerated weight, carcass weight, and drumstick weight were significantly ($P<0.05$) influenced by the type of energy source in the diet. This result is inconsistent with the findings by Bakoshi et al (2023) who found that no influence ($p>0.05$) across the treatment groups, but supported by Kawu et al. (2020) study which showed a significant ($P<0.05$) influence on carcass weight and dressing percentage. However, defeathered weight, carcass yield, and the weights of the head, neck, breast muscle, wing, thigh, shank, drumstick, and back were not significantly ($P>0.05$) affected. This finding is consistent with that of Abdullah et al. (2005), who noted that while overall body weight and some carcass traits can be diet-sensitive, others remain relatively unaffected.

Organ Characteristics

There were no significant effects ($P>0.05$) on the kidneys, lungs, heart, spleen, filled gizzard, liver, pancreas, small intestine weight, small intestine length, caecal weight, and caecal length. However, the weights of abdominal fat, eviscerated gizzard, and proventriculus were significantly ($P<0.05$) affected by the dietary sources of energy. Notably, birds fed with pearl millet and foxtail millet had lower abdominal fat compared to those fed with maize and sorghum millet. This reduction in abdominal fat is supported by the findings of Kumar et al. (2016), who reported that broilers fed with millet-based diets exhibited lower fat deposition compared to those on maize-based diets. The study also found that the proventriculus and eviscerated gizzard weights were larger in birds fed with maize compared to those given foxtail millet and pearl millet. These results are consistent with the observations of Hassan et al. (2003), who noted that maize-fed broilers tended to have larger gastrointestinal organs due to the higher fiber content in maize, which requires more digestive effort.

Table 3: Carcass characteristics of broiler chicken fed pearl millet, foxtail millet and sorghum millet

Parameters	T 1 (Maize)	T 2 (PM)	T 3 (FM)	T 4 (SM)	P-VALUE	SEM
Lw (%)	1947.17^{ab}	1853.67^{b}	2138.83^{a}	2083.17^{a}	0.04	40.61
Bled (%)	1822.67^{ab}	1784.00^{b}	2029.50^{a}	1991.00^{ab}	0.09	41.95
defea. (%)	1696.83	1653.00	1897.83	1893.33	0.14	48.14
EVS. (%)	1540.17^{ab}	1466.50^{b}	1664.17a	1614.67^{ab}	0.11	30.83
carcass wt. (%)	1408.33^{ab}	1334.17^{b}	1535.00^{a}	1466.50^{ab}	0.10	30.19
Car. yield (%)	72.40	71.96	71.82	70.30	0.16	0.56
Head (%)	2.27	2.62	2.28	2.36	0.13	0.06
Neck (%)	4.82	4.70	4.41	4.89	0.61	0.13
brst m (%)	21.74	21.61	22.16	21.44	0.92	0.36
Wing (%)	8.36	8.44	8.29	8.15	0.64	0.08
Thigh (%)	11.34	10.31	10.44	11.10	0.33	0.23
Shank (%)	4.73	4.93	4.57	4.75	0.75	0.11
Drmst (%)	10.60^{ab}	11.22^{a}	10.57^{ab}	10.26^{b}	0.16	0.15
Back (%)	13.05	14.19	13.02	11.80	0.45	11.97

ad: means bearing different superscripts along the same row are significantly (P<0.05) different.
PM = Pearl millet; FM = Foxtail; SM= Sorghum millet; Brst m = Breast muscle
Defea = Defeathering; Drmst = Drumstick Car. yield = Carcass Yield; EVS = Evisceration
LW = Live weight

Table 4: Relative organ weights of broiler finisher chicken pearl millet, foxtail millet and sorghum millet

Parameters (%)	T 1 (maize)	T 2 (PM)	T 3 (FM)	T 4 (SM)	P VALUE	SEM
Abd ft.	0.92^{a}	0.46^{b}	0.43^{b}	0.92^{a}	0.04	0.09
Kidney	0.42	0.58	0.56	0.47	0.38	0.04
Lungs	0.48	0.65	0.55	0.50	0.33	0.03
Heart	0.58	0.49	0.48	0.52	0.13	0.02
Spleen	0.11	0.13	0.08	0.10	0.43	0.01
Gizzard	2.67	2.40	2.36	2.57	0.63	0.09
Evs. gizz.	2.02^{a}	1.69^{ab}	1.59^{b}	1.63^{b}	0.08	0.07
Liver	2.48	2.58	2.38	2.37	0.64	0.06
Provt.	0.54^{a}	0.48^{ab}	0.40^{b}	0.41^{b}	0.02	0.02
Pancreas	0.25	0.28	0.30	0.26	0.44	0.0
S.i wt.	5.21	4.71	4.72	4.70	0.65	0.17
S.i (cm)	12.04	10.79	10.93	11.28	0.73	0.41
l.Iwt	0.18	0.24	0.19	0.25	0.69	0.02
L.i (cm)	0.51	0.50	0.48	0.48	0.88	0.02
Cea. Wt	0.85	0.84	0.89	0.79	0.94	0.05
Cea. Cm	1.24	1.25	1.08	1-21	0.55	0.05

ab: means bearing different superscripts along the same row are significantly (P<0.05) different
PM = Pearl millet; FM = Foxtail; SM= Sorghum millet; Cae = Caeca
Abdft = Abdominal fat; Evs = Eviscerated; S.iwt = Small intestine weight
L.iwt = Long intestine weight

CONCLUSION AND APPLICATION

In conclusion, feeding pearl millet, foxtail millet, and sorghum millet as a substitute for maize as an energy source had no adverse effect on the organ and carcass characteristics of broiler chicken. The carcass and organs of the birds were similar to those of the birds fed with maize as the major source of energy. This study therefore recommend to farmers the application of these cereal grains as substitute for maize in places where they are available and cheaper than maize.

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EFFECT OF EUPHORBIA HETEROPHYLLA AQUEOUS LEAF EXTRACTS ON HAEMATOLOGY OF BROILER CHICKENS AT STARTER AND FINISHER PHASES

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ABSTRACT

A total of 192 day-old Arbor Acres chicks were used in a 6-week experiment to evaluate effect of *Euphorbia heterophylla* aqueous leaf extracts (EHLE) on haematology of broiler chickens at starter and finisher phases. Birds were randomly assigned in a 2 x 3 factorial experimental layout consisting of six treatments with four replicates of eight birds each. Main effects at starter phase show significant ($P<0.05$) increase for Packed cell volume (PCV), Haemoglobin (Hb), Red blood cells (RBC), White blood cells (WBC), Monocytes, Mean corpuscular volume (MCV) and Mean corpuscular hemoglobin (MCH) at concentration levels of 40mL/L water compared to 50mL/L water. Mean corpuscular haemoglobin concentration (MCHC) was not significantly ($P>0.05$) influenced. Frequency of administration did not significantly ($p>0.05$) influence haematological indices neither did interactive effect of concentration and frequency of EHLE administration on the same indices. At finisher phase there was no significant ($p>0.05$) effect on haematological indices except MCHC which increased ($p<0.05$) at 50mL/L water concentration. With increased frequency of EHLE administration, PCV, Hb, RBC and WBC were increased ($p<0.05$). For interactive effect of concentration and frequency of administration of EHLE in finishers, MCH was significantly ($p<0.05$) higher at administration of 50mL/L water for 0 days/week compared to 40mL/L water for 0 days/week. Conclusively, effect of EHLE on broiler haematology in this study shows values were within normal range indicating good health condition and no deleterious effect of extract at 40mL/L water and 50mL/L water for frequency reaching 5 days/week.

Key words: *Euphorbia heterophylla,* leaf extracts, broilers, haematology, health status

DESCRIPTION OF PROBLEM

Phytochemicals are non-nutritive secondary plant metabolites synthesized by plants, and they contribute to their defence against infections, pests, stressful conditions and physical damage (1). In animal production, phytochemical use as growth promoters are agreeably so because they present several biological properties, including antimicrobial, antioxidant, anti-stress, and nutrigenomic effects on the development of immunity (2). In addition, they stimulate secretion of digestive enzymes and make nutrients available for absorption. Several plants extracts have also been combined to enhance the haematological and serum biochemical parameters in animals (3). There is limited information on effect of *Euphorbia heterophylla extracts* on broiler production. This study was therefore carried out to evaluate effect of *Euphorbia heterophylla* aqueous leaf extract (EHLE) on haematology of broiler chickens at both starter and finisher phases.

MATERIALS AND METHODS

The experiment was carried out at the Poultry Unit, Directorate of University Farms (DUFARMS), Federal University of Agriculture Abeokuta. *Euphorbia heterophylla* aqueous leaf extract (EHLE) was prepared by

grinding dried (air-dried???) *Euphorbia heterophylla* leaves into powder and measuring 50g into 1 liter of freshly boiled water allowed to steep for 5 hours. Afterwards, the mixture was filtered with a muslin cloth and filtrate collected as *Euphorbia heterophylla* aqueous leaf extracts. The experiment was laid out in a 2x3 factorial combination of two concentrations (40mL and 50mL/L water) of EHLE at a frequency of three different administrations (0 day, 4 days and 5 days in a week) to make 6 treatment groups. One hundred and ninety two (192) day-old Arbor Acre broiler chicks were randomly divided into the 6 treatments with 4 replicates of 8 birds each:

Treatment 1: 40mL/L water (EHLE) 0 days/week; Treatment 2: 40mL/L water (EHLE) 4 days/week; Treatment 3: 40mL/L water (EHLE) 5 days/week; Treatment 4: 50mL/L water (EHLE) 0 days/week; Treatment 5: 50mL/L water (EHLE) 4 days/week; Treatment 6: 50mL/L water (EHLE) 5 days/week

For haematological indices assessment, blood samples were collected at 4 weeks (starter phase) and 6 weeks (finisher phase) of age from wing veins of two birds per replicate into EDTA (ethylene diamine tetracetic acid) treated sample bottles and taken to the laboratory for analysis. Using the General Linear Model of the Minitab statistical package, data collected was subjected to two way Analysis of Variance (ANOVA) and significant differences among means were separated.

RESULTS AND DISCUSSION

The results for main and interactive effects of concentration and frequency of EHLE administration on hematology of broiler chickens at starter and finisher phase is presented in Tables 1-4.

At starter phase, there was significant ($P<0.05$) increase for Packed cell volume (PCV), Haemoglobin (Hb), Red blood cells (RBC), White blood cells (WBC), Monocytes, Mean corpuscular volume (MCV) and Mean corpuscular hemoglobin (MCH) at concentration levels of 40mL/L water compared to 50mL/L water (Table 1). There was no significant ($P>0.05$) influence on Mean corpuscular haemoglobin concentration (MCHC). Frequency of administration at 0, 4 and 5 days did not significantly ($p>0.05$) influence haematological indices. Furthermore, interactive effect of concentration and frequency of EHLE administration on all haematological indices of broiler chickens (Table 2) showed they were not significantly ($P>0.05$) influenced.

The main effects of concentration and frequency of EHLE administration on hematology of broiler chickens at finisher phase are shown in Table 3. There was no significant ($p>0.05$) effect of concentration on haematological indices considered except MCHC. It was increased ($p<0.05$) at 50mL/L water concentration. As the frequency of administering EHLE increased, the PCV, Hb, RBC and WBC values were significantly ($p<0.05$) increased at 0 day to 4 or 5 days per week. Table 4 shows interactive effect of EHLE on haematology of broilers and the only parameter significantly ($p<0.05$) influenced was MCH. It was significantly ($p<0.05$) increased at administration of 50mL/L water for 0 days/week and significantly ($p<0.05$) reduced at concentration of 40mL/L water administered for 0 days/week.

The increase in values of indices at both starter and finisher phase corroborate the report that effect of garlic, ginger and chaya leaf on broiler chicken haematology showed significant ($P< 0.05$) increase in PCV, RBC, haemoglobin concentration and WBC (4).

Table 1: Main effect of *Euphorbia heterophylla* aqueous leaf extracts on haematology of broiler chickens at starter phase

Parameters	Concentration		SEM	P value	Frequency			SEM	P-value
	40mL/L	50mL/L			0 days	4 days	5 days		
PCV (%)	31.00[a]	28.58[b]	0.47	0.00	30.50	29.37	29.50	0.58	0.33
Hb (g/dL)	10.47[a]	9.75[b]	0.15	0.00	10.27	10.04	10.02	0.18	0.57
RBC×10^{12}/L	2.44[b]	2.62[a]	0.05	0.02	2.60	2.46	2.53	0.06	0.40
WBC×10^{9}/L	13.95[a]	12.77[b]	0.21	0.00	13.28	13.73	13.06	0.25	0.19
MCV (*fl*)	128.36[a]	109.96[b]	3.06	0.00	118.68	120.37	118.42	3.74	0.92
MCH (*pg*)	43.37[a]	37.49[b]	0.97	0.00	39.95	41.13	40.23	1.20	0.76
MCHC (g/dL)	33.81	34.14	0.13	0.10	33.72	34.19	34.02	0.16	0.15

Packed cell volume (PCV), Haemoglobin concentration (Hb), Red blood cell (RBC), White blood cell (WBC), Mean cell volume (MCV), Mean Corpuscular Haemoglobin (MCH), Mean corpuscular haemoglobin concentration (MCHC); [a,b,c] Means in the same rows by factor with different superscripts differ significantly (P<0.05)

Table 2: Interactive effect of E*uphorbia heterophylla* aqueous leaf extract and days of administration on haematology of broiler chickens at starter phase

	Treatments							
	1	2	3	4	5	6		
Concentration	40mL/L	40mL/L	40mL/L	50mL/L	50mL/L	50mL/L		
Frequency of administration	0 days	4 days	5 days	0 days	4 days	5 days	SEM	P-value
PCV (%)	31.50	31.62	28.87	29.87	29.50	27.37	0.82	0.14
Hb (g/dL)	10.47	10.72	9.85	10.23	10.07	9.32	0.26	0.09
RBCx10^{12}/L	2.53	2.38	2.53	2.40	2.66	2.67	0.09	0.64
WBCx10^{9}/L	13.87	13.60	13.07	14.38	12.70	12.53	0.36	0.94
MCV (*fl*)	125.36	133.91	114.93	125.80	112.01	102.93	5.29	0.12
MCH (pg)	41.66	45.37	39.16	43.10	38.29	35.08	1.69	0.09
MCHC (g/dL)	33.27	33.91	34.11	34.27	34.17	34.13	0.23	0.09

Packed cell volume (PCV), Haemoglobin concentration (Hb), Red blood cell (RBC), White blood cell (WBC), Mean cell volume (MCV), Mean Corpuscular Haemoglobin (MCH), Mean corpuscular haemoglobin concentration (MCHC)

Table 3: Main effect of *Euphorbia heterophylla* aqueous leaf extracts on haematology of broiler chickens at finisher phase

Parameters	Concentration		SEM	P-value	Frequency			SEM	P-value
	40mL/L	50mL/L			0 days	4 days	5 days		
PCV (%)	33.75	33.83	0.82	0.94	31.13[b]	35.50[a]	34.75[a]	1.00	0.00
Hb (g/dL)	11.17	11.35	0.25	0.61	10.31[b]	11.86[a]	11.56[a]	0.31	0.00
RBC×10^{12}/L	2.81	2.75	0.057	0.47	2.61[b]	2.91[a]	2.81[ab]	0.06	0.01
WBC×10^{9}/L	14.91	14.75	0.33	0.73	13.65[b]	15.79[a]	15.05[a]	0.40	0.00
MCV (*fl*)	120.19	123.24	1.93	0.27	119.64	122.20	123.30	2.37	0.54
MCH (*pg*)	39.77	41.41	0.64	0.07	39.71	40.89	41.16	0.78	0.39
MCHC (g/dL)	33.11[b]	33.58[a]	0.14	0.02	33.18	33.44	33.42	0.18	0.51

Packed cell volume (PCV), Haemoglobin concentration (Hb), Red blood cell (RBC), White blood cell (WBC), Mean cell volume (MCV), Mean Corpuscular Haemoglobin (MCH), Mean corpuscular haemoglobin concentration (MCHC); [a,b,c] Means in the same rows with different superscripts differ significantly (P<0.05)

Table 4: Interactive effect of E*uphorbia heterophylla* aqueous leaf extract and days of administration on haematology of broiler chickens at finisher phase

	Treatments							
	1	2	3	4	5	6		
Concentration	40mL/L	40mL/L	40mL/L	50mL/L	50mL/L	50mL/L		
Frequency of administration	0 days	4 days	5 days	0 days	4 days	5 days	SEM	P-value
PCV (%)	30.25	36.25	34.75	32.00	34.75	34.75	1.42	0.52
Hb (g/dL)	9.90	12.15	11.45	10.73	11.60	11.73	0.44	0.30
RBCx10^{12}/L	2.68	2.95	2.80	2.55	2.87	2.82	0.09	0.74
WBCx10^{9}/L	13.85	15.45	15.42	13.45	16.13	14.68	0.57	0.43
MCV (*fl*)	113.16	123.37	124.03	126.12	121.02	122.57	3.35	0.04
MCH (*pg*)	37.06^{b}	41.36^{ab}	40.88^{ab}	42.36^{a}	40.41^{ab}	41.45^{ab}	1.12	0.02
MCHC (g/dL)	32.81	33.53	32.99	33.55	33.35	33.84	0.25	0.09

Packed cell volume (PCV), Haemoglobin concentration (Hb), Red blood cell (RBC), White blood cell (WBC), Mean cell volume (MCV), Mean Corpuscular Haemoglobin (MCH), Mean corpuscular haemoglobin concentration (MCHC)); ^{a,b,c} Means in the same rows with different superscripts differ significantly ($P<0.05$)

CONCLUSION AND APPLICATION

In conclusion, effect of EHLE on broiler haematology in this study showed that values were within normal range indicating good health condition and no deleterious effect of the extract at concentration 40mL/L water and 50mL/L water for frequency reaching 5 days per week.

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Monogastric Animal Production: MGP 052

RESPONSE OF BROILER CHICKENS UNDER VARYING STOCKING DENSITIES TO ADDITION OF PHYTOGENIC FEED ADDITIVIES AT STARTER PHASE

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ABSTRACT

Phyto-additives has stress ameliorating potentials in broiler. A 3-weeks feeding trial was conducted to evaluate the performance of broiler chickens fed three phytogenic additives (2g of ginger per kg of feed, 2g of garlic per kg of feed and 2g of African nutmeg per kg of feed) at 0% and 0.20% inclusion levels under three different stocking densities, Standard stocking density-SSD (0.125m^2/birds), Medium stocking density-MSD (0.08m^2/birds), High stocking density-HSD (0.06m^2/birds). Two-Hundred and eighty-eight (288) one-day old Arbor Acre strain of broiler chickens were randomly divided into twelve (12) treatments of three replicates each. There were eight (8) birds per replicate to make a total of 24 birds per treatment. No antibiotics was given to the broilers where phyto-additives were added. Feed and water were supplied *ad libitum* and data were collected on performance characteristics of the birds. The daily feed intake, daily weight gain, FCR, Final weight, FC/KG/FEED and FC/KG/WG were significantly affected ($P<0.05$). Birds on T5 (medium stocking density) had the highest final body weight of 792.71 g. The daily weight gain was significantly higher in T4 (ginger at standard stocking), 37.09 g, which was similar to the value of 791.83 g, 783.08 g, 780.46 g in T1, T5, T10 (control diet (SSD), ginger (SSD), ginger (MSD), African nutmeg diet (SSD) respectively. The highest FG/KG/WG of ₦797.51 was obtained in birds fed African nutmeg at HSD (T12), while the lowest value was obtained in T2. FCR value of 2.18g is significantly higher in T12 (African nutmeg at HSD) which is similar to the value of 2.17g and 2.13g obtained in T11 and T3 (African nutmeg at MSD and garlic at MSD respectively), while the birds in T2 control at MSD had the lowest. It was concluded that Arbor Acre strain of broiler chicken can be reared on medium stocking densities and standard stocking densities with 2g of Ginger diet and African nutmeg diet without the use of any synthetic antibiotics.

Keywords: Performance characteristics, Stocking density, Antibiotics, Phytogenic feed additives, Daily feed intake.

INTRODUCTION

High stocking density of broilers is a management routine intended for decreasing cost related with labour, fuel, housing, and equipment, but may have detrimental effect on poultry health, immune system, welfare, and productive performance (9), hence high stocking density is assumed as a factor of stress. Any condition that has an adverse impact on an animal's biological system is referred to as stress (21). Some studies have reported the effects of stocking density on growth performance (4), feed intake and carcass quality (7). Animals under stress can present both behavioural and physiological changes, but many interventions are being used to ameliorate the impact of stress in poultry production. The most important of them is introduction of various nutritional manipulations (15), decrease in feed and increase water supply during the period of stress (20). The effect of stocking density on feed conversion ratio and mortality has remained a debatable issue (19). Antibiotic Growth Promoter (AGP) is commonly used by the farmer to improve feed utilization and to maximize performance, improve health status of broiler chickens (13), however, the use of AGP has been prohibited because of residues in chicken products, which is harmful to human health (17). Attention is now shifted to the use of non-antibiotic feed additives especially those of plant origin, called Phytogenic Feed additives-PFAs, (3). Herbs, spices, and various plant extracts have been reported to contain antimicrobial, appetizing, and digestion stimulating properties (5) and their usage in poultry improved body

weight gain (8). Ginger have been reported to possess useful pharmacological potent chemical substances for use in poultry (6), this is due to its antioxidants, antibacterial, anti-inflammatory, antiseptic, anti-parasitic and immune-modulatory properties, while Garlic (*Allium sativum*) is a spice that has been indicated to possess antibacterial, antifungal, anti-parasitic, antiviral, antioxidant, anti-cholesteremic, anti-cancerous and vasodilator characteristics (11). African nutmeg, *Monodora myristica* is rich in antibiotic, antioxidant and antimicrobial properties, which make it fit for use as natural feed additive (2,12). This present study examined the response of broiler chickens to three phytogenic feed additives under varying stocking density

MATERIALS AND METHODS

Experimental site

The experiment was carried out at the Poultry Unit of the Teaching and Research Farm, Ladoke Akintola University of Technology (LAUTECH), Ogbomoso, Oyo State, Nigeria.

Tests Ingredients

The three phytogenic feed additives (ginger, garlic and African Nutmeg) were purchased from a reputable market. Each diet was supplemented with 0.20% of ginger, garlic and African nutmeg.
The gross Composition of experimental diets (g/100kg) is presented in Table 1.

Table 1: Gross Composition of experimental diets (g/100kg)

Ingredients	0% T1	0% T2	0% T3	2% T4	2% T5	2% T6	2% T7	2% T8	2% T9	2% T10	2% T11	2% T12
***Fixed ingredient**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Ginger meal	--	--	--	+++	+++	+++	--	--	--	--	--	--
Garlic meal	_	_	_	_	--	--	+++	+++	+++	--	--	--
African nutmeg	--	--	--	--	--	--	--	--	--	+++	+++	+++
Calculated Analysis												
Crude protein (%)	21.20	21.20	21.20	21.38	21.38	21.38	21.52	21.52	21.52	21.44	21.44	21.44
Ether extract (%)	3.10	3.10	3.10	3.10	3.10	3.10	3.10	3.10	3.10	3.10	3.10	3.10
Crude fiber (%)	3.10	3.10	3.10	3.10	3.10	3.10	3.18	3.18	3.18	3.48	3.48	3.48
Megajoule (MJ)	12.60	12.60	12.60	12.60	12.60	12.60	12.60	12.60	12.60	12.60	12.60	12.60
Phosphorus (%)	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Calcium (%)	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10

Diet 1 - Control diet on SSD; Diet 2 - Control diet on MSD; Diet 3 - Control diet on HSD; Diet 4 – 2g of ginger/kg of feed on SSD; Diet 5 - 2g of ginger/kg of feed on MSD; Diet 6 - 2g of ginger/kg of feed on HSD; Diet 7 - 2g of garlic/kg of feed on SSD; Diet 8 - 2g of garlic/kg of feed on MSD; Diet 9 - 2g of garlic/kg of feed on HSD; Diet 10 - 2g of African nutmeg/kg of feed on SSD; Diet 11 - 2g of African nutmeg/kg on MSD; Diet 12 - 2g of African nutmeg/kg on HSD.
*Fix ingredients: Maize 54.00g, Fishmeal 3.00kg, Soybean meal 32.00kg, soya bean oil 2.00g, wheat offal 5.00kg, Limestone 1.00kg, Dicalcium phosphate 2.00kg, salt 0.25kg, premix 0.25kg, Lysine 0.25kg, Methionine 0.25kg.

Experimental birds and management

Two hundred and eighty (280) Arbor Acres train of broiler chicks were used for the experiment. The birds were weighed and randomly distributed into twelve (12) treatments of 24 birds each. Each treatment was replicated 3 times at the rate of 8 birds per replicate in a completely randomized design. The birds were offered adequate feed and clean water *ad-libitum* on daily basis throughout the experiment, while routine medication and vaccination was administered to only birds under the control. The experiment lasted for 3 weeks.

Data collection

Growth performance characteristics

Initial weight was recorded as the body weight of the day-old chicks on arrival from the hatchery, and final weight was the body weight of the birds at the end of the experiment. Initial weights were subtracted from final weights to obtain weight gains. Daily feed intake was the amount of feed consumed by each bird per day, and average total feed intake was estimated as the total feed consumed by each bird. The feed conversion ratio was calculated as feed intake divided by body weight gain. Mortality was calculated in percentage (18).

Data analysis

All data collected were subjected to one-way analysis of variance arranged in 4 × 3 factorial layout. Significant (P<0.05) differences among treatment means were separated using Duncan's Multiple Range Test as contained in (16) package.

RESULTS AND DISCUSSION

Table 2 showed the Starter performance characteristics of birds at three weeks of age. Dietary treatment significantly (P<0.05) affect the final weight, total weight gain, daily weight gain, Fain:Gain, Feed Cost/Kilogram/FEED and Feed Cost kilogram /Weight Gain. Birds on T5 (ginger and MSD) has highest (P<0.05) total weight gain, 751.42g, which is similar to 750.96g, 742.79g, 737.00g in T10 (African nutmeg of SSD), T1 (control diet of SSD) and T4 (Ginger of SSD) respectively. While the lowest value (548.04g) was reported in T9 birds (2g of Garlic in HSD). This study is in line with the result of (14) who reported that dried Ginger powder increased the body weight of broiler when included in the diet at 2%.Birds on T5 (ginger MSD) has the highest (P<0.05) for final weight, 792.71g, which is similar to the value of 791.83g, 783.08g, 780.46g in T10(African nutmeg at SSD), T1(control diet SSD) and T4(ginger SSD) respectively. While the lowest value (584.25g) was recorded in birds fed T9(2g African nutmeg). The daily feed intake of 61.83g was higher in T5 (ginger at MDS) which consumes more feed compared to all other treatment, supporting the report of (1), that ginger enhance feed intake in broiler chickens. The lowest value (50.85g) of daily feed intake was reported in T9 (High Stocking density). This result is in line with the study of (10) who reported that there is linear decline in feed intake in High Stocking density. Daily weight gain was significantly higher in T4 (ginger at SSD), value 37.09g, while the lowest value of 26.09g was observed in T9. Fed Conversion Ratio (FCR) value of 2.18g in T12 fed African nutmeg at high stocking density has the highest significant value (p<0.05) which is similar to the value (2.17g, 2.13g) T11, T6 of birds fed African nutmeg at MSD and Garlic at MSD respectively, while the lowest value (1.44g) for Feed Conversion Ratio (FCR) was recorded in T2) birds fed normal diet at medium stocking density. The highest significant value (797.51g) for feed gain/KG/weight was observed in birds fed African nutmeg at HSD (T12), which is similar to the value (790.55) of T11(African nutmeg at MSD), while the lowest value (524.32g) of feed gain/KG/weight was recorded in (T2) bird.

Table 2: Performance characteristics Of Broiler Chickens Fed Diet Containing Phytogenic Feed Additives Under Different Stocking Densities.

Parameters	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	SEM	P-VALUE
Initial weight (g)	42.08	41.58	42.58	43.45	41.29	41.33	42.62	42.45	41.58	40.87	41.70	41.62	0.56	0.08
Final weight (g)	783.08^{a}	716.38^{ab}	728.79^{ab}	780.46^{a}	792.71^{a}	631.58^{c}	767.42^{b}	690.29^{c}	584.25^{d}	791.83^{a}	678.63^{c}	679.50^{c}	39.09	0.02
Total weight gain (g)	742.79^{a}	679.88^{ab}	686.21^{ab}	737.00^{a}	751.42^{a}	592.04^{c}	724.79^{a}	647.83^{bc}	548.04^{c}	750.96^{a}	636.92^{bc}	637.88^{bc}	38.45	0.02
Daily weight gain (g)	35.37^{a}	32.37^{ab}	32.67^{ab}	37.09^{a}	35.78^{a}	28.19^{bc}	34.51^{ab}	30.85^{ab}	26.09^{c}	35.76^{b}	30.33^{ab}	30.38^{ab}	1.83	0.02
Daily feed intake (g)	59.13^{a}	51.01^{bc}	61.16^{a}	57.98^{b}	61.83^{a}	58.58^{a}	59.66^{a}	57.77^{b}	50.85^{c}	57.97^{b}	58.51^{a}	61.02^{a}	1.41	0.07
Feedcost/KG /feed(₦)	349.79	319.37	365.00	365.00	365.00	349.79	365.00	365.00	319.38	365.00	365.00	365.00	12.41	0.01
Feed: Gain	1.72^{b}	1.44^{c}	1.99^{ab}	1.76^{b}	1.72^{b}	2.13^{a}	1.87^{ab}	1.92^{ab}	1.84^{ab}	1.71^{b}	2.17^{a}	2.18^{a}	0.13	0.01
FeedGain/KG/ Weight(₦)	627.5^{bc}	524.32^{c}	728.44^{ab}	641.79^{b}	628.83^{bc}	778.81^{ab}	684.92^{b}	702.38^{ab}	673.36^{b}	627.08^{bc}	790.55^{a}	797.51^{a}	89.96	0.01
Mortality	0.04	0.13	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.13	0.00	0.00	0.02	0.01

[abcd] Means in the same row with different superscripts are significantly different ($p<0.05$)
T1=Control of SSD, T2=Control of MSD,T3=Control of HSD,T4=2%Ginger ofSSD,T5=2%Ginger of MSD,T6=Ginger of HSD,T7=2%Garlic of SSD,T8=2%Garlic of MSD,T9=2%Garlic of HSD,T10=2%African nutmeg of SSD,T11=2%African nutmeg of MSD,T12=2%African nutmeg of HSD.

CONCLUSION

In conclusion, birds on T1 (783.08g),T2 (716.38) T4 (780.46g), T5 (792.71g), T10 (791.83g) present the best results terms of final body weight and also gave good feed conversion ratio.
Ginger and African nutmeg at 2g inclusion level at (Standard Stocking Density SSD, Medium Stocking Density MSD respectively) good performance of growth characteristics of Arbor Acre stains of broiler chicken without the use of synthetic antibiotics.
It is therefore recommended that Arbor Acre strains of broiler chicken should be reared on medium stocking densities MSD and Standard Stocking Density SSD with 2g of ginger and African nutmeg without the use of any synthetic antibiotics.

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Monogastric Animal Production: MGP 053

INFLUENCE OF FLASHED-DRIED CASSAVA PULP ON PERFORMANCE CHARACTERISTICS AND ECONOMY VALUES OF STARTING BROILERS CHICKENS

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ABSTRACT

A study was conducted with two hundred and forty (240) day-old unsexed Cobb 500 broiler starters to diets containing varying levels of flashed dried cassava pulp (FDCP) to examine performance and economy values. The broilers were allotted on weight equalization to four dietary treatments, replicate into six (6), with 10 birds per replicate. Tested ingredient replaced maize at 0, 5, 10 and 15%. Data showed significant impact ($p<0.05$) on average protein intake, protein efficiency ratio (PER), feed cost/kg, feed intake cost/kg and feed cost/weight gains among dietary treatments. Average protein intake significantly ($p<0.05$) ranged between 338.22 and 349.52 (g). PER significantly ranged from 2.67 to 2.57. Feed cost significantly ($p<0.05$) ranged between ₦ 471.00 and ₦456.60. Feed intake cost/kg significantly ($p<0.05$) between (₦709.51 and ₦674.55). Significant ($p<0.05$) different from ₦787.15 to ₦755.08 were obtained on feed cost per weight gain. Conclusively, FDCP can be integrated in the diet of starting broiler diet up to 15% inclusion levels without affecting performance traits and economy values.

Key words: Performance characteristics, economy values, broilers, FDCP and varying.

DESCRIPTION OF PROBLEM

Broiler chickens are fast growing birds and described as good converters of feed and marketed at least from sixth weeks of age (1). The increase in the poultry industry is having a profound effect on the request for feed and raw materials for feed production, this couple with the fact that the key feed ingredients like maize is in high demand for human food. Poultry farmers who depend on commercial feeds sourced from the market continuously suffer some forms of financial loss due to sub-standard nature of such feeds. Feed accounts for 70% of the total cost of production. Therefore, the solution to this is, is to explore non-conventional feedstuffs (NCFs). NCFs includes feed resources that are not usually used in commercial poultry nutrition such as waste products of seeds/animals, industrial waste from agro-allied industries, and by-products of plant and animal sources that have no value for humans and industries (2). Cassava pulp is the solid, moist by-product of cassava starch and comprises approximately 10-15% of the original root weight and can be used at 8% and 20% in the diets of broilers and layers respectively without posing any deleterious effects (3 and 4) their health and productivity.

MATERIALS AND METHODS

Experimental area: The experiment was carried out at the Poultry Unit of the Directorate of University Farms (DUFARMS), Federal University of agriculture, Abeokuta, Ogun-State, Nigeria. The farm is located in the tropical rainforest vegetation zone of South-Western Nigeria.

Sourcing Of Test Ingredient

The test ingredient (FDCRP) was obtained from Psaltry industry, a starch processing industry along Maya Ado-Awaye Road, Iseyin Local government area, Oyo-State, Nigeria.

Experimental Diets and Design

Four iso-proteinous and iso-caloric starter diets were formulated, such that FDCP replaced maize at 0, 5, 10 and 15% levels in diets 1, 2, 3, and 4 respectively. The experiment was arranged in a completely randomized design. The gross composition of experimental diet is presented in Table 1.

Table 1: Gross composition (%) of experimental diets for broiler starters (0 – 4 weeks)

Ingredients (kg)	0%	5%	10%	15%
Maize	50.50	45.50	40.50	36.00
FDCP	0.00	5.00	10.00	15.00
Full fat soybean	15.00	16.50	18.00	19.00
Ground nut cake	20.00	20.00	20.00	20.00
Wheat offal	6.00	4.50	3.00	1.50
Fish meal (72%CP)	3.50	3.50	3.50	3.50
Lime stone	1.50	1.50	1.50	1.50
Bone meal	2.50	2.50	2.50	2.50
Lysine	0.20	0.20	0.20	0.20
Methionine	0.30	0.30	0.30	0.30
Vitamin/mineral Premix	0.25	0.25	0.25	0.25
NaCl	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00
Calculated values				
ME (MJ/kg)	11.95	11.83	11.75	11.66
Crude protein (%)	23.22	23.17	23.12	23.07
Calcium (%)	1.67	1.67	1.67	1.68
Phosphorous (%)	0.58	0.58	0.57	0.57
Lysine (%)	0.88	0.85	0.82	0.80
Mthionine (%)	0.57	0.56	0.54	0.53

FDCP = Flashed Dried Cassava Pulp. **NaCl = Sodium Chloride**

Management of Experimental Birds

Two hundred and forty (240) day-old unsexed Cobbs 500 broilers were bought from a reputable hatchery. Birds were assigned into four dietary treatments replicated six times with ten birds per replicate. The experimental diets and water were given *ad libitum* throughout the study which lasted for twenty-eight days. The birds were managed intensively on deep litter with wood shaving as bedding and all necessary vaccinations and medications were strictly observed.

Data Collection

Data were collected on initial body weights (g/bird), average daily weight gain (g), weekly live body weight (g), daily feed intake (g), feed: gain ratio, daily protein intake, mortality was recorded as it occurred while prevalent market prices were used to obtain economy of production as followed; cost of 100kg feed in (₦/kg) = Total cost of ingredient/kg, feed cost per 1kg (₦/kg) was calculated as the ratio of cost of 100kg of feed to 100 i.e $\frac{\text{Cost for 100 kg of feed}}{100}$, feed intake cost/weight gain (₦/kg) = FCR x Cost of 1kg of feed and feed intake cost/bird in (₦/kg) = feed intake (kg) x Cost 1kg of feed

Statistical Analyses s

Data obtained were subjected to one way analysis of variance (ANOVA) using SPSS version 27. Significant ($p<0.05$) means among variables were separated using Duncan's multiple range test (3).

RESULTS AND DISCUSSION

Results of performance characteristics of starting broiler chickens are presented in Table 2. Results showed significant ($P<0.05$) effect on average protein intake, protein efficiency ratio (PER), feed cost/kg, feed intake

cost/kg and feed cost/weight gains. Birds on 0% FDCP consumed highest (349.54 g) significant ($p<0.05$) average protein intake while 5% FDCP consumed least (338.22 g). Highest (2.67) significant PER was observed from birds on 5% FDCP while least (2.57) was obtained from birds on 0% FDCP. Highest significant ($p<0.05$) feed cost/kg, (₦471.37), was obtained from 0% FDCP while least was observed from 15% FDCP, (₦456.60). Birds fed 0% FDCP had the highest (₦709.51) significant ($p<0.05$) differences feed intake cost/kg, while those on 15% FDCP had the least (₦674.55). Birds fed on 0% FDCP recorded the highest (₦787.15) significant ($p<0.05$) feed cost per weight gain while those on 5% FDCP had the least (₦755.08). This finding is consistent with the report of (4) who found no discernible changes on average daily gain, final and overall weight gain of broilers fed Baobab pulp diets. The mortality ranged between 0.10 to 1.67% were obtained in broilers in this finding was lower than values of 6.67-8.89% reported by (5). This proved that FDCP used contained cyanide level that is safe for birds. Feed cost/kg and feed intake costs/kg were significantly reduced across dietary treatments; hence, FDCP maximizing profit, showing that its inclusion in poultry feed resulted in lowered feed costs per kilogram gained. This was in agreement with (5) who reported that agro-industrial by-products reduced cost of feeding weaned rabbits, pigs and poultry.

Table 2: Growth characteristics and economy values of broiler starter fed varied flashed-dried cassava pulp as replacement for maize (0-4 weeks)

	FDCP levels of replacement					
Parameters	**0%**	**5%**	**10%**	**15%**	**SEM**	**P-value**
Initial weight (g/bird)	44.17	44.67	44.33	44.00	0.35	0.942
Final weight (g/bird)	943.33	946.67	938.33	942.50	9.70	0.995
Average weight gain(g/bird)	899.17	902.00	894.00	898.50	9.65	0.995
Daily weight gain (g/bird)	32.11	32.21	31.93	32.10	0.34	0.995
Average feed intake (g/bird)	1505.27	1459.72	1467.13	1477.33	8.88	0.366
Daily feed intake (g/bird)	53.70	52.13	52.40	52.76	0.32	0.362
Average protein intake(g/bird)	349.52^{a}	338.22^{d}	339.20^{c}	340.82^{b}	1.35	0.001
Feed conversion ratio	1.67	1.62	1.65	1.65	0.02	0.803
Protein efficiency ratio	2.57^{c}	2.67^{a}	2.64^{b}	2.64^{b}	0.01	0.001
Mortality (%)	1.67^{a}	0.00^{b}	0.00^{b}	0.00^{b}	0.218	0.001
Feed cost/kg (₦)	471.35^{a}	466.10^{b}	460.86^{c}	456.60^{c}	1.69	0.001
Cost of feed intake/kg(₦)	709.51^{a}	680.38^{b}	676.14^{c}	674.55^{c}	4.30	0.001
Cost of feed/weight gain (₦)	787.15^{a}	755.08^{d}	760.42^{b}	759.99^{c}	10.68	0.001

$^{a, b, c, d}$ = Means within the same row with different superscripts are significantly different ($P<0.05$). SEM= Standard error of the mean.

CONCLUSION AND APPLICATION

Conclusively, flashed dried-cassava pulp did not pose any negative effect on performance characteristics and cost of production of broiler starter.

Flashed-dried cassava pulp could be used up to 15% inclusion level in broiler starter without deleterious impact on performance characteristics and cost of production.

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PERFORMANCE AND COST-BENEFIT ANALYSIS OF FEEDING DIFFERENT LEVELS OF MISTLETOE (MLM) LEAF MEAL TO COCKERELS

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ABSTRACT

A 16-week study was conducted to evaluate the growth performance of cockerels fed different levels of mistletoe leaf meal (MLM). The leaves were collected, dried, and ground to finer particles. A total of 150-day-old cockerels were assigned to 5 experimental groups of 30 birds and each treatment was replicated 3 times with 10 birds, in a completely randomized design. The test ingredient was included at graded levels of 0, 5, 10, 15, and 20%; with water provided *ad libitum*. The growth parameters were recorded on a daily and weekly basis and computed from the values obtained in daily feed intake and weekly weight changes. Feed samples and MLM were analyzed for proximate composition. The cost-benefit of the study was computed based on the cost of the diets from the prevailing market prices of the items. The crude protein contents for chick mash (17.87 - 21.53%) and grower mash (16.00 - 16.91%). The metabolizable energy obtained for both the experimental chick and grower mash were 2704.72 to 2797.33 kcal/kg and 2612.44 to 2693.07 kcal/kg, respectively. Final body weight was higher in feed with 5 % MLM (2436.20 g) compared to the control (2160.00 g) and total weight gain, daily feed intake, daily gain weight, and feed conversion ratio followed the same pattern while the final body weight was inferior in the control. The cost-benefit analysis revealed that costs of feed per kilogram, total feed intake, and cost per kg gain were lower in birds fed diets containing MLM than in the control. The feeding of MLM to cockerels up to 5 % could be recommended while further studies should be conducted to evaluate the effect of MLM in other poultry species.

Keywords: Cockerel, cost-benefit, Growth, mistletoe leaf meal, performance.

INTRODUCTION

Poultry production, especially broiler chickens and cockerels is the quickest way of achieving sufficient animal protein source for the Nigerians due to their quick generation interval and fast growth rate [6]. However, the poultry industry has been bedeviled by many problems such as nutrition, management, diseases, and other environmental factors.

As feed makes up 70–80% of the entire production costs, it is the most crucial input for economical chicken production [18;12;]. In order to lower the cost of raising livestock, alternative feedstuffs that can replace the pricey conventional feedstuffs are now needed due to their high cost [6]. The literature has ample evidence of the use of non-traditional feed components in compounding chicken feed to lower production costs [10; 1; 20;4; 15]. In our current context, non-conventional feedstuffs provide the finest possibilities for lowering feed prices and therefore lowering the cost of meat and animal products [16]. One of such alternative sources of protein can include the use of leaf meals. Several studies were conducted on the use of various leaf meals as protein sources for broiler chickens' production [13; 21]. Leaf meals aid not only as a source of protein but also provide some required vitamins, minerals, and oxycarotenoids [2]. Mistletoe leaf meal (MLM) has the potential of providing the above-mentioned opportunities. The objectives of the study are to assess the growth performance and cost-benefit analysis of cockerels fed graded levels of MLM.

MATERIALS AND METHODS

Processing of Mistletoe leaves

The leaves were dried on the bare floor in a well-ventilated room for 7 days and were later ground to fine particle size using a hammer mill. The milled leaves were incorporated into the diets at levels of 0, 5, 10, 15, and 20% in T1, T2, T3, T4, and T5, respectively. Treatment 1 (T1) had no MLM and served as the control. Averagely 17.87 to 21.53% and 16.00 to 16.91% CP diets (Tables 1 and 2) were fed to the birds during the starter phase (3-6 weeks) and the grower phase (9-16 weeks), respectively.

Management of the Experimental Birds

A total of 150 days-old cockerels were used for the experiment, the chicks were brooded together using the deep litter system, during which they were fed with an experimental diet, chick mash at 3-8 weeks, and grower mash at 9-16 weeks. Throughout the experimental duration feed and water are provided without restriction. All the routine vaccinations (Newcastle disease vaccine and Gumboro disease vaccine: 1st and 2nd doses were administered via drinking water at 2, 3, and 5 weeks). However, from 6 to 8 weeks dose of fowl pox vaccine was administered via the wing vein, and medication necessary for the birds' good health was strictly adhered to according to specification.

Proximate analysis of mistletoe leaves and the experimental diets

This feed composition was grouped into Moisture, crude protein, ash, crude fiber, ether extract, and nitrogen-free extract (NFE). The determination was done according to the procedures described by [3]. NFE and metabolizable energy (ME) in kcal/kg was calculated using the formula as described by [14]: %NFE = 100 - (%CF + %CP + %EE + %Ash ME (Kcal/kg) =37 x % CP +81 x %EE + 35.5 x % NFE.

Experimental Diets

Five experimental diets were formulated for the study which were differentiated by the levels of inclusion of the test material. Treatment 1 (T1) served as the control with a 0% level of Mistletoe leaf meal (MLM) and 5, 10, 15, and 20 percent MLM, respectively for treatment 2, 3, 4, and 5. The treatment diets for chick starter and grower mash are presented (Tables 1) and (Table 2).

Data collection

Growth and economic performance

The daily feed intake was taken as feed serves minus leftovers was computed and recorded daily while changes in body weight were recorded weekly by weighing the bird individually on the scale and subtracting the difference from the initial weight. The feed Conversion Ratio (FCR) was computed based on the values obtained from feed intake and changes in body weight. The economic analysis of cockerel production was based on the cost of the ingredients used from the usual market prices at the time of purchase are computed as the cost/kg of feed (/kg) and the cost of feed consumed per bird, feed cost per weight gain (/kg).

Statistical analysis

All data collected were subjected to analysis of variance ANOVA (Completely Randomized Design) using SAS [17] software statistical package and significant differences between treatment means were separated by Least Significant Differences (LSD).

RESULTS AND DISCUSSION

Growth Performance of cockerels fed graded levels of mistletoe leaf meal (MLM)

Table 3 presents the growth performance of cockerels fed the experimental diets, the results for the chick phase showed that final body weight (FBW), total weight gain (TWG), daily weight gain (DWG), daily feed intake (DFI), and feed conversion ratio (FCR) differed significantly ($P<0.05$) among the treatment groups. The results obtained for FBW for the chicks' phase ranged from 744.60 to 1081.30 g for the treatment groups. The results for TWG mean values obtained ranged from 511.00 to 820.53 g among the treatment groups. The DFI mean values ranged from 37.80 to 45.29 g for the treatment groups. Birds on diets containing MLM had significantly ($P<0.05$) higher DFI than the control (0% MLM). The higher feed intake of these groups

is to compensate for the lower energy of the diets. The values obtained for DFI are close to the findings of [4] who reported 50.20 to 50.31 g/head/day when they fed composite leaf meal as an alternative premix to broiler starter. The increased feed intake of the starter chicks on diets containing MLM tallies with the increase in fiber content of the diets. The mean values for DWG varied from 12.17 to 19.54 g for the treatment groups at the chick's phase.

Table 1: Composition of the Experimental Chick Mash (3-8 weeks)

	Inclusion Levels of Mistletoe Leaf Meal (%)				
Ingredients (%)	0	5	10	15	20
Maize	51.50	51.50	50.05	50.05	50.05
Wheat Offal	9.70	9.70	9.70	9.70	9.70
Mistletoe leaf meal	0.00	5.00	10.00	15.00	20.00
Groundnut Cake	19.55	15.00	10.00	6.00	1.00
Soya bean meal	10.00	10.00	10.00	10.00	10.00
Fish Meal	5.00	5.00	5.00	5.00	5.00
Bone Meal	3.00	3.00	3.00	3.00	3.00
Salt (NaCl)	0.25	0.25	0.25	0.25	0.25
Premix*	0.50	0.50	0.50	0.50	0.50
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Calculated analysis					
ME (Kcal/kg)	2620.22	2625.22	2630.67	2536.30	2643.52
Crude protein (%)	17.61	17.67	17.60	17.57	17.74

Table 2: Ingredient of the Experimental Grower Mash (9-16 weeks)

	Inclusion Levels of Mistletoe Leaf Meal (%)				
Ingredients (%)	0	5	10	15	20
Maize	52.20	54.00	53.70	51.70	50.70
Wheat Offal	12.00	12.00	12.00	12.00	12.00
Mistletoe leaf meal	-	5.00	10.00	15.00	20.00
Groundnut Cake	20.50	13.70	9.00	6.00	2.00
Soya bean meal	6.20	6.20	6.20	6.20	6.20
Fish Meal	5.00	5.00	5.00	5.00	5.00
Bone Meal	3.00	3.00	3.00	3.00	3.00
Salt (NaCl)	0.25	0.25	0.25	0.25	0.25
Premix*	0.50	0.50	0.50	0.50	0.50
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Calculated analysis					
ME (Kcal/kg)	2613.37	2692.27	2623.78	2629.41	2643.52
Crude protein (%)	17.34	16.67	16.58	16.75	16.97

**Vit-Mineral Premix from Bio-mix supplied/kg: Vit A 4,000,000.00 IU; Vit D3 800,000.00 IU; Vit E 9, 200.00mg. Niacin 11, 000.00mg; Vit B1 720.00mg; B2 2000.00mg; B6 1, 200.00mg; B12 6.00mg; Pantothenic acid 3, 000.00mg. Biotin 24.00mg; Folic acid 300.00mg; Choline Chloride 120, 000.00mg; Cobalt 80.00mg; Copper 1, 200.00mg; Iodine 400.00mg; Iron 8, 000.00mg; Manganese 16, 000.00mg; Selenium 80.00mg; Zinc 12,000.00mg; Antioxidant 500.00mg*

The FCR for the chick phase obtained ranged from 2.05 to 3.27 for the treatment diets. Treatment 1 (control, 0% MLM) and 2 (5% MLM) were superior to the rest of the treatment groups. The FCR mean values (2.05 to 3.27) obtained in this study are close to the value (2.30 – 2.80) obtained by [13] who fed Pawpaw leaf meal. The results of FCR revealed that there is proper utilization of nutrients in all the dietary treatments, this indicates that the diets are adequate in meeting the nutritional requirements of the cockerels. The results generally indicated that MLM serves as an alternative protein source for starter chicks.

The growth parameters obtained for the grower phase revealed significant (P<0.05) differences for FBW, TWG, DWG, and FCR but DFI did not differ significantly (P>0.05) among the treatment groups. The FBW values ranged from 1851.40 to 2436.20 g for the treatment groups. The slight decrease in weight at higher levels of MLM was probably due to lower energy and crude protein (CP) availability associated with lower digestibility of crude fiber (CF) components reported in diets containing leaf meals. The mean DWG values which ranged from 15.88 to 27.04 g are in line with the reports of [9] who reported daily weight gain of 16.85 to 20.19 g for cockerels.

The FCR values obtained ranged from 3.17 to 4.89 among the treatment groups. The control diet (0% MLM) is comparable to the diets containing MLM except diet 5 (20% MLM). The FCR mean values of birds on diet 2 (5% MLM) were superior to the control (0% MLM).

Table 3: Growth Characteristics of Cockerels Fed Graded Levels of Mistletoe Leaf Meal

	Inclusion Levels of Mistletoe Leaf Meal					
Parameter	0	5	**10**	**15**	**20**	**SEM**
Chick Phase (3-8 weeks)						
Initial body weight (g/bird)	259.83	260.77	242.93	248.90	233.57	9.49^{NS}
Final body weight (g/bird)	1036.60^{b}	1081.30^{a}	905.20^{c}	890.50^{c}	744.60^{d}	63.23*
Total weight gain (g/bird)	776.73^{ab}	820.53^{a}	662.27^{bc}	641.60^{c}	511.00^{d}	55.97
Daily feed intake (g/bird)	37.80^{c}	39.72^{c}	42.91^{ab}	42.58^{b}	45.29^{a}	1.16*
Daily weight gain (g/bird)	18.49^{ab}	19.54^{a}	15.77^{bc}	15.28^{c}	12.17^{d}	1.31*
Feed conversion ratio	2.05^{c}	2.34^{c}	2.73^{b}	2.79^{b}	3.27^{a}	0.14
Grower Phase (9-16 weeks)						
Initial body weight (g/bird	879.60	872.06	866.60	864.60	870.12	18.24^{NS}
Final body weight (g/bird)	2160.00^{ab}	2436.20^{a}	2154.00^{ab}	1990.50^{b}	1851.40^{b}	15.97*
Total weight gain (g/bird)	1280.40^{ab}	1564.14^{a}	1287.40^{ab}	1125.90^{ab}	981.28^{b}	22.46*
Daily feed intake (g/bird)	81.04	82.26	82.75	82.73	82.64	1.46^{NS}
Daily weight gain (g/bird)	22.87^{ab}	27.04^{a}	22.40^{ab}	22.42^{ab}	16.88^{b}	3.46*
Feed conversion ratio (FCR)	3.17^{b}	3.71^{b}	3.72^{b}	4.63^{ab}	4.89^{a}	0.67*
Mortality (%)	0.00	0.00	0.00	0.00	0.00	

a, b, c, d, = means within the same row bearing different superscripts differ significantly (P < 0.05), NS = Not Significant (P>0.05), * =Significant (P<0.05), SEM = Standard error of the mean.

Cost[U35]-benefit analysis of cockerels fed graded levels of MLM

The cost-benefit analysis of growing cockerels fed graded levels of MLM is presented in Table 4. The results revealed that final body weight, feed cost, cost of total feed consumed, and total weight gain were reduced in the cockerel-fed diets containing MLM. The results of the total feed intake showed significant (P<0.05) differences among the treatment groups. The mean values obtained ranged from 3.27 to 3.45 kg. Birds on diets 2 and 5 (5 and 20% MLM) significantly (P<0.05) recorded the highest and lowest values, respectively while those on diets 3 and 4 (10 and 15% MLM) were statistically similar (P>0.05) to diet 1 (control). The total weight gain revealed significant (P<0.05) differences among the treatment groups. The mean values obtained ranged from 1.13 to 1.55 kg among the treatment groups. The cost per kilogram feed obtained in this study was observed to reduce as the level of MLM increased in the diets. The pattern of decline of these

variables is in line with the report of [19] who reported that the use of unconventional feed ingredients as an alternative ingredient for convectional feeds reduced the cost of poultry production since most of them can be obtained at a little or no cost and are quite rich in nutrients. However, feed cost per kilogram body weight gain tends to be higher in cockerels fed 20% MLM than in the control (0% MLM). However, diets 2 (5% MLM) and 3 (10% MLM) recorded better values (₦528.25 and ₦597.52, respectively). This, therefore, suggests that the inclusion of MLM at 20% levels has a lower economic advantage than the other inclusion levels.

Table 4: Cost-Benefit Analysis of Cockerels Fed Graded Level of Mistletoe Leaf Meal

	Inclusion Levels of Mistletoe Leaf Meal					
Parameter	0	5	**10**	**15**	**20**	**SEM**
Initial weight (g/bird)	879.60	872.06	**866.60**	**864.60**	**870.12**	**18.74***
Final weight (g/bird)	2160.00^{ab}	2436.20^{a}	2154.00^{a}	1995.50^{b}	2151.40^{b}	18.24^{NS}
Total weight gain (g/bird)	3.34^{b}	3.45^{a}	3.33^{b}	3.32^{b}	3.27^{c}	0.01*
Feed cost (₦/kg)	221.55^{a}	211.30^{b}	206.69^{c}	195.58^{d}	196.58^{d}	0.32*
Total feed cost (₦)	739.97^{a}	7280.98^{b}	688.67^{c}	649.32^{d}	623.19^{e}	0.78*
Total weight gain (kg)	1.28^{b}	1.55^{a}	1.25^{c}	1.13^{d}	1.26^{e}	5.58*
Feed cost/kg gain (₦)	578.98^{b}	539.98^{d}	550.94^{c}	574.62^{b}	694.59^{a}	0.35*

Cost per kilogram of the ingredients used in compounding the experimental diets: Maize ₦105.00, Wheat Offal ₦70.00, Mistletoe leaf meal ₦45.00, Soya bean ₦246.75, Groundnut cake ₦100.00, Fish meal ₦141.67, Bone meal ₦100.00, Salt ₦140.00, Lysine ₦1350.00, Methionine ₦1350.00, and Premix ₦2000.00 (Price as of November 2019)

CONCLUSION

The nutrient contents of the diets are adequate for normal functioning and development of chicks and growers. The findings of this study revealed that diet containing 5 % MLM recorded a better growth performance and cost-benefits than the control (0% MLM).

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Monogastric Animal Production: MGP 055

INFLUENCE OF RAW *SENNA OBTUSIFOLIA* SEED MEAL ON CUT PARTS AND INTERNAL ORGANS OF STARTER BROILER CHICKENS

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ABSTRACT

Influence of raw *Senna obtusifolia* seed meal (SOSM) on cut parts and internal organs of broiler starter chickens was studied. One hundred and fifty arbor-acre unsexed one-day-old broiler chicks used were randomly allotted to five experimental diets of 30 birds each, replicated 3 times with 10 birds per replicate in a Completely Randomized Design. The levels of the raw SOSM were 0, 2.5, 5.0, 7.5 and 10% for Treatments1 to 5 respectively. Feed and water were provided *ad libitum* throughout the experiment which lasted for 28 days. At the end of the experiment, one bird from each replicate whose live weight was close to the mean weight was selected and fasted overnight with only water provided. The birds were weighed, slaughtered by severing the jugular vein, scalded in 60^0C hot water for 45 seconds, defeathered and weighed again. Cut parts and internal organs were weighed using sensitive scale and expressed as percentage of dressed weight. Results showed significant differences ($P<0.05$) for all the cut part parameters. Generally, the test diets up to 5% inclusion level (T3) had weights of percentage breast cut, back cut, thigh and wings that were not significantly different ($P>0.05$) from the control diet (T1). Also, both the control diet and test diets had good dressing percentages. Significant differences ($P<0.05$) were observed for all internal organs parameters. It was observed that mean weights of all the internal organs increased with increased inclusion of raw SOSM in broiler starter diets, only with the exception of the gall bladder. It was concluded that raw SOSM could be included up to 5% as a low-cost alternative energy feed ingredient in broiler starter diet.

Keywords: *Senna obtusifolia* seed meal, carcass quality, broiler starter chickens

DESCRIPTION OF PROBLEM

Poultry production has been identified as one of the quickest means of correcting inadequacy in animal protein intake among Nigerians. This is because poultry has short generation interval and general acceptability without any religious taboo (1). Feeding constitutes an important part of poultry production, however, poultry feed situations in Nigeria today is a national issue and has become one of great concern. According to (2), the average price of a 25kg bag of poultry feed was five naira in 1976. It rose to twelve naira in 1980, twenty-one naira in 1985 and seventy naira in 1990. (3) reported that in 1997, the price was six hundred and fifty naira. Today, the average price of a 25kg bag of poultry feed stands at a staggering figure of eighteen to twenty-three thousand naira. With these trends, less people are getting involved in raising poultry, resulting in a fall in animal protein supply to meet the needs of Nigerians. This therefore calls for solutions to check the steadily increasing prices of feeds so as to encourage more people to get back into poultry production and increase animal protein supply. One of such solutions involve the use of alternative, cheap feedstuff like *Senna obtusifolia* to achieve least cost energy ration for poultry, especially broiler chickens. *Senna obtusifolia* (synonyms *Cassia obtusifolia*, *Senna obtusifolia*, *Senna obtusifolia*) was originally described by Linnaeus as such (4, 5). It is also known as foetid cassia, sickle senna, chinese senna, sicklepod, coffee weed, coffee pod, java bean or arsenic weed. It is a dicot legume plant in the family *fabaceae*, subfamily *Caesalpinoideae* and genus *Senna*. The use of legume seeds in monogastric nutrition has attracted the attention of researchers worldwide. Several conventional legume seeds have been studied and evaluated for inclusion in non-ruminant diets in Nigeria (6, 7, 8, 9 and 10). There is however some unconventional legume seeds that are still under-utilized, which little are known about their nutritional

values, like sickle pod (*Senna obtusifolia)* seeds. Ukachukwu (2015) opined that these new unconventional alternative feed resources could play an important role in meeting feed deficit in developing countries. According to (11), raw *Senna obtusifolia* seed contains 88.50% dry matter, 11.50% moisture content, 9.63% crude protein (CP), 2.0% ether extract (EE), 10.0% crude fibre (CF), 5.0% Ash, 73.37% Nitrogen Free Extract (NFE), and 3.594 Kcal/g gross energy. The seeds of sickle pod (*Senna obtusifolia*) are one of such legume seeds, which seem to have good potential as alternative, cost-effective source of energy in monogastric diet, especially broilers. However, there is paucity of information on its utilization in broiler diet, and hence, the need for this research.

MATERIALS AND METHODS

The research was conducted at the Poultry Unit of Teaching and Research Farm, University of Uyo, Uyo, Akwa Ibom State. Uyo is located on latitude 4^0 59^1 and 5^0 04^1N and longitude 7^0 53^1 and 8^0 00^1E, with an elevation of about 60.96m above sea level. Uyo has a bi-modal rainfall pattern with mean annual rainfall of 2190mm and mean relative humidity of 81% (University of Uyo Meteorological Station Report, 2000). Mature dried pods of *Senna obtusifolia* were obtained from Yelwan Tudu of Bauchi State, Nigeria and were dehulled to release the seeds. The seeds were ground and stored in sack bag for feed formulation. Prior to the arrival of the chicks, the brooder, which was cleaned, washed and disinfected, was heated up using kerosene stove and electric bulbs. Also, black tarpaulin was used to cover the brooder to conserve heat. The heat source and tarpaulin were removed at the end of the brooding. The floor of the brooder was spread with wood shavings of 2cm thickness. One hundred and fifty (150) arbor acre day-old unsexed broilers were purchased from a reputable supplier in Uyo metropolis. On arrival, the chicks were weighed and given anti-stress in drinking water. The birds were randomly allotted to five experimental treatments with 30 birds per treatment, replicated thrice with 10 birds per replicate, in a Completely Randomized Design (CRD). Treatment 1 was control while SOSM was included at 2.5, 5, 7.5 and 10g/kg in Treatments 2, 3, 4 and 5 (Table 1). Feed and water were provided *ad libitum* throughout the experiment which lasted for 28 days. At the end of the experiment, carcass quality was carried out according to procedures described by (12). This involved selection of one bird from each replicate whose live weight was close to the mean weight. Those birds selected were fasted overnight with only water provided. The birds were weighed, slaughtered by severing the jugular vein and scalded in 60^0C hot water for 45 seconds, defeathered and weighed again. All cut parts were weighed and expressed as percentage of dressed weight. Also, visceral organs like heart, kidney, pancreas, gizzard and spleen was weighed immediately using sensitive scale and expressed as percentage of dressed weight. All data were analyzed using one-way Analysis of variance according to (13) and significant means were separated using new Duncan multiple range test using SPSS Version 25.0

RESULTS AND DISCUSSION

The cut parts (expressed as percentage of dressed weight) of starter broiler chickens fed raw *Senna obtusifolia* seed meal is as shown in Table 2. There were significant differences ($P<0.05$) for all the parameters measured. Generally, the test diets up to 5% inclusion level (T3) had weights of percentage breast cut, back cut, thigh and wings that were not significantly different ($P>0.05$) from the control diet (T1). This may be as a result of efficient utilization of nutrients in terms of ingestion, digestion, absorption and assimilation of the control diet compared with up to 5% of the test diet. This may further be implicated in the weights of full intestine of birds fed test ingredient, especially at 10% inclusion level (T5), after 12 hours of starvation before carcass analysis. Also, birds in the control diet and test diets had good dressing percentages, which according to (10), showed that their final live weights were not due to offals such as shank, intestine and head. The values for the percentage breast cut, drumstick and thigh for the birds fed control diet were numerically higher than all values for birds fed other diets. This implied better profitability of birds placed on control diet than others, since these are highly placed cut parts. The percentage breast cut for birds fed Treatment 1 diet (T1) (0%) was 27.09, T2 (2.5%) was 26.79, T3 (5%) was 26.08, T4 (7.5%) was 25.27 and finally T5 (10%) was 23.14 respectively. Although there was significant difference ($P<0.05$) between treatment means for the breast cut, there was however, no significant difference ($P>0.05$) between

birds fed treatments 1, 2, 3 and treatments 3 and 4. The weight of the drum stick for birds fed the control diet was significantly higher than birds fed experimental diets.

TABLE 1: COMPOSITION OF RAW *Senna obtusifolia* SEED MEAL FED TO STARTER BROILERS

Ingredients %	**Control 0(T1)**	**Levels 2.5(T2)**	**Of 5.0(T3)**	**Inclusion 7.5(T4)**	**(%) 10.0(T5)**
Maize	48.18	46.71	44.26	41.81	39.34
Soyabean meal	33.81	33.79	33.74	33.69	33.66
Senna obtusifolia seed meal	-	2.50	5.00	7.50	10.00
Palm kernel meal	10.00	10.00	10.00	10.00	10.00
Fishmeal	3.00	3.00	3.00	3.00	3.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Vit/TM premix*	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100
Calculated Nutrients					
Crude Protein	23.00	23.00	23.00	23.00	23.00
ME (Kcal/g)	2850	2832	2813	2795	2776

*1kg of premix contains: vitamins A (5,000,000Iu), Vitamin D_3 (1,000,000 1U), Vitamin E (16,000mg), vitamin K_3 (800mg), vitamin B_1 (1,200mg), Vitamin B_2 (22,000mg), Niacin (22,000mg), Calcium panthothenate (4,600mg), Vitamin B6 (2000mg), Vitamin B_{12} (10mg), Folic acid (400mg), Biotin (32mg), Choline chloride (200,000mg), Manganese (48,000mg), Iron (40,000mg), Zinc (32,000mg), Copper (3,400mg), iodine (600mg), Cobalt (120mg), Selenium (40mg), antioxidant (48,000mg).

Table 2 Cut Parts (expressed as percentage of dressed weight) of Starter Broiler Chickens fed Raw *Senna obtusifolia* Seed Meal

	Levels of Inclusion of Raw *Senna obtusifolia* Seed Meal					
Parameters	**T1 (0%)**	**T2 (2.5%)**	**T3 (5%)**	**T4 (7.5%)**	**T5 (10%)**	**SEM**
Live weight at slaughter (g)	896.67 ^{a}	858.00 ^{a}	849.00 ^{a}	818.67 ^{ab}	704.00 ^{b}	21.04
Dressed weight (g)	642.77 ^{a}	565.70 ^{a}	552.60 ^{ab}	548.83 ^{ab}	466.20 ^{b}	18.39
Dressing Percentage (% LWT)	72.17 ^{a}	65.91 ^{b}	65.06 ^{b}	67.00 ^{b}	66.10 ^{b}	1.47
Breast cut (% of DWt)	27.09 ^{a}	26.79 ^{a}	26.08 ^{ab}	25.27 ^{b}	23.14 ^{c}	0.61
Back cut "	20.65 ^{a}	20.01 ^{ab}	19.89 ^{ab}	19.62 ^{b}	19.00 ^{b}	0.43
Drum stick "	15.40 ^{a}	14.84 ^{b}	14.28 ^{b}	13.91 ^{c}	13.73 ^{c}	0.32
Thigh "	15.40 ^{a}	15.17 ^{a}	15.29 ^{a}	14.98 ^{b}	13.29 ^{c}	0.38
Wings "	15.63 ^{a}	14.27 ^{ab}	14.15 ^{ab}	13.79 ^{b}	13.28 ^{b}	0.29
Abdominal Fat "	1.23 ^{a}	1.08 ^{a}	0.90 ^{ab}	0.67 ^{b}	0.37 ^{c}	0.15
Full Intestine (Si+Li)* "	11.60 ^{c}	12.46 ^{b}	12.50 ^{b}	12.82 ^{b}	13.57 ^{a}	0.38

^{a,b,c} Means with different superscripts in the same row are significantly different ($P<0.05$). LWT = Liveweight; DWt = dressed weight

***** = Small intestine + large intestine

However, drum stick for birds fed T2 and T3 diets, were statistically similar, but significantly different ($P<0.05$) from birds fed T4 and T5 diets, which were similar. There was no significant difference ($P>0.05$)

between birds fed the control diet (T1), T2 and T3 for the weight of the thigh. However, these were significantly different (P<0.05) from birds fed T4 and T5 diets. Although the weight of the wings showed significant difference (P<0.05) across treatment means, however, birds fed T2 and T3 as well as T4 and T5 diets were statistically similar. The least significant value (0.37) of abdominal fat for T5 (10%) diet showed the hypolipidemic ability of *Senna obtusifolia* seeds, which makes the meat of birds fed SOSM, a good dietary source of protein for cardiovascular disease patients (11). The mean internal organs (expressed as percentage of dressed weight) of starter broiler chickens fed raw *Senna obtusifolia* seed meal are as shown in Table 3. There was significant differences (P<0.05) for all the parameters measured. Generally, it was observed that the mean weights of all the internal organs increased with increased inclusion of raw *Senna obtusifolia* seed meal (SOSM) in broiler starter diets, only with the exception of the gall bladder. The mean weights of the heart ranged from 0.58 in control diet (T1) to 1.08 (T5). The weights for T2, T3 and T4 were 0.85, 0.88. 0.87 respectively. The mean weighs of kidney increased with increasing inclusion of raw SOSM, with T1 having 0.32, T2 0.35, T3 0.42, T4 0.49 and T5 0.61. Also, the mean weights of liver ranged from 3.52 in control diet (T1) to 4.05 in T5, which recorded the highest mean weight. This may be because the liver is a major detoxification organ. Also, since T5 with the highest inclusion level (10%) of raw SOSM, probably has the highest level of anti-nutritional factors, this increases the activities of the liver, which may result in the enlargement and probably increased in its weight (9). Assam *et al*., (2019) reported that raw SOSM contained 0.087% tannins, 0.046% phytate, 0.994Mg/g saponins and 0.883Mg/g hydrogen cyanide. According to (9), increase in metabolic activities of kidney, liver and heart due to anti-nutritional factors has resulted in their increase in weight. The result of this study showed that the mean weight of gall bladder decreased with increasing inclusion of raw SOSM in broiler starter diet. This may be attributed to the hypolipidemic activity of the test ingredient, which leaves little or no fat to be emulsified.

Table 3Internal Organs (expressed as percentage of dressed weight) of Starter Broiler Chickens fed Raw *Senna obtusifolia* Seed Meal

	Levels of Inclusion of Raw *Senna obtusifolia* Seed Meal					
Parameters (% DWT)	T1 (0%)	T2 (2.5%)	T3 (5%)	T4 (7.5%)	T5 (10%)	SEM
Heart	0.58 ^{b}	0.85 ^{ab}	0.88 ^{ab}	0.87 ^{ab}	1.08 ^{a}	0.07
Liver	3.52 ^{b}	3.58 ^{b}	3.88 ^{ab}	3.99 ^{a}	4.05 ^{a}	0.15
Kidney	0.32 ^{c}	0.35 ^{c}	0.42 ^{bc}	0.49 ^{b}	0.61 ^{a}	0.05
Spleen	0.12 ^{c}	0.16 ^{b}	0.18 ^{b}	0.22 ^{b}	0.52 ^{a}	0.07
Proventriculus	0.90 ^{ab}	0.86 ^{b}	0.97 ^{a}	0.91 ^{ab}	0.89 ^{b}	0.03
Empty Gizzard	3.56 ^{c}	4.06 ^{b}	4.15 ^{b}	4.33 ^{a}	4.37 ^{a}	0.13
Lungs	0.77 ^{b}	0.97 ^{a}	0.97 ^{a}	0.98 ^{a}	0.99 ^{a}	0.04
Gall Bladder	0.14 ^{a}	0.13 ^{ab}	0.12 ^{ab}	0.11 ^{b}	0.10 ^{c}	0.02
Pancreas	0.39 ^{b}	0.40 ^{b}	0.48 ^{b}	0.53 ^{ab}	0.61 ^{a}	0.03

^{a,b,c} Means with different superscripts in the same row are significantly different (P<0.05)
DWT = Dressed weight

CONCLUSION

It was concluded that raw SOSM could be included up to 5% as a low-cost alternative feed ingredient in broiler starter diet, because of better carcass quality obtained.

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Monogastric Animal Production: MGP 056

EVALUATION OF BIOAVAILABILITY OF CALCIUM, PHOSPHORUS IN DIETS CONTAINING RAW AND HEAT TREATED ROCK PHOSPHATE ON WISTAR RATS

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ABSTRACT

Researches on minerals and its bioavailability for livestock are less emphasised unlike protein and carbohydrate in animal science. In raw and heat treated rock phosphate (RRP and HTRP) studies, forty five (45) weanling Wistar rats with initial average weights of (47.09 ± 01 g) at 4-5 weeks of age at start were randomly allotted to nine dietary treatments in 2×4+1 augmented factorial design. Rock phosphate replaced bone Ash at levels of 0, 25, 50, 75, and 100 % respectively. At the end of the study at 21 days, three rats per treatment were sacrificed for evaluation of Ca and P bioavailability in serum and feaces. The result recorded in serum Ca main effect within the treatments proved that HTRP had high ranged mean value of 4.12 - 5.99 mg/dl while interaction phase showed that HTRP had ranged mean values of 3.96 - 6.08 mg/dl and RRP had 3.68 - 5.99 mg/dl. Results obtained in faeces main effect of HTRP Ca bioavailability indicated mean value of 80.77 % and control showed low value of 59.45 %. 100 % inclusion level had high mean value of 79.79 % and 0 % with low mean value of 59.45 %. However, HTRP and RRP had no impact on phosphate at main effect as well as calcium and phosphorus in interaction phase. The research showed that rock phosphate supplied calcium and phosphorus that were comparable to that of bone ash (control), and normal range values for serum and faeces of Wister rats found in literature.

Keywords: Calcium, Phosphorus Bioavailability, Raw rock phosphate and Heat treated rock phosphate.

DESCRIPTION OF PROBLEM

Researches on minerals and its bioavailability for livestock are less emphasised unlike protein and carbohydrate in animal science.

Alternative and more readily available sources of calcium and phosphorus should be evaluated for use in animal diets. Calcium and phosphorus are the most valuable mineral elements required in large amount by all types of animals as revealed by (1).

Calcium sources in the country have been identified, such as (oyster shell, periwinkle shell, limestone, di-calcium phosphate and bone ash/meal). However, there aren't as many efforts focused on finding local substitutes for the important mineral nutrients, such as phosphorus and calcium (2).
Another source is rock phosphate, a naturally occurring sedimentary rock with high calcium and phosphorus content. Although it is considerably less expensive in some areas of Nigeria, its use has been restricted due to its high fluoride content (3).

The technique to reduce the fluoride concentration of crude rock phosphate is heat treatment. Deflourinated or soft rock phosphate is another name for heat-treated rock phosphate (HTRP), which likewise has fluoride concentrations much lower than raw rock phosphate (RRP) (4).
Tolerance to low levels of fluoride consumption is dependent on the functioning of high levels of intake; however, toxic effects on the system may occur. It is difficult to determine the fluoride sensitivity of diverse species, unless settings under which they are assessed are standardized as noted by (5).
Laboratory rat and mouse diet has been carefully examined and defined in contrast with several other species as an overview (6).

MATERIALS AND METHODS

Experimental site

The experiment was conducted at the Rat room, Department of Animal Science, University of Ibadan (GPS Coordinates: 7.4432°N, 3.9003°E) (7).

Ethical Approval

University of Ibadan Animal Care and Use Research Ethics Committee approved experimental procedures before the commencement of the study (Approval ID: 23/049).

Collection of Phosphate Rocks

Phosphate sediments were obtained in Ogun State, between Ososun and Ifo Junction, about 43 and 48 kilometers north of Lagos.

Heat Treatment of RRP

Phosphate ore was ground into powder and sieved using 200 µm sieves. Samples (1000 g) were heated for five hours at varying temperature rates of 10 °C/min between 650 °C and 950 °C until the color changed from brownish grey to reddish brown, thereby deflourinating rock phosphate from 6.30 to 0.09 % (8 and 9).

Housing and management of Wistar rats

In raw and heat treated rock phosphate (RRP and HTRP) studies, forty five (45) weanling Wistar rats with initial average weights of (47.09 ± 01 g) at 4-5 weeks of age at start, were randomly allotted to nine dietary treatments. For the purpose of evaluating bioavailability, feed and water were available *ad-libitum*. As a pre-trial or acclimatization period, five rats per treatment were housed in 32 x 14 x 11 cm, all-wire individual hutches in an open, ventilated house for seven days before the research work began. Diets of different treatments, 10 g were served at 8:00 am every day. The rats were put on dietary regimens that included 0, 25, 50, 75, and 100% replacement of bone ash/meal in a full Randomized Design (CRD) (2 × 4) + 1 Augmented Factorial which took place over the course of 21 days.

Bio-Availability of Wistar rat serum biochemistry

Sampling of blood (2ml) per rat for Ca and P analysis at 21days, after starving the animals for 8-10 hours was done. The methods for estimating bioavailability and requirements were fortress diagnostic procedure for Ca and P serum biochemistry.

Method for estimating bioavailability and requirements in faeces

Apparent absorption = (Ca intake – total faecal excretion)/(Ca intake)*100.

Apparent absorption = (P intake – total faecal excretion)/(P intake)*100.

Statistical analysis:

Experimental design was Complete Randomized Design (CRD) (2 × 4) + 1 Augmented Factorial. Data obtained from the experiment were analysed using 9. The means variances were separated using Duncan Multiple Range Test as described by (11)

RESULTS OF THE RESEARCH

Table 1a: Main effect of graded levels of rock phosphate inclusion on bioavailability of calcium and phosphorus in Wistar rat serum

Parameters	Treatments				Percentage levels					
	Control	HTRP	RRP	P-value	0	25	50	75	100	P-value
Calcium mg/dl	5.99[a]	4.91[b]	4.12[b]	0.013	5.99[a]	3.97[c]	5.25[ab]	3.87[c]	4.98[b]	0.009
Phosphorus mg/dl	8.32	9.78	9.58	0.793	8.32	9.35	9.11	9.41	10.85	0.411

[abc] Means with different superscripts on the same row significantly differs (p<0.05) from one another mg/dl= milligram per decilitre

Table 1b: Interaction effect of graded levels of rock phosphate inclusion on bioavailability of calcium and phosphorus in Wistar rat serum

Parameters	HTRP Percent Levels					RRP Percent levels				
	0	25	50	75	100	25	50	75	100	P-value
Calcium mg/dl	5.99^{ab}	3.96^{bc}	6.08^{a}	4.06^{abc}	5.54^{abc}	3.97^{bc}	4.42^{abc}	3.68^{c}	4.42^{abc}	0.179
Phosphorus mg/dl	8.32	8.89	9.72	11.66	8.87	9.81	8.51	7.17	12.83	0.021

^{abc} Means with different superscripts on the same row significantly differs ($p<0.05$) from one another mg/dl= milligram per decilitre

Table 2a: Main effect of graded levels of rock phosphate inclusion on bioavailability of calcium and phosphorus in Wistar rats faeces

Parameters	Treatments				Percentage levels					
	Control	HTRP	RRP	P-value	0	25	50	75	100	P-value
Calcium %	59.45^{b}	80.77^{a}	74.50^{a}	0.116	59.45^{b}	73.57^{a}	79.50^{a}	77.66^{a}	79.79^{a}	0.612
Phosphorus %	63.13	69.16	67.02	0.632	63.13	71.09	64.58	67.09	69.59	0.729

^{ab} Means with different superscripts on the same row significantly differs ($p<0.05$) from one another %= percentage

Table 2b: Interaction effect of graded levels of rock phosphate inclusion on bioavailability of calcium and phosphorus in Wistar rats faeces

Parameters	HTRP Percent levels					RRP Percent levels				
	0	25	50	75	100	25	50	75	100	P-value
Calcium %	59.45	81.45	75.90	82.58	83.16	65.70	83.11	72.75	76.43	0.213
Phosphorus %	63.13	73.64	76.79	59.49	66.72	68.55	52.38	74.70	72.46	0.049

There were no significant differences ($P>0.05$) in all parameters measure %= percentage

DISCUSSION

The bioavailability is used to assess the calcium and phosphorus from feedstuffs as digestible Ca and P. The minerals evaluation in feedstuffs is subject to various factors, including dietary, animal, and experimental influences. Consequently, different bioavailability may be assigned to different feedstuffs, as described by (12). Results obtained in Table 4a: main effect of Ca and P bioavailability in serum indicated that rock phosphate significantly ($P<0.05$) impacted Ca at main effect and interaction phases but had no significant ($P>0.05$) effect on P at both phases. This could be ascribed to the presence of magnesium oxide and other mineral contents in the diets, due to the fact that magnesium interferes with calcium for absorption. The result recorded in serum Ca main effect within the treatments proved that HTRP had high ranged mean value of 4.12 to 5.99 mg/dl and that of Percentage inclusion levels ranged of 3.87 to 5.99 mg/dl. The mean values

at interaction phase showed that HTRP had ranged values of 3.96 to 6.08 mg/dl and RRP had 3.68 to 5.99 mg/dl. Meanwhile, Results obtained in Table 4b: main effect of Ca bioavailability in faeces indicated high mean value of 80.77 % for HTRP and control showed low mean value of 59.45 %. However, 100 % inclusion level had the bioavailability high mean value of 79.79 % and 0 % with the low mean value of 59.45 %. HTRP and RRP had no impact on phosphorus at main effect as well as calcium and phosphorus in interaction phase. Conclusion of the research showed that rock phosphate supplied high bioavailability of calcium and phosphorus that falls within the value of control diet and normal literature ranged values in serum and faeces.

CONCLUSION AND APPLICATION

The research showed that rock phosphate supplied calcium and phosphorus that were comparable to that of bone ash (control), and normal range values for serum and faeces of Wister rats found in literature. However, the analysed composition of rock phosphate showed that phosphate content was 31.00 % and calcium was 10.16 %. But Ca: P requirement ratio is 2:1 according to literature. Therefore, other calcium sources such as calcium carbonate ($CaCo_3$) could be used along with rock phosphate in order to augment the calcium mineral requirements for rats.

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Monogastric Animal Production: MGP 057

NUTRITIVE VALUE OF FERMENTED CASSAVA PEEL MEAL ON THE NUTRIENT DIGESTIBILITY OF BROILER CHICKENS

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ABSTRACT

A study was conducted to examine the effect of fermented cassava peel meal on the nutrient digestibility of broiler chickens. One hundred and fifty (150) unsexed day-old chicks (arbor acre breed) were obtained from a reputable hatchery and used for the study. The chicks were randomly allocated to five treatments (T1; 0%, T2; 5%, T3; 10%, T4; 15%, and T5; 20%) each with three replicates and ten birds per replicate in a completely randomized design. Feed and water were given to the birds ad libitum and the experiment lasted 8 weeks. This study demonstrated that the digestibility of dry matter, ash and nitrogen-free extract (NFE) was not significantly ($p>0.05$) affected. However, crude protein, crude fibre, and ether extract were significantly ($p<0.05$) affected across the treatment groups. The findings of this study showed that the incorporation of fermented cassava peel meal in broiler chicken diets up to 20% did not have deleterious effects on nutrient digestibility.

Keywords: Broiler chicken, fermented cassava peel meal, nutrient digestibility

DESCRIPTION OF PROBLEM

In developing nations, one of the most effective ways to address the animal protein shortage is through poultry production, especially broiler farming. Broilers, known for their rapid growth rates, are a prime source of meat. Compared to ruminants, broiler production benefits from simpler management, higher turnover rates, and faster returns on investment (1, 2). To improve broiler production and mitigate the rising cost of feed ingredients, such as corn and soybean, which serve as the primary energy and protein sources in livestock diets, researchers advocate for the use of affordable, locally available, and nutritionally viable alternative feedstuffs that do not compete with human or industrial uses, thus reducing the reliance on conventional feedstuff for livestock production (3). Cassava is a vital dietary staple food in many tropical regions, providing an average of 285 calories per person per day and feeding over 800 million people (4, 5). It serves as the main source of dietary energy for most of the population in the lowland and subhumid tropics of West and Central Africa (6, 7). Cassava peel is a promising by-product that is abundantly available in regions where cassava is grown and processed for food. Cassava peels are often discarded and left to decompose, creating a waste disposal problem, and posing a health hazard to humans (1). The outer covering of the tuber, known as the peel, comprises 10-13% of the tuber's weight (8). While cassava peels offer potential as a cost-effective feed for non-ruminant, their application is hampered by anti-nutritional factors like hydrocyanic acid and high non-starch polysaccharides (9, 10, 11). Therefore, the processing of cassava peel is essential for improved utilization and acceptability by the animals. Numerous processing methods have been reported and used by different authors to improve the nutritive value of cassava, such as sun drying, soaking in water and retting oven drying, and enzymes (1, 12, 13, 14). According to (15), fermentation has been employed as a method to enhance the nutritional profile of cassava peel for livestock feeds, by mitigating anti-nutritional factors, lowering crude fiber, and enriching protein content. Furthermore, (1) observed an enhanced crude protein content when fermented cassava peel was fed to broiler chickens. Also, (8) reported improved performance and carcass traits in broiler chickens fed cassava peel

fermented with rumen filtrate. Thus, this study was conducted to determine the effects of fermented cassava peel on the nutrient digestibility of broiler chickens.

MATERIALS AND METHODS

Experimental site

The experiment was conducted at the Poultry Unit of the Livestock Teaching and Research Farm, Joseph Sarwan Tarka University Makurdi Benue state. Makurdi is located at Latitude 7°44' North and Longitude 8°54' East and lies within the Southern Guinea Savannah Region of Nigeria. The annual temperature ranges from 21^0C in January and 35^0C in March. The annual rainfall ranges between 1105mm to 1600mm (16).

Collection and Preparation of Cassava Peels

Fresh cassava peel was collected from a garri processing factory within the Makurdi metropolis. Fresh rumen content was obtained from the abattoir at North Bank Cattle Market Makurdi, water was added to the rumen content at 1:1, thoroughly mixed, and sieved. 1 kg of fresh cassava peel was mixed with rumen filtrate, placed in a polythene bag, sealed, and left for 48 hours under shade to ferment. The fermented cassava peel was then sun-dried, crushed, and mixed with other feed ingredients to form a complete diet.

The cassava peel meal was supplemented in the diets at T1; 0%, T2; 5%, T3; 10%, T4; 15% and T5; 20%.

Experimental Animals, Management and Design

One hundred and fifty (150) unsexed day-old chicks (arbor acre breed) were purchased from a reputable hatchery and used for the study. The chicks were weighed and randomly allocated into five dietary treatments (T1; 0%, T2; 5%, T3; 10%, T4; 15% and T5; 20%), each with three replicates and ten birds per replication in a completely randomized design. The chicks were housed in cages constructed with wood and wire mesh. The birds were vaccinated adequately. Feed and water were provided *ad libtum*. The starter diet was offered from 1-4 weeks while the finisher diet was given from 5-8 weeks of age.

Table 1: Nutrient Composition of Starter Diets

Ingredients	T1 (0%)	T2 (5%)	T3 (10%)	T4 (15%)	T5 (20%)
Maize	50.60	48.07	45.54	43.01	40.48
BCPM	0.00	2.53	5.06	7.59	10.12
Maize offal	5.00	5.00	5.00	5.00	5.00
Brewers Dry Grain	4.00	4.00	4.00	4.00	4.00
SBM	34.60	34.60	34.60	34.60	34.60
Blood meal	1.80	1.80	1.80	1.80	1.80
Limestone	1.00	1.00	1.00	1.00	1.00
Bone ash	2.00	2.00	2.00	2.00	2.00
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Remix	0.25	0.25	0.25	0.25	0.25
Common salt	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Nutrient Composition					
ME (Kcal/kg)	2947.52	2939.63	2923.98	2908.33	2892.68
Crude Protein	23.18	22.96	22.73	22.51	22.28
Crude Fibre	4.70	4.63	4.56	4.49	4.42
Calcium	1.01	1.01	1.01	1.01	1.01
Avail. Phosphorus	0.59	0.58	0.58	0.57	0.56

SBM = Soybean meal, ME = Metabolizable energy, BDG = Brewer dried grain, BCMP = Biodegraded cassava peel meal, Premix supplied per kilogram, Vit A: 10000000IU, Vit D3: 2000000mg, VitK3: 2000mg, VitB1: 3000mg, VitB2: 5000mg, Niacin:45000mg, Calcium panthothenate:10000mg VitB6:4000mg, Choline chloride:300000mg, Folic acid:1000mg, Biotin:50mg, Manganese:300000mg, Iron:120000mg, Zinc:80000mg, Copper:8500mg, Iodine:1500mg, Cobalt:300mg, Selenium:120mg, Antioxidant:120000mg.

Table 2: Nutrient Composition of Finisher Diets

Ingredients	T1 (0%)	T2 (5%)	T3 (10%)	T4 (15%)	T5 (20%)
Maize	55.50	52.73	49.95	47.18	44.40
BCPM	0.00	2.78	5.55	8.88	11.10
Maize Offal	6.00	6.00	6.00	6.00	6.00
BDG	5.50	5.50	5.50	5.50	5.50
SBMS	28.00	28.00	28.00	28.00	28.00
Blood meal	1.00	1.00	1.00	1.00	1.00
Limestone	0.50	0.50	0.50	0.50	0.50
Bone Ash	2.50	2.50	2.50	2.50	2.50
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Nutrient Composition					
ME(Kcal/kg)	2982.29	2943.49	2904.70	2865.90	2827.44
Crude protein	20.53	20.42	20.32	20.21	20.10
Crude fibre	4.70	3.99	5.25	4.46	3.29
Calcium	1.00	1.00	1.00	1.00	1.00
Avail. Phosphorus	0.22	0.22	0.21	0.28	0.19

SBM = Soybean meal, ME = Metabolizable energy, BDG = Brewer dried grain, BCMP = Biodegraded cassava peel meal. Premix supplied per kilogram VitA,; 10,000,000IU, VitD3:20,000,000mg, VitK3:2000mg. VitB1:3000mg., VitB2:5000mg, Niacin:45000mg., Calium panthothenate:10000mg., VitB6:4000mg., Choline chloride: 300,000mg., Folic acid: 1000mg. Biotin:50mg, Manganese: 300,000mg., Copper:8500mg. Iodine:1500mg., Cobalt:300mg., Selenium:120mg., Antioxidant: 120000mg. Iron: 120000mg., Zinc:80000mg

Digestibility studies

During the last week of the study, a 5-day digestibility trial was carried out using six birds per treatment. Before faecal collection, the birds were deprived of feed for 12 hours to clear the gastrointestinal tract, the birds were however allowed free access to drinking water. A clean polythene bag was placed under the cage for daily faecal collection. The collected faecal samples from each replicate were oven-dried, bulked, thoroughly mixed, ground, and used for further analysis. Nutrient digestibility was determined using the formula below.

$$\frac{\text{Nutrient in feed} - \text{Nutrient in feaece}}{\text{Nutrient in feed}} \times 100$$

Laboratory analysis

The Proximate analysis of fermented cassava peel meal was determined according to the method described by (17).

Statistical Analysis

The data collected were subjected to a one-way analysis of variance (ANOVA) using SPSS Version 20 (18). Duncan's Multiple Range Test (DMRT) was used to compare the mean at $p<0.05$ level of significance.

RESULTS AND DISCUSSION

The proximate composition of the fermented cassava peel meal is presented in Table 3. The results revealed that the cassava peel contained 9.04% crude protein, 12.95% crude fiber, 1.45% ether extract, 10.03% ash, and 66.17% nitrogen-free extract (NFE). The crude protein content of 9.04% recorded in this study is higher than the 5.46%, 5.70%, and 5.75% reported by (19), (20), and (9). Additionally, the crude fiber content of 12.95% in this study is lower than the 14.83% reported by (20) and (9), and 15.5% reported by (10). The

ether extract of 1.45% observed in this study is in line with the value reported by (9). The ash content of 10.03% is also comparable to the value obtained by (21). The observed differences in the proximate analysis could be attributed to variations in cassava varieties, processing methods, and storage conditions employed by the different researchers.

Table 4 shows the effect of nutrient digestibility of broiler chickens fed fermented cassava peel. There were no significant differences ($p>0.05$) in the digestibility of dry matter, crude ash, and nitrogen-free extract among the treatment groups. However, significant differences ($p<0.05$) were observed for crude protein, fiber, and ether extract digestibility. Birds in the T2 and T3 groups exhibited higher crude protein digestibility compared to other treatment groups and the control. Additionally, broiler chickens in the T3 group showed improved crude fiber digestibility relative to the control group. The result of this study aligned with (9), who reported enhanced nutrient digestibility in birds fed enzyme-treated cassava peel meal. Conversely, (22) found that cassava peel meal enriched with Calapogonium mucunoides does not improve nutrient digestibility in broiler chickens. The improved nutrient digestibility observed in our study can be attributed to the beneficial effects of fermented cassava peel on gastrointestinal tract health. These benefits include lowering gastric pH, enhancing nutrient absorption, reducing pathogenic microbial activity, and improving the gut lining structure (23, 24). Additionally, treated cassava peel may reduce antinutritional and fiber components, releasing trapped nutrients and making them more accessible for the chickens' utilization (9, 25).

Table 3: Proximate analysis of fermented cassava peel meal

Parameter	FCPM
Dry matter	93.05
Crude protein (%)	9.04
Crude fibre (%)	12.95
Ether extract (%)	1.45
Ash (%)	10.03
Nitrogen-free extract (%)	66.17

FCPM = Fermented cassava peel meal

Table 4: Effect of biodegraded cassava peel meal on nutrient digestibility of broiler chickens

Parameter	T1	T2	T3	T4	T5	SEM
Dry matter	85.61	82.86	82.72	79.09	78.00	1.71
Crude protein	83.59^{b}	86.77^{a}	85.03^{a}	78.48^{c}	82.31^{b}	1.64*
Crude fibre	43.30^{c}	44.76^{b}	47.69^{a}	45.83^{b}	43.39^{bc}	4.64*
Ether Extract	65.93^{b}	72.94^{a}	69.95^{ab}	64.94^{bc}	62.72^{c}	5.08*
Ash	65.54	67.44	65.04	68.61	68.57	5.20
NFE	90.43	88.66	88.94	87.43	85.31	1.12

^{abc} Means with different superscripts within the row indicate significant differences ($p<0.05$)

CONCLUSION AND APPLICATION

The findings of this study showed that fermented cassava peel meal can be included in broiler chicken diets at levels up to 20% without adversely affecting nutrient digestibility. This supplementation level is recommended for poultry farmers.

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Monogastric Animal Production: MGP 058

CLIMATE CHANGE AND ANIMAL NUTRITION: IMPACTS, CONSEQUENCES, AND MITIGATION : REVIEW.

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ABSTRACT

The ramifications of climate change on animal nutrition, productivity, and health are highly concerning, with extensive implications for global food security, sustainable agriculture, and ecosystem services. An in-depth analysis of various studies published between 2010 and 2023 revealed that climate change impacts animal nutrition through diverse pathways, including shifts in disease prevalence, changes in feed crop yields and quality, increased heat stress and drought, and effects on animal reproduction and productivity. Livestock production systems are particularly susceptible due to their dependence on climate-sensitive feed crops, limited genetic diversity in breeding programs, and inadequate animal husbandry practices. Promising strategies for mitigation include innovative feed supplementation, climate-resilient breeding programs, improved animal husbandry practices, and the integration of climate-smart agriculture and livestock production. These insights highlight the pressing need to address the challenges posed by climate change to animal nutrition and sustainable livestock production through collaborative research across different disciplines.

Keywords: Climate change, animal nutrition, livestock production, mitigation strategies,smart-climate agriculture.

INTRODUCTION

The livestock industry plays an important role in the world's food systems by making protein and nutrients for human consumption (1). Climate change refers to significant and lasting changes in the Earth's climate patterns, particularly over an extended period. It encompasses both natural fluctuations and alterations caused by human activities. The primary driver of recent climate change is the increase in greenhouse gases (GHGs) in the atmosphere, largely due to the burning of fossil fuels, deforestation, industrial processes, and agricultural practices. With the world population on a continuous increase, there is an upsurge on the demand for animal-based food sources, which exerts pressure on livestock production systems (2). Despite this opportunity for increase production, the industry however is confronted with numerous challenges due to climate change, which affects animal nutrition, productivity, and general health (3).

The impacts of climate change, such as rising temperatures, altered precipitation patterns, and extreme weather events, are disrupting livestock production systems (4). These changes lead to challenges in feed crop availability and quality, compromising animal health and productivity, including changing disease and parasite dynamics (5). Furthermore, climate change is impacting animal reproduction, growth, and overall productivity, posing risks to the sustainability and resilience of the livestock industry (6). Understanding the impact of climate change on feed availability, quality, and nutrient requirements for livestock is crucial for mitigating its effects on animal health, productivity, and environmental sustainability (7,8).

This review seeks to offer an in-depth analysis of how climate change is influencing animal nutrition and livestock production systems, highlighting vulnerabilities and potential mitigation strategies. By exploring the intricate connections between climate change, animal nutrition, and livestock production, we can identify effective solutions to support the long-term sustainability of the industry and ensure global food security.

MATERIALS AND METHOD

A thorough examination of existing literature was conducted to investigate and analyze the correlation, between climate change and animal nutrition. Various reputable scientific publications were methodically searched to collect information on this subject. Databases like PubMed, Scopus, Web of Science and Google Scholar were utilized.

RESULTS AND DISCUSSION

This review studies highlighted the implications of climate change on animal nutrition, which includes; reduced feed availability, nutrient deficiencies and compromised animal health and performance (9). Heat stress is often the concern in livestock production which results to poor feed intake, nutrient utilization, and immune function (10). Changes in feed composition and quality also present challenges for maintaining optimal nutrition in livestock, further exacerbating the impact of climate change on animal agriculture (11). There is therefore a clear link between climate change and animal nutrition, with implications for sustainable agriculture and food production. Despite variations in study methodologies and livestock species, common trends have emerged regarding the detrimental effects of climate change on feed resources and nutrient requirements in animals (12). Addressing these challenges requires a holistic approach that considers both environmental sustainability and animal welfare in the face of a changing climate (13).

Some key effects of climate change worthy of note include:

Feed scarcity and quality decline: Climate changes disrupt crop yields, pasture growth, and feed nutritional value. Climate change has significant effect on livestock production, particularly in terms of feed scarcity and quality decline (14).

Water scarcity: Changes in precipitation patterns and temperature impact water availability, affecting animal hydration and nutrient absorption (15,16). Rising temperatures and altered precipitation patterns can lead to reduced water quality and availability, affecting animal health and productivity (17).

Heat stress and temperature extremes: Increased temperatures and intense weather events lead to heat stress which affects animal nutrition, productivity, and overall health (18,19,20).

Shifts in disease and parasite dynamics: Climate change alters the distribution and prevalence of disease-carrying insects and parasites which impacts animal health and nutrition (21,22).

Nutrient cycling and soil fertility disruptions: Climate fluctuations affects soil nutrient cycling, impacting the availability of essential nutrients for animal growth and development. Changes in temperature and precipitation patterns can change soil nutrient dynamics, resulting to reduced soil fertility and nutrient availability, ultimately affecting animal nutrition and productivity (23).

Changes in animal migration and grazing patterns: Climate change influences animal migration and grazing patterns, affecting nutrient intake and overall nutrition (24). Changes in temperature and precipitation patterns affect the availability and quality of forage resources, leading to reduced nutrient availability and altered nutrient cycling (25).

Mitigation strategies for climate change

Sustainable feed production and sourcing: it focuses on reducing the environmental footprint of feed ingredients, decreasing greenhouse gas emissions, and minimizing deforestation and habitat destruction (26,27). Example include; utilizing alternative feed ingredients, improving feed efficiency, promoting local sourcing and certifications and standards (28).

Improved feed efficiency and nutrient utilization: it involves optimizing feed formulations, enhancing animal digestion and utilizing additives or technologies to improve nutrient absorption and utilization (29,30). By improving feed efficiency, livestock producers can reduce the environmental footprint of animal agriculture, including greenhouse gas emissions and resource consumption (31,32).

Development of climate-resilient animal breeds: Climate-resilient breeds are characterized by their ability to thrive in various environmental conditions, such as heat stress, drought, and changing patterns of disease. (33). Breeding programs focused on enhancing climate resilience aim to improve the productivity, well-being, and sustainability of livestock production systems in the face of climate uncertainty (34).

Implementation of precision agriculture: utilizing sensors, monitoring systems, and data analytics, farmers can precisely monitor the nutritional needs of individual animals and adjust feed rations accordingly (35). Advanced technologies such as automated feeders, robotic feeding systems, and real-time monitoring devices enable precise control and monitoring of feed intake by individual animals (36)

Integration of agroforestry and silvopastoral systems: Agroforestry systems incorporate trees, shrubs, and other vegetation alongside pasture areas, creating a diverse range of forage resources for grazing animals (37). They contribute to improved feed quality for livestock example, leguminous trees and shrubs can fix nitrogen, increasing protein content in the diet and enhancing the availability of essential amino acids for animals (38). Agroforestry systems can help buffer against seasonal fluctuations in forage availability by providing supplementary feed sources during periods of scarcity (39).

Promotion of economy and reduced food waste: Promoting the economy and reducing food waste in animal nutrition can be achieved through various strategies such as utilizing by-products from food processing industries, implementing precision feeding practices, and enhancing feed efficiency in livestock production systems *(*40).

Implications on Policy and Practice: Policy development and agricultural practices aim at enhancing animal nutrition resilience to climate change. Policymakers, industry stakeholders, and researchers must collaborate to develop sustainable solutions that address the complex interplay between climate change and animal nutrition.

Conclusion: Climate change affects the well-being and productivity of livestock, endangering global food security and sustainable agriculture. There are intricate relationships between climate change, animal nutrition, and livestock production systems, exposing vulnerabilities and potential mitigation strategies. Climate changes disrupt feed crop yields and quality, while intensified heat stress and drought further erode animal health and productivity. Livestock production systems are particularly susceptible due to their dependence on climate-vulnerable feed sources and limited genetic diversity in breeding programs.

Therefore, novel approaches to feed production, climate-resilient breeding and integrated climate-smart agriculture are crucial for countering these anomalies. By improving research and innovation, we can develop effective solutions to bolster the resilience and sustainability of animal nutrition in the face of climate change.

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Monogastric Animal Production: MGP 059

HAEMATOLOGY AND GUT ASSAY OF GROWER PIGS FED SOLID WASTE PRODUCT OF SUGAR INDUSTRY (SWAPSI) AS REPLACEMENT FOR MAIZE

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ABSTRACT

Twenty-four (24) Land race grower pig of equal sex and average live weight of (26-30.33kg/pigs) were utilized in a 35days experiment to evaluate the serum and lipid profile of grower pigs fed solid waste product of sugar industry (SWAPSI) as a replacement for maize. Four (4) treatments diets namely T1, T2, T3, and T4 were compounded to be iso-caloric (2900kcal/kg ME) and iso-nitrogenous (18% crude protein), the SWAPSI was replacing maize at 0, 25, 50, and 75%. The experiment was arranged in a Completely Randomized Design. Each treatment was replicated 3 times having two pigs per replicate. Feed and water were provided to the animals daily and all standard routine management practices were strictly observed throughout the experiment. At the end of the feeding trial, blood samples were collected for haematology and gut content for microbial assay evaluation. The result showed There was no significant (P>0.05) difference across most of the parameters except for MCV, MCH and MCHC. Pigs placed on 75% SWAPSI had higher values for MCV (79.50), MCH (27.00) and MCHC (33.00) compared with 0% (61.50, 16.00 and 26.50). Microbial assay indicates non-significant and negative population of enzymes in the salmonella species in the gut content of growing rabbits. It is concluded that 75% SWAPSI might be included in diets of grower pigs without detrimental effect in the blood haematology and microbial semonella species.

Keywords: Grower pigs, Hematology, Maize, Gut assay, SWAPSI

INTRODUCTION

The blood is the major fluids portion that constitutes the white and red blood cells. It has many functions in the body system of an animal such as transporting of nutrients, regulating of bio-functions, protect the entire animal body system as well as exercise homeostatic control (Nasyrova *et al.*, 2006). Haematology blood parameters are good indicators of the physiological and health status in animals (Etim et al., 2013; Koomkrong et al., 2017). It has been reported that haematological parameters could be employed to highlight the stress condition during transport The quality of feed and additives usefulness has been accessed by the animals via blood, the fast and available means of assessing the chemical, nutritional and the level of immunity status of animals in feeding trials (Ezea *et al*., 2021). Existence of metabolites and other constituent elements could be investigated through blood examination thereby leading to detect the condition of stress as might be associated by nutrition, environment or disease (Aderemi, 2004). Report has shown that microbial content in pig gut system had relationship with digestion and health condition of pigs and SWAPSI as an alternative energy source could improve digestion due to its fibrous nature (Alu *et al*., 2022). It is on this background information that this study is to be carryout to determine the effect of feeding SWAPSI to replace maize in the diets for grower pigs to access the Haematology and microbial count and enzymes.

MATERIALS AND METHODS

Location to the Study

This study was conducted at the Livestock Complex of the Department of Animal Science, College of Agricultural Science and Technology, Lafia. The farm is located in the Southern Guinea Savannah Zone of Nigeria on Latitude $8^0 28^l$N and longitude $8^0 31^l$E. The average minimum temperature is 23^0C and maximum temperature is 36.9^0C. Mean monthly relative humidity is 74%. The mean annual rainfall is 823mm; the mean monthly temperature is 35.06^0C (NIMET 2010).

Sources of experimental feed ingredients and processing

SWAPSI was sourced from sugar processing industry in Numan LGA of Adamawa State. The SWAPSI collected, was sun dried for 2 - 3 days to reduce the moisture content and also to avoid the growth of mould and rancidity after which it was grinded to produced swapsi meal. Other ingredients were purchased (from bio- ingredient Ltd Abuja) such as maize, rice offal, ground nut cake, fish meal, palm oil, lysine, methionine, salt and premix.

Proximate Analysis determination of SWAPSI

Proximate composition such crude protein, dry matter, ether extract, crude fiber and nitrogen free extract of swapsi were determined using the procedure outlined by (AOAC, 2010) as described by (Alu *et al.*, 2018). See Table 1.

Table 1. Percent proximate composition of SWAPSI

Parameters (%)	Values
Crude protein	7.16
Ether extract	5.62
Crude fibre	21.06
Ash	4.12
Moisture	4.13
Nitrogen free extract	57.91
Metabolizable energy kcal/ME	277.51

Experimental diets

The experimental diets was designed to be isonitrogenous (18% crude protein) and isocaloric (2900kcal/kg ME) for the weaner pigs with four (4) levels inclusion of the SWAPSI (0, 25, 50 and 75%) that replaced maize as source of energy. T1 contain 0% SWAPSI serves as control, T2 contains 25% SWAPSI, T3 contain 50% SWAPSI, and T4 contains 75% SWAPSI for grower pig's production. The feed was balanced to meet the nutrients requirement of pigs as thus presented in Table 2.

Experimental animals and their management

Twenty four (24) land race grower pigs of equal sex and average live weight of (26-30.33kg/pigs) were purchased from commercial pigs farm and reared in an open- sided pig pen. Before the arrival of pigs, pens were well fumigated, disinfected and equipped with feeders and drinkers throughout the period of the experiment. Piglets were fed with experimental diets and drinking water were provided to them *ad-libitum* and other routine management practices were adopted as outlined by Alu *et al*. (2009) throughout the experimental period.

Experimental design

Pigs were randomly assigned into a test diets (4) treatment in a Complete Randomized Design (CRD) with 3 replicates having 2 pigs per replicate. The following statistical model were used:

$Y_{ij} = U + A_i + e_{ij}$

where Y_{ij} =individual observation, U= population mean, A_i = effect of factor A, and e_{ij} = experimental error

Table 2. Percent ingredients composition of the experimental diets for grower pigs

	Percent inclusion of SWAPSI			
Parameters	**T1 (0%)**	**T2 (25%)**	**T3 (50%)**	**T4 (75%)**
Maize	28.00	21.00	14.00	7.00
SWAPSI	0.00	7.00	14.00	21.00
Maize bran	44.00	44.00	44.00	44.00
Groundnut cake	19.50	20.00	20.00	18.00
Palm oil	4.00	4.00	4.50	4.50
Bone meal	1.00	1.00	0.50	0.50
Blood meal	2.00	2.00	2.00	4.00
Lysine	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**
Probiotics	+	+	+	+
Toxin binders	+	+	+	+
Acidifiers	+	+	+	+
Calculated analysis				
Energy	2951.07	2905.61	2900.92	2961.61
Protein	18.11	18.15	18.03	18.56
Crude fibre	6.20	7.45	8.74	9.98
Ether Extract	7.63	7.78	8.39	8.33
Ash	1.89	2.11	2.31	2.48
Calcium	0.65	1.20	1.60	2.14
Phosphorus	0.37	0.62	0.79	1.04
Lysine	0.77	0.82	0.86	0.97
Methionine	0.41	0.43	0.44	0.46

Blood and gut content collection

At the end of the feeding trial, 2ml each of blood samples were taken from the slaughtered animal via the jugular vein into anti-coagulant bottles for hematological studies according to Schmidt and Schmidt (1963). White blood cell (WBC), Red Blood Cell (RBC), hemoglobin (Hb), hematocrit (Hct), Mean Cell Volume (MCV), Mean Cell Hemoglobin (MCH), Mean Cell Hemoglobin Concentration (MCHC), Red Cell Distribution Width (RDW), Platelet Count (PLT) and Mean Platelet Count were determined using Randox commercial kit (Randox Co. UK), while Complete Blood Count (CBC) measures the red blood cell count, white blood cell count, platelets, hemoglobin. These haematology tests can help identify, diagonose and monitor conditions including anemia, infection, leukemia and hemophilia.

Gut content collection

At post moterm, fresh faecal samples were collected directly from the rectum of individual pigs using sterile gloves and placed in a sterile container and transferred to the lab within 10-15minutes of collection for culture and identify enzymes populations on gut content of grower pigs under the following parameters: Microbial count, catalase, coagulase, oxidase, motility, citrate and urease

RESULTS AND DISCUSSION

Table 3 showed the results of haematological parameters of grower pigs fed SWAPSI diets at 0, 25, 50 and 75%. There was no significant (P>0.05) difference across most of the parameters except for MCV, MCH and MCHC. Pigs placed on 75% SWAPSI had higher values for MCV (79.50), MCH (27.00) and MCHC (33.00) compared with 0% (61.50, 16.00 and 26.50). However, 25 and 50% (68.50 and 67.00) were statistically similar for MCV and 25% for MCH (22.50) only. The microbial in Table 4 indicates non-

significant and negative population of enzymes in the salmonella species in the gut content of growing pigs in the present study. The non-significant values for most of the parameters indicate that the pigs are healthy, and their blood parameters are within the normal range. Alternatively, it could be also suggested that experimental diets tested did have negative effect and is there safe. The higher MCV in the treatment 4 (75%) could be due to the genetic not nutritional factors. This is because genetics in pigs predisposed some breeds of pig's line that have naturally higher MCV values. The value of 60-80 fl indicating the normal range for piglets and 50-70 fl a normal range growing and range of 50-60 for adult. This is lower than the values obtained in this study and does not cause any adverse effect. This agreed with (Etim et *al.*, 2013; Koomkrong *et al.*, 2017) who reported similar values for MCH between 17 to 21 pg MCHC between 30 to 34 g/dL as observed in the study.

Table 3. Effect of SWAPSI on haematology of growing pigs

	Percent inclusion of SWAPSI					
Parameters	**0%**	**25%**	**50%**	**75%**	**SEM**	**LOS**
Packed cell volume (%)	34.50	32.50	36.50	38.00	2.121	NS
Haemoglobin	9.25	10.50	10.25	12.95	0.75	NS
Red blood cells	5.70	4.70	5.60	4.75	0.43	NS
White blood cells	11.10	8.80	12.40	10.15	1.52	NS
Blood platelets	297.00	179.00	249.50	208.00	27.77	NS
Mean corpuscular volume (fl)	61.50^{b}	68.50^{ab}	67.00^{ab}	79.50^{a}	2.90	*
Mean corpuscular haemoglobin	16.00^{c}	22.50^{ab}	19.00^{bc}	27.00^{a}	1.61	*
Mean corpuscular haemoglobin concentration	26.50^{d}	32.00^{b}	28.00^{c}	33.00^{a}	1.02	*

Means for groups in homogeneous subsets are displayed, mean on the same row having similar superscript were not significantly different from each other.

Table 4: Effect of SWAPSI on *salmonella spp* culture and enzymes populations on gut content of grower pigs

	Percent inclusion of SWAPSI					
Parameters	**0%**	**25%**	**50%**	**75%**	**SEM**	**LOS**
Microbial count	2.6450	2.7800	3.7850	3.6300	0.36	ns
Catalase	Negative	negative	negative	negative	-	-
Coagulase	Negative	negative	negative	negative	-	-
Oxidase	Negative	negative	negative	negative	-	-
Motility	Negative	negative	negative	negative	-	-
Citrate	Negative	negative	negative	negative	-	-
Urease	Negative	negative	negative	negative	-	-

SWAPSI= solid waste product of Sugar industry, SEM= standard error of mean, LOS= level of significance.

CONCLUSION AND RECOMMENDATIONS

It is concluded that SWAPSI might be included at 75% in diets of grower pigs without detrimental effect in the blood haematology and microbial salmonella species count and enzymes.

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Monogastric Animal Production: MGP 060

PERFORMANCE INDICES OF BROILER FINISHER BIRDS ADMINISTERED GRADED LEVELS OF AFRICAN NUTMEG (*Monodora myristica*) EXTRACT

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ABSTRACT

This study was conducted to investigate the effects of aqueous African Nutmeg seed extract (*Monodora myristica*) and their effects on performance indices of broiler finishers. A hundred and twenty-day-old Agrited Broiler Chicks were used in a Completely Randomized Design experiment that lasted for 28 days. The birds were randomly placed into four treatments consisting of 30 birds in each treatment group, there were 3 replicates per treatment with 10 birds per treatment. The birds in all the treatment groups were fed *ad-libitum* with commercial feed and aqueous seed extracts of *Monodora myristica* was added to the water at different inclusion level. The Treatments comprised T_1 (0ml/l), T_2 (5ml/l), T_3 (10m/l), T_4 (15ml/l). Data collected on performance indices, were subjected to Analysis of Variance (ANOVA). Results obtained from the performance indices revealed that all the examined parameters differ significantly ($P<0.05$) except the initial average body weight. Birds subjected to treatment 3 (10ml/l) competed effectively with the birds in the control group which recorded the best result (2.19±0.17) in the feed conversion ratio. No mortality was recorded in all the groups. The study concluded that the addition of aqueous extract of *Monodora myristica* at 15ml/l should be adopted by farmers.

Keywords: Broiler chickens, Feed conversion ratio, Feed intake, Performance, Weight gain

DESCRIPTION OF PROBLEM

Nigeria is highly deficient in animal protein security with per capita consumption put at 9.3g/day as against the 34g/day recommended by the FAO to be the minimum requirement for the growth and development of the body [1]; [2]; [3] this implies that only about 27 percent of the minimum requirement in animal protein is secured. Therefore, one serious challenge facing the country today is the attainment of substantial increase in the domestic animal supply to mitigate the deficiency in animal protein availability in the menu of the citizens. The major problem of development and expansion of livestock industries in developing countries are the reduced supply, high demand, and prohibitive cost of feeds and feedstuffs especially protein source [4]. The ever-increasing cost of livestock feeds with the attendant increase in the cost of animal products such as meat. Egg, and milk shows that there is need to explore the use of non-conventional feed ingredients in the feeding of domestic animals [5]; [6]; [7]; [8]. Poultry products are among the most widely eaten foods on the planet, and they are seen to be the quickest way to close the gap created by the prevalence of animal protein deficiencies in many developing nations [9]. Numerous countries employ excessive amount of necessary antibiotics when producing chicken, endangering the safety of those products [10]. Therefore, there is need to explore any available substitute to synthetic antibiotics.

The major subject of interest in this study is *Monodora myristica*. As much as the usefulness, effectiveness and importance of synthetic antibiotics can never be over emphasised on the basis of the effects that have over the years been recorded, ranging from increment in efficiency and growth rate of animals, therapeutic and prophylactic benefits as well as reduction in the incidence of infectious diseases [11], it is worthy of note that its use overtime often results to increased production of antibiotic-resistance bacteria [12]. Despite the fact that bacterial resistance is a common occurrence, it has been sped up by humans as a result of the increased and careless use of antibiotics for both human and animal health [13]. The use of antibiotics of chicken farmers has also increased significantly, and most significantly, there is a high rate of non-observance of the withdrawal period following antibiotic treatment. [14] resulting in ingestion of resistant

bacteria by the final consumers. It is therefore necessary to look into alternatives that would not negatively impact the health of consumers as well as the animals.

MATERIALS AND METHODS

Experimental Site

This study was conducted at the poultry unit of the Rivers State University's Teaching and Research Farms in Nkpolu-Oroworukwo, Port Harcourt. The test site is located in Nigeria's tropical rainforest, agro-ecological zone, with average monthly rainfall, temperature, and relative humidity readings of 200.45mm, 22.54-31.03°C, and 69.08-112.47%, respectively [15].

Processing of *Monodora myristica* Seed

Monodora myristica seeds were sourced from Mile Three market in Port Harcourt Local Government Area of Rivers state. The seed sample were toasted over fire, de-hulled by cracking and milled. 150grams (150g) of the milled *Monodora myristica* was added to four litres of boiled water. The water was boiled to a temperature of 100°C before adding the 150grams of milled *Monodora myristica.* After this, the mixture was stirred and allowed to cool. The extract was sieved through a muslin cloth into bottles and stored in a refrigerator to prevent spoilage.

Experimental Birds and Management

A total 120 unsexed-day-old broiler birds were used for this research. The day-old chicks were purchased from Agrited, Nigeria Ltd, Ibadan, Oyo state, Nigeria. These birds were brooded for four weeks, using electric bulbs and coal pot as the source of heat for this research. All sanitary measures were done before the arrival of the chicks. Wet litters were changed while adhering strictly to sanitary measures which included washing of feeders and drinkers as well as maintaining a clean environment. The birds were fed on commercial diet (broiler starter and finisher) for the duration of the research. Measurement was taken daily to ascertain the exact quantity of feed offered to the birds during the finishing stage (four weeks) and the leftover measured everyday using an electronic scale and a measuring cylinder.

Experimental Design and Treatment

The birds were allocated randomly to four treatment groups in a Completely Randomized Design (CRD). Each of the treatment was divided into 3 replicates of 10 birds each, the initial body weight was taken and at the end of four weeks prior to treatment, the birds were housed in floor pens. The experimental treatment began at the finisher phase, and it comprised T_1 (0ml of extract/l of water), T_2 (5ml of extract/l of water), T_3 (10ml of extract/l of water) and T_4 (15ml of extract/l of water). This procedure lasted for a period of 28 days. The weight of the birds was taken weekly, the final weight was taken on the day the experiment terminated.

Performance Indices of Broiler Finisher

Body Weight: The body weight of the birds at four weeks of age was taken to form the initial body weight of the birds. Body weight was measured weekly using weighting scale.
Body Weight Gain (**g**): This is the difference between the initial body weight and the final body weight i.e. from the fourth week through eight weeks of age.
Average Daily Weight Gain per bird can be calculated thus;

$$\frac{\text{Final live weight} - \text{Initial live body weight}}{28 \text{ days}}$$

Feed Intake (**g**): Amount of feed consumed was ascertained daily using the formula below:
Feed given-leftover--feed intake

Feed Conversion Ratio: This is the ratio of feed consumed to one unit of body weight gain. It was estimated using the formula below:

Feed conversion ratio = $\frac{\text{Feed Consumed}}{\text{Weight Gained}}$

% Mortality: The mortality rate (%) is the number of deaths divided by the total population multiplied by 100.

Experimental Design and Data Analysis

The data collected were subjected to a one-way analysis of variance (ANOVA) in a Completely Randomized Design (CRD). Significant differences in treatment means were separated using Duncan Multiple Range Test. The statistical analysis was done using SPSS version 18 [16].

RESULTS AND DISCUSSION

The performance indices of birds administered *Monodora myristica* water extract are presented in **Table 1**. The performance indices measured were initial body weight, final body weight, total feed intake, average weight gain, feed conversion ratio and mortality. Significant difference ($p < 0.05$) due to treatment effects existed in the final average body weight, average weight gain, feed intake and feed conversion ratio. Results indicated that the final body weight have 3.77kg, 3.53kg, 3.97kg and 3.76kg for treatments 1, 2, 3, and 4 respectively, which implied that T_3 had the best result. With regards to the average weight gain, T_3 had the highest value at 1.66kg, while the other values obtained for treatments 1, 2, and 4 are 1.50kg, 1.23kg and 1.50kg respectively. The feed conversion ratio showed significant difference ($p< 0.05$). The results also showed that the feed conversion ratio was 2.61, 2.73, 2.19 and 2.42 respectively. Feed conversion ratio was best in T_3 and least in T_2 and T_1.

Table 1: Effects of Varying Levels of *Monodora myristica* Seed Extract on Performance Indices of Broiler Finishers

	Treatments			
Parameters	**T_1 (0ml/, control)**	**T_2 (5ml/l)**	**T_3 (10ml/l)**	**T_4 (15ml/l)**
Initial body weight (kg) (4wks)	2.27± 0.13	2.30±0.03	2.31± 0.04	2.26± 0.02
Final body weight (kg) (8wks)	$3.77±0.15^{ab}$	$3.53±0.03^{b}$	$3.97± 0.04^{a}$	$3.76± 0.12^{ab}$
Average weight gain (kg)	$1.50 ± 0.03^{ab}$	$1.23± 0.09^{b}$	$1.66± 0.04^{a}$	$1.50± 0.05^{ab}$
Feed Intake (kg)	$3.92± 0 .12^{a}$	$3.36± 0.21^{b}$	$3.64± 0.16^{ab}$	$3.64± 0.13^{ab}$
Feed conversion ratio	$2.61± 0.04^{a}$	$2.73± 0.07^{a}$	$2.19± 0.17^{b}$	$2.42± 0.09^{b}$
Mortality	0	0	0	0

a,b,c values within each row with different superscript differs significantly (P<0.05)

The performance characteristic data, represents a very important aspect in animal studies. Inclusion of *Monodora myristica* aqueous extract in broiler production showed significant difference ($P<0.05$) in the final body weight gain with T_3 having the highest weight gain of (3.53kg). Feed is an important factor to take into consideration, using the figure (3.92kg) for control and (3.64kg) 15ml/l in feed intake, one could see a great opportunity to reduce feed intake, while maintaining improved weight gain. These two feeding regimens yielded different weights gain with 15ml/l of *Monodora myristica* aqueous extract having a comparative weight gain with the birds in the control group. *Monodora myristica* extract up to 15ml/l reduced feed intake and presented a better feed conversion ratio, final body weight gain and average weight gain when compared with the control. Although the weight gain reduced as the level of *Monodora myristica* aqueous extract increased to 15ml/l yet the values obtained competed significantly with the control. This may be related to the nutritional values of *Monodora myristica*. [17] reported that *Monodora myristica* contained high levels of carbohydrate (35.92%) and protein (16.00%) in its aqueous extract which makes the plant to be rich in calories and very good source of energy and protein.

CONCLUSION

This study investigated the effects of aqueous extract of *Monodora myristica* seed on the performance indices. Owing to the performance record on the effect of *Monodora myristica* on the conversion efficiency of the birds and their weight gain, it may be concluded that *Monodora myristica* is a good growth promoter at 15ml/l inclusion. This research findings will serve as useful information to poultry producing industries.

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EGG QUALITY CHARACTERISTICS OF LAYERS FED HORNED MELON (*Cucumis metuliferus*) AS SUBSTITUTE FOR COMMERCIAL PREMIX

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ABSTRACT

Horned melon (*Cucumis metuliferus*), is a fruit rich in various phytochemical components important in the daily diet and has high economic value which has not been fully exploited. The objective of the study is to evaluate the internal and external characteristics of egg of layers fed horned melon as substitute for vitamin/mineral premix. One hundred and twenty Isa Brown laying birds were grouped into 4 treatments with three replicates of ten birds each**.** The horned melon fruits were harvested, oven dried for 3 days and milled into horned melon fruit meal and used at 0, 25, 37.5 and 50% in treatments 1-4 respectively in replacement of commercial premix in the diets of layers. The birds were fed for 10 weeks. Two eggs were selected per replicate every week for five consecutive weeks and cracked with dull end of knife into yolk separator. The parameters considered for internal features were yolk colour, yolk length, egg shape index, albumen weight, yolk weight. External characteristics considered were egg weight, egg width, shell thickness, egg length and shell weight. The results showed that all parameters considered were not significantly ($p>0.05$) different across the treatments. The ranges for egg length, egg width, egg weight, shell thickness, shell weight, yolk weight, yolk height, yolk colour score and albumen weight were 5.03 – 5.29, 3.94 – 4.48, 58.07 – 60.40, 0.43 – 0.45, 0.67 – 0.77, 28.67 – 31.00, 1.26 – 1.79, 4.06 – 6.75 and 18.08 – 22.40, respectively. Conclusively, horned melon meal was not detrimental to egg quality of experimental birds when used as replacement of commercial premix in layer diets.

Keywords: Horned melon, Egg weight; yolk weight and shell thickness.

DESCRIPTION OF PROBLEM

Egg quality defines those characteristics of an egg that affect consumer acceptability and preference. Components of egg quality include external and interior characteristics. The quality of the egg once it is laid cannot be improved. Egg quality has a genetic basis, but it is also affected by the age of the laying hens, diets and by the hens housing (1, 2). Proteins, fats, carbohydrates, vitamins, minerals and water are essential for a quality egg, but vitamins have an additional dimension as hey are required in adequate levels to enable the animal to efficiently utilize all other nutrients in the feed. Therefore, optimum nutrition occurs only when the bird is offered the correct mix of macro- and micronutrients in the feed and is able to efficiently utilize those nutrients for its growth, health, reproduction and survival (3). The main dietary inclusion of vitamins and minerals in poultry production is usually through premixes, though certain quantities are obtained from other major ingredients. However, some plants are very high in vitamins and minerals. Horned melon (*Cucumis metuliferus*), is an annual vine in the family, Cucurbitaceae (4), it is also known as Kiwano melon. It has been reported that horned melon fruit comprised 90% moisture, about 10% protein, 6% fat, and 45% carbohydrate (5) . The levels of sugar in horned melon are relatively low compared to netted melon which is 7.86g/100g (6). Major nutrients contained in horned melon are Iron (32.88%), Magnesium (22.14%), Vitamin C (13.67%), Phosphorus (12.29%) and Vitamin B_6 (11.31%). Other minor nutrients include; Vitamin A, Vitamin B_5, Vitamin B_3, Vitamin B_2 and beta-carotene (7). Some secondary metabolites like the alkaloids, flavonoids, saponins, saponins glycoside, volatile oil and cardiac glycosides are also present in

both the leaves and the seeds (8). This rich mineral and vitamin content of horned melon could be exploited in poultry feeding.

MATERIALS AND METHODS

The experiment was carried out at the Poultry Unit, Teaching and Research farm of Oyo State College of Agricultural and Technology Igboora. One hundred and twenty 12-week old birds were purchased from a reputable farm and raised to laying phase. The birds were grouped into 4 treatments with three replicates of fifteen birds each**.** The experimental design adopted was completely randomized design. The gross composition of the four diets is shown in table 1.

Two eggs were selected at random from each replicate every week for egg quality analysis for five consecutive. The egg were weighed and measured vertically and longitudinally with the aid of Venier calipers and then cracked with dull edge knife centrally. The yolk was separated with yolk separator and yolk color was measured with Roche yolk score. After the eggs were broken, eggshell thickness was measured with a QCT shell thickness micrometer (TSS, England) at the equatorial area after removal of shell membranes. Egg shell weight was determined after drying. All Data were subjected to one-way analysis of variance. Means showing significant ($p<0.05$) differences were separated using Duncan Multiple Range Test (9).

RESULTS AND DISCUSSION

Results obtained were presented in table 2 and 3 and revealed that there were no significant differences in all the parameters considered. However external egg quality of birds fed the control diet had the highest values of egg breath, egg weight, egg shell weight, egg shell index, egg surface area and egg shape index were 5.03cm, 4.68cm, 60.40g, 7.08g, 98.84, 71.96 cm^2 and 9.85, respectively. Values for other treatments varied and did not show any trend. Treatment 3 (37.5% horned melon meal) had the lowest values for egg breath (3.93 cm), egg shell index (72.17) and egg surface area (66.03 cm^2) while those fed 50% horned melon recorded lowest values for egg shape index (6.83) and highest value for egg length (5.29cm)

Internal qualities shown in table 3 reviewed that the mean values for all the parameters were not dietary influenced as there were no significant differences ($P>0.05$) across the treatments. Treatment 4 (50% horned melon meal) recorded 1.79cm and 6.75 for yolk height and yolk colour score, respectively that were similar ($P>0.05$) to 1.26cm recorded by treatment 1 for yolk height and 4.06 recorded by treatment 3 for yolk colour score

The results of this study showed no significant difference across the treatments. These results proved that horned melon provided enough vitamins and minerals that supported egg production and the maintenance of egg qualities. The rich vitamins and minerals content of horned melon might have assisted to support the quality of the eggs of the fed birds. Major nutrients contained in horned melon are Iron (32.88%), Magnesium (22.14%), Vitamin C (13.67%), Phosphorus (12.29%) and Vitamin B_6 (11.31%). Other minor nutrients include; Vitamin A, Vitamin B_5, Vitamin B_3, Vitamin B_2 and beta-carotene, (7). The obtained results in this study showed that vitamins/minerals content of horned melon was enough to support egg characteristics of layers. Kiwano melon provides nutrients that supported bone remodeling and maintenance of bone strength, including magnesium, vitamin C, and zinc (10). The vitamin C and water in kiwano melon may support collagen production, wound healing, and protection from sun damage (7). Kiwano melon is a rich source of magnesium and potassium. These minerals can reduce inflammation, prevent the accumulation of arterial plaque, and help regulate blood pressure. Kiwano melon also offers multiple nutrients that are vital for a healthy immune system, including vitamin C, zinc, iron, and magnesium (7).

Lim (11) reported that horned melon contains twice the amount of Vitamin C found in cucumber. A fresh fruits of horned melon contain 2 mg/100g of Na (12). Low sodium and high levels of K in human diet have

been reported to be beneficial in the prevention of high blood pressure (13). This makes horned melon a suitable fruit in regulating the blood pressure which is a major cause of death in the world (14).

Rudrappa (11) reported that fresh fruits of horned melon contain 123 mg/100g of K, 1.13 mg/100g of Fe, 37 mg/100g of P. The benefits of high K intake in human bodies include prevention of stroke, coronary heart disease and hypertension (15) while Iron plays a role in oxidation metabolism, transport and cellular proliferation (16). The range required for adults is 8.7mg/day in males and 14.8mg/day in females hence consumption of a few horned melon fruits per day is enough to achieve this daily requirement (14).

Table 1: Gross composition of diets replacement of premix **with** *Cucumis metuliferus* meal

Ingredients	**Treatment 1 0% HMM**	**Treatment 2 25% HMM**	**Treatment 3 37.5% HMM**	**Treatment 4 50% HMM**
Premixes	0.3	0.225	0.1875	0.15
Horned melon meal	0.00	0.075	0.1125	0.15
Maize	53	53	53	53
Soya bean meal	23	23	23	23
Corn bran	13.5	13.5	13.5	13.5
Oyster shell	8	8	8	8
Dicalcium phosphate	1.5	1.5	1.5	1.5
Common Salt	0.3	0.3	0.3	0.3
Methionine	0.2	0.2	0.2	0.2
Lysine	0.2	0.2	0.2	0.2
Total	**100**	**100**	**100**	**100**
Calc. Energy	2600	2615	2620	2625
Calc. Protein	16.50	16.60	16.65	16.70

Table 2: External egg characteristics of layers fed the four experimental diets

Parameters	**T1 (0% HMM)**	**T2 (25% HMM)**	**T3 (37.5% HMM)**	**T4 (50% HMM)**	**SEM**	**P-value**
Egg length (cm)	5.03	5.25	5.03	5.29	0.11	0.85
Egg breadth (cm)	4.68	4.13	3.94	4.03	0.16	0.40
Egg weight (g)	60.40	58.67	59.18	59.00	1.39	0.91
Egg shell thickness (cm)	0.43	0.45	0.44	0.43	0.63	0.61
Egg shell weight (g)	7.08	6.67	6.67	6.67	0.41	0.25
Egg shell index	98.84	78.72	72.17	76.25	5.75	0.51
Egg surface area (cm^2)	71.96	70.49	66.03	69.15	1.88	0.75
Egg shape index	9.85	9.44	9.75	6.83	0.55	0.27

T = treatment; HMM = Horned Melon Meal

Table 3: Internal egg qualities of layers fed the four experimental diets

Parameters	**T1 (0% HMM)**	**T2 (25% HMM)**	**T3 (37.5% HMM)**	**T4 (50% HMM)**	**SEM**	**P-value**
Yolk weight (g)	28.67	31.00	30.11	30.34	0.52	0.19
Yolk height (cm)	1.26	1.58	1.59	1.79	0.06	0.60
Yolk color score	6.50	5.33	4.06	6.75	0.47	0.15
Albumen weight (g)	20.25	21.00	22.40	18.67	2.27	0.46

T = treatment; HMM = Horned Melon Meal

CONCLUSION

Replacement of commercial layer premix up to 50%with horned melon meal did not adversely affect both the internal and external quality of eggs of the fed experimental birds. These proved that horned melon provided enough vitamins and minerals that supported egg production and the maintenance of egg qualities.

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Monogastric Animal Production: MGP 062

EFFECTS OF PULVERIZED *JATHROPHA TANJORENSIS* (HOSPITAL TOO FAR) LEAF ON PERFORMANCE AND HAEMATOLOGY OF RABBITS

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ABSTRACT

This study was carried out at the research farm of the Rivers State University, Nkpolu, PortHarcourt to investigate the effects of pulverized *Jathropha tanjorensis* leaf in weaner rabbits. A total of 24 New-Zealand weaner rabbits obtained locally, were assigned randomly into 4 treatment groups and used for the study which lasted for six weeks then subjected to completely randomized design (CRD), the data analysis was subjected to Analysis of Variance (ANOVA) and the means were separated using Duncan's multiple range test. There were 4 experimental diets which were incorporated with 4 weeks-pulverized *Jathropha tanjorensis* leaf, as follows; T1 (control;0g/kg), T2 (15g/kg), T3 (30g/kg) and T4 (45g/kg). The results obtained showed that T2 had the best average weekly weight gain (1098.88g) as well as least feed conversion ratio, the test material showed no significant difference ($p<0.05$) in the haematologic and serum biochemical parameters, T2 had the highest Packed Cell Volume of 34.00±3.00 and the highest haemoglobin concentration of (11.30±1.00) % for the treatment groups. In conclusion, T2 (15g/kg) showed the best result indices, so it is advised to incorporate *J. tanjorensis* at 15g/kg in rabbit diets to achieve maximum yield.

Key words: Pulverized, leaf, Hematology, Performance and Rabbits.

DESCRIPTION OF PROBLEM

The use of phytochemicals in their natural form, as leafy vegetables or plant extracts or as feed additives, as a way to reduce the condition of use of conventional drugs is an area that needs vast research in order to determine what quantity of the particular plant that could serve as a boost for the animal as well as strengthen the immune system, the physiologic mechanisms and the overall health of the weaner rabbits (8). The objectives are to determine the effects of *J. tanjorensis* leaf on growth parameters hematology of weaner rabbits under normal environmental condition.

MATERIALS AND METHODS

The research was conducted at the rabbitry unit of the teaching and research farm, Rivers State University, Port Harcourt and lasted for eight (8) weeks using twenty-four (24) weaner rabbits which were acclimatized to the research environment for two weeks and during this period were fed poultry growers mash *ad libitum*, then subsequently, fed different dietary inclusion levels of dried, pulverized, *J. tanjorensis* leaf for 6 (six) weeks. Freshly harvested leaves of *J. tanjorensis* leaves were rinsed with water, air-dried for four weeks on the slabs in the Animal Science laboratory and milled into coarse fine powder using an electric blender.
Completely Randomized Design (CRD) was adopted for this experiment. The rabbits were assigned randomly to four dietary treatments of 6 rabbits per treatment which was divided into 2 rabbits per replicate, and this was replicated thrice. Feed and water were given *ad libitum.* The daily quantity of feed consumed was obtained by subtracting the left-over feed from that which was initially given. The four experimental diets were as follows: T1 (control;0g/kg), T2 (15g/kg), T3 (30g/kg) and T4 (45g/kg) of pulverized *J. tanjorensis* leaf, respectively. The initial body weights of the rabbits were recorded, then subsequently weighed weekly to determine the growth performance indices. Growth performance record on live body weight, feed intake, feed efficiency, body weight gain and mortality were obtained weekly. At the end of the experiment, 5 mls of blood was collected from the jugular vein from each of two rabbits per replicate and used for haematology. All the data obtained were analyzed using the standard procedures of Analysis of

Variance (ANOVA). Means were separated using Duncan Multiple Range Test (DMRT) according to Statistical Analysis System procedures SAS (1999).

RESULTS AND DISCUSSION

From table 1 below, T2 (15g/kg) recorded the highest value at ($p<0.05$) for average weekly weight gain and body weight gain respectively, as T2 had the highest value for body weight gain when compared to the other treatment groups, it explains why *J. tanjorensis* does not need to be consumed in excess, which correlates with the findings of (3) and (2) that there was no significant difference ($p<0.05$) in the body weights of the rabbits and (3) who reported that *J. tanjorensis* should not be consumed in excess to get maximum yield. There was no significant difference ($p>0.05$) for FCR as T2 had the least FCR of 0.4859 for the treated group, compared to T1 (Control) that had 0.7170. This indicates that rabbits in T2 consumed less feed to produce 281.67g and is in consonance with (9), (8) who reported that *J. tanjorensis* is a blood building herb that has high proteinemia which explains the increase in body weight but also relates to the findings of (3) that even if it is a blood building herb, it should not be consumed in excess. Table 2 also showed that T2 also showed highest Packed Cell Volume (PCV) values (34.00±3.00) which is within the normal range as reported by (7) and is in consonance with (6) and (9). The plant has good blood-building properties, this is in consonance with the findings of (9). The Haemoglobin, Red Blood Cell and all the haematologic values are within the normal range. The White Blood Cells (WBC) in rabbit ranges from 3.0-1.5x 10^6/mm (7) and (6). PCV and RBC values are lower than the control values and is in consonance with the findings of (5) and (4) while haemoglobin values for control is higher which is at variance with (5) and (4) who stated that Pcv, Hb and Wbc levels are usually lower than that of normal control values. Lymphocyte and monocyte count were normal and in consonance with (7).

Table 1: Effect of *Jathropha tanjorensis* leaf on growth performance characteristics.

Parameters	TREATMENTS			
	T1 (0g/kg)	T2 (15g/kg)	T3 (30g/kg)	T4 (45g/kg)
Initial body weight (g)	863.00	950.00	870.67	980.00
Final body weight (g)	1155.33	1231.67	1148.00	1209.00
Body weight gain (g)	292.33	281.67	278.00	229.00
Average weekly weight gain (g)	997.58^{ab}	1096.88^{a}	971.71^{b}	1058.54^{ab}
Average weekly feed intake (g)	707.63^{a}	701.25^{ab}	694.79^{b}	707.08^{a}
Feed conversion ratio	0.7170	0.4859	0.6545	0.5322
Feed efficiency	1.4097	1.5642	1.3986	1.4970

Values within each row with different superscript differ significantly ($p<0.05$)

Table 2: Effect of *Jathropha tanjorensis* leaf on hematological performance characteristics.

Parameters	TREATMENTS			
	T1 (0g/kg)	T2 (15g/kg)	T3 (30g/kg)	T4 (45g/kg)
Packed cell volume (%)	30.00	34.00	33.00	31.50
Haemoglobin (g/dl)	11.70	11.30	11.00	10.50
Red blood Cell x $10^{12/1}$	6.60	5.30	5.10	4.70
White blood cell $10^{9/1}$	12.15	11.85	12.75	12.10
Platelets (%)	231.00	216.00	46.50	31.00
Neutrophils (%)	43.50	42.50	49.50	51.00
Eosinophill (%)	4.00	2.50	3.00	4.00
Monocyte (%)	6.50	6.50	5.50	9.00

Values within each row with different superscript differ significantly ($p<0.05$)

CONCLUSION AND APPLICATIONS

T2; 15(g/kg) had the best performance in terms of growth parameters and hematological indices. Therefore, dried pulverized *Jathropha tanjorensis* leaf should be supplemented in farm animals' diets or as feed additive at 15g/kg inclusion level for optimum performance.

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EFFECTS OF DIETARY INCLUSION OF AQUEOUS *Phyllanthus amarus* LEAF EXTRACTS ON GROWTH PERFORMANCE AND SERUM LIPID PROFILE OF BROILER CHICKENS

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ABSTRACT

Effects of dietary inclusion of varying levels *Phyllanthus amarus* leaf extracts (PALE) on the growth performance and serum lipid profile of broiler chickens were investigated. One hundred and twenty 1- old chicks were randomly allocated to four treatments with three replicates, made up of ten birds each in a completely randomized design (CRD). The extraction was done by adding varying weights of ground *Phyllanthus amarus* leaf in one (1) litre of boiled water, leaving it for thirty minutes and were designated as T_1 (0g/L), T_2 (20g/L), T_3 (30g/L), T_4 (40g/L), respectively. The treatments were administered by adding the extracts to drinking water of the birds for 42 days. Data were analysed by one way analysis of variance and Duncan's multiple range test of the same package was used to separate the treatment means where differences occurred. The extract had no effects at ($P < 0.05$) level of significance on the feed intake, feed conversion ratio, and weight gain, but there were effects on the lipid profile indices at the same level of significance. The birds on the (PALE) had lower cholesterol levels, triglycerides, high density lipoproteins, and low density lipoproteins than the control. It was concluded that the extract had a positive effect on the health status of the birds. Recommendations were made for higher doses of the extract which might show the effect on growth performance better.

Keywords: *Phyllanthus amarus*, leaf extract, growth performance, lipid profile, health status

DESCRIPTION OF PROBLEM

The ever-increasing global population growth has led to a resultant increase in the initialization of intensive livestock production practices that can efficiently meet the higher demands for food. A common method applied to maximize yield is the use of sub-therapeutic doses of antibiotics growth promoters (1). Antibiotics increase animal growth efficiency by inhibiting the growth of microbes in the guts thereby enhancing immune response in the host (2). They have been shown to improve the health status of intensively raised animals and to reduce the microbial load in meat that can cause food borne diseases for humans (3). The use of synthetic antibiotics has however been associated with an increasing rise in antimicrobial resistance (AMR). The imposing risk presented by the possibility of cross resistance which may bring about the emergence of multi-drug resistant pathogens which will further limit treatment in both man and animals (4), necessitated the ban on their usage by the European Union since 2006. This has led to search for natural alternatives that can guarantee food safety (1).

One of such natural alternatives are phytogenic feed additives, which have had their uses in ethno-medicine for ages. Studies have been done using leaf meals of medicinal plants, the use of these for monogastrics are limited due to the limited extent to which they can utilise fibrous materials (5). A better alternative might be the use of infusions of such plants. (6) reported that neem infusion could be used as a natural growth promoter and immune stimulant, as it lowered mortality and produced higher antibody titres when used for broilers. The result of (7) showed that aqueous ginger extract enhanced digestibility and positively affected live weight, and feed consumed.

Phyllanthus amarus is said to have hepatoprotective, analgesic, anti-inflamatory, hypolipidemic, anti-oxidant, and anti-microbial properties.(8). It contains some bioactive compounds which may affect haematological and serum biochemical parameters as well as nutrient utilisation in animals.(9, 10 11). It

however contains some anti-nutritional compounds like tannins, cyanide, oxalates, phytates. There is therefore need to ascertain the safe level of administration of this plant as an alternative to synthetic antibiotics. Haematological and serum biochemical responses are used to assess the clinical and physiological responsiveness and well-being of chickens (12).

Objective

This study was aimed at assessing the effects of *Phyllanthus amarus* leaf extracts on the performance and blood lipid profile of broiler chickens

MATERIALS AND METHODS

Animals and Experimental Design

The experiment was conducted at the Poultry Unit of the livestock farm, Kwara State College of Education, Ilorin, Kwara State, Nigeria. Ilorin is located within coordinates 8° 30′ North and 4° 33′ East; with an annual rainfall of 1185mm and temperature range of 33°C - 37°C. The *Phyllanthus amarus* leaves were collected from the premises of the college and air-dried at room temperature and ground into powder. The day old chicks were purchased from Yamfy Hatchery, Ilemona, Kwara State, Nigeria.

A standard broiler diet was formulated for the research and used for all the treatments.
One hundred and twenty 1-day-old chicks were assigned to the four treatments of the experiment, having 10 birds each, with three replicates on deep litter, in a completely 679andomized design (CRD)

Growth performance parameters (live weigh and feed intake) were measured using a digital scale. Feed consumed was calculated by finding the difference between the served and leftover feed quantities each day. Body weight was measured weekly and the change determined by subtracting the new from that of the previous weeks.

Chemical Analysis – The proximate composition of the feed and the *Phyllanthus amarus* leaf were determined by the method of AOAC (2019).

Statistical Analysis – Data obtained were analysed by one way analysis of variance (ANOVA) Duncan's multiple range test was used to separate the treatments means where differences occurred at $P < 0.05$.

RESULTS AND DISCUSSION

Table 1: Performance Characteristics of Broilers Fed with Varying Levels of *Phyllanthus amarus* Leaf Extract

Parameters	Levels of PALE			
	0ml/L	20ml/L	30ml/L	40ml/L
Initial body weight(g/b)	54.67±2.0	55.67±2.1	56.67±1.8	56.11±1.9
Final body weight(g/b)	1666.11±10	1688.00±8.2	1603.22±9.0	11682.33±9.8
Average daily feed intake(g/b)	143.14±2.1	139.21±2.0	138.60±2.2	141.97±2.0
Average daily weight gain(g/b)	67.20±0.5	66.93±0.48	66.00±5.1	67.93±0.49
Water intake (mL/L)	3678.97±4.2	3660.50±3.8	3597.8±4.0	3670.32±4.1
Feed conversion ratio	2.13±0.2	2.08±0.1	2.10±0.09	2.09±0.08

Table 1 shows the mean values for average daily weight gain, average daily feed intake, and feed conversion ratio. There were no significant differences across the treatments, the mean values for feed conversion ratio for other treatments were however lower than that of the control , this may be due to improved digestibility, activation of the immune system and anthelmintic action (14). *Phyllanthus amarus* is said to contain essential

oils, and is therefore capable of increasing digestibility of nutrients by stimulating enzyme secretion, and stabilizing the gut microflora while not improving growth performance (15)

Table 2: Serum Lipid Indices of Broilers Fed with *Phyllanthus amarus* Leaf Extracts

Parameters	Levels of PALE			
	0mL/L	20mL/L	30mL/L	40mL/L
Cholesterol (mg/dL)	129.50^{b}±0.8	126.7^{ab}±0.6	118.59^{ab}±0.7	114.89^{a}±0.8
Triglycerides(mg/dL)	235.90^{b}±2.2	211.94^{ab}±2.1	189.10^{a}±2.0	199.24^{a}±1.8
LDL(mg/dL)	36.93±0.7	24.67±0.5	31.74±0.7	31.65±0.6
HDL(mg/dL)	119.24^{b}±3.0	59.67^{a}±2.5	49.40^{a}±2.7	37.39^{a}±2.6

Means with different superscripts on the same row differ significantly (P<0.05) HDL–High density lipoprotein,LDL–Low density lipoprotein

Table 3: Phytochemicals present in *Phyllanthus amarus* Leaf Extracts

Saponins	Coumarins
Glycosides	Triterpenes
Alkaloids	Steroids
Phenolics	

Triglyceride levels must have been of dietary origin or due to other factors as the birds on PALE had lower indices for serum lipids and therefore lower risks of cardiovascular and other types of diseases associated with hyperlipidemia when compared with those on the control (16).The values were indicative of lower lipid levels in the serum of the birds and triglycerides were significantly different between the control T_1 and the treatments with PALE ,T_2, T_3 and T_4.The values for the control were higher than those of *Phyllanthus amarus* leaf extract ,the low density lipoprotein (LDL) and high density lipoprotein (HDL) were of similar pattern .The mean values for serum cholesterol ,and low density lipoproteins were within the normal range recommended by(17).23.77±5.83mg/dL–32.47±8.84mg/dL(≤1.30mg/dl)and125mg/dL–200mg/dL for the LDL and triglycerides respectively. The control had the highest mean value for given the PALE . This agrees with the findings of (10&18) who reported that the cardioprotective potential of *P.amarus* aqueous extract, is mainly due to its ameliorative and antioxidant potentials, coupled with its anti-hyperglycemia and anti-hyper-lipidemic properties, they went further to report that its ability to reduce body fat may be attributed to the presence of flavonoids, quercetin, rutin, ligans (phyllanthin and hypophyllanthin), saponins and the phenolic compound gallic acid which are all cardioprotective in action.

Results of the phytochemical analysis(table 3) also showed that the *Phyllanthus amarus* leaf contained antinutritional factors ,but the better feed conversion ratios obtained with the birds on PALE suggest that they must have been neutralized appreciably with the high heat used for the extraction which reduces such (19,20 NOT INCLUDED IN THE REFERENCES) this coupled with the short period used for steeping ,most probably reduced the toxicity of the PALE.

The results indicate that the level of PALE given did not adversely affect the health status of the birds, but rather improved it.

CONCLUSION AND APPLICATION

It can be concluded that the *Phyllanthus amarus* leaf extract has potentials for improving feed conversion efficiency of broilers, in terms of improved feed utilization and it has hypolipidemic effect, it can therefore be included in broiler diets. Further studies with higher levels of inclusion that may provide better demonstration of the effects is recommended.

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PROXIMATE AND PHYTOCHEMICAL COMPOSITION OF THREE PROCESSING METHODS OF TURMERIC AS PHYTOGENIC MATERIAL

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ABSTRACT

The present study examined the proximate and phytochemical composition on three processing methods (sun-dry, oven-dry and air-dry) of turmeric meal. Air-dry increased the content of the dry matter (92.20 %), crude protein (15.10 %) and reduced crude fibre (9.05 %) compared to other processing methods, whereas, sun-dry increased the content of ether extract (10.20 %) and nitrogen free extract (42.27 %). Oven-dry increased the levels of tannins (0.86 %) and saponin (1.73 %) whereas, oxalate (0.36 %) and alkaloids (1.17 %) were reduced by oven-dry compared to sun-dry and air-dry methods. The findings revealed that all processing method had positive influence in improving the nutritive quality of the turmeric whereas, air-dry improved the crude protein and reduced the crude fibre on the turmeric.

Keywords: turmeric, proximate, phytochemicals, minerals, vitamins

DESCRIPTION OF PROBLEM

Notable phytogenic materials commonly used in poultry production are; ginger, onion, garlic, cinnamon, pepper, thyme, mustard, mint, nutmeg, anise, turmeric etc. (1,2). Reports have showed that these materials influence the eating pattern, secretion of digestive fluids and improve feed intake of the animals. Further studies also established that these materials can selectively influence the microorganisms by an anti-microbial activity or by a favorable stimulation of the eubiosis of the microflora.

Turmeric has been reported as an important herbal material given to its biological important in both human and animal system. It contains some vital components such as Vitamin C, a co-factor in many physiological reactions and β carotene an important antioxidants for optimal body functioning, (3). (1) reported 92.90 % dry matter, 15.20 % crude protein, 9.20 % crude fibre, 1.32 % ether extract, 7.8 % ash and 58.00 % nitrogen free extract for sun-dry turmeric; therefore, the author recommended that turmeric had health improving potential when use as feed additive in poultry feed.

Processing techniques has significant effect on the nutritive quality of a feedstuff, (1) reported positive impact of dietary important of sun-dry turmeric in broiler performance. Other authors like (4,5,6) had all examined the dietary potency of sun-dry turmeric in poultry. There is paucity of information on other processing methods. This work was carried out to examined the proximate and phytochemical composition on three processing methods (sun-dry, oven-dry and air-dry) of turmeric meal

MATERIALS AND METHODS

Procuring and processing of turmeric

Fresh turmeric rhizomes were procured from the local market within Makurdi town, Benue State. Fresh rhizomes were washed with clean water to remove the attached foreign materials such as moldy soil, it subsequently chopped into smaller pieces using sharp knives. Chopped turmeric rhizomes were divided into three equal parts. First part was sun-dried on a flat and clean concrete floor for 5 days, sun-drying was done

during the dry season at the temperature ranged of 35 ^{0}C to 40.03 ^{0}C. The second part was oven dried at 70^0 C for 48 hours while the third part was air-dried for 10 days. All the samples were dried to a constant weight and were subsequently ground with Eurolex Mixer / Grinder model MG1153 (a domestic blender) into powdery form of 0.05 mm and stored in an air tight container until needed for chemical analysis. Sub-samples were taken from each sample to analyze for chemical composition.

Proximate analysis of sun-dry, oven-dry and air-dry turmeric powder

Sun-dry, oven-dry and air-dry turmeric powders were analyzed for proximate components; Dry Matter (DM), Crude Fibre (CF), Crude Protein (CP), Ash and Ether Extract (EE), using methods of the Association of Official Analytical Chemists (7). Samples analyzed were carried out in triplicates and values were reported in percentages.

Determination of phytochemical composition of sun-dry, oven-dry and air-dry turmeric

Phytochemical analysis measured were tannin, saponins, oxalate, alkaloids and flavonoids of sun-dry, oven-dry and air-dry turmeric powder. All the samples were determined in triplicates. Oxalate and phytate content were carried out according to the method (8). Content of tannin was performed according to the method of (9) whereas, saponins, flavonoids and alkaloids were determined using the methods of (10).

Statistical analysis

Data collected were subjected to analysis of variance (ANOVA) using (11) software package, the means were separated using Duncan Multiple Range Test; the results were significant at 5 % level of probability.

RESULTS AND DISCUSSION

Proximate composition of Sun-dry, Oven-dry and Air-dry turmeric powder is presented in Table 1. Processing methods had significant effect on all the nutritional contents evaluated. Significant higher value of dry matter and crude protein were obtained for air-dry processing method with the least value recorded for sun-dry and oven-dry respectively. Sun-dry processing method showed superiority in terms of ether extract and carbohydrate composition. Crude fibre and ash were higher for oven-dry. Sun-dry recorded the least values in terms of dry matter and ash content. Obtained result showed that crude protein and carbohydrate were low when samples were oven dry and crude fibre when air-dry. Range value 90.50 – 92.20 recorded for dry matter was within the range reported by (1) for ginger and turmeric. Value range of 89 to 95 % was reported (12). Dry matter of a feedstuff determines the extent of its shelf-life. It makes the materials more stable during packaging and storage. Crude protein value with range value of 11.20 – 15.10 % was higher than value 7.70 and 14 % reported by (13) and (14) but within the value range of 12.60 to 15.20 % reported by (1). The protein content in the processed samples were all less that 18 %, showing that the materials are not qualified to be classified as a protein source but a spice that can enhance the nutritive value of the feed materials. Also, higher crude protein obtained for air-dry may be likened to the merit of lack of nutrient loss due to heat. Sun-dry and oven-dry are processing methods that involve exposing the materials to varied degrees of heat intensity. Crude fibre obtained is relatively higher in oven-dry processing method, the result seems not explainable, it is expected that oven-dry had low content of crude fibre due to exposure to high intensity of heat (70^0 C) for 48 hour. However, moderate fibre content obtained in the processed samples can also be a contributory factor in enhances the dietary fibre of the diet. Ash is a composition of many useful minerals that help in both physiological and metabolic functions of the body. Ash content ranged of 5.53 to 7.82 % reported for the processed samples are within value range of 3.50 to 8.20 obtained by (1). Proximate analysis revealed that sun-dry processing method improves carbohydrate composition of turmeric, though, the value obtained is lowered compared to the value reported by (1). The result showed that the turmeric rhizome subjected to sun-dry, oven-dry and air-dry processing methods are relatively good dietary component of carbohydrate.

Effect of turmeric powder subjected to sun-dry, oven-dry and air-dry processing methods on phytochemical composition is presented in Table 2. The result obtained showed that all sample accumulate phytochemical but at different concentration, this may imply that the turmeric under the three processing method had medicinal properties. Phytochemical contents observed in the processed turmeric are low compared to soybean, groundnut cake, barley and wheat bran (1). Saponins reach plant was

Table 1: Proximate composition of sun-dry, oven-dry and air-dry turmeric powder

Parameters (% DM)	Processing methods				
	Sun-dry	Oven-dry	Air-dry	SEM	p-value
Dry matter	90.50[c]	91.75[b]	92.20[a]	0.18	<.00
Crude protein	13.10[b]	11.20[c]	15.10[a]	0.42	<.00
Crude fibre	9.90[b]	12.15[a]	9.05[c]	0.71	<.00
Ether extract	10.20[a]	10.02[b]	10.07[b]	0.30	<.00
Ash	5.53[b]	7.40[a]	7.82[a]	0.80	<.00
NFE	42.27[a]	40.73[c]	42.11[b]	0.94	<.00

[abc]Means within each row with different superscripts are significantly different (P< 0.05).

Table 2: Phytochemical composition of sun-dry, oven-dry and air-dry turmeric powder

Parameters (%)	Processing methods				
	Sun-dry	Oven-dry	Air-dry	SEM	p-value
Saponin	1.40[b]	1.73[a]	1.22[c]	0.29	<.00
Tannin	0.44[b]	0.86[a]	0.68[b]	0.22	<.00
Oxalate	0.52[a]	0.36[b]	0.53[a]	0.06	<.00
Flavonoids	0.82	0.74	0.89	0.04	0.12
Alkaloids	1.62[b]	1.17[c]	1.84[a]	0.23	<.00
Phytates	2.84	2.23	2.21	0.29	0.09

[abc]Means within each row with different superscripts are significantly different (P< 0.05).

reported for its immune enhancement (15). Additionally, saponins inhibit the absorption of alcohol, cholesterol and iron in the digestive system (16). Flavonoids and phytate were not significantly influenced by the processing methods. Oven dry contained higher value of saponins and tannins whereas, least contents of oxalate and alkaloids was obtained with oven-dry. High level of tannin above 2-3 % was implicated in growth inhibition, reduced feed palatability and intake as well as increased excretion of cholesterol concentration (17). Sun-dry and oven-dry methods were more efficient in reducing the tannin concentration of the turmeric. Oxalate in high concentration is corrosive and caused sudden death in animal (18).

Oven-dry significantly reduced the oxalate content compared to sun-dry and air-dry methods. Non significant differences observed for flavonoids indicated that processing methods had no effect on the flavonoids content of the turmeric. Flavonoids have been recognized for its antioxidative properties and enzyme inhibition in animals (19). Alkaloid was significantly reduced by oven-dry method compared to other processing methods. The value 1.17 to 1.84 % obtained was higher than 7.21 % reported by (1). Difference observations by different authors may be attributed to processing method, geographical location of the harvested turmeric, different analytical procedure and varietal differences (20).

CONCLUSION

The findings revealed that all processing method had positive influence in improving the nutritive quality of the turmeric either by improving certain nutritional content or reducing the content of certain phytochemicals. However, air-dry improved the crude protein and reduced the crude fibre on the turmeric, air-dry also showed more merit when macro-minerals such calcium and phosphorus and amino acid profile notably lysine and methionine were considered.

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Monogastric Animal Production: MGP 065

PERFORMANCE AND NUTRIENT DIGESTIBILITY OF BROILER CHICKENS FED DIET SUPPLEMENTED WITH *Morinda lucida* AND *Vernonia amygdalina* LEAF MEAL

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ABSTRACT

Brimstone (*Morinda lucida*) leaf meal (MLLM) and Bitter leaf (*Vernonia amygdalina*) meal (VALM) were evaluated for their effect on the productive performance and nutrient digestibility of broiler chickens. Five experimental diets were formulated such that the control had no MLLM/VALM, treatments B and C contained MLLM at 0.5 and 1% respectively also D and E contained VALM at 0.5 and 1% respectively. A total of 150 day-old Arbor Acre broiler chicks were randomly allocated to the treatments comprising 30 birds of 10 birds per replicates. Productive performance parameters measured include Daily Feed Intake (DFI) and Daily Weight Gain (DWG) while Feed to Gain Ratio (FGR) was estimated. The feacal samples and feed were analyzed for crude protein, crude fibre, ether extract, ash, Metabolizable energy and nitrogen free extract to determine nutrient digestibility. Data collected were subjected to one-way analysis of variance and treatment means separated using Duncan Multiple Range Test at $p<0.05$. Result indicated that the birds fed control diet had the highest value (2015.24g) for Final Live Weight, FLW, followed by those fed MLLM (0.5%) and those fed VALM (1%) had the lowest value. Average Daily Weight Gain (ADWG) significantly ($p<0.05$) followed the same trend (decreasing with increased supplementation) with FLW. Birds fed VALM (1%) had the poorest (3.10) FCR. The birds fed diet supplemented with MLLM (1%) had the highest DM, CP, CF, ash, and NFE digestibility (86.68, 92.18, 79.97, 89.29, 78.88, and 86.26) respectively. In conclusion, while MLLM shows promise, especially at the 1% inclusion rate, VALM appears less beneficial at the levels tested.

Key words: Phytogenics; meat-type chicken; medicinal plants; plant-based bioactive compounds

DESCRIPTION OF PROBLEM

Researchers worldwide have recognized the therapeutic value of medicinal plants as a potential source of alternative, health-promoting, and effective treatments with minimal side effects(1). Medicinal plants are defined as those whose organs contain compounds usable for therapeutic purposes or as starting materials for synthesizing pharmaceutical products (2). These plants are crucial for healthcare globally, particularly in developing nations (3). Research indicates that in many developing countries, medicinal plants serve as a significant alternative to conventional medicine, especially for underprivileged rural populations with limited healthcare access (1). Additionally, medicinal plants are valuable resources for chemical and biological studies in the field of natural products (3). These plants naturally produce and store various secondary metabolites, including alkaloids, sterols, terpenes, flavonoids, saponins, glycosides, cyanogenic compounds, tannins, resins, lactones, and volatile oils, among others (3).

The application of plant-based bioactive compounds, including *Morinda lucida* (Brimstone) and *Vernonia amygdalina* (Bitter leaf), presents an encouraging approach to enhancing broiler chicken production by potentially improving growth performance, feed efficiency, and carcass quality in broiler chickens. Previous research indicates that *Vernonia amygdalina* has been associated with improved body weight and feed conversion ratios, as well as enhanced dressing percentages in broilers, suggesting its efficacy as a feed additive (4). Similarly, studies on *Morinda lucida* have shown its ability to improve weight gain and reduce pathogenic bacteria in the gastrointestinal tract, enhancing the overall health of the birds (5).

Hence, the aim of this study is to determine the effect of *Morinda lucida* and Bitter leaf (*Vernonia amygdalina*) in broiler chickens diet as indicated by performance and nutrient digestibility of the birds.

MATERIALS AND METHODS

Animals and Experimental Design

The study was conducted at the Teaching and Research Farm (Broiler Unit), Ladoke Akintola University of Technology, Ogbomoso. The geographical information of Ogbomoso is as retrieved in (6) and reported by (7)

Procurement of Test Ingredient

Brimstone leaf (*Morinda lucida*) and Bitter leaf (*Vernonia amygdalina*) were harvested from Ladoke Akintola University of Technology, Ogbomoso, Teaching and Research Farm plots. It was plucked from the stem of the trees, rinsed with water, air-dried for two weeks and the dried leaves were ground in an electric mill to a powder.

Experimental birds, diets and management

One hundred and fifty (150) day-old broiler chicks (Arbor Acre) from a reputable hatchery in Nigeria were used for the study. The birds were randomly allotted to five dietary treatments of 3 replicates each. The birds were subjected to standard poultry routine practices and offered feed and drinkable water *ad libitum* on daily basis throughout the experiment which lasted for seven (7) weeks. During this period broiler starter and finisher diets were offered at 0-3 and 4-7 weeks respectively. Five broiler starter and finisher diets were formulated such that Diet A is the control, diet B / C were supplemented with 0.05% and 1% *Morinda lucida* and D / E were supplemented with 0.05% and 1% *Vernonia amygdalina* powder respectively, at starter and finisher phases and their control diets are maize (52.1, 57.00), soya meal (27, 23), Groundnut cake (8.00, 4.00), Wheat offal (5.00, 8.60), Fish meal (72% CP) (3.00, 2.50), Di-calcium phosphate (3.00, 3.00), Limestone (1.00, 1.00), Lysine (0.20, 0.20), Methionine (0.25, 0.25), Broiler premix (0.25, 0.25), Salt (0.20, 0.20), to make a total of 100kg diet respectively. The analysed composition = %crude protein (23.05/19.50), %ether extract (5.05/3.75), %crude fibre (4.31/4.60), %ash (7.10/6.50), %dry matter (93.11/92.69) %nitrogen free exract (53.60/56.99) and %ME (kcal/kg) (2875.67/2920.13) for starter and finisher diets respectively.

Data collection

Productive Performance

Data were collected daily on Feed Intake (DFI) and Average Daily Gain (ADG) while Feed to Gain Ratio (FGR) was computed using the appropriate formula.

Nutrient Digestibility and Metabolic Trial

At the 7th week of age two birds from each replicate were selected randomly and moved into clean metabolic cage. Four days acclimatization was made prior to three days total collection period. Birds were fed with their respective diet with the recording of feed intake and excreta collected from each replicate taken on daily basis. The collected excreta were weighed and then oven- dried at 60ºC, the dried faecal sample were ground and thereafter the proximate composition was determined according to (11).

Statistical Analysis

The data collected were subjected to a one-way analysis of variance (ANOVA) using the procedure of (12). Significant mean differences were determined using Duncan's Multiple Range Test of the same package at a 5% probability level.

RESULTS AND DISCUSSION

The productive performance and nutrient digestibility of broiler chickens fed diets containing *Morinda lucida* and *Vernonia amygdalina* presented in Table 1 revealed that in the case of productive performance the parameters measured were not significantly ($p>0.05$) affected except the FLW and ADWG. The birds fed control diet had the highest value (2015.24g) for FLW, followed by those fed 0.5%MLLM and those fed

1%VALM had the lowest value. Average Daily Weight Gain (ADWG) significantly ($p<0.05$) followed the same trend (decreasing with increased supplementation) with FLW. Birds fed 1%VALM had the poorest FCR (3.10%). The birds fed diet supplemented with 1%MLLM had the highest dry matter, crude protein, crude fibre, ash, and NFE digestibility (86.68, 92.18, 79.97, 89.29, 78.88, and 86.26%) respectively. These results suggest that supplementing the broiler chicken diet with 1% MLLM had a positive effect on nutrient digestibility compared to the control and other treatments.

The birds fed control diet outperformed those fed diets supplemented with either MLLM or VALM in all the productive performance parameters which aligns with some recent studies on herbal supplements in poultry diets that while some herbal extracts can improve performance of broiler chickens, higher inclusion rates may negatively impact growth parameters (7). This could explain why increased supplementation of MLLM and VALM led to decreased performance in the current study. The poorer FCR with increased supplementation, especially for VALM (1%), suggests this herb may interfere with nutrient utilization at higher levels. This is consistent with findings by (8) that 600g of VALM per 100kg diet had the poorest FCR and corroborated by the result obtained by (7) that *Picralima nitida* at 0.2% had the highest value for FCR. In this context, it could be agreed that some phytogenic feed additives can improve FCR, others may have adverse effects depending on inclusion rate and composition.

The superior nutrient digestibility of MLLM (1%) across most parameters is noteworthy. Recent research by (9) who used 1g and 2g of *Morinda lucida* per kg diet showed improved nutrient digestibility in broilers chickens, and these is attributed to its bioactive compounds (alkaloids, sterols, terpenes, flavonoids, saponins, glycosides, cyanogenic compounds, tannins, resins, lactones, and volatile oils, among others) enhancing digestive enzyme activity. The lower digestibility values for VALM treatments, especially for ash and NFE, suggest potential anti-nutritional factors. This aligns with findings by (10), who reported that while *V. amygdalina* leaf meal can be beneficial at low levels, higher inclusions may reduce nutrient utilization due to its bitter principles and tannin content.

Table 1: Productive Performance and Nutrient Digestibility of Broiler Chickens fed *Morinda lucida* and *Vernonia amygdalina*

Parameter	A Control	B (0.5%MLLM)	C (1%MLLM)	D (0.5%VALM)	E (1% VALM)	SEM
Productive Performance (g)						
ILW	42.46	38.59	39.32	38.88	38.19	0.43
FLW	2015.24^{a}	1974.60^{ab}	1880.00^{abc}	1760.91^{bc}	1701.99^{c}	41.53
ADWG	40.26^{a}	39.51^{ab}	37.57^{abc}	35.14^{bc}	33.95^{c}	0.84
ADFI	103.65	102.57	104.04	103.22	104.78	1.56
FCR	2.58	2.60	2.77	2.96	3.10	0.07
Nutrient Digestibility (%)						
Dry matter	80.67^{ab}	83.45^{ab}	86.68^{a}	77.17^{b}	76.15^{b}	1.33
Crude protein	86.69^{b}	87.82^{ab}	92.18^{a}	88.21^{ab}	86.09^{b}	0.79
Crude fibre	69.46^{ab}	73.32^{ab}	79.97^{a}	67.65^{b}	66.36^{b}	1.82
Ether extract	87.24^{ab}	86.75^{ab}	89.29^{a}	83.43^{b}	84.92^{ab}	0.83
Ash	62.05^{bc}	72.^{95ab}	78.88^{a}	55.40^{c}	56.16^{c}	2.85
NFE	80.55^{ab}	83.98^{a}	86.26^{a}	75.56^{b}	74.94^{b}	1.46

abc: Means with different superscript on the same row differ significantly ($P<0.05$).
SEM: standard error of mean.
ILW= Initial live weight, FLW= Final live weight, ADWG = Average daily weight gain, ADFI = Average daily feed intake, FCR = Feed conversion ratio, NFE = Nitrogen free extract.

CONCLUSION AND APPLICATION

In conclusion, while MLLM shows promise, especially at the 1% inclusion rate, VALM appears less beneficial at the levels tested. These findings underscore the importance of optimizing inclusion rates when using herbal supplements in poultry diets, as excessive levels may negate potential benefits.

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Monogastric Animal Production: MGP 066

A COMPARATIVE ASSESSMENT OF *POSTPRANDIAL* AMINO ACID DYNAMICS OF PROTEIN FEEDSTUFFS IN BROILER CHICKENS

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ABSTRACT

The study investigated postprandial amino acid dynamics of various protein feedstuffs—soybean meal, fish meal, black soldier fly larvae, and casein—in broiler chickens. Forty unsexed 14-day-old Arbor Acres broiler chicks were housed in metabolic cages, 2 chickens per cage. On day 17, chickens were offered a nitrogen-free diet for 40 hours then fasted for 8 hours preceding sample collection. On day 19, chickens in each cage were randomly allotted to one of a soybean meal, fish meal, black soldier fly larvae, or casein -based diet for 20 minutes. Blood was drawn *preprandial*, and 30,60,120,180,and 300 minutes *postprandial* and total amino acid concentrations were measured. Maximum plasma amino acid concentration, C_{max}, time to reach maximum plasma amino acid concentration, T_{max}, and area under the plasma amino acid concentration-time curve, $AUC_{0\text{-}300mins}$ were estimated using the linear trapezoidal method. The study found no significant differences in C_{max}, T_{max}, or $AUC_{0\text{-}300mins}$ among the different protein feedstuffs. These results suggested no variability in protein digestibility among the tested feedstuffs, contradicting the results of earlier studies in other species. The study also highlighted large interindividual variability in animals, and assessment of *postprandial* total amino acids rather than assessment of *postprandial* individual amino acids as challenges to the adoption of *postprandial* plasma amino acid response studies as a proxy for other protein digestibility assessment protocols.

Keywords: Protein digestibility, Animal proteins, Plant proteins, Digestion kinetics, Plasma amino acid dynamics, Broiler chickens

DESCRIPTION OF PROBLEM

Postprandial response studies are a novel approach to understanding digestion and nutrient absorption in animals and have their roots in our current understanding of *postprandial* physiology while the metabolism of proteins/amino acids are conventionally studied in protein balance, growth or protein deposition studies. Few studies have evaluated the *postprandial* rise in circulating amino acids as an indicator of protein digestibility (1,2). *Postprandial* amino acid dynamics refer to the changes in circulating levels of amino acid in the bloodstream immediately following a meal and is considered a direct and rapid tool for assessing the "absorption potential" of protein sources (3). Factors such as type of protein, food/feed matrix, amino acid balance of the diet, gastric emptying, and processing conditions to which the protein feedstuffs are subjected have been reported to modulate protein digestion and amino acid absorption kinetics, and ultimately postprandial amino acid response in pigs and humans (4–9). Despite identified drawbacks of the postprandial amino acid response technique which include, non-dietary amino acid supply into the blood from protein turnover and catabolism (2) and large interindividual variability amongst animals in response to dietary proteins (10), it does offer a snapshot of the absorption and utilization amino acid immediately following dietary supply of proteins/amino acids - a window in which circulating amino acids are considered primarily from dietary sources. (4). The authors also noted a dearth of publications from studies assessing *postprandial* amino acid responses in chickens, hence the current study aims to investigate the influence of protein feedstuffs; soybean meal, fish meal, black soldier fly (*Hermentia illucens*) larvae, and casein, on the *postprandial* amino acid dynamics of broiler chickens.

MATERIALS AND METHODS

Animals and Experimental Design

Fifty unsexed broiler day old chicks (Arbor acres, 40.0 ± 2.0g) were obtained from a reputable hatchery and brooded and raised on deep litter on a broiler starter diet (3007 kcal/kg metabolizable energy, 23% crude protein, 6.82% crude fat, 4.41% crude fibre, 1.13% calcium, and 0.48% available phosphorus) formulated to meet the nutrient requirements of broiler starter chickens (11,12). On day14, forty chickens were randomly selected and allocated to twenty units of 148cm ×96cm ×116cm metabolic cages for a four-day acclimatization period. On day 17 all the chickens were offered to a nitrogen-free diet (Table 1) for 40 hours to achieve a depleted-state and subsequently fasted for 8 hours, while *ad libitum* water supply was maintained during this period. On day 19, approximately 1mL blood was sampled in ethylenediaminetetraacetic acid, EDTA-laden tubes for baseline amino acid quantification. Subsequently the experimental diets; soybean meal, fish meal, black soldier fly (*Hermentia illucens*) larvae, and casein-based diets (Table 1) were randomly offered chickens in 4 cages each, i.e. 8 chickens per diet, for 20 minutes and thereafter withdrawn. Blood was again sampled at 30,60,120,180,and 300 minutes *postprandial*.

Table 1. Gross composition and calculated nutrients of experimental diets

Ingredients (g/1000g)	Nitrogen free diet	Soybean meal	Fish meal	Black soldier fly larvae	Casein
Soybean meal	-	483.00	-	-	-
Black soldier fly larvae	-	-	-	410.00	-
Fish meal	-	-	323.00	-	-
Casein	-	-	-	-	245.90
Corn starch	766.50	359.30	555.50	415.00	579.30
Dextrose	80.00	60.00	28.00	85.50	40.00
Cellulose	75.00	-	55.00	55.00	60.00
Soya oil	25.00	57.00	10.00	5.00	40.00
Dicalcium phosphate	30.50	18.20	14.00	16.50	15.50
Limestone	7.00	10.00	2.00	0.50	6.80
Sodium bicarbonate	3.50	2.00	2.00	2.00	2.00
Vitamin-mineral premix	5.00	3.00	3.00	3.00	3.00
Sodium chloride	2.50	2.50	2.50	2.50	2.50
Titanium dioxide	5.00	5.00	5.00	5.00	5.00
Total	1000	1000	1000	1000	1000
Calculated analysis					
Metabolizable energy (kcal/kg)	3207	3097	3155	3143	3629
Crude protein (%)	0.54	21.50	21.50	21.50	21.48
Crude fat (%)	2.80	6.60	3.60	6.70	5.20
Crude fibre (%)	5.30	3.10	3.60	6.00	4.00
Calcium (%)	0.87	0.87	1.82	2.14	0.86
Available phosphorus (%)	0.41	0.34	0.95	0.62	0.40
Digestible methionine (%)	0.08	0.34	0.59	0.43	0.59
Digestible lysine (%)	0.15	1.38	1.62	1.26	1.80
Digestible threonine (%)	0.23	0.93	1.00	0.94	0.95

Composition of vitamin mineral premix per kg/diet: vitamin A, 10,000 IU; vitamin D3, 2,000 IU; vitamin E, 32 mg; vitamin K3, 1.6 mg; vitamin B1, 2.5 mg; vitamin B2, 4.4 mg; niacin, 44 mg; calcium pantothenate, 9.2 mg; vitamin B6, 4 mg; vitamin B12, 0.02mg; choline chloride, 400 mg; folic acid, 0.8 mg; biotin, 0.064 mg; manganese, 96 mg; iron, 80 mg; zinc, 64 mg; copper, 6.8 mg; iodine, 1.2 mg; cobalt, 0.24 mg; selenium, 0.096 mg; antioxidant, anticocci 20g /1000g feed.
Calculated analysis based on nutritional values of feed ingredients (NRC, 1994; Feedipedia).

Chemical Analyses

Quantification of plasma total amino acid (PTAA) concentration was performed using a spectrophotometric method based on the ninhydrin test (Moore and Stein, 1954) with modifications. Briefly, the blood samples were centrifuged at 15,000 rpm for 10 mins to separate plasma, deproteinized by mixing one part plasma to one part 8% sulfosalicylic acid and centrifuged again. Aliquots were combined with a 3% ninhydrin in dimethyl sulfoxide, DMSO mixture to produce a purple-coloured product and read in a spectrophotometer against serial dilutions of a lysine standard at 420nm.

Calculations and Statistical Analyses

Non-compartmental analysis of the postprandial plasma amino acid concentration-time data was conducted in PKSolver a pharmacokinetic and pharmacodynamic data analysis add-in program in Microsoft Excel) to calculate maximum plasma amino acid concentration, C_{max}, time to reach maximum plasma amino acid concentration, T_{max}, and area under the plasma amino acid concentration-time curve, $AUC_{0\text{-}300mins,}$estimated using the linear trapezoidal method (13). Data obtained; plasma amino acids concentration at different time points and *postprandial* plasma amino acid concentration -time curve indices, were subjected to analysis of variance, ANOVA and significant means were separated using Tukey honestly significant difference (HSD) test at 95% probability in JASP (version 0.18.3.0) statistical package.

RESULTS AND DISCUSSION

The result of the effect of different protein feedstuffs; soyabean meal, fish meal, black soldier fly larvae and casein, on *postprandial* plasma amino acid response variables in broiler chickens is shown in Table 2. *Postprandial* plasma amino acid concentration peaked at 120 minutes postprandial in chickens on the black soldier fly and casein-based diets, and at 165mins and 185 mins in chickens on the soybean meal and fish meal-based diets, respectively. However, no significant ($P > 0.05$) effects of protein feedstuffs investigated were observed on the maximum plasma amino acid concentration, C_{max}, time to reach maximum plasma amino acid concentration, T_{max}, and area under the plasma amino acid concentration-time curve, $AUC_{0\text{-}300mins}$ of chickens in this study, implying no variability in protein digestibility for the different feedstuffs. This observation is not consistent with earlier research where significant differences ($P<0.05$) *in postprandial* amino acid response variables in response to different protein sources were reported in pigs. One of the biggest challenges to the study of postprandial metabolism as postulated by Ravindran and Bryden (1999) is the large interindividual variability amongst animals in response to dietary proteins, a trend which was also observed in *postprandial* plasma amino acid response variables investigated in the current study. The observed interindividual variability could be influenced by endogenous protein sources which are not confounding factors in *postprandial* glucose response hence their reliability as a proxy for starch digestibility studies (14,15). Also, *postprandial* assessment of responses of individual amino acids to dietary amino acid balance were observed to be more sensitive to dietary protein sources compared to *postprandial* assessment of total amino acids in pigs (1).

Table 2. Effect of protein feedstuffs on *postprandial* plasma amino acid response variables in broiler chickens

Postprandial plasma amino acid concentration -time curve indices	Soyabean meal	Fish meal	Black soldier fly larvae	Casein
Maximum concentration, C_{max}, mg/ml	0.15 ± 0.13	0.12 ± 0.02	0.34 ± 0.23	0.26 ± 0.19
Time to reach maximum concentration, T_{max}, mins	165.0 ± 88.5	185.0 ± 105.0	120.0 ± 75.9	120.0 ± 114.0
Area under the curve, $AUC_{0\text{-}300mins}$, mg/ml*min	22.9 ± 9.8	21.7 ± 4.2	52.5 ± 39.0	29.5 ± 16.2

CONCLUSION AND APPLICATION

The postprandial plasma amino acid response protocol used to investigate different protein sources; soybean meal, fish meal, black soldier fly (*Hermentia illucens*) larvae, and casein, suggests no variability in protein digestibility among the tested feedstuffs, and showed large interindividual variability amongst animals in response to the dietary proteins. The findings contribute to the understanding of protein digestion and absorption dynamics in poultry, with implications for optimizing analytical protocols and feed formulations.

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A COMPARATIVE ASSESSMENT OF THE STANDARDIZED ILEAL AMINO ACID DIGESTIBILITY OF PROTEIN FEEDSTUFFS IN BROILER CHICKENS

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ABSTRACT

The study aims to provide a comprehensive assessment of the standardized ileal amino acid digestibility (SIAAD) of full fat black soldier fly (*Hermentia illucens*) larvae alongside conventional and reference protein sources in broiler chickens. Fifty unsexed Arbor Acres broiler chicks were raised on a standard starter diet and, from day 19, were fed one of four experimental diets containing either soybean meal, fish meal, black soldier fly larvae, or casein (reference protein). Chickens were slaughtered on day 21, and digesta from the distal ileum was collected, dried, and analysed for amino acid content. The SIAAD values of the protein sources were estimated and compared using ANOVA and means separated using Tukey honestly significant difference (HSD) test at 95% probability. Results indicated superior SIAAD for casein, a comparative SIAAD for fish meal and full fat black soldier fly, and a superiority of black soldier fly over soybean meal for the majority of amino acids, emphasizing the feasibility of black soldier fly larvae as a viable protein feedstuff in broiler diets.

Keywords: Protein quality, Protein feedstuffs, Meat-type chickens, Full-fat Black Soldier fly larvae, Animal proteins, Plant proteins

DESCRIPTION OF PROBLEM

"Protein digestibility" is a measure of the extent to which the protein fraction of any feedstuff is broken down and absorbed by the digestive system. The age and health status of animals, source of protein i.e. animal *vs* vegetable proteins, ingredient composition (1,2), antinutrient profile (3), processing conditions applied to the feedstuffs/diets, feed form (1), and the diet matrix impact digestive efficiency and protein metabolism in chickens, hence precise assessment of protein digestibility in chickens is critical for diet optimization, enhanced bird health and performance, efficient meat/egg production, and minimized environmental impacts (4). The assessment of protein digestibility in ileal digesta rather than in excreta stems from research that demonstrated negligible net absorption of amino acid in the caeca/colon, and significant alterations in amino acid digestibility estimates attributable to hindgut proteolysis (5). The standardized ileal digestibility (SID), is considered a more accurate estimate of true protein and amino acids available to the chickens (4,6) as it accounts for endogenous amino acids arising from non-dietary proteins such as digestive enzymes, sloughed-off intestinal cells, mucus, and other proteinaceous secretions expelled in the digesta and provides a basis for comparing the nutritional value of different fed ingredients on a more equitable basis. The black soldier fly (*Hermentia illucens*) larvae is proposed as a suitable alternative protein for poultry nutrition hence this study seeks to estimate and compare the SIAAD of full fat black soldier fly (*Hermentia illucens*) larvae against that of other conventional protein feedstuffs in broiler chickens.

MATERIALS AND METHODS

Animals and Experimental Design

Fifty unsexed day-old broiler chicks (Arbor acres, 40.0 ± 2.0g) were obtained from a reputable hatchery, brooded and raised on deep litter. Chicks were fed a broiler starter diet (3007 kcal/kg metabolizable energy, 23% crude protein, 6.82% crude fat, 4.41% crude fibre, 1.13% calcium, and 0.48% available phosphorus) from day1-18 (7,8). On day14, forty chickens were randomly distributed to twenty units of

148cm×96cm×116cm metabolic cages[U36][R37]. On day19, chickens in each cage were offered one of the experimental diets; soybean meal, fish meal, black soldier fly (*Hermentia illucens*) larvae, and casein (Table 1) containing titanium dioxide (as inert marker), and on day 21, all chickens were slaughtered by a jugular bleed and digesta harvested from the lower half of the ileum. Digesta was pooled per cage, dried at 55°C, ground and stored in airtight bags until analyses.

Table 1. Gross composition and calculated nutrients of experimental diets

Ingredients (g/1000g)	Nitrogen free diet	Soybean meal	Fish meal	Black soldier fly larvae	Casein
Soybean meal	-	483.00	-	-	-
Black soldier fly larvae	-	-	-	410.00	-
Fish meal	-	-	323.00	-	-
Casein	-	-	-	-	245.90
Corn starch	766.50	359.30	555.50	415.00	579.30
Dextrose	80.00	60.00	28.00	85.50	40.00
Cellulose	75.00	-	55.00	55.00	60.00
Soya oil	25.00	57.00	10.00	5.00	40.00
Dicalcium phosphate	30.50	18.20	14.00	16.50	15.50
Limestone	7.00	10.00	2.00	0.50	6.80
Sodium bicarbonate	3.50	2.00	2.00	2.00	2.00
Vitamin-mineral premix	5.00	3.00	3.00	3.00	3.00
Sodium chloride	2.50	2.50	2.50	2.50	2.50
Titanium oxide	5.00	5.00	5.00	5.00	5.00
Total	1000	1000	1000	1000	1000
Calculated analysis					
Metabolizable energy (kcal/kg)	3207	3097	3155	3143	3629
Crude protein (%)	0.54	21.50	21.50	21.50	21.48
Crude fat (%)	2.80	6.60	3.60	6.70	5.20
Crude fibre (%)	5.30	3.10	3.60	6.00	4.00
Calcium (%)	0.87	0.87	1.82	2.14	0.86
Available phosphorus (%)	0.41	0.34	0.95	0.62	0.40
Digestible methionine (%)	0.08	0.34	0.59	0.43	0.59
Digestible lysine (%)	0.15	1.38	1.62	1.26	1.80
Digestible threonine (%)	0.23	0.93	1.00	0.94	0.95

Composition of vitamin mineral premix per kg/diet: vitamin A, 10,000 IU; vitamin D3, 2,000 IU; vitamin E, 32 mg; vitamin K3, 1.6 mg; vitamin B1, 2.5 mg; vitamin B2, 4.4 mg; niacin, 44 mg; calcium pantothenate, 9.2 mg; vitamin B6, 4 mg; vitamin B12, 0.02mg; choline chloride, 400 mg; folic acid, 0.8 mg; biotin, 0.064 mg; manganese, 96 mg; iron, 80 mg; zinc, 64 mg; copper, 6.8 mg; iodine, 1.2 mg; cobalt, 0.24 mg; selenium, 0.096 mg; antioxidant, anticocci 20g /1000g feed.
Calculated analysis based on nutritional values of feed ingredients (NRC, 1994; Feedipedia).

Chemical Analyses
Samples of feed and digesta were analysed for dry matter, titanium, nitrogen and amino acid composition using standard procedures (9).

Calculations and Statistical Analyses
The apparent ileal digestibility (AID) of amino acids was calculated from the dietary ratio of nutrient to inert marker relative to the corresponding ratio in the ileal digesta, and basal ileal endogenous amino acid losses, BIAAL, estimated from chickens on the nitrogen-free diet (4). The SIAAD was then estimated by the equation:

$$SIAAD, \% = AID, \% + BIAAL\ (mg/kg\ DM\ intake)/Ingredient\ AA(mg/kg\ DM)$$

Data obtained were subjected to analysis of variance, ANOVA and significant means were separated using Tukey honestly significant difference (HSD) test at 95% probability in JASP (version 0.18.3.0) statistical package. The cages were the experimental units.

RESULTS AND DISCUSSION

In the current study, casein (milk protein) was used as the reference protein and compared to black soldier fly (*Hermentia illucens*) larvae, fish meal, and soybean meal. The influence of these protein feedstuffs on, SIAAD percentage in broiler chickens is presented in Table 2. The SIAAD of the dispensable amino acids; proline, tyrosine, cystine, and alanine in black soldier fly larvae compared favourably with soybean meal and fishmeal, but the SIAAD of threonine and histidine were similar for all feedstuffs tested. The SIAAD for lysine, phenylalanine, tryptophan, glycine, serine and aspartic acid in black soldier fly larvae compared favourably with casein and fishmeal and were significantly higher ($p<0.001$) than in soybean meal. The SIAAD of leucine, isoleucine, methionine, valine, arginine and glutamic acid were significantly highest ($p<0.001$) in casein and least in soybean meal, while their values in black soldier fly larvae and fishmeal were similar. The SIAAD values obtained for black soldier fly larvae in the current study agrees with SIAAD values reported for defatted black soldier fly larvae (10) except for histidine (92.21 *vs* 61.0%) and glycine (87.36 *vs* 78.3%). Conversely SIAAD values reported for soybean meal were similar to SIAAD values reported by (1) but higher than published SIAAD values (11) except for lysine (79.30 *vs* 79.84%), methionine (77.37 *vs* 82.77%), aspartic acid (82.71 *vs* 93.25%), cystine (79.33 *vs* 97.59%) and glutamic acid (73.0 *vs* 93.32%). Also, SIAAD values for fish meal in the current study are generally higher than values from (12)[U38][R39] and these variabilities could be attributed to feedstuff origin and processing conditions.

Table 2. Effect of protein feedstuffs on standardized ileal amino acid digestibility, SIAAD,%, in broiler chickens

	Soybean meal	Fish meal	Black soldier fly larvae	Casein
Indispensable amino acids				
Leucine	$81.74^{c} \pm 3.52$	$88.86^{b} \pm 0.09$	$87.37^{b} \pm 1.83$	$92.72^{a} \pm 2.27$
Lysine	$79.30^{c} \pm 1.50$	$88.46^{ab} \pm 0.04$	$87.97^{ab} \pm 2.66$	$91.06^{a} \pm 2.44$
Isoleucine	$80.94^{c} \pm 1.26$	$91.40^{b} \pm 0.55$	$88.35^{b} \pm 0.25$	$92.97^{a} \pm 2.30$
Phenylalanine	$80.24^{b} \pm 4.04$	$90.21^{a} \pm 2.06$	$90.88^{a} \pm 1.58$	$92.74^{a} \pm 2.36$
Tryptophan	$84.93^{b} \pm 1.61$	$90.67^{a} \pm 2.15$	$91.29^{a} \pm 0.77$	$92.45^{a} \pm 1.96$
Methionine	$77.37^{c} \pm 3.03$	$88.76^{b} \pm 1.09$	$88.20^{b} \pm 1.70$	$92.09^{a} \pm 2.59$
Valine	$81.52^{c} \pm 3.55$	$89.69^{b} \pm 0.59$	$87.70^{b} \pm 0.60$	$92.51^{a} \pm 2.24$
Arginine	$79.72^{c} \pm 2.37$	$90.20^{b} \pm 0.46$	$89.54^{b} \pm 1.58$	$97.40^{a} \pm 0.99$
Threonine	$86.14^{ab} \pm 0.79$	$88.10^{ab} \pm 1.42$	$87.57^{ab} \pm 1.56$	$93.45^{a} \pm 3.42$
Histidine	$85.69^{ab} \pm 2.01$	$91.75^{ab} \pm 1.83$	$92.21^{a} \pm 0.77$	$92.94^{a} \pm 1.89$
Dispensable amino acids				
Proline	$85.19^{b} \pm 2.50$	$88.54^{ab} \pm 1.98$	$88.35^{ab} \pm 0.93$	$91.46^{a} \pm 2.59$
Tyrosine	$79.35^{b} \pm 3.73$	$86.99^{ab} \pm 1.39$	$86.99^{ab} \pm 1.39$	$92.38^{a} \pm 2.19$
Cystine	$79.33^{b} \pm 3.90$	$89.27^{ab} \pm 1.69$	$89.30^{ab} \pm 0.27$	$92.51^{a} \pm 2.07$
Alanine	$79.35^{b} \pm 4.89$	$88.22^{ab} \pm 0.20$	$87.42^{ab} \pm 1.45$	$92.43^{a} \pm 2.28$
Glutamic acid	$73.00^{c} \pm 3.10$	$83.88^{b} \pm 0.20$	$81.85^{b} \pm 1.54$	$91.43^{a} \pm 4.98$
Glycine	$78.21^{b} \pm 3.16$	$89.22^{a} \pm 0.19$	$87.36^{a} \pm 2.02$	$90.90^{a} \pm 2.61$
Serine	$81.32^{b} \pm 3.55$	$88.40^{a} \pm 0.57$	$88.46^{a} \pm 1.42$	$91.49^{a} \pm 2.35$
Aspartic acid	$82.71^{b} \pm 1.35$	$88.98^{a} \pm 0.53$	$88.05^{a} \pm 1.42$	$91.37^{a} \pm 2.48$

Means with different superscripts differ significant from each other at $p<0.001$

CONCLUSION AND APPLICATION

On the basis of SIAAD values from this study, full fat black soldier fly (*Hermentia illucens*) larvae is at par with fish meal and superior to soybean meal for all indispensable amino acids except threonine and histidine, and the dispensable amino acids; proline, tyrosine, cystine, and alanine. This affirms full fat black soldier fly (*Hermentia illucens*) larvae as a high-quality protein feedstuff for broiler chicken feeding.

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PERFORMANCE CHARACTERISTICS IN BORAN BLACK LAYERS FED GRADED LEVELS OF ZINC SUPPLEMENTED DIETS

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ABSTRACT

This study evaluated the impact of varying levels of zinc supplementation on the performance characteristics of laying birds. Sixty (60) Boran black point of lay were utilized for this study. Birds were divided into four groups: a control group (T_1) with zero zinc supplementation and three treatment groups receiving 30,000 mg/MT (T_2), 60,000 mg/T (T_3), and 90,000 mg/T (T_4) of zinc respectively. Birds were monitored for twelve (12) weeks feeding while providing ample drinking water *ad libitum*. The parameters assessed include hen-day Production (HDP), feed intake, egg weight, feed efficiency, and mortality rates and results were subjected to analysis of variance (ANOVA). The results revealed that HDP remained consistent across T_1 (69.50%), T_2 (69.73%), and T_3 (70.13%) but significantly decreased ($p<0.05$) in T_4 (62.53%). Feed intake was highest in T_3 (129.20g/bird/day), with T_2 (121.27g/bird/day) also showing increased intake compared to the control, Birds on T_4 had reduced intake, as egg weight remained unaffected across all groups with a range of 54.53g - 55.46g, while optimal feed efficiency was recorded in T_2 (115.30g/bird/day). Mortality rates were low and showed no significant differences ($p<0.05$) among groups with T_4 recording zero mortality, while T_1, T_2, and T_3 recorded 0.04, 0.02 and 0.07% respectively. However, the outcome of this study emphasized that moderate zinc supplementation optimizes laying performance and feed utilization without adverse effects, but excessive levels may reduce productivity as observed in the study.

Keywords: egg weight, feed efficiency, hen-day production, mortality, zinc

DESCRIPTION OF PROBLEM

The dietary inclusion of zinc has been shown to enhance the productivity and health of laying hens. Zn acts as a cofactor for numerous enzymes and is involved in DNA synthesis, cell division, and protein metabolism, which are critical processes for maintaining optimal growth and egg production in poultry (1). The increased bioavailability of zinc has been associated with enhanced egg production and improved egg shell quality, key performance indicators in the poultry industry. Additionally, zinc supplementation has been linked to improved feed conversion ratios, indicating more efficient utilization of feed resources by the birds (2). The impact of zinc on immune function is another critical aspect of its supplementation, in that Zinc deficiency in poultry can lead to compromised immune responses, making birds more susceptible to infections and diseases (3). Adequate zinc levels are essential for the proper development and function of reproductive organs, influencing laying performance and egg fertility (4). However, zinc supplementation is not only beneficial for current laying cycles but also for the future reproductive potential of the birds. Therefore this study seeks to evaluate the impact of varying levels of zinc supplementation on the performance characteristics of laying birds.

MATERIALS AND METHODS

Animals and management

The experiment was carried out at the poultry unit of the teaching and research farm, Edo State College of Agriculture and Natural Resources, Iguoriakhi, Edo State. Sixty (60) Boran Black birds of 18weeks old were purchase from a reputable source in Benin and housed in a battery cage system. A composite diet was formulated as presented in table 1 to meet NRC (5) nutrient requirements for laying birds. The birds were randomly assigned to four (4) treatment groups of three (3) replicate contain ing five (5) birds each via a complete randomized design. Zinc was used as test ingredient in varying levels of 0mg-T_1, 30,000-T_2, 60,000-T_3 and 90,000mg/tonne-T_4. All recommended health and management practice were highly routine, while providing ample drinking water *ad libitum*. Birds were fed grower mash prior to 10% lay, after which layer mash (control diet) was offered until 50% lay then each of the four (4) dietary treatments were fed in triplicate groups for ten (10) weeks trial period.

Data collection:

Feed was supplied as needed and residual feed was measured to determine intake. Egg production was recorded daily together with hen-day production (HDP), kg feed/kg egg laid were calculated for each on weekly basis. Egg weight was also determine at lay.

Statistical analysis

All data obtained were subjected to ANOVA and significant treatments were separated (11)

Table 1: Gross composition of experimental diet

Ingredient	Percentage (%)
maize	50.00
wheat bran	9.00
groundnut cake	7.50
palm kernel cake	7.75
Soyabean meal	13.00
Bone meal	1.80
Limestone	8.15
Methionine	0.10
Lysine	0.10
Salt	0.25
Vitamin premix	2.50
Total	100
% CP	17.13
ME Kcal/kg	2603.23

[1]*Composition of vitamin premix per kg of diet: vitamin A, 12500 I.U; vitamin E, 40mg; vitamin K_3, 2mg; vitamin B_1, 3mg; vitamin B_2, 5.5mg; niacin, 5.5mg; calcium pantothenate, 11.5mg; vitamin B_6, 5mg; vitamin B_{12}, 0.025mg;choline chloride, 500mg, folic acid,1mg; biotin, 0.08mg; manganese, 120mg;iron 100mg; zinc, 80mg; copper, 8.5mg; iodine, 1.5mg; cobalt, 0.3mg;selenium, 0.12mg, anti-oxidant.*

RESULTS AND DISCUSSION

This study examines the impact of varying zinc supplementation levels on the performance characteristics of laying birds. In table 2 the control group (T_1) had an HDP of 69.50%, which was comparable to T_2 (30,000 mg/MT zinc) and T3 (60,000mg/MT zinc) with HDP values of 69.73% and 70.13%, respectively. However, T4 (90,000mg/MT zinc) exhibited a significantly lower ($p<0.05$) HDP of 62.52%. Observed differences were significant ($p<0.05$) for T4 when compared to the control and other treatment groups, with T4 having decreased HDP levels at 90,000mg/MT supplementation and subsequently decrease egg production. However, a significant reduction in HDP as observed in the group supplemented with the highest level of

zinc (T4) indicates that excessive zinc supplementation may have negative effects on the laying performance of the boran black bird. High levels of zinc can potentially lead to toxicity, disrupting physiological functions and reducing the productivity of the hens (6). This result aligns with findings (12) that decreased egg production in laying hens exposed to high dietary zinc levels, suggesting that while zinc is essential, its over-supplementation can be detrimental to egg-laying performanc. Feed intake is a critical determinant of poultry health and productivity. In the current study, the increased intake recorded for birds on T2 could be attributed to role zinc plays in enhancing appetite and nutrient absorption (7), while T4 had a slightly higher intake than T1 but were significantly lower ($p<0.05$) than T2 and T3. The results show that egg weights across all treatments are fairly consistent, with T1 at 54.73g, T2 at 55.46g, T3 at 54.53g, and T4 at 54.89g, indicating no significant differences ($p<0.05$) among treatment groups, in that supplementation did not affect egg weight across all groups. This could be due to the fact that zinc within the supplemented range, does not directly influence the size or mass of the eggs, indicating that while zinc is crucial for overall health and metabolic functions, it does not necessarily impact egg weight unless there is a severe deficiency (8). Laying birds on 30,000mg MT/bird demonstrated the best feed efficiency(kg feed/kg egg) at 3.17%, while birds on T3 and T4 had feed efficiencies of 3.41 and 3.32% respectively, having no significant difference ($p<0.05$) among treatment. Feed efficiency can be attributed to the role of zinc in enhancing nutrient absorption and metabolic processes (Bao et al., 2020). While birds on T3 also showed a good feed efficiency similar to the control group, the efficiency was slightly lower than T2, indicating that moderate zinc supplementation optimizes feed utilization, potentially reducing feeding costs and improving economic returns. Birds on control group (T1) had a mortality rate of 0.04%, with T2 and T3 having mortality rates of 0.02% and 0.07%, respectively, while T4 had zero mortality (0.00%), thereby indicating no significant differences ($p<0.05$) among treatment groups. Zinc is known for its role in immune function and its antioxidant properties, which can enhance the bird's resilience to diseases and stressors (3). This aligns with the findings (10) on the importance of zinc in supporting immune health and reducing mortality in poultry.

Table 2: Performance Characteristics of Layers fed zinc supplemented diets

Parameters	T_1 (Control)	T_2 (30,000MG/MT ZINC)	T_3 (60,000MG/MT ZINC)	T_4 (90,000MG/MT ZINC)	SEM
HDP (%)	69.50[a]	69.73[a]	70.13[a]	62.52[b]	1.11
Feed Iintake (g/bird/day)	112.4[b]	121.27[a]	129.20[b]	115.30[c]	1.26
Egg Weight (g)	54.73	55.46	54.53	54.89	0.51
Kg feed/kg egg	3.43	3.17	3.41	3.32	0.08
Mortality (%)	0.04	0.02	0.07	0.00	1.33

a, b, c: Means with different letters on the same row are significantly different at $P<0.05$

CONCLUSION AND APPLICATION

The study provides a comprehensive analysis of the effects of zinc supplementation on the performance characteristics of laying birds. Moderate zinc supplementation (30,000 mg/MT) significantly enhances feed intake and improves feed efficiency without negatively impacting egg production, weight, or mortality. However, excessive zinc supplementation (90,000 mg/MT) leads to a significant reduction in HDP and altered feed intake patterns, suggesting potential adverse effects at high zinc levels. The findings align with existing research indicating that while zinc is essential for optimal poultry health and performance, there is

a threshold beyond which its supplementation becomes detrimental. The study underscores the importance of carefully balancing zinc levels in poultry diets to maximize performance benefits while avoiding toxicity.

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EGG QUALITY AND PRODUCTION PERFORMANCE OF LAYER BIRD FED VARYING INCLUSION LEVELS OF *Sida acuta* LEAF MEAL AS ADDITIVE

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ABSTRACT

A 70 days feeding trial was conducted to evaluate the effect of dietary inclusion of varying level of *Sida acuta* leaf meal (SALM) as additive on the performance and egg quality parameters of ISA brown Laying birds. Two hundred and ten birds were randomly divided into six dietary treatments of 35 birds per treatment with five replicates (i.e.7 birds per replicate). They were fed six experimental diets containing 0g, 1g, 2g, 3g, 4g, 5g each of SALM per 1000g of the layer's feed. These dietary inclusions are designated as T1, T2, T3, T4, T5 and T6 respectively. Data collected include feed intake, daily egg production, external and internal egg quality parameters. Data collected were subjected to ANOVA. Result showed that Average daily feed intake, Egg weight, average egg weight and length showed no significant difference ($p>0.05$) among the treatment means while final weight, feed conversion ratio, cost per egg, hen day production (HDP), average egg/bird/40days, average egg/day, gain per egg, weight differences, egg shape index, average egg width and average shell weight and all internal egg quality parameters showed a significant difference ($p<0.05$) among the treatment means, while T3 performed better in the production performance of the birds in terms of HDP and cost per egg, T4 performed better in egg quality characteristics of the Layer birds in term of egg weight, yolk length and albumen height. It was concluded that SALM can be included as a feed-additive to boost performance and improve egg quality of ISA brown Laying Hen.

Keywords: Layers, *Sida acuta*, Poultry, Egg, Performance

DESCRIPTION OF PROBLEM

Poultry production has contributed considerably to the economic development of Nigeria (Heise *et al.*, 2015). Poultry products including egg is widely consumed due to the lack of cultural and religious bias towards it. There are many challenges nowadays in poultry production, including food safety, environmental issues, meeting welfare standards, ban of nutritive antibiotics, gut health, feed rich in fiber ingredients and maintaining high efficiency of production (Pirgozliev *et al.*, 2019). The continued use of conventional feed additives of animal sources in poultry diets has become a critical issue due to the high competition among livestock species and industrial purposes (El-Hanoun *et al.*, 2020).

There is need for the use of phyto-additive since it is available freely on the farm. Feed additives are commonly used in the poultry industry to improve feed utilization (Pirgozliev *et al.*, 2019). These additives, derived from herbs, spices, and other plant materials, contain bioactive ingredients that can improve the efficiency of egg production and contribute to the overall health of the birds (Abdelli *et al.*, 2021). *Sida acuta*, a plant with potential medicinal properties can be used as a replacement for antibiotics in the diet of poultry birds, with positive effects on productive performance, caeca microbial population, and immune modulatory activity (Shittu and Alagbe, 2020). Additionally, botanical or herbal products, including *Sida acuta*, are considered as phytogenic feed additives for poultry birds to improve egg weight and ovary characteristics, thereby enhancing poultry health and production (El-Sabrout *et al.*, 2023). The phytochemicals in *Sida acuta* leaf might improve feed utilization, enhance gut ecology, and stimulate the immune system, contributing to overall health and performance of the birds. Therefore, this study was conducted to investigate use of *Sida acuta* as a feed additive in layer bird nutrition to potentially improve laying performance and egg quality.

METHODOLOGY

The experiment was conducted at the Poultry Unit, Ladoke Akintola University of Technology, Ogbomoso, Oyo State Nigeria. A total number of 210 birds were purchased from a reputable source. The birds were weighed on arrival and allotted on weight equalization to six dietary treatments in a completely randomized design (CRD). Fresh and matured leaves of *Sida acuta* was collected within the farm premises and was air dried until it forms crispy, to keep the nutrients in the leaves intact. After which it was milled then added to the feed as an additive. Six experimental diets were formulated using commercial layers mash and *Sida acuta*. Treatment 1 contains 1g of the additive in 1kg of feed, Treatment 2 contains 2g of *Sida acuta* in 1kg of feed, Treatment 3 contains 3g of *Sida acuta* in 1kg of feed, Treatment 4 contains 4g of *Sida acuta* in 1kg of feed, Treatment 5 contains 5g of *Sida acuta* in 1kg of feed while treatment 6 is the control which contain 0g of *Sida acuta*. Each treatment was replicated five times with 7 birds per replicate. The feeding trial lasted for 8weeks after the production percentage of the birds reached 80%.

During this period, Eggs were collected twice daily, by 12noon and 2pm. During these collection periods, hands were used to turn the feed available in the feeding troughs to make a fresh feed available to the birds. The number of eggs laid by birds in each replicate was recorded daily. The eggs were sampled at random every week throughout the period of 8 weeks. Each egg was assessed separately for internal and external egg quality traits. For external egg quality traits, data on egg weight (g), egg length (cm), egg width (cm), egg shape index and egg shell thickness (mm) were collected. Individual egg weight was measured using a sensitive electronic balance while egg length and breadth were measured using a vernier caliper. The egg shape index is a ratio of the length and breadth of the egg. Shell thickness was measured for individual dry egg shells to the nearest millimeter using a micro meter screw gauge. The internal egg quality traits measured include egg yolk percentage (%), yolk colour was measured with Roche yolk colour fan, Albumen weight (g), Albumen height (mm), Albumen percentage (%) and Haugh unit. The Haugh unit was calculated from egg weight and albumen height according to the method of Haugh (1937). An egg separator was used to separate the yolk from the albumen. The height of the albumen was measured at its widest expanse and midway between yolk edge and the external edge of the thick albumen using a tripod micrometer. Yolk height was measured at the highest point using a tripod micrometer. The Yolk and albumen were placed in separate Petri dishes which had initially been weighed. The differences in the weight of each Petri dish after and before the introduction of the yolk and albumen were taken as the weights of the yolk and albumen respectively. Yolk index was calculated as the ratio of the yolk height to yolk width.The data collected will be arranged in a completely randomized design

RESULTS AND DISCUSSION

The production performance of layers fed varying inclusion level of *Sida acuta* leaf meal are presented in table 1. There was no significant difference ($P>0.05$) in the Average daily feed intake and Egg weight while significant differences ($P<0.05$) were observed in the Final weight, Feed conversion ratio, Feed conversion ratio in kg (FCR in kg), Cost per egg, Henday production, Average egg/bird/40days, Average egg/day, gain per egg and weight differences. The range gotten for Hen-day Production (HDP) (96.00 – 103.85) was greater than the report of Ogundeji and Akinfala (2022) who reported a range of (66.97 – 72.14) for HDP of Laying hen fed cassava-based meal diet. The variability in Hen Day production with some groups significantly outperforming the control likely reflects enhanced overall health and reproductive function due to the additive. Enhanced Hen Day Production can be linked to better nutrition and stress reduction as stated by Morales *et al*. (2016) who studied similar effects using plant extracts. The stability in egg weight and mass despite increased production suggest that while the number of eggs increased, their individual quality in terms of size was maintained.

The result of the egg quality of birds fed varying level of *Sida acuta* is presented in Table 2 below. The result shows that the Egg shape index, average egg width and average shell weight, yolk index, albumen, average egg weight, average albumen weight, average yolk height, average yolk length, average albumen height,

yolk colour, average albumen height (mm) shows a significant difference ($p<0.05$) among the treatment means while the average egg weight and average egg length does not show significant difference ($P>0.05$) among the treatment means. The result obtained showed that there was significant increase in the egg shape index, average egg weight when compared to the control group. This shows that *Sida acuta* can possibly enhance the structural integrity of the eggs.

TABLE 1: Production performance of layers fed diets with varying level of *Sida acuta* leaf meal additive

PARAMETERS	T1 (1g)	T2 (2g)	T3 (3g)	T4 (4g)	T5 (5g)	T6 (Control)	SEM	P-Value
IW(g)	1.62	1.62	1.65	1.55	1.56	1.72	0.00	0.07
ADFI/BIRD(g)	108.56	109.28	108.57	108.57	108.28	97.77	2.86	0.06
FW(g)	1.59^{a}	1.63^{a}	1.44^{b}	1.49^{b}	1.62^{a}	1.62^{a}	0.01	0.04
FCR	135.62^{b}	126.72^{b}	131.91^{b}	134.28^{b}	127.95^{b}	154.42^{a}	2.53	0.045
FCR IN KG	0.13^{b}	0.12^{b}	0.13^{b}	0.13^{b}	0.12^{b}	0.15^{a}	0.00	0.045
COST/ EGG(₦)	49.43^{b}	46.19^{b}	48.08^{b}	48.94^{b}	46.64^{b}	56.28^{a}	0.92	0.043
HDP (%)	96.00^{ab}	103.85^{a}	98.71^{ab}	96.71^{ab}	101.42^{ab}	79.33^{b}	3.00	0.03
AE/B(g)	32.00^{ab}	34.61^{a}	32.90^{ab}	32.23^{ab}	33.80^{ab}	26.44^{b}	1.00	0.034
AE/D	0.80^{ab}	0.86^{a}	0.82^{ab}	0.80^{ab}	0.84^{ab}	0.66^{b}	0.02	0.03
EW(g)	59.74	58.47	59.65	58.53	60.56	61.21	0.42	0.07
GAIN/EGG(₦)	17.23^{a}	20.48^{a}	18.58^{a}	17.72^{a}	20.02^{a}	10.38^{b}	0.92	0.045
WD(g)	0.02^{c}	-0.01^{cd}	0.20^{a}	0.05^{bc}	-0.06^{d}	0.09^{b}	0.01	0.01

^{abcde}: Mean along the same row with different subscript are significantly different ($p<0.05$), SEM: Standard Error Of Mean, IW: Initial Weight, FCR: Feed Conversion Ratio, ADFI: Average Daily Feed Intake/Birds, HDP: Hen Day Production, AE/B: Average Egg/Birds, AE/D: Average Egg/Day, WD: Weight Difference, FW: Final Weight, EW: Egg Weight

TABLE 2: Egg Quality of Laying Birds Fed Varying Level of *Sida acuta* leaf meal additive

PARAMETERS	T1	T2	T3	T4	T5	T6	SEM	P-value
Egg shape index	79.91^{a}	79.04^{ab}	79.30^{ab}	80.11^{a}	77.46^{b}	77.29^{b}	0.33	0.02
Average egg weight(g)	59.72	60.24	60.55	61.04	59.03	60.76	0.27	0.06
Average egg length (inch)	2.16	2.19	2.18	2.17	2.17	2.22	0.00	0.065
Average egg width (inch)	1.72^{a}	1.72^{a}	1.72^{a}	1.73^{a}	1.68^{b}	1.71^{b}	0.00	0.042
Average shell weight (g)	8.93^{b}	8.54^{b}	8.96^{b}	9.09^{b}	8.81^{b}	10.18^{a}	0.15	0.04
Average shell thickness (inch)	0.02	0.02	0.02	0.02	0.02	0.02	0.00	0.07
Yolk	26.35^{a}	25.93^{a}	26.15^{a}	24.57^{b}	26.10^{a}	26.33^{a}	0.18	0.037
Yolk index	0.47^{a}	0.48^{a}	0.49^{a}	0.39^{c}	0.43^{b}	0.41^{bc}	0.00	0.03
Albumen	58.64^{ab}	60.32^{a}	57.91^{ab}	59.84^{a}	58.98^{ab}	56.06^{b}	0.46	0.025
Average Egg weight	59.71^{a}	60.23^{a}	60.54^{a}	61.03^{a}	59.02^{a}	60.75^{a}	0.27	0.04
Average albumen weight	35.03^{a}	36.34^{a}	35.06^{a}	36.53^{a}	34.81^{a}	34.06^{a}	0.32	0.04
Average yolk height	0.67^{a}	0.70^{a}	0.69^{a}	0.56^{b}	0.61^{b}	0.59^{b}	0.01	0.043
Average yolk length	1.40^{a}	1.43^{a}	1.41^{a}	1.43^{a}	1.38^{a}	1.42^{a}	0.00	0.07
Average albumen height	0.22^{a}	0.24^{a}	0.21^{a}	0.25^{a}	0.22^{a}	0.22^{a}	0.00	0.07
Yolk colour	8.96^{b}	9.68^{a}	9.43^{ab}	9.75^{a}	9.39^{ab}	9.00^{b}	0.08	0.045
Average albumen height (mm)	5.60^{a}	6.09^{a}	5.37^{a}	6.38^{a}	5.78^{a}	5.76^{a}	0.16	0.07

^{abc}: Mean along the same row with different subscript are significantly different ($p<0.05$). SEM: Standard Error of Mean

Anderson *et al.* (2018) indicated that herbal supplements might influence the metabolic pathways related to calcium and other minerals essential for shell formation, thus improving the egg's structural resilience. The uniform shell thickness across all treatment indicates that *Sida acuta* can influence shell thickness and this is supported by Denis *et al.* (2022) who stated that feeding plant-based extract can affect the egg shell thickness and other external egg qualities of laying hens. The yolk weights show minimal variation across the treatments, with T4 showing a statistically lower value compared to the others. This may suggest that the level of *Sida acuta* in T4 could have negatively affected yolk deposition. This is in line with the findings of Asaniyan (2023), who noted that altering the feed of laying hens could alter yolk weight. The yolk index gotten in this experiment is greater than the range value (0.365 - 0.388) by Asaniyan (2023) in his experiment using cassava-based meal diet in Layers. There was an average increase in albumen and yolk indices compared to the control experiment and this correlate with the findings of Khan and Nakamura (2016) who stated that herbal additions in hen diets could modify egg internal qualities, primarily through changes in nutrient absorption and metabolism.

CONCLUSION AND APPLICATION

From the results of this study, it can be concluded that *Sida acuta* can be added as a feed additive to layer diet to boost their production performance and enhance their egg qualities.

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GROWTH PERFORMANCE AND CARCASS CHARACTERISTICS OF BROILER CHICKS FED VARYING INCLUSION LEVELS OF *Sida acuta* LEAF MEAL AS ADDITIVE

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ABSTRACT

A four weeks experiment was conducted in broiler birds to determine the growth performance and carcass characteristics of the birds fed with varying level of *Sida acuta* leave meal (SALM). A total number of one hundred and ninety two (192) day old chicks was gotten from a reputable farm and were randomly allotted to four dietary treatments with forty-eight birds per treatment. Each treatment consists of four replicates with twelve birds per replicate. Treatment 1 (T1) contained 0g inclusion of SALM in 1000g of feed, Treatment 2 (T2) contained 1g of SALM in 1000g of feed, Treatment 3 (T3) contained 2g of SALM in 1000g of feed, while Treatment 4 (T4) contained 3g of SALM in 1000g of feed. The result of the Growth performance of Broiler chicks fed varying inclusion level of SALM feed additives revealed that there were significant difference ($p<0.05$) in the growth parameters across the treatments except in price per kilogram feed which showed no significant difference ($p>0.05$) across the treatment means. The result of the carcass characteristics of broilers chicks fed varying levels of SALM additive showed that all parameters measured were affected significantly ($p<0.05$) across the treatments except the back weight. Treatment 3 performed better in the growth performance parameters of the broiler chicks than other treatments while T4 performed better in carcass traits than the other treatments. The experiment concluded that inclusion of SALM as feed additive improves the growth performance and carcass trait of broiler chicks.

Keywords: Broilers, Poultry, *Sida acuta*, Performance

INTRODUCTION

Poultry production in Nigeria has expanded rapidly in recent years, with local production only meeting 30% of the demand for chicken eggs and meat, thus there is huge scope for the industry to expand (Heise *et al.*, 2015). The ban on the use of certain antibiotics/additives has led to the use of alternative feed additives such as phytogenics, organic acids, prebiotics, probiotics, enzymes, and their derivatives in broiler production (Ayalew *et al.*, 2022). The usage of feed additives in broiler feed is essential, especially due to the ban on the use of certain antibiotics. These additives play a pivotal role in enhancing broiler performance, health, and overall productivity by promoting ingestion, absorption, nutrient assimilation, and growth of animals, as well as improving the overall health of birds. Phytogenic feed additives have been identified as a promising alternative to antibiotics in broiler production (Murugesan *et al.*,*2015*).

Sida acuta is a phytogenic plant with various phytochemical and nutritional properties which shows promising effect due to immune-modulatory effects and the ability to influence the microbial population in the gut of broiler chickens (Shittu *et al*., 2021). Various bioactive compounds present in *Sida acuta*, including alkaloids, flavonoids, saponins, and phenolic compounds, contribute to its therapeutic properties, such as antioxidant, anti-inflammatory, antimicrobial, and immunomodulatory effects. Traditional medicinal practices have long utilized *Sida acuta* for treating a range of ailments, including respiratory infections, gastrointestinal disorders, fever, and inflammatory conditions (Adeyemi *et al*.,2018) and it is believed that incorporating this plant as feed additive in broiler diet will improve their performance. This experiment is therefore carried out to investigate the effect of varying dietary inclusion level of *Sida acuta* leave meal additive on the growth performance and carcass characteristics of broiler chickens.

MATERIALS AND METHODS

The experiment was carried out at the Poultry Unit of the Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomosho, Oyo State, Nigeria. A total number of one hundred and ninety-two (192) day old chicks was gotten from a reputable farm and were randomly allotted to four dietary treatments with forty-eight birds per treatment. Each treatment consist of four replicates with twelve birds per replicate. The birds were subjected to normal brooding procedures through monitored charcoal pot for four weeks as source of heat, experimental diets and clean water were supplied *ad libitum* throughout the period of the experiment. The design of this experiment was Complete Randomized Design. *Sida acuta* leaves was harvested in the vicinity of LAUTECH campus and air dried before being processed into powered form and stored in a clean container which was covered to prevent moisture from getting into the container. A broiler starter feed was formulated for the chicks. The feed was divided to four dietary treatments. Treatment 1 contained 0.00g inclusion of *Sida acuta* leave meal (SALM) in 1000.00g of feed, Treatment 2 contained 1.00g of *Sida acuta* in 1000.00g of feed, Treatment 3 contained 2.00g of *Sida acuta* in 1000.00g of feed, and Treatment 4 contained 3.00g of *Sida acuta* in 1000.00g of feed.

The chicks were weighed on a weekly basis for weight gain throughout the period of the experiment. Individual feed intake was recorded daily to calculate the average daily feed intake and feed conversion ratio. Left over feed was collected and weighed daily with sensitive weighing scale. Feed consumption for day were also obtained from the differences between the feed given per day and left over.
Daily Feed Intake = Total Feed offered – Left over

Body weight gain was calculated from the differences between the body weight for the given week and that of the previous week. Final weight were taken and recorded at the end of the experiment. Feed conversion ratio were calculated by dividing the average feed intake (Kg) by the average body weight gain (Kg) at the end of the experiment.

$$\text{Feed conversion ratio (FCR)} = \frac{Average\ feed\ intake\ (Kg)}{Average\ body\ weight\ gain\ (Kg)}$$

Also, Carcass characteristics was evaluated by selecting three birds from each replicate. The selected chicks were starved overnight to empty their gastro intestinal tract. The live weight was taken and recorded. The jugular vein of the birds were severed and the birds were allowed to bleed to prevent meat contamination by the blood. After this the birds was reweighed to get the bled weight and afterwards the birds were defeathered without using hot water and the defeathered weight was taken and recorded. Also the eviscerated and carcass weight was also taken and recorded. After evisceration, the primal cut such as shanks, wings, neck, back, breast, head, thigh, and drumstick were weighed and recorded.

RESULTS

The result of the Growth performance of Broiler chicks fed varying inclusion level of *Sida acuta* feed additives revealed that there were significant difference ($p<0.05$) of the growth parameters across the treatments except Initial weight and FCR which shows no significant difference ($p>0.05$) across the treatment means. The final weight and total weight gain were highest in T3, where chicks were fed 2g of *Sida acuta* leave meal per kg of feed. Consistent with the total weight gain, the average daily weight gain were also highest in T3. The lowest weight is observed in T1 which is the control group and this suggest that inclusion of *Sida acuta* leaf meal into the diet of broiler can positively influence the weight gained by the chicks. T3 also exhibited a significantly better feed conversion ratio compared to the other groups. Lower FCR values in T3 suggest a more efficient conversion of feed into body mass. The range of values gotten for FCR (1.51 – 1.63) in this experiment is lower than the range gotten by Adeyeye *et al.,* (2024) who reported a range of (1.91 -2.35) for FCR in his experiment when broiler chickens where fed diets containing phytogenic blends as feed additive. This shows that including *Sida acuta* leave meal in diet of broiler will make them have better feed efficiency than other non-conventional phytoadditves. This is also evident in the

range of values gotten for weight gained (1082.06-1239.00) in this experiment compared to the report of Adeyeye *et al.* (2024) who reported a range value of (449.00 – 526.50) for daily weight gain in the experiment of feeding Broiler chicks phytogenic blends as feed additive

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Table 1 Growth performance of chicks fed varied inclusion level of *Sida acuta* leaf meal

Parameter	T1	T2	T3	T4	SEM
IW (g)	48.60	43.10	41.66	39.46	-
FW (g)	1130.66^{b}	1260.00^{a}	1280.66^{a}	1176.66^{ab}	20.27
WG (g)	1082.06^{b}	1216.90^{a}	1239.00^{a}	1137.20^{ab}	20.39
ADWG (g)	38.64^{b}	4.46^{a}	44.25^{a}	40.61^{ab}	0.72
ATFI (g)	1667.50^{b}	1878.66^{a}	1880.44^{a}	1855.38^{a}	22.79
ADFI (g)	59.55^{b}	67.09^{a}	67.15^{a}	66.26^{a}	0.81
FCR	1.54	1.55	1.51	1.63	0.02

^{abc} Means on the same row followed by different superscript are significantly different (P<0.05). SEM-Standard Error of Mean, T1= Control, T2= 1g of *Sida acuta* to 1kg feed, T3= 2g of *Sida acuta* to 1kg of feed, T4= 3g of *Sida acuta* to 1kg of feed, W= weight, Avg= average, G= gain. Initial weight gain, Final weight gain, Weight gain, Average daily weight gain, Feed conversion ratio, Cost per Kg weight gain and Price per Kg feed.

The result of the carcass characteristics of broilers chicks fed varying levels of *Sida acuta* leaf meal additive is shown in Table 2. All parameters were affected significantly (p<0.05) across the treatments except the back weight. The relative wing weight documented the highest value in T_1 (8.54) and the least value in T_2 (7.55). The relative breast weight recorded the highest value in T_4 (26.72) and recorded the least value in T_1 (21.64). The relative thigh weight ranges from 10.29 (T3) to 8.89 (T2) while the relative drumstick weight ranges from 9.76 (T1) to 8.39 (T2). Birds fed control diet had significantly (p>0.05) lower live weight values when compare with those fed varying levels of *Sida acuta* leaf meal. The live weights were similar between treatment groups. The inclusion of *Sida acuta* is in agreement with the report of Ologhobo *et al.* (2004) who mentioned that higher values of slaughter weights were recorded for birds fed phytoadditives leaf meal as compared to those fed on the control diets which had the lowest weight values. Birds fed 3g of *Sida acuta* leaf meal (T4) has a higher relative breast weight compared to others. Durrani *et al*. (2006) observed higher breast and thigh weights of broilers fed diet containing 5 g/kg of turmeric powder. The relative increase in breast weight could be as a result of bioactive chemicals (alkaloids, flavonoids) present in *Sida acuta* (Perumalsamy *et al.*, 2019). Relative weight of thigh was significantly (p<0.05) higher among birds fed 2g of *Sida acuta* leaf meal. Hussein (2013).

Table 2: Carcass Characteristics of broiler chicks fed varying level of *Sida acuta* leaf meal additive

PARAMETERS	**T_1**	**T2**	**T3**	**T4**	**SEM**
L/Wt (g)	1130.66^{b}	1260.00^{a}	1280.66^{a}	1176.66^{ab}	20.27
Head	3.41^{a}	2.32^{b}	3.53^{a}	3.34^{a}	0.11
Neck	3.19^{a}	2.57^{b}	3.23a	2.48b	0.11
Wing	8.54^{a}	7.55^{b}	8.28ab	7.88ab	0.15
Back	14.37	15.90	13.74	14.14	0.61
Breast	21.64^{b}	22.03^{b}	25.25^{a}	26.72^{a}	0.52
Thigh	9.77ab	8.89^{b}	10.29^{a}	8.91^{b}	0.23
Drumstick	9.76^{a}	8.39^{c}	9.15^{b}	9.00^{b}	0.13
Shank	4.90^{a}	4.28^{b}	4.16^{b}	4.25^{b}	0.09

^{a,b,c}; means within the same row that do not share a common subscript are significantly different (p< 0.05). L/Wt implies Live weight. SEM: Standard Error of Mean

CONCLUSION

The experiment has shown that supplementation of *Sida acuta* leave meal as feed additive improves the growth performance and carcass trait. Therefore, the inclusion of *Sida acuta* proved to be effective in broiler production and can be used in place of synthetic antibiotics since it is readily available.

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GROWTH PERFORMANCE AND HAEMOTOLOGICAL INDICES OF RABBITS FED RUMEN LIQUOR FERMENTED SUGARCANE SCRAPPING MEAL

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ABSTRACT

The study aimed to assess the impact of incorporating rumen liquor sugar cane scrapping meal (RLFSCSM) into rabbit diets on growth performance and haemotological indices. A total of 24 mixed breed grower rabbits of similar live weight (700 – 832g) were used and subjected to a Completely Randomized Designed (CRD) with 4 treatments, 3 replicate having 2 rabbits each. The rabbit diets were formulated to replace maize at different percentages 0, 10, 20 and 30% representing T1, T2, T3, and T4 respectively. Feeding and other routine management practices were strictly adhered to according to standard practices throughout the experimental period. The results showed a $p<0.05$ increase in the total weight gain (676.83g/rabbit), average daily gain (19.34 g/rabbit) and average daily feed intake (73.29g/rabbit). However, haematological parameters showed mixed effects, with a decrease in hemoglobin (10.77 to 10.50g/dL) and packed cell volume (35.50 to 33.66%) at certain inclusion levels of RLFSCSM but increases at higher levels. Red blood cell count remained relatively stable across treatments, while mean corpuscular hemoglobin and mean corpuscular hemoglobin concentration improved (21.67 pg and 31.67 g/L) with increasing RLFSCSM levels. White blood cell counts and mean corpuscular volume were unaffected by RLFSCSM inclusion. It was concluded that diet containing 30% RLFSCSM could improve general performance and health without detrimental effects when fed to grower rabbit.

Keywords: Body weight; Growth; Haematology; Liquor; Rabbits.

DESCRIPTION OF PROBLEM

The distinctive qualities of the rabbit (*Oryctolagus cuniculus*) make it suitable for production on both a small and large scale. These qualities may offer a quicker solution to the low animal protein issues in developing nations such as Nigeria [1]. These characteristics include, among others, small size, quick growth, high potential for reproduction, short generation interval, ability to use non-competitive diets, production of meat that is relatively high quality, and good genetic improvement potential [2].

Studies have shown that feeds account for about 70% of the production cost in livestock animal of which 40% comes from maize as source of energy [2]. Maize as an energy source has direct competition with humans in terms of food, arising from a variety of uses in both industrial and human nutrition. This makes it necessary to look for widely available and reasonably priced alternatives [2]. Agro-industrial waste products, including sugarcane scrappings, are easily found as unconventional feed ingredients that can be used in place of monogastric diets' energy sources, like maize, wheat, rice offal, and cassava peels [3].

It has been stated by [4] that rumen liquor can be used for both in-vitro and in-vivo fermentation of sugarcane and other agro-industrial waste in ruminant and monogastric animals. Research has shown that fermentation process stimulates growth, and the immune system in hens [5]. Furthermore, several authors reported different feeding mechanism to rabbits with a mixture of forages, pelleted and concentrate diets with better rate of growth, high digestibility, and good health [6]. It is against this background that conversion and

inclusion of rumen liquor fermented sugarcane scrappings to replace maize in rabbit diets becomes important.

METHODOLOGY

Location of the study:
The study was carried out at the Federal University of Lafia, Nasarawa State, in the Research and Teaching Farm of the Department of Animal Science, Faculty of Agriculture. The Farm is situated in the Southern Guinea Savannah Zone of Nigeria and is located on latitude 8028.78N and Longitude 8033.11E. The typical monthly relative humidity is 74%, with an average lowest temperature of 23ºC and a maximum temperature of 36.90ºC. [7].

Experimental feed ingredients:
The test ingredient (sugarcane scrappings) was obtained at the market in Lafia metropolis of Nasarawa State, Nigeria. Other ingredients obtained from Global feed industry, which is in Maraba along Keffi – Abuja Road, Nasarawa State.

Rumen Liquor:
Rumen liquor, obtained from the Lafia Municipal Abattoir, was filtered, and used as an inoculum for fermentation processes in the study.

Rumen liquor inoculation with sugarcane scrapping:
Sugarcane scrappings were inoculated with rumen liquor to initiate fermentation. After 72 hours of fermentation, samples were processed into rumen liquor fermented sugarcane scrapping meal (RLFSCSM) for nutrient analysis according to [8] methods.

Experimental Diets:
The experimental diet was 15% isonitrogenous crude protein and 2500 kcal/kg ME with test ingredients. Four (4) experiment diets were tag T1, T2, T3 and T4 respectively. T1 contained (0%RLFSCSM) which serves as the control diet, T2 contained (10% RLFSCSM), T3 contained (20% RLFSCSM), and T4 contained (30% RLFSCSM).

Proximate analysis of RLFSCSM
Nutrient composition for raw sugarcane scrappings is Dry matter = 97.41%, Crude protein = 7.46%, Ether extract = 3.10%, Crude fiber = 27.25%, Ash = 4.44%, Nitrogen free extract = 55.13%, and Metalizeable energy = 2487.07 kcal/ME. while that of fermented sugarcane scrappings are Dry matter = 96.34%, Crude protein = 11.02%, Ether extract = 2.26%, Crude fiber = 16.86%, Ash = 3.20%, Nitrogen free extract = 62.99%, and Metalizeable energy = 2828.75 kcal/ME, as described by [9].

Experiment Design:
Twenty-four (24) rabbits were distributed to the test diets T1, T2, T3 and T4 respectively. Completely Randomized Design (CRD) was used for four treatments with 3 replicates and each having 2 rabbits. $Yij = \mu + ti + eij$ is the statistical model that was employed, in which eij represents the random error, ti denotes the treatment effect i, μ is the population mean, and Yij represents jth observation of treatment ith.

Management of experimental animals:
Five (5) weeks old composite grower rabbits of equal sex (12 male and 12 female) and average live weight (700-832g) were purchased and reared under controlled conditions with standard management practices throughout the trial period in accordance with [10].

Table 1: Experimental diets for grower rabbits with percent inclusion of RLFSCSM

Ingredients	T1 (0% RLFSCSM)	T2 (10% RLFSCSM)	T3 (20% RLFSCSM)	T4 (30% RLFSCSM)
Blood meal	0.50	1.50	1.50	1.50
Salt	0.25	0.25	0.25	0.25
Maize bran	21.00	24.00	24.00	26.00
Groundnut cake	25.00	23.00	23.00	24.00
Rice offal	20.00	18.00	18.00	15.00
Premix	0.25	0.25	0.25	0.25
Maize	30.00	27.00	24.00	21.00
***RLFSCSM**	0.00	3.00	6.00	9.00
Bone meal	2.00	1.50	1.50	1.50
Lysine	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Palm oil	0.50	1.00	1.00	1.00
TOTAL	100.00	100.00	100.00	100.00
Calculated analysis				
Energy kcal/kg ME	2506.05	2506.39	2505.34	2507.02
Protein %	18.01	18.03	18.01	18.03
Crude fibre %	4.63	5.37	5.92	6.62
Ether Extract %	5.46	5.77	5.82	5.82
Ash %	5.78	5.44	5.52	5.11
Calcium %	0.84	0.71	0.73	0.75
Phosphorus %	0.67	0.68	0.78	0.88
Lysine %	0.82	0.85	0.87	0.90
Methionine %	0.44	0.45	0.45	0.46

***RLFSCSM** = rumen liquor fermented sugarcane scrapping meal; The vitamin- mineral premix supplied the following per 100kg of diet: vitamin A15,000 I.U, vitamin D3 300,000 I.U.,vitamin E 3,000 I.U., vitamin K 2.50mg, vitamin B1 (thiamin) 200mg, Riboflavin (B2) 600mg, pyridoxine (B6), Niacin 40.0mg, vitamin B12 2mg, Pantothenic acid 10.0mg, folic acid 100mg, Biotin 8mg, choline chloride 50mg, anti-oxidant 12.5mg, manganese 96mg, zinc 6mg, Iron 24mg, Copper 0.6mg, Iodine 0.14mg, Selenium 24mg, cobalt 214mg. Using Feedwin software version 1.01.

Collection of data and processing:

Feed intake:

Every day, the necessary amount of feed was weighed before being fed to the animals. To determine the real feed consumption for that day, leftovers were weighed and deducted from the feed that was supplied. Feed intake (g) = feed given (g) – feed left out (g). The entire sum of the daily feed intake was divided into seven (7) to determine the weekly feed consumption. Total daily feed intake / 7 equals weekly feed consumption. The total weekly feed intake for the duration of the experiment was divided by the number of days to get the average daily feed intake.

Weight gain:

To determine the true weight disparities, rabbits were weighed on a scale at the start and conclusion of each week. By deducting the initial weight from the end weight, weight gain is calculated by the foll owing equation: Final body weight (g) - initial body weight (g).

Feed Conversion Ratio:

The Feed Conversion Ratio (FCR) was used to measure the animal's efficiency in converting feed mass into body mass. It is defined as the ratio of the amount of feed consumed by the animal to the amount of weight

gained by the animal over a specific period. FCR is given by the following calculation FCR = feed intake/weight gain.

Haematological parameters:
At the end of the 35 days experiment, blood samples were collected via the ear veins of three (3) selected rabbits from each treatment group and 5ml syringe was used for the collection and samples of blood were analyzed using haemocytometer while Hb and PCV were determined using methods adopted by [2].

Statistical analysis
All data collected were analysed using SPSS MODEL 22. Means were separated using Ducan Multiple Range Test (DMRT) at (P<0.05).

RESULTS AND DISCUSSION

The experimental diet was 15% isonitrogenous crude protein and 2500 kcal/kg ME with test ingredients. Four (5) experiment diets were tag T1, T2, T3 and T4 respectively. T1 contained (0%RLFSCSM) which serves as the control diet, T2 contained (10% RLFSCSM), T3 contained (20% RLFSCSM), and T4 contained (30% RLFSCSM) as shown in Table 1 below. The metabolizable energy ranges from 2506.05 to 2507.02 kcal/ME while the crude protein values were between 18.01 to 18.03. this agrees with the recommended nutrient requirements of grower rabbits for optimum performance as outlined by (10). The higher values obtained in T2 for TWG and ADG might be associated with inclusion of RLFSCSM in the diet.

Table 2: Rumen liquor fermentation on growth performance of grower rabbits fed sugarcane scrapping meal for 35 days.

Parameters	Percent inclusion level of fermented SCSM					
	T1 (0%)	T2 (10%)	T3 (20%)	T4 (30%)	SEM	LOS
Initial body weight (g/rabbit)	792.67	792.67	832.00	810.67	36.89	Ns
Final body weight (g/rabbit)	1228.17	1469.50	1260.83	1336.00	43.57	Ns
Total weight gain (g/rabbit)	435.50^{b}	676.83^{a}	428.83^{b}	525.33^{ab}	37.48	*
Average daily gain (g/rabbit)	12.44^{b}	19.34^{a}	12.25^{b}	15.01^{ab}	1.07	*
Average daily feed intake (g/rabbit)	55.76^{c}	66.89^{ab}	63.59^{b}	73.29^{a}	2.15	*
Feed conversion ratio	4.82	3.49	5.29	4.88	0.32	Ns

^{abc*} Means on the same row having similar superscripts were not significant (P>0.05), ns=not significant, * = significant at (P<0.05), SEM= standard error of mean, LOS= level of significance.

Table 3: Rumen liquor fermentation on haematological indices of grower rabbits fed sugarcane scrapping meal (35 days)

Parameters	Percent inclusion level of fermented SCSM					
	T1 (0%)	T2 (10%)	T3 (20%)	T4 (30%)	SEM	LOS
Haemoglobin (g/dL)	10.77^{a}	6.90^{b}	10.50^{a}	10.07^{ab}	0.64	*
Packed cell volume (%)	35.50^{a}	23.33^{b}	33.66^{ab}	32.00^{ab}	1.97	*
Red blood cells (x10^{12}/l)	5.50^{a}	3.47^{b}	5.47^{a}	5.27^{a}	0.33	*
White blood cells (x10^{9}/l)	8.87	6.30	9.00	9.07	0.75	ns
Mean corpuscular volume (fL)	63.00	66.67	62.00	61.67	1.07	ns
Mean corpuscular haemoglobin (pg)	20.00^{ab}	21.67^{a}	19.00^{b}	19.00^{b}	0.39	*
Mean corpuscular haemoglobin concentration (g/l)	10.50^{c}	28.33^{b}	30.33^{a}	31.67^{a}	0.42	*

^{abc*} Means on the same row having similar superscripts were not significant (P>0.05), ns=not significant, * = significant at (P<0.05).

This is because fermentation has improved the nutritional status of diet thereby making the diet more palatable. This is in concordance with [11] who stated that fermenting rice offal with rumen filtrate improves overall production profitability of rabbit and increases cheaper animal protein. The average daily weight gain in the present study was comparable with daily body weight gain with rabbits fed 20% rumen filtrate fermented rice husk 20.54 g by [11] but feed intake was slightly lower compared with 93.88 g from [11]. The feed intake in this present study increased from T1 to T4. The consistent increase in feed intake in the group fed with RLFSCSM implied acceptability of the diets. This could be because of the palatability of the diet at 30% inclusion meal of RLFSCSM. This is also confirmed by [12] who suggested that fermented rumen content and sludge mixture in rabbit feed increases consumption and body weight increment while reducing food conversion. White blood cells and mean corpuscular volume were not altered by RLFSCSM. The reduction in Hb and PCV of 10% did not cause any anemic condition. However, 20 and 30% inclusion of RLFSCSM improved the Hb and PCV (10.07 and 10.50 g/dL). This might be associated with RLFSCSM percent inclusion which is probably due to the fermentation at 72 hours. Fermentation is believed to have a positive relation with rabbit's blood haemoglobin and packed cell volume. This assertion agreed with the previous work by [13] who said that rabbits fed fermented feeds had improved hemoglobin levels and PCV compared to those on non-fermented diets, indicating better overall health and nutrient utilization. The increase in the Mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) and the non-significant white blood cells suggest better utilization of RLFSCSM by rabbits. This is associated with the presence of microbes still present in the rumen liquor which helps to degrade fibre component of the diet making complex carbohydrate and protein available for the animals. This is in consonant with [14] who stated that fermented feeds containing probiotics like *Lactobacillus spp* which improved antibody production.

CONCLUSION AND RECOMMENDATION

The results from the study provided a means of using RLFSCSM as locally available feed ingredientsfor rabbits' diet, thereby improving general performance and health without detrimental effects. The study recommends up to 30% inclusion of RLFSCSM in the diets of grower rabbits for general growth performance and normal physiological function.

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Monogastric Animal Production: MGP 072

EFFECT OF NUTRIENT DIGESTIBILITY OF GRADED LEVELS OF SUNFLOWER SEED (*HELIANTHUS ANNUS* L.) CAKE FED TO RABBITS

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ABSTRACT

The research was conducted to evaluate the dietary inclusion levels of sunflower seed cake (SFSC) on the nutrient digestibility of weaner rabbits. Forty-five (45) weaner rabbits of mixed breeds and sexes were randomly allotted into five (5) dietary treatment groups with 9 rabbits per treatment and 3 per replicate in a completely randomized design (CRD). Five diets were formulated containing SFSC at 0, 10, 20, 30 and 40% as dietary inclusion levels. Three rabbits per treatment were used for this trial, they were transferred to metabolic cages for feaces collection. This lasted for 7 days after a waiting period of 24 hours was observed for the rabbits to void the previous feed offered to them before the commencement of faecal collection. Results of the nutrient digestibility of graded levels of SFSC fed to rabbits indicated that apart from CF digestibility, all other digestibility parameters measured were significantly ($P<0.05$) influenced by the dietary treatments. Rabbits fed 30% SFSC recorded significantly ($P<0.05$) higher and better values of the digestibility components measured though, this is statistically the same the 40% SFSC treatment. It is concluded that nutrients were better digested in rabbits fed 30% SFSC and up to 40% SFSC do not have adverse effect in the digestibility of nutrients.

Keywords: Sunflower seed cake, Rabbits, Nutrient, Digestibility

DESCRIPTION OF PROBLEM

The increasing competition between human and livestock for available gains and feed coupled with Nigeria's neglect of Agriculture, has led to high cost of available feed resources. Non-conventional feed ingredient could be processed into a high-quality feedstuff that can favourably supplement protein and energy sources which currently plays the dual purpose of feeding man and his livestock. Sunflower seed cake (SFSC) is the most important oil seed after soybean, rapeseed and cottonseed (1). It has been used as animal feed, organic fertilizer and soil compost and research are being conducted for its human consumption (2). It is a valuable and safe product whose protein, fibre and oil contents are highly variable due to variations in oil extraction process (3). According to (4), SFSC has crude protein of 31.57%, crude fat 11.20%, crude fibre 27.34%, ash 5.32% and nitrogen free extract 20.94%. (5) reported 91.48% DM, 33.52% CP, 3.11% EE, 27.23% CF and 6.85% ash. In many instances, the contradictory reports on the nutritive value of SFSC have impeded its broad use as an alternative protein feedstuff even in geographical areas where SFSC is produced cheaply and in substantial amount. It can replace more conventional and expensive protein sources such as soybean meal and groundnut cake (6). This study is aimed at determining the effect of sunflower seed cake on the nutrient digestibility of growing rabbits.

MATERIALS AND METHODS

The experiment was carried out at the Rabbitry Unit, Department of Animal Science Teaching and Research Farm, Ahmadu Bello University, Zaria. Zaria is located within the Northern Guinea Savanna zone of Nigeria, with latitude 11º 09′ 01.78″N and longitude 7º 39′ 14.79″E at an altitude of 671m above sea level (7). Five experimental diets (0, 10, 20, 30 and 40%) respectively of SFSC inclusion, were formulated to meet the requirements in accordance to rabbits in the tropics (8) as shown in Table 1.

Forty-five (45) weaner rabbits of mixed breeds and sexes were randomly assigned to five dietary treatment groups 9 rabbits/treatment and 3/replicate in a completely randomized design (CRD). Rabbits were housed in metal cages of 55 cm x 40 cm x 40 cm. The experiment lasted for eight weeks (56 days) after an initial one-week adjustment period for the rabbits to get accustomed to the feed and confinement. Proper sanitation and necessary routine management was carried out. Feed and water were supplied *ad- libitum.*

Table 1: Gross composition of experimental diets

	Graded levels of sunflower seed cake (%)				
Ingredients	**0**	**10**	**20**	**30**	**40**
Maize offal	33.50	33.50	33.50	33.50	33.50
Soybean (Full fat)	28.00	25.20	22.40	19.60	16.80
Sunflower seed cake	0.00	2.80	5.60	8.40	11.20
Rice offal	35.00	35.00	35.00	35.00	35.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Common salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100**	**100**	**100**
Calculated Analysis					
ME (Kcal/kg)	2698.00	2640.96	2659.22	2771.48	2776.74
Crude protein (%)	16.48	16.35	16.23	16.11	16.00
Crude fiber (%)	17.67	17.82	17.96	18.11	18.25
Ether extract (%)	7.58	7.13	6.68	6.23	5.78
Chemical analysis (%)					
Dry Matter	87.62	89.04	89.51	90.54	90.83
Crude Protein	16.28	16.22	16.18	15.92	15.64
Crude Fiber	13.15	13.75	14.90	14.95	15.82
Ether Extract	12.17	10.85	11.10	11.52	10.56
Ash	11.48	10.90	12.08	12.16	12.86
Nitrogen Free Extract	46.92	48.28	45.74	45.45	45.12

ME = Metabolizable Energy

At the 8th week, 3 rabbits having equal weights were randomly selected from each treatment and transferred into metabolic cages with facilities for collection of faeces period of seven days for nutrient digestibility studies. A waiting period of 24 hours was observed for the rabbits to void the previous feed offered to them before the commencement of faecal collection. A measured quantity of the experimental diet was offered daily and faeces collected were recorded. Thirty (30g) of the faecal sample was oven dried at 105°C for 24 hours. The dried feaces were bulked and milled; and a representative sample for each group were subjected to proximate analysis according to (9) procedures at the Biochemistry Laboratory, Department of Animal Science, Ahmadu Bello University, Zaria.

The digestibility of each nutrient was estimated using the following formula.

$$\% \text{ Digestibility of nutrient} = \frac{\text{Nutrient in feed intake (gm)} - \text{Nutrient in feaces (gm)}}{\text{Nutrient in feed intake (gm)}} \text{ X } 100$$

Statistical analysis

All data collected were subjected to analysis of variance (ANOVA) using General Linear Model (GLM) procedure of Statistical Analysis System (10). Significant differences among treatment means were separated using Dunnett's Test.

RESULT AND DISCUSSION

The result of the apparent nutrient digestibility of graded levels of SFSC fed to rabbits is shown on Table 2. There were significant (P<0.05) differences in all the parameters measured except for crude fiber digestibility. The mechanisms directing the growth responses observed in the rabbits appear to be related to nutrient. The apparent nutrient digestibility estimates showed that nutrients especially DM, CP, CF and NFE were better digested by rabbits fed 30 and 40 % SFSC diets. As shown in this study, rabbits fed 20, 30 and 40 % SFSC had significantly (P<0.05) higher values for DM digestibility when compared to the control and 10 % SFSC. These values were similar to the range of 62.35-82.03 % observed by (11) and much lower than the report of 88.07-90.06% by (12) who fed rabbit with wild sunflower inclusion. Studies have shown that dietary fiber increases DM digestibility (13), so the increase in DM observed in 20, 30 and 40 % SFSC could be due to the nature of fiber content in the diet. The values of CP obtained in this study fell within the range of 76.32-84.36 % reported by (14) but higher than the range of 55.34-74.83% by (12). Although, this result is contrary to the values (42.21- 62.23 %) reported by (11). The better digestibility of this nutrient could be attributed to the fiber content of the feed as it did not affect digestion of this nutrient. The ash digestibility was significantly (P<0.05) higher and similar in rabbits fed 20 (67.57 %), 30 (73.87 %) and 40 % SFSC (70.69 %) while the control (51.43 %) and 10 % SFSC (46.94 %) were observed to have similar values. The result was within the values (32.00 – 73.93%) reported by (14). The EE digestibility increased with increase in the inclusion of SFSC, however, the 30 and 40 % SFSC (76.74 and 74.76 %) had significantly (P<0.05) higher digestibility than the other treatments which were statistically similar. The EE and NFE digestibility do not follow any trend, but highest values were obtained on 30 % inclusion of SFSC respectively. The high digestibility of NFE showed that it contained a high readily available carbohydrates which the carbohydrate-based enzymes in the stomach were able to act upon.

The values of CF digestibility despite not significant suggests that CF contents in all the dietary treatment did not affect the digestion of various nutrients evaluated. The result obtained in this study is contrary to the reports of (15) that high fiber in rabbit diets depressed digestibility as it reduces the period of exposure of food to the digestive enzyme and absorptive surfaces. It was however observed that the apparent nutrient digestibility values recorded across the dietary treatments showed higher digestibility of nutrient for rabbits fed 30% and that rabbit could tolerate up to 40% SFSC without any adverse effect in the digestibility of nutrients.

Table 2: Apparent nutrient digestibility of graded levels of sunflower seed cake fed to rabbits

	Graded levels of SFSC (%)					
Nutrients (%)	**0**	**10**	**20**	**30**	**40**	**SEM**
Dry Matter	75.89^{b}	70.12^{c}	79.20^{a}	83.89^{a}	79.86^{a}	2.52
Crude Protein	72.34^{b}	60.62^{c}	64.53^{c}	87.93^{a}	84.29^{a}	4.84
Crude Fiber	87.86	85.65	84.41	89.43	87.64	1.63
Ether Extract	61.42^{b}	61.63^{b}	66.29^{b}	76.74^{a}	74.76^{a}	3.74
Ash	51.43^{b}	46.94^{b}	67.57^{a}	73.87^{a}	70.69^{a}	6.03
Nitrogen Free Extract	81.84^{c}	90.67^{b}	89.75^{b}	95.74^{a}	91.44^{b}	2.87

^{abc}: Means with different superscript on the same row differ significantly at P<0.05 SFSC: sunflower seed cake
SEM: standard error of mean

CONCLUSION

It is concluded that up to 40% inclusion level of sunflower seed cake could be digested by rabbits without any adverse effect.

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Effect of Feeding Graded Levels of Gliricidia Leaf Meal (GLM) on Meat Quality of Weaner Rabbits

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ABSTRACT

The aim of this study is to determine the effect of feeding graded levels of Gliricidia leaf meal (GLM) on meat quality of weaner rabbits. A total number of 27 mixed breed unsexed weaner rabbits of 6 weeks was divided into 3 dietary treatments (Treatment 1; control, Treatment 2; 25 % inclusion level of gliricidia leaf meal (GLM) and Treatment 3; 50% GLM). Fresh Gliricidia sepium leaves were harvested, shade dried and milled to produce leaf meal. Each treatment had 8 rabbits with 4 replicate of two rabbits each in a completely randomized design. Meat quality parameters were collected for evaluation. Data were analysed using descriptive statistics and ANOVA at $_{\alpha 0.05.}$ The physicochemical the cold shortening indicates highest significant different in rabbit fed control with least in rabbit fed 25.0% GLM, under the thermal shortening the rabbits fed 50% GLM indicates the highest significant different with the least in rabbits fed 25.0%, the Oxidative rancidity indicates highest significant different fed control with least fed with 25.0% of GLM. There were no significant different obtained in all the physical properties except the cooking loss loin. The cooking loss loin was highly significant in rabbit fed 25.0% GLM with least value obtain in rabbit fed control diet. In conclusion dietary treatments with varying gliciridia leaf meal up to 25.0% inclusion level is highly significant different in physical properties and chemical.

Keywords: Gliricidia leaf meal, physicochemical, meat quality, weaner rabbits, oxidative rancidity

INTRODUCTION

The search for alternative feed resources for farm animals as a way of reducing production costs, and making livestock products more readily available to the populace in the tropics is far from over (1). A situation in which the average Nigerian still consumes only about 7.4g of animal protein per day (2), which is still far below the recommended animal protein level of 35g per required by an average adult human for proper health, is undesirable. It is known that some tree legumes in the tropics, notably Gliricidia sepium have attracted attention for their ability to provide large quantities of high quality forages all year round as well as their ability to maintain a sustainable environment and soil fertility through nitrogen fixation (3). The use of these legumes as livestock feeds has the potential of significantly bringing down the cost of commercial livestock feeds, which are very high in Nigeria, primarily because the conventional ingredients used to supply the protein components in these feeds also serve as food for humans, and as raw materials in industries. However, studies by Akpata (4), Aletor and Aledetimi (5) and Ologhobo *et al.* (6) have shown that the use of some legumes as protein sources could produce some undesirable physiological and biological alterations when such legumes are fed in their raw state to monogastric animals, which may be manifest in the carcass characteristics and meat qualities of the animals. Since these qualities reflect the physiological responses of animals to their health, environment and nutrition (7), values reported for rabbits in the temperate zone may not be useful in assessing the health and nutritional status of rabbits in the production. This study was therefore carried out to ascertain the effect Effect of dietary replacement of SBM with varying levels of GLM based diet on Carcass characteristics and meat quality of rabbits.

MATERIALS AND METHODS

Experimental site/study location: The research was carried out at Dagwom farm division of the National Veterinary Research Institute (NVRI) Vom, Jos south Local Government Area of Plateau State Nigeria. Experimental Diet: Fresh Gliricidia sepium leaves were harvested, shade dried and milled to produce leaf meal. Three diets were formulated to contain Gliricidia sepium leaf meal (GLM) at 0 (control), 25.0% and 50.0% levels.

Experimental Animals and Data Collections: A total number of 27 mixed breed unsexed weaner rabbits of 6 weeks was divided into three dietary treatments (Treatment 1; control, Treatment 2; 25 % inclusion level of gliricidia leaf meal (GLM) and Treatment 3; 50% GLM) of 9 rabbits each.

Meat quality evaluation
Water holding capacity: was determined according to Wardlaw, Maccaskill, and Acton (8).
pH: according to method described by (9).

$$\text{Cold shortening} = \frac{\text{Initial length} - \text{final length}}{\text{Initial length}} \times 100$$

$$\text{Thermal shortening} = \frac{\text{Initial length} - \text{final length}}{\text{Initial length}} \times 100$$

$$\text{Cooking yield} = \frac{\text{Weight of cooked meat}}{\text{Weight of raw meat}} \times 100$$

Oxidative rancidity: Thiobarbituric acid value (TBA) was estimated by modified methods of (10).
Experimental design: A completely randomized design was used for this experiment (CRD).
Data Analysis: All data that were generated were analyze using SPSS version 25 and differences between means were separated using the DUNCAN'S multiple range test.

RESULTS

Table 1 shows the effect of Gliricidia leaf meal on Physical Properties. There were no significant different obtained in all the physical properties except the cooking loss from the Loin. The cooking loss loin was highly significant in rabbit fed 25.0% GLM with least value obtain in rabbit fed control diet.

Table 1: Effect of Gliricidia Sepium leaf meal on Physical properties….of ..

Parameters	Control	25% GLM	50% GLM	SEM
Cooking Loss Loin(%)	17.27^{b}	21.61^{a}	16.82^{b}	4.66
Cooking Loss thigh(%)	23.13^{a}	20.47^{ab}	17.23^{b}	4.77
Ph	6.98	6.85	6.97	0.03
Water holding capacity (%)	55.00	44.44	46.11	2.60

$^{a, b}$ Means in the same row not sharing superscript are significantly different at P<0.05.
GLM = Gliricidia leaf meal
SEM = Standard error mean

Figure 1 shows the effect of Gliricidia leaf meal on Physicochemical. The physicochemical the cold shortening indicates highest significant different in rabbit fed control with least in rabbit fed 25.0% GLM,

under the thermal shortening the rabbits fed 50% GLM indicates the highest significant different (P<0.05) with the least in rabbits fed 25.0%, the result for Oxidative rancidity indicates highest significant different in meat from rabbits fed control diet with least fed with 25.0% of GLM.

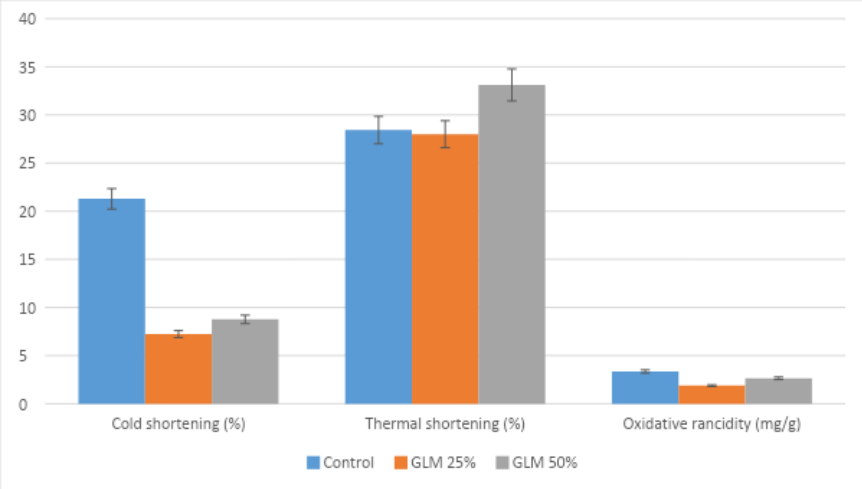

Figure 1: Effect of Gliricidia leaf meal on Physicochemical properties of Rabbit meat

DISCUSSION

Meat quality is usually defined as a measurement of attributes or characters that determine the suitability of meat to be eaten as fresh or stored for reasonable period without deterioration (11). Meat quality and consistency are important in ensuring consumer satisfaction. Quality of meat is affected by the genetic propensity of the animal, how the animal is reared, and the nutritional status during production. These factors affect the fat, lean and connective tissue component of meat and therefore influence meat quality. Genetic differences are being understood as genetic markers are being developed for many major quality characteristics within species. As the production segment selects animals to maximize quality, reduction in meat quality can be obtained. However, these animals must be fed and reared to maximize quality. Quality also is strongly influenced by conditions at the slaughter plant. How animals are handled pre-slaughter affects the rate of rigor mortis. The application of stunning and exsanguination methods that ensure reduced animal stress are important to meat quality. The application of electrical stimulation and how the carcass is chilled influence the rate of rigor mortis and subsequent meat quality. In this study, cold shortening indicates highest significant different in rabbit fed control with least value recorded in meat from rabbit fed 25.0% GLM. Thermal shortening of meat from rabbits fed 50% GLM indicates the highest significant different (P<0.05) with the least in rabbits fed 25.0%. The Oxidative rancidity of meat indicates highest significant different in rabbit fed control with least value in meat from fed with 25.0% of GLM. The cooking loss from the loin was highly significant (P<0.05) in rabbit fed 25.0% GLM with least value obtain in rabbit fed control diet. Similarly, the sensory evaluation the colour indicates highly significant different in control with least in rabbits fed 25.0% GLM, aroma indicates highly significant different in control with least in rabbit fed 50.0%, flavour having highly significant different in rabbit fed 50.0% GLM with least in control, juiciness indicates highly significant different in rabbit fed 50.0% GLM with least in control, tenderness indicates highly significant different in control with least rabbit fed 25.0% GLM, texture indicates highly significant different in rabbit fed 25.0 with least in control and overall acceptability shows highly significant different in rabbit fed 25.0% with least fed control which agrees with the finding of Amata I.A.(12) the effect of feeding Gliricidia leaf meal on the hematological, serological and carcass characteristics of weaned rabbit in the tropics. Also this result was in agreement with the result of (13) who work on Effects of *Albizia Julibrissin* Leaf Meal on the Carcass and Sensory Characteristics of Local Rabbits (Oryctolaguscuniculus). The result obtained could be due to the bioactive compound presence in the Gliricidia.

CONCLUSION

In conclusion dietary treatments with varying gliciridia leaf meal up to 25.0% inclusion level is highly significant different in physicochemical properties. Dietary treatment has no adverse effects to meat quality.

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Monogastric Animal Production: MGP 074

EFFECT OF BROODING AND FEED RESTRICTION ON PERFORMANCE OF ARBOR ACRE BROILER CHICKENS AT FINISHER PHASE

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ABSTRACT

Brooding effect on performance was examined in arbor acre chickens. A total of 48 day old arbor acre chicks were used for the experiment which was carried out in 2 stages of brooding stage and finisher stage. For the brooding stage, the chicks were grouped into two treatments (24 chicks per treatment) and 3 replicates (8 chicks per replicate) per treatment. Treatment one (T1) was supplied with heat source while treatment two (T2) had no heat source but was heavily covered with thick nylon to reduce heat loss. The second stage had 3 treatments of feed restriction and three replicates per treatment along the line of brooding method. The heated brooding after 3 weeks was divided into T1 fed once daily at 8:00hours, T2 fed twice daily at 8:00 hours and 16:00 hours, and T3 fed thrice daily at 8:00, 12:00 and 16:00 hours. The same design was replicated for the heatless brooding. Daily ambient temperature, relative humidity and mortality were recorded while feed intake and body weight gain, were recorded on weekly basis. The analysis was done using general linear model and Duncan Multiple Range Test of SPSS. The results show that brooding at starter phase have a significant ($P<0.05$) influence on the performance, linear measurement and slaughter yield of arbor acre broiler chickens. Birds under T1, T2 and T3 (1253.45, 1055.76 and 1176.00 respectively) had better significant ($P<0.05$) final weight gain in heatless brooding than heated brooding. The FCR was better under heated T3 (1.65) and heatless T2 (1.67). The result of the experiment showed that heatless brooding for Arbor acre broiler chickens at starter phase and finishing them with thrice per day feeding restriction could improve performance.

Keywords: Carcass yield, heatless, restricted feeding, brooding, linear measurements

DESCRIPTION OF THE PROBLEM

Poultry farming is one of the most efficient animal husbandry methods and it provides nutritional security to a significant number of the world population. Broiler chickens production is an important sub-sector of poultry production in Nigeria with enormous potential to bring about desired economic change and it has continually contributed positively in the areas of food provision (poultry meat), employment generation and a source of livelihood to producers (1). It has been reported in the literatures that small scale broiler producers are predominant and they represent more than half of broiler production and supplies a little above one quarter of poultry meat in the world. In Nigeria small scale producers represent approximately 94 percent of total poultry keeping, and account for nearly four percent of the total estimated value of the livestock resources in the country. It is therefore important to work in areas of production to alleviate the challenges encountered during brooding and rearing.

Locally available resources are used to enhance production and essential management activities like brooding and feeding during the finisher phase. Brooding, which encompasses the care and provision of supplemental heat to chicks is important to give the chicks a good start at the early developmental stage. Abe *et al*. (2) reported that the normally recommended brooding temperatures of 35^0 C, 32^0 C, and 29^0 C for the 1st, 2nd, and 3rd weeks, respectively, could be reduced to 29^0 C, 27^0 C, and 24^0 C when warm-room brooding is used. Abe *et al*. (2) stated that a brooding temperature as low as 27^0 C during the first week was adequate in warm-room brooding systems. Fawwad et al. (3) compared the effects of three brooding techniques (gas, electric and wood) on broiler chicken performance. They recorded significant differences in weight gain, feed consumption, feed conversion ratio, respiratory rate and recommended gas brooding as

an economical technique to enhance the productive performance of birds. Alternative heat sources such as charcoal pots, kerosene lanterns and stoves can be adapted by small scale poultry producers in Nigeria because of the high cost and unavailability of sophisticated brooding equipment. Therefore, this study investigated the effects of brooding and feed restriction on performance of arbor acre broiler chickens.

MATERIALS AND METHODS

Experimental site

The experiment was carried out at the poultry unit of the Teaching and Research Farm of Adekunle Ajasin University, Akungba-Akoko, Ondo State, Nigeria. The farm falls within latitude 7º 28` 0`` N and longitude 5º 44' 0`` E (4).

Animal and experimental Design

The 48 experimental birds were divided into two groups, heated (H) and heatless (L), with 24 chicks per group and eight chicks per replicate. The H group were supplied with external heat using kerosene lantern while the L group were not supplied with heat but the cage was covered with cellophane bag to conserve heat inside the cage though with ventilation to avoid ammonia congestion within the cage. After the brooding/ starter phase which lasted for three weeks the birds were subjected to restrict feeding along the line of brooding method. The 24 birds in each group were divided into three feeding treatments (T1, T2 and T3) with two replicates per treatment. The feeding treatment are T1 which is once feeding (8:00 hour *ad libitum*), T2 which is twice feeding (8:00 and 16:00 hours) and T3 which is thrice feeding (8:00, 12:00 and 16:00 hours). The birds were fed a total of 105g of feed per day. The bird were fed commercial feed and water was provided freely.

Data Collection

Weekly data were collected on growth performance and feed intake. At the end of experiment which lasted for 35 days, 4 birds per treatment were sacrificed after stunning to determine the slaughter yield. The feed intake was recorded weekly for each replicate. Feed left over was subtracted from the amount of feed offered to the birds on weekly basis to determine the feed intake. Body weight gain was also recorded for each replicate. The average weight gain per bird was noted by deducing the difference between the final body weight and initial body weight and dividing this value by the number of birds per replicate. Feed conversion ratio (FCR) was calculated by finding the ratio of the feed intake to the body weight gain. Mortality (%): was calculated as the ratio of the number of dead birds to the total number of birds per replicate, expressed as a percentage.

Statistical Analysis

Data obtained were subjected to analysis of variance in a Completely Randomized Design. Significantly ($P<0.05$) different means were separated using Duncan multiple's range test (5)

RESULTS AND DISCUSSION

As seen in Table 1, the average initial weight (AIW) varied significantly ($P<0.05$) with chicks under T2 having the lowest initial weight especially in heatless brooding (365.29g) which could be that the birds were using most of the feed consumed to generate heat to keep the body warm during the starter phase since there was no external heat supplied. T1 had the highest significantly ($P<0.05$) different weight (884.52g) in heated brooding. The average bodyweight of 1.88 kg, 1.81 kg and 1.65 kg attained by Arbor Acre, Ross and Marshal respectively at 8 weeks of age by Udeh and Ogbu (6) was higher than the result of this study but were in line with the report of Akanno *et al*., (7) that broiler birds attain a market weight of 1300.00-2000.00g at 8-10 weeks of age. The AWG was highest (690.47g) in T2 followed by T1 (593.95g) under heatless brooding respectively. It is interesting to discover that T2 which had the lowest initial weight was able to record the highest weekly weight at the end of the experiment though with second FCR (1.67) next to heated brooding in T3 which recorded the lowest (1.65) FCR. The better FCR recorded in T2 under heatless could be unconnected to superior performance to make for the lost performance during the starter phase. Feed conversion ratio is one of the major criteria of detecting high performing bird as opined by Rezaei *et al.* (8) where they stated that FCR and growth rate are conventionally the mode of appraising the performance of broiler birds (2).

Table 1. Performance of Arbor acre broiler chickens reared under different brooding and restricted feeding method

Parameters	T1 (8hrs *ad libitum*)		T2 (8hrs and 16hrs)		T3 (8hrs, 12hrs and 16hrs	
	Heated	Heatless	Heated	Heatless	Heated	Heatless
AIW g	884.52 ±0.15^{a}	659.50 ±0.10^{c}	546.47 ±0.10^{e}	365.29 ±0.15^{f}	615.00 ±1.00^{d}	713.70 ±0.10^{b}
AFW g	1209.10 ±0.10^{b}	1253.45 ±0.15^{a}	992.19 ±0.05^{f}	1055.76 ±0.10^{e}	1066.76 ±0.10^{d}	1176.00 ±1.00^{c}
AWG g	324.58 ±0.25^{f}	593.95 ±0.05^{b}	445.72 ±0.15^{e}	690.47 ±0.25^{a}	451.76 ±0.90^{d}	462.30 ±0.90^{c}
AFI g	935.58 ±0.02^{d}	994.83 ±0.10^{b}	993.62 ±0.01^{c}	1140.34 ±0.03^{a}	805.44 ±0.02^{f}	832.84 ±0.08^{e}
FCR	2.88	2.23	1.78	1.67	1.65	1.80
Survival (%)	100.00	100.00	100.00	100.00	100.00	100.00

^{a,b,c,d,e,f} = means with the same superscript letters across the row are not significantly (P>0.05) different. AIW=Average initial weight; AFW=Average final weight: AWG=Average weight gain; AFI=Average feed intake; FCR=Feed conversion ratio

CONCLUSION AND APPLICATION

The study was able to look at the consequence of different brooding methods during the starter phase on the finisher phase of arbor acre broiler chickens. It could be concluded from the result of the experiment that arbor acre birds reared under heatless brooding at starter phase and finishing them with thrice per day feeding restriction could improve performance.

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Monogastric Animal Production: MGP 075

EVALUATION OF IRISH POTATOES MEAL (IPPM) IN THE DIET OF BROILER STARTER CHICKENS

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ABSTRACT

This study was designed to examine the growth performance of broiler starter chicks fed IPPM as a replacement for maize in a four-week feeding trial. Three hundred and seventy-five (375) one-day-old Abor-Acre chicks were assigned to five treatment groups using a completely randomized design. Each treatment group contained 75 chicks and was replicated thrice with twenty five chicks per replicate. The IPPM was incorporated in the diets at 7.5%, 15.0%, 22.5%, and 30.0% as a replacement for the maize used in the control diet. At the end of the four-week feeding trial, growth parameters such as final body weight, weight gain, feed intake, feed/gain ratio and mortality were measured. The results revealed a Significant difference ($p < 0,05$) in the growth parameters measured. Birds on 7.5% and 15.0%IPPM have the highest Final weight, daily weight gain and feed – to - gain ratio, which is similar to that of 0%, 15.0% and 22.5%IPPM, while those fed 30% IPPM in place of maize had the lowest Final weight, daily weight gain and feed-to-gain ratio. The average feed consumed increased linearly as the inclusion level of IPPM increased from 7.5% to 30% IPPM. Thus, the optimal inclusion level of IPPM in broiler diets as a replacement for maize should not exceed 15.0%. It was therefore concluded that the inclusion of IPPM in the diet of broiler chicks is beneficial.

Keywords: performance; Irish potatoes peel meal; Inclusion levels, replicates; Broiler chicks.

DESCRIPTION OF PROBLEM

Animal husbandry is vital to the agricultural industry and plays a great role in the national economy. Poultry is also a significant part of Animal agriculture. In Nigeria, the major constraint of poultry production has always been the high cost of quality feeds. Feed cost was estimated to be about 67-75% of the total cost of production (1). This high cost has been attributed to the over-dependence onexpensive conventional feedstuffs such as maize which is mainly used in poultry as feed formulation as a major source of energy. This high cost of feed necessitates research into non- conventional feedstuffs (NCF) that are readily available, cheap and nutritionally safe for the consumption of poultry. The utilization of Irish potatoes peel meal can lower feed costs because it contains moderate energy, and therefore may be used to substitute maize in poultry feed. This study was, therefore, carried out to evaluate the influence of Irish potatoes peel waste meal on performance of broilers starter, and therefore look at the possibility of partially substituting for maize as a potential feed ingredient to lower the demand for maize and other grains while also meeting their nutritional requirements. This study will further provide a fair knowledge for monogastric nutritionists, farmers and the feed industries at large on how to economically substitute maize and other grains with IPPM in broiler starter diets, thus reducing the cost of producing the feed and overall cost of production of broiler chickens.

Objective: To develop a poultry feeding system with Irish potato peels .

MATERIALS AND METHODS

Experimental site
The experiment was conducted at the poultry section Department of Livestock, Ministry of Agriculture, Mariri, in Kumbotso Local Government Area of Kano State, The area lies between latitude 11°55'49"N and 11°59'43"N and longitude 8°31'18"E and 8°36'19"E at an altitude of 460m above sea level. (2).

Sample Collection
Irish potato peels were collected from various kitchens at homes and also restaurants. At the end of the collection of the Irish potato peels were sun-dried to reduce the moisture content and then milled before being homogenized with other feed-stuffs. The IPPM was included in the experimental diets at graded levels of 0, 7.5. 15.0, 22.5, and 30%, these five levels represented treatment 1,2,3,4, and five respectively.

Determination of chemical composition:
The proximate composition of samples of the IPPM experimental diets and faecal samples was determined according to AOAC (3). The formula given by Pauzenga (4) was used to estimate metabolizable energy. The energy value was estimated from proximate analysis data.

Management of the animals
Three hundred and seventy-five (375) one-day-old Abor-Acre chicks were assigned to five treatment groups using a completely randomized design. Each treatment group contained 75 chicks and was replicated thrice with twenty- five chicks per replicate. A known weight of feed was given daily while water was given *ad libitum.* The management of the broiler chickens was carried out according to the standard procedures for cleaning, brooding vaccination and medication. The feeds and the birds were weighed weekly.

Performance analysis
At the end of the experiment, three birds per treatment were selected to know the performance of the birds being fed by the IPPM. The performance of the birds in terms of feed final body weight, weight gain, feed intake and feed-to-gain ratio was measured and recorded. The mortality of birds was also recorded and calculated. The experiment lasted for four weeks.

Statistical analysis
All data were recorded and analyzed using analysis of variance (ANOVA). Means were separated by the Duncan Multiple Range Test. (5) The starter diet was formulated to be iso-nitrogenous and iso-caloric and to meet standard requirements as recommended by (6). The composition of the experimental diet is shown in Table 1.

RESULTS AND DISCUSSION

Performance of birds
The composition of the broiler starter diet from day one to week four is shown in table 1. The results of the performance of day-old chicks fed with IPPM for four weeks are shown in table 2. There were significant differences ($p<0.05$) between treatments with respect to final weight feed intake, weight gain, feed/gain ratio and live weight at four weeks.

Feed consumption increased significantly ($p<0.05$) with the inclusion of IPPM and with the highest level up to 22.5% after which a decrease occurred at a 30% inclusion level of IPPM, having the lowest total feed intake among the treatments having IPPM. The observed increase trend in feed intake as IPPM increased could be because of the increase in the bulkiness of feed as a result of high fibre, with increasing level of IPPM, since birds tend to consume more feed when the feed is bulky to receive similar levels of nutrients to meet their required needs. This result agrees with the findings of (7) who reported that bulky feeds which are high in fire are rather low in nutrient concentration per unit volume. Weight of the bulkier feed contributes less digestible nutrients and makes other nutrients less available. However, reduction in feed

consumption occurs when feed becomes excessively bulky. This is consistent with the results of Onimisi *et al.* (2005) who explained that the weight of excessive bulky feed consumed by birds is reduced thereby causing a physical limitation on the intake of digestible nutrients. The highest weight gain and highest final weight were recorded for the birds fed 15.0% IPPM at the end of the four-week feeding trial. However, the birds on 0% and 10% IPPM recorded similar weight gain and final weight gain with the birds on 15% IPPM. Therefore, the growth rate is significantly ($p<0.05$) similar for birds on 0%, 7.5% and 15.0% IPPM. There was a significant reduction in the weight gain of birds on 22.5% to 30% IPPM. The inclusion of IPPM in the diets of broiler chicks increased feed consumption significantly ($p<0.05$) but with non-significant ($p>0.05$) differences in weight gain. The linear increase occurred in feed /gain ratio with increasing level of IPPM in diet levels, beyond 15.0% significantly depressed the ability of birds to convert feed materials into weight. The feed conversion efficiency of birds reduced with a higher level of IPPM in the diet.

Table 1: Gross composition of broiler chicks diets containing Irish potatoes peel meal. (IPPM)

Ingredients (%)	0	7.5	15.0	22.5	30.0
Maize	55.85	48.0	42.00	34.00	28.50
IPPM	0.00	7.50	15.00	25.50	30.00
Groundnut cake	0.00	22.50	22.50	22.50	22.50
Soybean meal	6.00	6.00	6.00	6.00	6.00
Maize offal	7.00	7.00	7.00	7.00	7.00
Fish meal	2.00	2.00	2.00	2.00	2.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Limestone	1.00	1.00	1.00	1.00	1.00
Common salt	0.30	0.30	0.30	0.30	0.30
Methionine	0.30	0.30	0.30	0.30	0.30
Lysine	0.10	0.10	0.10	0.10	0.10
*Vitamin /trace min. premix	0.25	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100**	**100**	**100**
Calculated Analysis (%)					
ME (kcal/kg)	3045	3065	3023	3084	3024
Crude Protein	23.00	23.00	23.00	23.00	23.00
Crude fibre	4.05	4.66	5.35	6.43	6.50.
Available phos.(%)	6.80	6.92	6.45	6.00	6.95
Ash	6.40	6.45	6.45	6.42	6.15
Methionine (%)	0.57	0.57	0.56	0.55	0.54
Lysine (%)	1.05	1.06	1.06	1.07	1.07
Calcium	1.21	1.23	1.12	1.19	1.20

Table 2: Growth performance of broiler Chicks fed Irish Potatoes Peel Meals

	Treatments						
	T_1	T_2	T_3	T_4	T_5	SEM	LOS
Parameters	0%	7.5%	15%	22.5%	30%		
Initial weight (g/b)	68.00	68.00	68.80	68.00	68.00	0.00	NS
Final weight (g/b)	590.20^a	620.45^a	588.60^a	495.15^b	480.85^b	6.93	*
Weight gain (g/b)	522.00^a	522.45^a	519.80^a	427.15^b	412.85^c	6.24	*
Feed intake (g/b)	1200.19^b	1370.35^a	1392.65^a	1400.58^a	1280.10^b	12.95	*
Feed /Gain Ratio	2.60^a	2.62^a	2.67^a	3.27^b	3.10^b	0.06	*
Mortality	00	00	00	00	00	00	NS

a,b,c = Means within the same row with different superscripts differ significantly ($P<0.05$)
SEM = standard error of means *= significant difference NS =Not significant

CONCLUSION AND APPLICATION

From the results of the trials, it is concluded that up to 15.0% of Irish potatoes eel meal may be included in the diet of broiler starter chicken without any significant negative effect on growth performance

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Monogastric Animal Production: MGP 076

EFFECT OF DIETARY SUPPLEMENTATION OF SOME PHYTOGENIC FEED ADDITIVES ON GROWTH RESPONSE AND GUT MORPHOMETRY OF BROILER CHICKENS

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ABSTRACT

This experiment was carried out with one hundred and eighty (180) unsexed day-old Arbor acre strain of broilers to evaluate the growth response and gut morphometry and microbial count of broiler chicken fed diets supplemented with (phytogenic feed additives) *Euphorbia hirta* leaf meal (EHM), clove (CM), Turmeric (TM) and black pepper (BPM) in a six-weeks feeding trial. The birds were randomly allotted into four (6) experimental groups of 30 birds per group, which were further divided into 3 replicates of 10 birds per replicate in a completely randomized design (CRD). Treatment (T1) which was the control was served with a basal diet, Treatments (T2) were served with 20g of oxytetracycline/100kg of feed, T3, T4, T5 and T6) were fed diets supplemented with EHM, CM, TM and BPM at 500g/100kg of feed respectively at both starter and finisher phase. Data were collected on growth response. At the end of the experiment, 3 birds were randomly selected from each treatment, sacrificed by cervical dislocation and about 3cm of the jejunum of each bird was harvested into well-labeled sample bottles, and fixed into 10% formalin solution for Gut morphometry evaluation. The result of the growth response showed a significant difference ($p<0.05$) in feed consumed, and gut morphometry showed a significant ($p<0.05$) difference in all parameters measured. Villi height ranged from (262170 - 403.85µm), cryptal depth (97.09 - 142.01µm) and mucosal thickness (325.23 - 533.17µm) Therefore it can be concluded that including Phytogenic materials at 500g/100kg feed to broiler feed can increase their nutrient absorption in the small intestine.

Key words: broiler, growth response, gut morphometry, phytogenic additives

DESCRIPTION OF PROBLEM

Poultry production is undergoing a continuous challenge to develop management strategies to optimize chickens' efficiency while limiting food safety concerns. Traditionally, antimicrobials have been widely used for improving health and growth performance in poultry; however, the increased public awareness about the risk of developing cross-resistance of pathogens to antibiotics has resulted in the gradual removal of antibiotics for therapeutic and prophylactic uses in food animals (1). The shift away from antibiotic supplementation has resulted in tremendous growth in research focusing on the implementation of effective alternative control methods, management and dietary amendments aiming to improve animal health, welfare, and productivity. A wide range of feed additives including a broad spectrum of essential oils and related compounds from botanical sources to organic acids (1), as well as probiotics and prebiotics (2), chemicals such as aldehydes (3), exogenous enzymes (4) and competitive exclusion products (5) have been used in animal production. Particularly, phytogenic feed additives (PFAs), also popularly referred to as phytobiotics or botanicals, have gained an increasing interest as cost-effective feed additives with proven positive effects on broiler chickens' intestinal health. Indeed, antioxidative, immunomodulatory and growth-promoting effects have also been largely described in the literature.

Euphorbia hirta, is a small herb common to tropical countries and a number of reports have shown that *E. hirta* possesses antibacterial activity (6), *in vitro* antioxidant (7), analgesic, antipyretic, anti-inflammatory properties and anti-depressant for blood pressure (8). Black pepper (*Piper nigrum*) is a flowering vine in the family Piperaceae genus Piper. Piperine is one of compounds of black pepper which has an attaché effect.

Black pepper increases digestion by arousing digestive liquids in the stomach and eradicating infectious bacteria. Clove (*Syzygium aromaticum* (L.) is one of the most ancient and valuable spices of the Orient. It is a member of the family *Myrtaceae*. Tumeric (*Curcuma longa*) has been put to use as a foodstuff, cosmetic, and medicine. It is widely used as a spice in South Asian and Middle Eastern cooking. It lends curry its distinctive yellow colour and flavour. This study was carried out to evaluate the dietary supplementation of pytogenic products (*Euphorbia hirta*, clove, Turmeric and black pepper on the growth response and gut morphometry of broiler chickens.

MATERIALS AND METHODS

The research was carried out at the Poultry research unit of the Federal College of Animal Health and Production Technology, Moor Plantation, Ibadan, Nigeria. *Euphorbia hirta* was sourced from different locations within and outside the campus, air dried until 10% moisture content was obtained and then milled into *Euphorbia hirta leaves meal (EHM).* Dried Clove, Turmeric and black pepper were sourced from a local market in the Ibadan metropolis cleaned and milled into Clove meal (CM), Turmeric meal (TM) and black pepper meal (BPM) respectively A total number of 180 birds were sought from a reputable hatchery in Ibadan. The birds were brooded for seven days after they were randomly distributed into six (6) dietary treatments of 30 birds per treatment which were further divided into 3 replicates of 10 birds per replicate in a completely randomized design (CRD). Birds on treatment one (T1) were fed with basal diet, Treatment two (T2) were fed diet supplemented with feed grade Oxytetracycline at 20g/100kg of feed, while birds on Treatment three (T3), four (T4), five (T5) and six (T6) were fed diets supplemented with EHM, CM, TM and BPM at 500g/100kg of feed respectively. A Known quantity of feed was supplied to the birds and the left over removed and weighed to determine the actual feed consumed on a daily basis. The daily feed consumption was added together for 7 days to obtain the feed consumption per week. The body weights were taken on weekly basis. The difference between mean weights for two successive weeks was taken to obtain the average weight gain of birds per week. The feed conversion ratio was calculated as a ratio of feed consumption and body weight gain. At the end of the experiment, 3 birds per treatment was randomly selected slaughtered by cervical dislocation and well-bled, and about 3cm of the jejunum of each birds was collected into well-labeled sample bottles and fixed into 10% formalin solution for morphometry evaluation.

RESULTS AND DISCUSSION

The results of the growth response of broiler chickens fed diets supplemented with EHM, CM, TM and BPM are presented in Table 1. It was revealed that the dietary supplementation significantly ($p<0.05$) influenced the weight gain, while all other parameters were not significantly ($p>0.05$) influenced. Birds fed diet supplemented with black pepper had the highest value (4140.79g) for the feed consumption, while those on basal diets consumed the lowest (3776.57g). The non-significant differences observed in the performance parameters measured except feed intake indicated that the phytogenic material used had no negative effect on the birds. The non-significant change in the parameters reported in this study is in agreement with (9) who supplemented ginger (*Zingiber officinale*) in the diets of broiler chicken. (10) Also reported that dried medicinal crops have no negative effect on the broiler performance and carcass traits.

The results of the growth response of broiler chickens fed diets supplemented with EHM, CM, TM and BPM is presented in Table 2. The dietary treatments significantly ($p<0.05$) influence the villi length, cryptal height and mucosal thickness. Birds fed with the phytogenic material have similar villi lengths which were significantly higher than what was recorded for those on the control diets and oxytetracycline. A Similar trend was also observed with mucosal thickness.

TABLE 1: Growth Response of Broiler Chicken Fed Diet Supplemented With *Euphorbia Hirta*, Clove, Turmeric, Black pepper.

a,b,c,d- means along the same row with different superscript are significantly different.

PARAMETERS	T1	T2	T3	T4	T5	T6	± SEM
Initial Weight (g/bird)	216.60	215.73	217.50	217.07	216.63	214.50	_
Final Weight (g/bird)	2460.33	2376.67	2490.00	2416.67	2466.67	2410.33	35.47
Weight Gain (g/bird)	2244.00	2161.00	2272.67	2200.00	2250.00	2195.66	35.82
Feed Intake (g/bird)	3776.57^{b}	3977.27^{ab}	3990.17^{ab}	3992.63^{ab}	3945.67^{ab}	4140.79^{a}	39.31
FCR (%)	1.68	1.85	1.76	1.81	1.75	1.93	0.045
Mortality(%)	3.33	0.00	0.00	0.00	0.00	3.33	0.76

FCR: Feed Conversion Ratio

The present study showed jejunal villus length increased in birds fed with herbal products compared with control. The other parameters were also significantly different. The increase in villus height and villus surface area are capable of greater absorption of available nutrients (11) The increased villus length in the small intestine could be associated with a higher absorptive intestinal surface (12) which facilitates nutrient absorption and hence, has a direct impact on growth performance also due to the enhanced absorptive area and the increased activity cryptal depth recorded which is an indication of a higher mucosal proliferation activity and greater intestinal glandular activity.

Table 2: Growth Response of Broiler Chicken Fed Diet Supplemented With *Euphorbia Hirta*, Clove, Turmeric, Black pepper.

Parameter (µm)	T1	T2	T3	T4	T5	T6	±SEM
Villi Length	262.70^{b}	330.83^{b}	351.85^{a}	403.85^{a}	368.97^{a}	355.40^{a}	10.67
Cryptal Depth	142.01^{a}	102.77^{b}	97.09^{b}	149.81^{a}	106.24^{b}	115.14^{b}	9.41
Mucosal thickness	325.23^{b}	447.97^{b}	493.64^{a}	528.95^{a}	505.18^{a}	533.17^{a}	14.03

^{abc} means on the same row with different superscripts are significant differently ($P<0.05$)

CONCLUSION AND APPLICATIONS

1. *Euphobia hirta*, clove, Turmeric and Black pepper meals as phytobiotics improved the performance of broiler chicken and also resulted in comparable performance with the control.
2. The gut morphometry revealed that supplementing broiler chickens diets with *Euphobia hirta*, clove, Turmeric and Black pepper meals shows improvement in the jejuna villi length, cryptal dept and mucosal thickness.
3. Farmers can include *Euphobia hirta*, clove, Turmeric and Black pepper meals as phytobiotics supplements in the diets of their broilers diets for improved performance and gut morphometry.

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Monogastric Animal Production: MGP 077

ZOOTECHNICAL PERFORMANCE AND COST-BENEFIT ANALYSIS OF PIGS FED REJECTED CASHEW KERNEL MEAL

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ABSTRACT

Growth response and cost-benefit analysis of pigs (large white x landrace, n=40, average initial weight = 8.67±0.3kg) fed rejected cashew kernel meal (RCKM) were examined from the weaner to the growing phase. They were randomly allotted to four groups designated as diet 1, 2, 3, and 4 containing 0%, 5%, 10% and 15% rejected cashew kernel meal respectively in a completely randomized design for eighty-four days. Feed intake differs significantly ($P<0.05$) across the groups. Pigs that were offered 5% rejected cashew kernel meal had the highest feed intake, with a decreasing trend across those who were given rejected cashew kernel meal. All the data for the cost-benefit analysis were significant across the groups ($P<0.05$). From the outcome of this investigation, it can therefore be concluded that dietary inclusion of RCKM up to 15% reduced the feed cost, increased profit, and did not trigger any deleterious effects in pigs in terms of growth performance, thus RCKM was well tolerated by the pigs without adverse physiological effects, supported optimal growth, health, and wellbeing of pigs from weaner to grower phase.

Keywords: pig, monogastric, feedstuff, cashew

DESCRIPTION OF PROBLEM

Conventional feed ingredients have been reported to be facing supply constraints and fluctuating prices, thus, resulting to the exploration of alternative feedstuffs has become imperative (1). Due to the requirement for sustainable and economical livestock production, the effective use of novel feed resources in modern animal production systems is receiving a lot of attention (2). Cashew (*Anacardium occidentale L.*) processing generates substantial by-products, among which rejected cashew kernel is noteworthy. Although the cashew nut itself is widely recognized for its nutritional value, the kernels that do not meet market quality standards, often referred to as rejected cashew kernel meal, have been underutilized (3).
Feed resource efficiency may be significantly increased by including rejected cashew kernel in animal diets, especially for growing pigs (4). Fortified with essential minerals, dietary fiber, energy, and proteins, rejected cashew kernel meal shows promise as a whole or partial replacement for traditional feedstuffs in animal diet formulation, thus, reducing feed expenses (5).

Comprehensive research is necessary before using rejected cashew kernel meal in pig diets, even if it seems promising. It is necessary to evaluate its effects on growth performance, organ development, and other vital organs in order to determine its appropriateness as a feed resource. Therefore, by assessing the growth response and the economic efficiency in pigs, this study explores the potential of rejected cashew kernel meal as an unconventional feed resource for pig nutrition. The goal is to provide scientific insights that can guide effective and efficient strategies for maximizing the utilization of rejected cashew kernel meal while ensuring animal health and well-being.

MATERIALS AND METHODS

Experimental site: The experiment was carried out at Ladoke Akintola University of Technology Teaching and Research Farm's piggery unit, Ogbomoso, Oyo State, Nigeria.

Preparation of test ingredients: The rejected cashew kernel was bought from a local cashew processing firm in Ilorin, Kwara State, Nigeria. Extraneous materials were removed from the cashew reject kernel before being milled and added to other feed ingredients for complete ration formulation.

Management of experimental animals: Forty 8-week-old weaner pigs (Large white x Landrace) were dewormed, vaccinated, and acclimatized for one week prior to the start of the experiment. The pigs were distributed into four groups with ten replicates each in a completely randomized design with each pig as a replicate. The pigs were offered feed and fresh water *ad libitum* throughout the feeding trial. The experiment lasted for 84 days.

Experimental diets: Four diets were constituted to contain 0%, 5%, 10%, and 15% reject cashew kernel meal designated as diet 1, 2, 3, and 4 respectively. The metabolizable energy of the diets ranges from 2732.14 to 2902.44 kcal/kg while the diets were isonitrogenous with 19% crude protein (Table 1).

Table 1. Composition of the experimental diet

Ingredients (%)	Diet 1	Diet 2	Diet 3	Diet 4
Maize	21.00	18.00	12.00	2.00
Soya bean meal	1.00	4.00	7.50	10.00
Groundnut cake	15.00	10.00	5.00	0.00
RCKM	0.00	5.00	10.00	15.00
Corn bran	11.50	11.50	14.00	21.00
*Fixed ingredients	51.50	51.50	51.50	51.50
Total	100.00	100.00	100.00	100.00
Calculated Nutrients				
M. Energy (kcal/kg)	2732.14	2829.21	2891.76	2902.44
Crude Protein	19.58	19.54	19.69	19.72
Ether Extract	5.09	6.17	8.42	10.02
Crude Fibre	8.26	8.64	8.22	8.59

*Fixed ingredients = Palm kernel cake-50.00%, limestone-1.00%, premix-0.25% and salt-0.25%, M:Metabolizable

Data collection: Data on the initial, final weight, total and average daily weight gain, feed offered, and average daily feed intake were collected while the feed conversion ratio of the pigs was computed according to (6). The economic indices; feed cost, feed cost/kg weight gain (/kgWG), income/kgWG, profit/kgWG, and economic efficiency of growth were calculated by adopting the methods described by (6).

Experimental design and statistics: Data collected were subjected to a one-way ANOVA using SAS (2003) (7). Significant means were separated by Duncan`s multiple-range test of the same statistical package.

RESULTS AND DISCUSSION

Table 2 shows the growth response of pigs fed diets containing rejected cashew kernel meal (RCKM). The final and average feed intake parameters varied considerably ($P<0.05$), while feed:gain ratio, final weight, and total weight change were unaffected ($P>0.05$). The pigs fed diet 2 had the highest values, followed by those fed diet 3, diet 1, and diet 4 respectively ($P<0.05$).

This study revealed noteworthy implications for the growth performance of growing pigs when rejected cashew kernel meal was introduced into their diets. Notably, the weight gain (ADG) and feed:gain (FCR), do not vary significantly unlike the feed intake in response to the dietary treatments. This was consistent with the findings of (8) who reported that feeding cashew nut meal to weaner pigs had no significant effect on ADG and FCR. However, (4) reported a reduction in feed intake in response to the increasing dietary inclusion of cashew nut meal in weaner pigs, while (8) reported similar feed intake in pigs fed cashew kernel meal-based diets and those fed the control diet. It is worthy of note that the elevated feed intake recorded in

pigs given the diet containing 5% rejected cashew kernel meal (RCKM) may be due to the level of ether extract in RCKM (3). Consequently, the 5% inclusion of RCKM in pig's diet resulted in a moderate level of lipids in the diet which can improve palatability thereby, increasing feed consumption (9). However, high dietary inclusion levels of lipids can result in depressed feed intake (10) as seen in pigs fed with diets containing 10 and 15% RCKM respectively.

Table 2. Growth performance of pigs fed rejected cashew kernel meal (RCKM)

Parameters (kg/pig)	Diet 1	Diet 2	Diet 3	Diet 4	SEM	P-Value
Initial weight	8.76	8.60	8.68	8.64	0.33	0.99
Final weight	42.84	46.80	46.20	43.06	1.41	0.69
Total weight gain	34.08	38.20	37.52	34.42	1.14	0.49
Average daily weight gain (/d)	0.41	0.46	0.45	0.41	0.01	0.46
Total feed intake	106.59^{c}	121.98^{a}	114.12^{b}	101.59^{d}	1.77	0.00
Average daily feed intake (/d)	1.27^{c}	1.45^{a}	1.36^{b}	1.21^{d}	0.02	0.00
Feed:gain ratio	3.26	3.21	3.05	3.01	0.10	0.81

$^{a\ b\ c\ d}$Means within rows for different groups with different superscripts differ ($P < 0.05$); kg – kilogram; SEM: standard error of means

The economic indices of pigs fed rejected cashew kernel meal (RCKM) are shown in Table 3. All of the parameters were affected ($P<0.05$). There was a linear reduction in the feed cost and feed cost/kg weight gain as the level of RCKM inclusion increased. Additionally, pigs fed diet 1 had the highest income/kg weight, whereas pigs fed diet 2 had the lowest income/kg weight. The profit/kg weight gain and (economic efficiency of gain) EEG increased as the inclusion level.

Table 3. Economic indices of pigs fed rejected cashew kernel meal (RCKM)

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	SEM	P-Value
Feed cost (kg)	74.28^{a}	69.19^{b}	64.34^{c}	57.85^{d}	1.55	0.00
Feed cost/kg weight gain	240.80^{a}	221.83^{ab}	196.24^{bc}	173.65^{c}	8.46	0.04
Income/kg weight gain	755.53^{a}	734.49^{b}	738.77^{ab}	749.62^{ab}	3.51	0.01
Profit/kg weight gain	514.52^{b}	512.66^{b}	542.52^{ab}	575.96^{a}	9.02	0.03
EEG	223.37^{b}	232.36^{b}	277.31^{ab}	339.34^{a}	14.24	0.01

$^{a\ b\ c\ d}$Means within rows for different groups with different superscripts differ ($P < 0.05$); SEM: Standard error of means ; ;Kg: Kilogram

From the result of this study, dietary inclusion of RCKM resulted in a reduction in feed cost. Consequently, this also resulted in reduction in cost per body gain. These findings coincide with those of (11) and (12) that the inclusion of alternative feed resources in pig ration significantly reduces feeding cost in the cost of production, thereby resulting in high financial returns. Moreover, the initial reduction in income and profit observed in diet 2, and the subsequent increase in these parameters gave credence to the results of (3) who observed a similar trend in income per kilogram weight gain and profit per kilogram weight gain of weaned pigs fed with cashew kernel reject meal. Furthermore, the economic efficiency of gain also increased significantly as the level of RCKM increased in the diet, indicating that dietary inclusion of RCKM in swine ration resulted in improved economic efficiency in line with the finding of (13) who reported improve production efficiency in laying chickens. The use of alternative feedstuffs with reduced cost and economic gain has been reported (14).

CONCLUSION

In conclusion, RCKM can be included in pigs' diets up to 15% without any deleterious effect on growth performance. Also including RCKM in pigs' diets up to 15% resulted in the improved economic efficiency of production.

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Monogastric Animal Production: MGP 078

EVALUATION OF EUBIOTIC COMBINATION AS AN ALTERNATIVE FOR ANTIBIOTIC GROWTH PROMOTERS IN BROILER CHICKENS DIET

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ABSTRACT

A feeding trial was conducted to evaluate the response of broiler chickens fed diets containing eubiotic combinations as an alternative to antibiotic growth promoters (AGPs). A total of 510-day old Ross broiler chicks were allotted randomly to five dietary treatments each replicated thrice, with 34 chicks per replicate. The diet consisted of 0g of control diet, 9g Bacillus subtilis (BS) + 100g Essential oil (Eos), (9gBS+100gEos), 100g Essential oil (Eos)+ 400g Organic acids (OA)(100g Eos+400g OA), 9g Bacillus subtilis(BS)+ 400g Organic acids(OA) (9g BS+400g OA) for T1-T4 respectively while T5 had Oxytetracycline an Antibiotic growth promoter(AGP). Parameters collected were on growth performance, blood mineral composition, tibia bone quality and carcass quality. All data were subjected to analysis of variance and significant differences among treatment means were compared using the Tukey test of significance. Performance results showed that birds fed combination of (9gBS+100gEos) had significantly ($P < 0.05$) higher final weight, weight gain, better feed conversion and least cost of production which were at par with birds fed (9g BS+400g OA).. Result for bone quality showed that birds fed levels of Eubiotic combination had significantly higher tibia bone ash than birds on control and AGPs. Results for carcass showed that birds fed combination of 9gBS+100gEoswere significantly ($P < 0.05$) higher in terms of live weight, dressed weight and dressing percentage which were at par with birds fed combination of 9g BS+400g OA. eubiotic combinations increased, bone strength, and absorption of blood minerals from the GIT. It is concluded that combined levels of 9gBS+100gEosand 9g BS+400g OAsignificantly improved the performance of birds. Eubiotic combinations can therefore be potential Alternative to antibiotics in broiler chicken diet.

Key words*:* Bacillus subtilis,Essential oil, Organic acids, Performance, broiler chickens

DESCRIPTION OF PROBLEMS

Healthy balance of micro-flora in the gastrointestinal tract is closely related with performance in broilers. This is of greatest interest among broiler producers because of its impact on economic profitability. The Increase in bacterial resistance to antibiotics in both humans and livestock has caused an increase in public and governmental interest in eliminating sub-therapeutic use of antibiotics in livestock as it raises concerns for food safety, environmental conservation and producing safer human foods from animal sources more efficiently and at lower cost. This has given impetus to continued search for new feed additives that would positively modulate the gut microbiota, increase rate of growth and reduce cost of production. (1;2). The alternatives to antibiotics being currently promoted are Eubiotics. 'Eubiosis' as used in the feed industry refers to a healthy balance of the microbiota in the gastrointestinal tract. The use of a single eubiotic product as an alternative to antibiotic growth promoters has been in practice, and studies has demonstrated its beneficial effects on improvement of growth performance (3;4). However, recent research and development of eubiotics combination products have been increasingly focused on.A way of potentiating the efficacy of a single eubiotic preparations may be in its combination in a synergestic approach. This is of greatest interest among broiler producers because of its impact on economic profitability (5**)** There is need for more information regarding the use of combined eubiotics and the possible mechanisms of actions in broiler

chickens. This study was therefore aimed at evaluating the effect of eubiotic combinations in the diet of broiler chickens on growth performance and carcass quality

MATERIALS AND METHODS

Experimental site
The experiment was conducted at the Poultry Unit of Animal Science Departmental Teaching and Research farm, Ahmadu Bello University, Zaria, Kaduna State, Nigeria. Zaria is located in the Northern Guinea Savannah Ecological zone on longitude 11˚09' 01.78'N and latitude 7˚39' 14.79' E, 671m above sea level. The climate is characterized by a well-defined dry and wet seasons and relatively dry with annual rainfall ranging from 700-1400mm.

Experimental Design and management of birds
Five hundred and ten (510) day-old Ross broiler chicks were allocated to five (5) dietary treatments, each replicated three times with 34 chicks per replicate each in a completely randomized design (CRD). The birds were housed in deep litter pens and managed with all necessary routine management practices and routine vaccination

Experimental diets
Five diets were formulated for the feeding trial to meet standard requirements of broiler chickens.Eubiotic combination were added as non-inclusive part of the diets.
Five diets were formulated as shown below.
Diet 1: 0 g of Eubiotic combination (Control)
Diet 2: Combination of *Bacillus subtilis* (9g) *and* Essential oils (100g)/100 Kg diet
Diet 3: Combination of Essential oils (100g) and Organic acid (400g)/100 Kg diet
Diet 4: Combination of *Bacillus subtilis* (9g) and Organic (400g) /100 Kg diet
Diet 5: Oxytetracycline at 60g/100Kg diet (as recommended by manufacturer).

Data Collection
Growth Study
Initial and final weights of birds were taken at the beginning and at the end of both starter and finisher phases. Feed intake was measured weekly while, weight gain feed/gain ratio and cost per Kg gain were computed for both phases. Mortality was recorded as they occur
Carcass evaluation;At the end of the finisher phase, 1 chicken per replicate that is 3 chickens were randomly selected from each treatment for carcass evaluation. The selected birds were fasted of feed for 12 hours, bled by severing the jugular vein and then scalding in hot water to remove the feathers. Live weight for each chicken was taken before slaughter. Dressing percentage was calculated and the weight of organs and the standard cut parts were taken. The organs were expressed as a percent of live weight while, the cut parts were expressed as percentage of dressed weight
Statistical Analysis: All data obtained from the three experiments were each statistically analysed using the General Linear Model Procedure of Statistical Analysis Systems and Significant difference between treatment means were separated using tukey test (6).

RESULTS AND DISCUSSION

Table1 showed the growth performance characteristics of broiler chickens fed Eubiotic combinations as natural growth promoters. There were significant ($P < 0.05$) differences in final weight, feed consumption, feed conversion ratio feed cost/gain (₦/Kg gain) and mortality. Birds fed combinations 9g BS+100g EOs had significantly ($P< 0.05$) high final weight, weight gain, better feed conversion and least cost of production which were at par with birds fed combinations of 9g BS + 400g of OA. The least performance was observed for birds fed combinations of 100g EOs+ 400g OA which were at par with birds fed AGP (Oxyteracycline) Based diet Feed consumption was significantly ($P<0.05$) higher for the control, combination of 9g BS+ 100g EOs and combinations of 9g BS+ 400g OA.

Table 1: Effect of Eubiotic combination on the performance of broiler chickens

Parameter	Control	9gBS+ 100gEos	100gEos+ 400g OA	9gBS+ 400gOA	oxytet	SEM
Initial weight (g/b)	1062.63	1107.10	939.80	1092.13	940.27	33.91
Final weight (g/b)	2205.17^{ab}	2299.37^{a}	2039.10^{b}	2288.67^{a}	2097.13^{b}	68.81
Weight gain (g/b)	1142.53	1192.27	1099.30	1196.53	1156.87	54.89
Feed intake (g/b)	1942.30^{a}	1883.79^{ab}	1820.33^{ab}	1914.45^{ab}	1945.33^{ab}	36.19
FCR	1.70^{b}	1.58^{a}	1.66^{ab}	1.60^{a}	1.68^{ab}	0.06
Feed cost (₦/Kg)	143.00^{a}	145.20^{b}	147.90^{c}	146.40^{d}	152.50^{e}	0.00
Feed cost/gain (₦/Kg gain)	241.67^{ab}	229.42^{ab}	236.64^{a}	234.24^{ab}	283.36^{b}	8.62
Mortality (%)	1.98^{b}	0.98^{a}	3.11^{b}	1.94^{ab}	2.11^{b}	1.87

a,b,,: Means with different superscripts on the same row are significantly different (P<0.05); FCR: Feed Conversion Ratio BS: *Bacillus Subtilis* EO:Essential oil, OA;Organic acid Oxytet; oxytetracycline (AGP)SEM: Standard error of mean.

The results show that combinations of 9g BS+ 100g EOs and 9g BS+400g OApromoted a significantly (P< 0.05) better body weight gain and FCR and decreased cost of production. The least performance observed for birds fed combinations of 100g EO +400gOAmay indicate that there was no synergetic effect between the two products.Growth performance was less compared to the other treatments.Results of research on application of eubiotics and its combination in nutrition of broiler chickens are not completely consistent. Some authors stated significant positive effects on broiler performance (7;8) whereas others established no influence on gain, consumption or conversion of feed (9). The assumption is that differences in results are consequences of numerous factors including type and part of plant parts used and their physical properties, preparation, method of photogenic additive and compatibility with other dietary components, health and environmental conditions of the chickens.

Carcass Characteristics of broiler chickens: The result showed that Birds fed combinations of 9g BS +100g EO were significantly (P< 0.05) higher in terms of dressed weight and dressing percentage which were at par with birds fed combination of 9g BS + 400g OA. Result for cut parts showed that breast and back cuts were also significantly (P< 0.05) higher for birds fed combination of 9g BS +100g EOs and which were also at par with birds fed combination of 9g BS+ 400g OA .The result for organ weight showed that liver and lung weight were significantly (P < 0.05) higher for birds fed combination of 100gEos + 400g OA.

The better carcass yield observed for birds fed combination of 9g BS+ 100g EOs as well as birds 9g BS+ and 400g OA could be attributed to the synergistic effect between the combined additives in which both additives improved the proliferation of beneficial bacterial, thereby leading to better nutrient absorption, favoring deposition in the muscle tissue, and resulting to higher weight of the birds in the group compared with other treatment and control as observed in the growth performance result. The use of phytogenics additives as an alternative to AGP has the ability to improve weight gain as well as carcass yield of broilers have been reported (10). However, (11), did not find differences in the carcass yield of broilers fed plant extracts and combinations of plant extracts.

CONCLUSION AND APPLICATION

Combinations of *Bacillus subtilis* + Essential oil and *Bacillus subtilis* + Organic acids significantly improved the performance of broiler chickens above the control, essential oils+organic acids and the AGP and also lowered cost of production, Combined levels of *Bacillus Bacillus subtilis* + Essential oil and *Bacillus subtilis* + Organic acids gave better carcass yield, Combined levels of *Bacillus subtilis* + Essential oil and *Bacillus subtilis* + Organic acids can potentially replace antibiotic growth promoters-AGP.

Table 2 Carcass characteristics of Broiler chickens fed Eubiotic combination

Parameter	Control	9g BS + 100g EOs	100gEOs+ 400gOA	9g BS + 400g OA	Oxytet	SEM
Live wt. (g/bird)	2133.30^{b}	2285.00^{a}	2000.00^{c}	2200.00^{ab}	2030.00^{b}	37.57
Dressed wt.(g/bird)	1608.67^{ab}	1716.67^{a}	14890.33^{c}	1701.33^{a}	1518.00^{b}	48.10
Dressing percent	67.96^{b}	72.81^{a}	64.39^{c}	71.48^{a}	67.76^{b}	2.16
Thigh %	15.70	17.47	15.04	16.36	16.30	0.40
Drum stick %	13.42	14.14	12.79	14.12	14.02	1.08
Breast %	28.36^{b}	32.61^{a}	27.13^{b}	31.10^{ab}	29.20^{b}	0.68
Back %	21.24^{b}	23.55^{a}	19.99^{c}	22.37^{a}	20.13^{b}	0.57
Liver %	2.17^{b}	2.00^{b}	2.80^{a}	1.92^{b}	2.51^{ab}	0.13
Lungs %	0.37^{ab}	0.30^{b}	0.51^{a}	0.27^{b}	0.41^{ab}	0.03
Kidney %	0.67	0.63	0.65	0.66	0.69	0.04

a,b,c, Means with different superscripts on the same row are significantly different (P<0.05); BS=*Bacillus subtilis Eos*= Essential oils, OA=Organic acids, Oxytet=oxytetracycline; SEM= Standard error of mean

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PERFORMANCE AND COST EFFECTIVENESS OF BROILER CHICKS FED SOYA BEAN CURDS RESIDUES AS PARTIAL REPLACEMENT FOR FULL-FAT SOYA BEAN.

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ABSTRACT

An experiment was conducted at the Poultry Unit of Teaching and Research Animal Farm, Federal University of Kashere to determine performance and economics of production of starter broiler chicks fed graded levels of soya bean curds residues. Diets were formulated in which soya bean curd residues replaced toasted soya bean at 0 (control), 20, and 40% level of inclusion tagged as diets 1, 2 and 3 respectively. 96-day old chicks (COBB 500 Strains) were allotted to the three experimental diets of 32 birds per treatment in a completely randomized design (CRD) that were replicated four times and the experiment lasted for 28 days. Results of final weight (502.50-570.63g), daily weight gain (21.33-25.13g), and feed conversion ratio (1.81-2.12) showed significant ($p<0.05$) difference with diet 1 having the highest values (570.63g, 25.13g and 1.81) then followed by diet 2 (530.00g, 22.34g and 1.97) respectively. The economics of production of broiler chicks fed graded levels of soya bean curds residues showed diets 3 to had the lowest feed cost ₦/kg gain of ₦589.53 while the highest value of ₦595.18 was diets 2, then followed by diet 1 (control) #593.53. It can be concluded that soya bean curds residues can be included to 20% levels without adverse effect on performance of the birds.

Key Words: Broiler chicken, Soya Bean Curd Resides, Toasted Soya Bean, Broiler Chicks

DESCRIPTION OF THE PROBLEM

The level of animal protein consumption in most developing countries of the world including Nigeria is very low (1). This low intake can be linked to high cost of the products arising mainly from shortages and high cost of production inputs, especially feedstuff (2). Despite the obvious contribution of the livestock industry, it's plagued with some challenges like inadequate nutrition, and competition with man which has impeded its development (3). Growing population, urbanization and economic growth in developing countries contribute to growing demand for livestock and also contribute a lot to the competition for feed ingredients (3).

The utilization of by-products from food industry has become widespread (4) and considerable quantities of these residues and agro-industrial by-products suitable for feeding livestock are being generated yearly in most developing countries; however, because of inadequate technical-know-how they are lost or underutilized by farmers (5). To meet the increasing demand for animal protein, emphasis need to be given to non-conventional sources of feed that can easily be managed as against the conventional sources required by humans and industries (5). Soya bean curds residue is a relatively inexpensive source of plant protein that is widely recognized for its high nutritional and excellent functional properties (6). This study was designed to evaluate the growth performance and the economics of production of starter broiler chicks fed graded levels of soya bean curd residues.

MATERIALS AND METHODS

This study was conducted at the Teaching and Research farm of Department of Animal Science, Federal University of Kashere. The Birds were fed commercial broilers starter (vital) for one week before transferring to the experimental diets. The birds were randomly allotted to three experimental diets of 32

birds per treatment that were replicated four times in a completely randomized design (CRD). Then clean water and experimental diets were provided *ad-libitum* throughout the experimental period of 28-days. Routine management such as vaccination and medications were followed strictly. The soya bean curd residue were obtained from local women who prepare and sell it as local cheese (awara) in Gombe metropolis, Gombe State, Nigeria. The soya bean curds residues were boiled for 30 minutes in a large metallic pot and then sun dried for two days. Three Experimental diets for starter phase (23%CP) were formulated in which soya bean curd residue replaced soya beans at 0(control), 20 and 40% coded as diets 1, 2, 3, respectively. Data on feed consumption, weight changes and feed conversion ratio were recorded. Daily Feed intake was determined by subtracting the left over every morning from the quantity offered previous day. Birds were weighed at the beginning of the experiment and weekly thereafter and weight changes were recorded. All data generated were subjected to Analysis of variance (ANOVA) using SAS (version 9.2) soft-ware package. Differences between treatments were separated using least significant difference (LSD) (7).

Table 1. Percentage composition of graded levels of soya bean curd residues fed to broiler chickens at the starter phase (1-4 weeks)

Ingredients	Diet 1 (Control)	Diets 2 (20%)	Diets 3 (40%)
Maize	43.14	43.14	43.14
Soya bean (Ful-fat)	39.16	31.33	23.50
Soya bean curd residues	0.00	7.83	15.66
Wheat offal	10.00	10.00	10.00
Fish meal	4.00	4.00	4.00
Bone meal	3.00	3.00	3.00
+Premix	0.25	0.25	0.25
Salt	0.25	0.25	0.25
Methionine	0.10	0.10	0.10
Lysine	0.10	0.10	0.10
Total	100.00	100.00	100.00
Calculated Analysis			
Crude Protein (%)	23.00	22.34	22.00
ME (kcal/kg)	2923.00	2899.00	2870.00
Ca (%)	2.36	2.18	2.00
P (%)	1.22	1.00	1.00

+A bio-organics nutrient supplement containing Vit. A; 4000000 i.u,Vit. D3; 800000 i.u, Vit. E; 9200mg; Niacin 11000mg; Vit. B2 2000mg; Vit. B6, 1200mg; Vit. B12 6mg; Vit. K3 800mg; Pantothenic acid 3000mg; Biotin 24mg; Folic acid 300mg; Choline Chloride 120000mg; Cobalt 80mg; Copper 1200mg; Iodine 400mg; Iron 8000mg; Manganese 16000mg; Selenium 80mg; Zinc 12000mg; Anti-oxidant 500mg.

RESULTS AND DISCUSSION

The results of daily feed intake are presented in Table 2. There was no significance ($P>0.05$) on daily feed intake among the birds, the highest feed intake (45.40g/bird/day) was obtained in broiler chicks fed with diet 1 (control), while the lowest daily feed intake was found on diet 2 (43.95g/bird/day) This agrees with the findings of (8) who reported that, the average daily feed intake of broilers fed graded levels of awara residue meal were significant ($P<0.001$). This observation also agreed with the result obtained by (9) who reported variation in the average daily feed intake in broilers fed urea treated rice offal soya beans based diet. Daily feed intake obtained from this research is slightly below the one reported by (10) which is 52.14g/day.

The results of growth performance are presented in Table 2. The result showed that daily weight gain was significantly ($P<0.05$) different across the treatments. The best daily weight gain attained was recorded in treatment 1 (25.13g/bird/day) followed by treatment 2 of (22.34). Furthermore, the daily weight gain obtained in treatment 3 (35.73g/bird/day) in this research is in agreement with the work of (11) who reported

a similar weight gain of (35.73g/bird/day) for broilers fed two sources of protein (soya bean meal and GNC). This also agrees with the work of (12) who reported a similar final weight gain of (1520.00g/bird/day) for broilers fed full fat soya bean based diet. However, the result obtained from daily weight-gain is below from the 35g recommended by (10), which may be attributed to stress.

Table 2: Growth performance of broiler chickens fed graded levels of soya bean curd residues at the starter phase (1-4 weeks)

	Diets			
Parameters	**1 (Control)**	**2(20%)**	**3(40%)**	**±**
Initial Weight (g)	193.75	195.00	182.50	3.45
Daily Feed Intake (g)	45.40	43.95	44.91	0.41
Daily Weight Gain (g)	25.13[a]	22.34[b]	21.33[b]	0.64
Feed Conversion Ratio	1.81[a]	1.97[ab]	2.12[b]	0.05
Final weight (g)	570.63[a]	530.00[b]	502.50[b]	9.56
Mortality (Number)	0.00	0.00	0.00	0.00

[a-b] Means within the same row with different superscripts are significantly different (P < 0.05)

The results of Feed Conversion Ratio (FCR) is presented in Table 2. FCR ratio was significant at different levels of inclusion of soya bean curd residue among the treatment. The best value was obtained from treatment 1 (1.81) while the lowest value was obtained from treatment 3(2.12). The values of FCR ranges from (2.26) in treatment 2 to (2.71) in treatment 3 and this conforms to the value of FCR of 2.94 obtained by (11). Furthermore; the FCR from this research is within the range with the feed conversion ratio value 0f (1.74) reported by (10). The result showed that there was no mortality, among the different treatments groups.

Table 3. Economics of production of broiler chickens fed graded levels of soya bean curd residues at the starter phase (1-4 weeks)

	Diets		
Parameters	**1 (Control)**	**2(20%)**	**3(40%)**
Total Feed Intake (kg)	0.68	0.66	0.67
Feed Cost (₦/kg)	331.67	306.61	281.56
Total Feed Cost (₦)	225.54	202.36	188.65
Total Weight Gain (kg)	0.38	0.34	0.32
Feed cost ₦/kg Gain	593.53	595.18	589.53

[a-b] Means within the same row with different superscripts are significantly different (P < 0.05)

The economics of production is presented in Table 3. The reduction in cost of feed/kg (₦) may be attributed to the lower cost of soya bean curd residue in the market especially when compared to the cost of soya bean which is costly due to high competition. Diet 1 (control) had the highest value while Diet 3 also had the lowest (best) value. The results obtained disagreed with the result of (8) who reported that the cost per diet in ₦/kg increases across the treatment as the level of inclusion of awara residue was increased. The implication here is that, there is significant reduction in cost of production of broiler chicken at starter phase when soya bean curd residues is used up to 40% especially when the cost of treatment 2 is compare with treatments 1 and 3.

CONCLUSION AND APPLICATION

From the results obtained in this study it can be concluded that soya bean curd residue can replace 20% part of soya beans without adverse effect on broiler chicken performance and concomitant reduction in feed cost and or cost of production. Further research should be conducted on the possibility of inclusion level of soya bean curd residue in the diets of various classes of poultry to enhance its utilization as a feed resources or ingredients.

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EVALUATION OF RELATIVE PRIMAL CUT WEIGHTS OF BROILER CHICKENS ON VARYING DOSAGES OF WATER LEAF (*Talinum triangulare*) AQUEOUS EXTRACT

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ABSTRACT

A total of one hundred and twenty (120) day old Anak 2000 broiler chicks were used to evaluate the relative primal cut weights of broiler chicken on varying dosages of water leaf (*Talinum triangulare*) aqueous extract (TTLE). Twenty birds were randomly selected based on their average initial weight. Each treatment group contained a total of twenty (20) birds which were divided into four (4) replicate groups of five (5) birds each. Treatment (T1-T6) are as follows: T_1 is the negative control (ordinary water), T_2 (positive control with the inclusion of Multivitamin), T_3 to T_6 (were supplied water leaf aquaeous extract at 30, 60, 90 and 120mls^{-}L) respectively, in completely randomized design.. Result showed that live weight, bled weight, plucked weight, eviscerated weight and dressing percentages were significantly highest in broiler chickens on 90mls of TTLE. Breast muscle showed significant variation ($p<0.05$) with highest value in control compared to those on 90mls of TTLE. Other primal cut assayed in this study showed similarity ($p>0.05$) among birds on the various oral treatment. It is therefore concluded that *Talinum triangulare* leaf extract (TTLE) can successfully be included orally in broiler chickens diet up to 90mls without any deleterious effect on the carcass weights.

Key words: Broiler chickens, Primal cuts, *Talinum triangulare*, Aqueous extract

INTRODUCTION

Feeding livestocks with diets composed of quality feed ingredients that are readily avalable, cheap and easily assessable is one of the ways to enhance the productivity of poultry birds. However, in this present day Nigeria, the high cost of poultry feed and conventional feed ingredients have greatly hampered the profitability in poultry production compared to other livestock species. The feed account for about 75% of the cost of production (Atteh, 2002), and 80% of the total cost of producing finished feed is the cost of raw materials (Longe, 2006). The use of these local, cheap and easily available feed ingredients, especially those that are not directly used by humans, has been given a special attention as the only viable alternative to the use of conventional feed ingredients (Akande *et al.,* 2007). High feed costs and shortage of necessary raw materials forced poultry farmers to search for alternative feed ingredients with lower costs with high phyto-biotic potential that could partially or wholly supplement these expensive conventional sources of protein and energy in broiler production. In Nigeria and many other countries, it has been established that green leafy vegetables are inexpensive, surpluses and readily available sources of protein due to its ability to synthesize amino acids from a wide range of available primary raw materials (Fasuyi, 2006). It also contains vitamins; as pro-vitamin A (Mbaegbu, 2012). Waterleaf (*Talinum triangulare*) is an herbaceous annual and perennial plant which exists in -wide range agro-ecological zones. The crude waterleaf protein content is favorable compared to the cowpea, peanut; millet and cashew nut content (Ofusor et al., 2008). Waterleaf (*Talinum triangulare*) is a rich source of vitamin C, vitamin E, Omega-3 fatty acids, calcium, magnesium, soluble fibers (pectin), potassium, β-carotene, proteins and dietary fiber (Ezekwe *et al.*, 2001). Diets with vitamins C and E, ingredients containing zinc and selenium can help protect animals from the damage of internal organs caused by free radicals. Ekine *et al.,* (2020) reported their success stories on the use of water leaf aqueous extract on the performance of broiler chickens. Olorunisola *et al.,* (2016) also reported that

methanolic extract of waterleaf has positive impact on the haematological parameters of winstar rats. This study is therefore geared towards the evaluation of primal-cuts of broiler chickens on varying dosages of water leaf (*Talinum triangulare*) aqueous extract.

MATERIALS -AND METHODS

Location, Sample collection and preparation

The experiment was carried out at the Poultry Unit of the Livestock Section, Teaching and Research Farm, Edo State College of Agriculture and Natural Resources, Iguoriakhi, Benin City for a period of eight (8) weeks.

Sourcing and processing of Water leaf

Fresh water leaf leaves - were collected in the Teaching and Research Farm environment as well as various farm sites in Iguoriakhi. The leaves were air dried for about 30mins after which two kilogram (2kg) of freshly cut *Talinum triangulare* leaves were separated from the stem, washed with clean water to remove contaminants like dust, dung, dirt and sand. It was then be drained, chopped, blended and sieved. The aqueous extract was then - filtered and collected in a clean container and then measured, quantity of filtrate was- taken subsequently in accordance with the experiment.

Management of experimental birds

A total of one hundred and twenty (120) day old Anak 2000 broiler chicks were purchased from a reputable hatchery in Ogun State, Nigeria. The birds were brooded for two weeks and thereafter 120 of them were randomly selected based on their average initial weight to each of the six water treatments (T_1-T_6). Each treatment group contained twenty (20) birds and replicated into four (4) to give five (5) birds per replicate. The birds were housed in a deep litter management system with wood shavings as litter materials. Prior to the arrival of the birds, the house was cleaned, washed and disinfected with Lysol. The brooder house was thereafter allowed to dry for a period of one week and was covered with black ploythene bag. Litter materials and wood shavings were spread evenly on the floor in the deep litter pen. Drinker and feeder of plastics materials were placed in the brooding house. To ensure ensure appropriate visibility and warmth within the brooder house, four rechargeable lights were placed at designated locations. The heat source was gradually withdrawn or reduced to avoid heat stress. The surroundings were thoroughly cleaned to ward off dangerous predators and rodents. Feed, vitalyte, and water were supplied *ad-libitum*.

Experimental ingredients and experimental design

Fresh leaves of *Talinum triangulare* (Water leaf) were sourced from matured plants at the Teaching and Research Farm, Edo State College of Agriculture and Natural Resources, Iguoriakhi, Benin City. The leaves were rinsed to remove dirt and sand and was then be picked, blended and sieved. Two (2) litres of warm water of about 60^0C was added per kilogram of waterleaf to facilitate the axtraction of the aqueous extract during sieving. The supernatant was stored in the refrigerator and maintained at 50C and then used for two (2) days as *Talinum trianguare* leaf extract after which a fresh extract was prepared. The main feed was commercial broiler feed that was purchased from the commercial animal feed store in Benin City. The feed (Broiler starter) was fed for three (2) weeks and thereafter finisher mash for Six (6) weeks. The *Talinum triangulare* leaf extract was supplied as followed.

Treatment 1--- water (w_0) only, Treatment 2-- water and Biovit, Treatment 3---water and 30mls TTLE, Treatment 4---- water and 60mls TTLE, Treatment 5---water and 90mls TTLE, Treatment 6---water and 120mls TTLE. The Biovit was given in water according to the manufactures recommendation of 5g per litre of water while birds on treatments 3, 4, 5 and 6 were have theirs in the following proportion of 30, 60, 90 and 120mls TTLE per litre of water respectively. The design for the experiment was completely randomized design (CRD)

Proximate analysis of waterleaf

Talinum triangulare leaves aqueous extract sourced and processed as indicated above was analysed for their proximate nutrients such as moisture, protein, fats, ash, Ether extract crude fibre and Nitrogen free extract (NFE) according to the method of AOAC (1990) to contain 85.32% Dry matter, 15.55% Crude protein, 6.52% Crude fibre, 4.73% Crude ash, 1.68% Ether extract and 58.55% NFE.

Primal cut Study

On the last day of the feeding trial, the birds were starved overnight, but water was given. Two (2) birds were then randomly selected in each replicates for primal cut study. The birds were tagged and weighed before and after slaughtering to determine the live and bled weight respectively. The slaughtered broiler chickens were dipped in hot water for about two minutes and the feathers were then be plucked. The plucked weights were recorded as well. The plucked chickens were eviscerated and the dressed weights estimated. The dressed weight refers to the weight of the birds being partially butchered, removing all the internal organs, head and shanks. The carcass was later be cut into parts, such as head, neck, wings, breast muscles, drumstick, shank, back and bursa. The weights of the parts were recorded and measured relative to the eviscerated weight.

The dressing percentage in relative to live weight was calculated as:

$$\text{Dressing percentage} = \frac{\text{Dressed weight}}{\text{Live weight}} \times 100\%$$

Statistical analysis

All the data collected were subjected to one way analysis of variance (ANOVA) and differences between means of the treatments were determined using Duncan's -Multiple Range -Test (DMRT) at 5 percent level of probability. All statistical procedures were in accordance to Steel and Torrie, (1990) with the aid of SPSS Version 20

RESULTS

Primal cut weights of broiler chickens on varying dosages of Tallinum triangulare leaf aqueous extract

The primal cut weights of broiler chickens as influenced by the inclusion of varying millages of *Tallinum triangulare* leaf extract (TTLE) (Table1) revealed that the live weight, bled weight, plucked weight, eviscerated weight, dressing percentage and primal cuts such as breast muscle were significantly ($p<0.05$) influenced by the treatment diets while the relative weight of head, neck, back, thigh muscles,drum sticks, shanks and wings were not significantly ($P>0.05$) affected by the oral treatments. Average live weight was significantly ($P<0.05$) influenced by the treatment diets with highest numerical value of 2.80kg/bird recorded for birds placed on 90mls of *Tallinum triangulare* leaf extract (TTLE) while least mean values of 2.53kg/bird was recorded among broilers placed on 60mls of *Tallinum triangulare* leaf extract (TTLE). Bled weight was significantly ($P<0.05$) different with highest mean value of 2.75kg/bird recorded for birds placed on 90mls of *Tallinum triangulare* leaf extract (TTLE) while lowest mean values of 2.48kg/bird was recorded among broilers placed on 60mls of TTLE. Plucked weight was significantly ($P<0.05$) affected by the treatment diets with highest men value of 2.70kg/bird recorded for birds placed on 90mls of *Tallinum triangulare* leaf extract (TTLE) while least mean values of 2.43kg/bird was recorded among broilers placed on 60mls of TTLE. Eviscerated weight showed significantly ($P<0.05$) variation among birds fed the treatment diets with higher value of 2.67kg/bird recorded for birds placed on 90mls of *Tallinum triangulare* leaf extract (TTLE) while lowest mean value of 2.33kg/bird was recorded among broilers placed on water containing vitamin. Dressing percentage was also significantly ($P<0.05$) influenced by the treatment diets with highest percentage value of 95.35% recorded for birds placed on 90mls of *Tallinum triangulare* leaf extract (TTLE) while least mean values of 90.00% was recorded among broilers placed on 120mls of TTLE. Relative weight of breast muscles showed significant variation ($p<0.05$) among broiler chicken placed on various millage of TTLE with highest percentage value of 1.36% in those given ordinary water while lowest weight (0.95%) was observed in those on 30mls of TTLE.

DISCUSSION

Primal cut weights of broiler chickens as influenced by varying dosages of tallinum triangulare leaf aqueous extracts.

The carcass yield of birds as influenced by the varying oral treatments revealed that birds on 90mls of *Tallinum triangulare* and had higher average live weight which translated to a higher bled weight, plucked weight, eviscerated weight and dressing percentage. The high value of live weight plucked weight, eviscerated weight and dressing percentage could be attributed to the fact that broiler chickens can perform well on 90mls of *Tallinum triangulare*. This lend support from the report of Nworgu, (2016) who reported a significant difference in the live weight, plucked weight and dressing percentages of growing pullets placed on varying dosages of Basil leaf (*Ocimum gratissimum*). The relative weight of head and neck did not differ among the broiler chickens placed on the various dietary treatments. The significant increase in the weight of breast muscles with highest value recorded among broiler chickens placed on control comparable to those on 90mls of *Tallinum triangulare* leaf extract could be as a result of the highest live weight recorded among birds that took the oral treatment (90mls of TTLE). This report is in tandem with the earlier report of Ayoola *et al.,* (2015) who observed a significant (P<0.05) difference in the weight of breast muscles of broiler chickens placed on Neem (*Azadirachta indica*) leaf meal. However, this finding negates the report of Alabi *et al.,* (2017) who observed no significant difference in the breast muscle and thigh muscle of broiler chickens placed on aqueous extract of Moringa oleifera leaf extract. The similarity recorded in the primal cut conform with the report of Ekine *et al.,* (2020) who reported similarity in the organ weights of broiler chickens placed on varying dosages of *Tallinum triangulare.*

Table 1: Primal cut weights of broiler chickens as influenced by the varying dosages of Tallinum triangulare leaf aqueous extract in Broiler Chicken diets.

	Experimental treatment (T)						
	W_o	W_b	30	60	90	120	
	Dosages of TTLE						
Parameters	**1**	**2**	**3**	**4**	**5**	**6**	**SEM±**
Average live weight (kg/bird)	2.67^{b}	2.57^{c}	2.70^{ab}	2.53^{c}	2.80a	2.70^{ab}	0.06
Bled weight (kg/bird)	2.61^{b}	2.50^{c}	2.68^{ab}	2.48^{c}	2.75^{a}	2.66^{ab}	0.04
Plucked weight (kg/bird)	2.60^{b}	2.47^{c}	2.50^{ab}	2.43^{c}	2.70^{a}	2.57^{bc}	0.42
Eviscerated Weight (kg/bird)	2.53^{b}	2.33^{c}	2.47^{c}	2.37^{bc}	2.67^{a}	2.43c	0.06
Dressing percentage (%)	94.75^{ab}	90.66^{c}	91.48^{bc}	93.67^{b}	95.35^{a}	90.00^{d}	1.28
Cut Parts (%)							
Head	0.18	0.12	0.13	0.14	0.13	0.16	0.14
Neck	0.25	0.20	0.20	0.22	0.16	0.19	0.14
Breast Muscle	1.36^{a}	1.09^{c}	0.95^{d}	1.17^{b}	1.27^{ab}	0.98^{d}	0.03
Back	0.92	0.60	0.53	0.66	0.81	0.56	0.07
Thigh Muscle	0.86	0.51	0.46	0.52	0.54	0.53	0.11
Drumstick	0.84	0.44	0.46	0.48	0.42	0.52	0.15
Shank	0.22	0.19	0.19	0.19	0.16	0.18	0.09
Wing	0.90	0.43	0.40	0.41	0.39	0.44	0.16

abcd: means in the same row with varying super script differ significantly (P<0.05),
SEM±: standard error of mean

CONCLUSION

It is therefore concluded that *Tallinum triangulare* leaf extract (TTLE) can successfully be included orally in broiler chickens diet up to 90mls without any deleterious effect on the carcass quality.

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EVALUATION OF AQUEOUS CHAYA LEAF EXTRACT PHYTOBIOACTIVE POTENTIALS IN IMPROVING PERFORMANCE AND BLOOD PROFILE 0F BROILER BIRDS

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ABSTRACT

Cnidoscolus aconitifolius (chaya) is a phytobiotic plant with great economic importance of nutritional and medicinal values in both human and broiler nutrition. The chaya plant is easily available and can be found in almost every part of Nigeria. This study was to investigate the potentials of phytobioactive components of chaya leaf extract to enhance broiler nutrition as well as performance and health status. A total of 180 Agrited day old broiler chicks were used in the 8 weeks study and were allocated randomly into 4 dietary treatment groups with 45 birds per treatment that was replicated 3 times with 15 birds per replicate in a Completely Randomized Design (CRD) . Inclusion of 40g Chaya Leaf Extract (CLE) showed improved final body weight, weight gain, FCR and low mortality rate as well as improved haematological and serum biochemistry parameters. Quantitative investigation of phytobioactive profile of chaya leaf extract and proximate analysis carried out showed respectively that CLE contains phytochemical components (Flavoniods, Saponins, alkaloids, Steroids and Cardiac Glycosides) and rich in crude protein, mineral and vitamins especially vitamin C as major of antioxidant to prevent oxidative stress and gastero – intestinal disease

Keywords: Broilers, Chaya leaf, Nutrition, Body weight and Disease resistance.

DESCRIPTION OF PROBLEM

Cnidoscolus aconitifolius is phytobiotic plant commonly known as chaya and belongs to the Family of Euphorbiceae. Chaya plant is a deciduous ever green perennial plant that grows to the height of 3 to 6 meters tall with five (5) stark semi broad leafy appearance. The plant originated from Central and Southern America (Mexico) from where it spread to other tropical countries including Nigeria (1). Chaya leaf has continued to be used as food, medicine and feed additive in the nutrition of broiler birds to enhance performance till date (2).The leaf is easily available, affordable and can be found in every part of Nigeria. The chaya plant is known as blood booster in the South East, Efo Iyana-Paja in the South West and hospital too far in the South -South region of Nigeria (3). It is important to know that Chaya leaf possessed immunomodulatory potentials and also been used as alternative to antibiotics to improve nutrition and health status of broiler birds. However, inclusion of the aqueous leaf extract in monogastric diet has improved final body weight, weight gain , FCR and feed intake (4).Aqueous chaya leaf has also been used to treat so many diseases such as Coccidiosis, diarrhea, insomania, gout, diabetes, kidney stone and anemia (5, 2).

Chaya leaf extract inclusion has improved PCV, WBC and platelet in broiler chickens to maintain physiolopic function to enhance immunity level and disease resistance (2). The chaya plant leaf contains protein, minerals and vitamins especially vitamin C (1, 6). The aim of this study was to investigate the phytobioactive potentials of Chaya leaf extract to enhance broiler nutrition and performance.

MATERIAL AND METHODS

This study was conducted at the Poultry section of Teaching and Research unit, University of Port Harcourt.

Experimental Design and Procedure

A total of 180 Agrited day old broiler chicks were used in the 8 weeks study and assigned randomly into 4 dietary treatment groups with 45 birds per treatment of 3 replicate that consist of 15 birds per replicate in a Completely Randomized Design (CRD) after the initial weights of the birds were obtained. At the end of the study, two birds were slaughtered from each replicate and blood samples were collected with anti-coagulant bottles for haematological analysis while blood plasma was used for serum biochemistry analysis, Carcass characteristics and organ weights of the birds were also determined.

Collection and Preparation of Experimental Diet

After harvesting, the leaves were rinsed with clean water to get them rid of dust and sun dried for two (2) days on a mat. The leaves were also gathered, weighed and grinded with an electric grinding machine as 20g, 40g and 60g of the grinded leaves were macerated with an equal 15 litre of water each for treatments (2, 3 and 4) which vary in the concentration of Chaya leaf extract that was given to broiler birds at 0g CLE , 20g CLE, 40g CLE and 60g CLE representing treatments (T_1, T_2, T_3 and T_4). The control group was given 0g of the leaf and 15 litre normal water.

The aqueous Chaya leaf extract was allowed for 3 hours to settle, then the filtrate was filtered and stored in 20 litre jerry can for immediate use in the study, while the remaining extract was 753haya753erated for subsequent use.

Table 1: Composition of Broiler Finisher Diet

Ingredients	**T_1(0g)**	**T_2(20g)**	**T_3(40g)**	**T_4 (60g)**
Maize	**51.5**	**51.5**	**51.5**	**51.5**
Soya bean	10	10	10	10
Groundnut cake	10	10	10	10
PKC	4.5	4.5	4.5	4.5
Fish meal	8.1	8.1	8.1	8.1
Wheat bran	4.7	4.7	4.7	4.7
Bone meal	3	3	3	3
Palm oil	4.4	4.4	4.4	4.4
Vitamin Pmx	2.5	2.5	2.5	2.5
Methionine	0.8	0.8	0.8	0.8
Lysine	0.2	0.2	0.2	0.2
Salt	0.3	0.3	0.3	0.3
Total	**100**	**100**	**100**	**100**
% Conc Of Chaya Leaf extract	0	2.67	5.33	8.0
Nutrient Calculated				
CP	20.18	20.18	20.18	20.18
ME	3004.32	3004.32	3004.32	3004.32
CF	4	4	4	4
Oil	7.94	7.94	7.94	7.94
Lysine	1	1	1	1
Methionine	041	041	041	041
Calcium	1.65	1.65	1.65	1.65
Phosphorus	1.05	1.05	1.05	1.05

Contains in the following per kg: vitamin A: 23000000 IU, vitamin D: 1,100000vitamin E: 1800 IU, vitamin K: 800mg, vitamin B12: 6mg, niacin: 7500mg, folic acid: 450mg, pantothenic acid: 3000mg, biotin: 40mg, antioxidant: 3000mg, cobalt: 80mg, copper: 2000mg, iodine: 400mg, iron: 1200mg, manganese: 1800mg, selenium: 60mg and zinc: 14000mg.

Statistical analysis

All collected data were subjected to One-way Analysis of Variance (ANOVA) using SPSS while Ducan Multiple Range Test were used for separation of means among treatments.

Ethical Approval for Research Title and Use of Experimental Animals

The research title as well as study protocols and procedure received necessary approval from the University of Port Harcourt Ethics Committee on Animal Care and Use before the commencement of the study.

Identification of 754haya plant -was properly done and given a voucher number: UPHE0586 at the Herbarium of the Department of Pharmacognosy and Phytotherapy, University of Port-Harcourt by Dr. Suleman M.

Table 2: **Volume of Water (Aqueous Chaya Leaf Extract) used as Test Ingredient for Broiler Starter phase during the Study**

		T_1(0g)	T_2(20g)	T_4(40g)	T_6(60g)
Starter phase	1st week	(0g) 7.5 lit	(0g) 7.5 lit	(0g) 7.5 lit	(0g) 7.5 lit
	2nd week	(0g) 9.5 lit	(30g) 9.5 lit	(50g) 9.5 lit	(70g) 9.5 lit
	3rd week	(0g) 10.5 lit	(40g) 10.5 lit	(60g) 10.5 lit	(80g) 10.5 lit
	4th week	(0g) 12 lit	(50g) 12 lit	(70g) 12 lit	(90g) 12 lit
Finisher phase	5th week	(0g) 13.5 lit	(60g) 13.5 lit	(80g) 13.5 lit	(100g) 13.5 lit
	6th week	(0g) 15 lit	(70g) 15 lit	(90g) 15 lit	(110g) 15 lit
	7th week	(0g) 16.5 lit	(80g) 16.5 lit	(100g) 16.5 lit	(120g) 16.5 lit
	8th week	(0g) 18 lit	(90g) 18 lit	(110g) 18 lit	(130g) 18 lit

Table 3: Proximate Composition of *Cnidoscolus aconitifolius* (754haya leaf)

Parameters	percentage (%)
Dry matter	91.75
Moisture	8.25
Crude protein	18.51
Crude lipid	6.25
Crude fibre	9.15
Ash	11.25
Nitrogen free extract	49.5
Calorific value (Kcal/100g)	275.52

RESULTS AND DISCUSSION

The result of the quantitative phytochemical investigation of Chaya leaf extract showed some amounts of phytobioactive components such as flavonoids, saponnins, alkaloids, steroids and cardiac glycosides. Flavonoids were in higher amount in the extract and they are known for their antioxidant activity, antimicrobial and antihyperglycaemic properties. This result aligns with the findings of (7) who reported that flavonoids contains antioxidant activity that could neutralize free radicals and protect broiler birds from developing gastro-intestinal diseases.

The value obtained for proximate analysis showed that Chaya leaf is a good source of crude protein (18.56%) compared to crude protein value obtained in Amaranthus (16.41g/100g) by (8). Table 5 showed the effect of Chaya leaf extract on broiler performance parameter. The result showed significant difference ($P<0.05$) in almost all the performance parameters considered in the study except mortality rate. Treatment 3 had highest final body weight and weight gain values with least feed intake value compared to control (T1) and other dietary treatments (T2, T3 and T4). Treatment 3 also had the best FCR value to achieve high weight gain. This implies that the inclusion of 40g Chaya leaf extract in broiler diet can improve performance and weight gain in broiler chickens. This result was in agreement with the report of (2) who reported improved body weight in pullet chicks fed phytomix (garlic, ginger and chaya leaf meal). The values obtained for haematological parameters proved that chaya leaf extract has the capacity to improve PCV, WBC, HB, RBC and Platelet in the dietary groups compared to control. This result was in tandem with the reports of (2, 9) who reported similar values for PCV, WBC, RBC and Platelet. The result also showed significant difference

(P<0.05) in the values obtained for albumin, urea concentration and creatinine in the dietary groups compared to control.

This result suggests that chaya leaf extract is a good source of dietary protein and has the potential to meet the protein requirements of broiler chicken to maintain normal physiological functions.

Table 4: Quantitative Phytochemical Screening of Aqueous Chaya Leaf Extract (*Cnidoscolus aconitifolius)* Administered to Broiler Chickens

Phytochemcial (mg/100g) components	Concentration Value
Saponin	1.97
Steroid	2.05
Flavonoid	3.90
Alkaloid	3.61
Cardiac glycoside	2.81

Table 5: Effect of Chaya Leaf Extract on Growth Performance of Broiler Finisher

Parameters (g)	T_1(0g)	T_2(20g)	T_3(40g)	T_4(60g)
Initial weight (g)	46.00 ±0.00	46.40 ±0.20	46.00 ±0.00	46.00 ±0.00
Final weight (g)	2903.44 ±49.69^{c}	3013.62 ±49.72^{b}	3130.67 ±10.61^{a}	2925.84.±42.75^{c}
Weight gain (g)	2857.44 ±49.84^{b}	2967.22±49.84^{a}	3085.13 ±49.95^{a}	2878.57±43.27^{b}
Feed intake (g)	3878.00 ±25. 98^{b}	3573.24±29.47^{a}	3586.20±27.19^{a}	3576.03±20.78^{ab}
Water intake (ml)	4303.52±72.27^{c}	4553.04±43.66^{ab}	4648.89±35.10^{a}	4395.32±45.43^{b}
FCR	1.35±0.03^{b}	1.21±0.01^{a}	1.14±0.03^{a}	1.23±0.02^{b}
Mortality (%)	2.2^{a}	1.2^{b}	1.2 ^{b}	1.6^{ab}

^{a,b,c} Means within each row bearing different superscript differ significantly (P<0.0)

Table 6: Effect of Aqueous Chaya Leaf Extract on Haematological parameters of Broiler Chicken

Parameters (g)	T_1(0g)	T_2(20g)	T_3(40g)	T_4(60g)
PCV (%)	23.00 ±1.76	23.33 ±1.97	26. ±1.23	24.29 ±1.63
HB (g/l)	8.16 ±0.25	7.61±0.99	9.01±0.21	8.05±0.22
RBC (10^6/ul)	3.60 ±0.18	3.65±0.21	3.95 ±0.29	3.95±0.09
WBC (10^3/ul)	12.95±0.33	12.20±20.18	11.13±0.51	11.88±0.67
Platelet (10^9)	226.67±4.42^{b}	234.16±9.45^{a}	241.50±8.00^{a}	213.83±3.11^{b}
Neutrophil (%)	43.16±0.44	40.16±0.60	38.83±2.80	43.16±1.30
Lymphocytes (%)	52.50±2.64	48.50±1.44	50.66±3.81	47.83±0.92
Eosinophil (%)	2.83±0.16	3.16±0.33	2.83±0.44	3.16±0.16
Monocytes (%)	5.83±0.44^{b}	7.66±0.33^{a}	5.50±0.50^{b}	6.50±0.86^{ab}

^{a,b,c} Means within each row bearing different superscript differ significantly (P<0.05).

Table 7: Effect of Aqueous Chaya Leaf Extract on Serum Biochemistry of Broiler Chickens

Parameters (g)	T_1(0g)	T_2(20g)	T_3(40g)
Total Protein (g/L)	39.33 ±8.92^{b}	51.83 ±1.09 ^{a}	47.16 ±4.12^{a}
Albumin (g/L)	29.33±1.69	28.47 ±5.03	29.33±3.60
Total bilirubin (umol/L)	8.68 ±0.36^{ab}	8.68±0.40^{ab}	7.61±0.51^{b}
Conjugated bilirubin (umol/L)	5.97±0.19	5.48±0.23	4.53±0.50
Urea (mmol/L)	2.16±0.23 ^{a}	2.18±0.33^{a}	2.00±0.14^{a}
Creatinine (umol/L)	45.33±4.62^{a}	48.33±2.74^{a}	44.33±2.02^{a}
HCO_3 (mmol/L)	24.33±1.16	25.16±0.17	24.50±1.25
Potassium (mmol/L)	3.47±0.19	3.43±0.24	3.57±0.18
Sodium (mmol/L)	129.83±6.96^{b}	128.83±8.53^{b}	133.00±7.26^{a}
Chloride (mmol/L)	70.16±3.91	69.67±0.83	67.83±2.46

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Monogastric Animal Production: MGP 082

THE DETERMINATION OF THE FEEDING VALUE OF THE *MORINGA OLEIFERA*-SUPPLEMENTED CASSAVA ROOT MEAL USING BROILER CHICKENS

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ABSTRACT

The study was designed to determine the chemical composition of cassava root meal supplemented with Moringa *oleifera* leaf meal (MOLM) and to compare the performance of broiler chickens fed diets containing cassava root meal supplemented with MOLM. The moringa leaves were plucked, washed, air-dried, and milled using an electric blender. The cassava roots were peeled, washed, cut into small pieces, sun-dried and milled. The MOLM was used to supplement cassava root meal at 1.5%, 3.0%, 4.5%, and 6.0%, and the mixtures were pelletized. A diet containing 20% crude protein was formulated for the finisher broiler chickens. Maize was replaced with the MOLM-supplemented cassava root meal. 180-day-old marshal broiler chicks were randomly allotted to the six (6) experimental diets and fed for 28 days of the finisher phase. The design used for the experiment was a completely randomized design. Supplementation of cassava root meal with MOLM increased its crude protein from 2.30% to 4.82%, crude fat from 1.48% to 2.18, and ash from 3.12 to 4.43%, as well as gross energy. The MOLM cassava-supplemented diet improved the performance of the birds in the finishers' phase. It was recommended that the supplementation of cassava root meal with MOLM should not be above 4.5% for the finisher broilers chickens.

Key Words: Moringa, Cassava root, Supplementation, Growth Performance, Chemical composition

DESCRIPTION OF PROBLEM

The Nigerian poultry industry is facing a tremendous setback and is on the verge of collapse arising from the high cost of feed, which accounts for 70–80% of the total cost of production. The high cost of poultry feed has been traced to the increasing cost of maize, sorghum, millet, and wheat, which are the main conventional sources of energy (1). A solution to the escalating cost of these ingredients has been the exploration and utilization of alternative feed resources, particularly roots and tubers, as partial or total replacements for the expensive conventional feed ingredients. Many researchers have utilized roots and tubers that have been chemically evaluated and utilized in poultry and pig feeding including cassava (2), cocoyam (3), sweet potato (4), and earth ball (5).

For instance, alternative energy resources, including cassava root, are inferior to maize in their nutritive value. For instance, the protein level of cassava root is very low. Therefore, when a balanced poultry ration is formulated, the cassava must be supplemented with protein, amino acids, fat, minerals, and vitamins at higher levels than the needed levels in cereal-based diets.

The supplementation of cassava with readily available and cheaper material holds great potential for maximizing the nutritive value of cassava root meal in poultry and livestock feeding.
Therefore, this study was designed to determine the chemical composition of cassava root meal supplemented with different levels of *Moringa oleifera* leaf meal. And also, to compare the performances of broiler chickens fed diets containing *M. Oleifera-supplemented* cassava root meal.

MATERIALS AND METHODS

Experimental sites

The proximate analysis was conducted at the central laboratory of the Faculty of Agriculture, University of Calabar. Cross River State, while the feeding trial was carried out in the Poultry Unit of the University of Calabar Teaching and Research Farm, Calabar.

Acquisition and preparation of the samples

The moringa leaves were plucked within the Calabar metropolis, destalked, washed, and air-dried at an ambient temperature of 35ºC with constant turning to avert fungal growth. The leaves were thereafter milled using an electric blender and stored at a 40-degree temperature in the refrigerator.

The fresh cassava roots were procured from Akpabuyo market, Cross River State, peeled, washed, cut into small pieces, and sun-dried on a tarpaulin sheet to dry out with regular turning. The dried cassava root was milled using a hammer mill with a 0.02 mm mesh and stored in a plastic drum for preservation.

The MOLM was used to supplement cassava root meal at the rates of 1.5%, 3.0%, 4.5%, and 6.5% per kilogram of cassava root meal. The mixtures were pelletized before proximate analysis and feed formulation.

Determination of the chemical composition of the test samples

The proximate analysis of the feed samples was carried out using the standard procedures of AOAC (2005), while the gross energy was determined using a bomb calorimeter (6).

Experimental diets

Diets containing 20% crude protein was formulated (Table 1) for the broiler chicks at the finisher phases. Diets 1 and 2 with maize and cassava were control diets, while diets 3 to 6 contained the four levels of moringa-supplemented cassava root meal.

TABLE 1: Composition of the experimental diets

	Broiler finisher diets					
	Levels of moringa leaf in cassava root meal					
Ingredients	**maize**	**cassava**	**1.5%**	**3.0%**	**4.5%**	**6.0%**
Maize	57.1		-	-	-	-
Cassava meal	-	57.1	57.1	57.1	57.1	57.1
Soybean meal	24.1	24.1	24.1	24.1	24.1	24.1
Fish meal	3.00	3.00	3.00	3.00	3.00	3.00
Palm kernel cake	4.00	4.00	4.00	4.00	4.00	4.00
Wheat offal	8.00	8.00	8.00	8.00	8.00	8.00
DCP	2.80	2.80	2.80	2.80	2.80	2.80
Salt	0.30	0.30	0.30	0.30	0.30	0.30
Methionine	0.20	0.20	0.20	0.20	0.20	0.20
Lysine	0.20	0.20	0.20	0.20	0.20	0.20
*Vit. /Mineral premix	0.30	0.30	0.3	0.3	0.3	0.3
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.00**	**100.0**
Analyses						
% Crude Protein	20.00	18.45	18.61	18.81	18.90	19.10
Metabolizable Energy (Kcal/Kg)	3,000	2975	2980	2982	2984	2986

*Minerals/ vitamins premix containing the following per kg.: Vitamin A-50000 I.U; vitamin-0000 IU; vitamin E-5,10,000IU; vitamin K- 2,500mg; pyridoxine- 1375, antioxidant-, 62.5g; Niacin- 13.750mg; vitamin B_{12} -7.5mg; pathogenic acid -3750mg; biotin-10mg; chorine chloride- 200g; manganese- 40g; zinc -25; Iron-10g; copper-2.50g; iodine- 0.6g; selenium -200mg; cobalt- 200mg

Experimental animals and management

A total of 180-day-old Marshal broiler chicks were purchased from the AGRITECH hatchery and raised under the same experimental condition for 28 days before the commencement of the experiment. The chicks were weighed and randomly allotted to the six (6) experimental diets. They were subdivided into three replicates of ten (10) birds each and housed in deep litter pens. Routine vaccinations and medication schedules were adhered to strictly, and birds were allowed access to dietary treatments and fresh, clean water *ad libitum* for 28 days during finisher phases.

Data collection and analysis

The average daily feed and weight gain were collected. The feed conversion ratio was calculated weekly based on the average weekly feed intake and the weight gain. The design used for the experiment was a completely randomised design. Data generated was analyzed using the general linear model procedure of SPSS options, Version 18.00 (7).

RESULTS AND DISCUSSION

Proximate chemical and gross energy composition of maize, moringa leaf meal and cassava root meals

The proximate chemical and gross energy composition of *M. oleifera* leaf meal, maize, cassava root meal, and MOLM-supplemented cassava root meal are presented in Table 2. Supplementation of cassava root meal with *M. oleifera* leaf meal increased its crude protein from 2.30% to between 3.60 and 4.82%, respectively. The crude protein value of 8.80% observed in maize was, however, higher than the values reported for the MOLM-supplemented cassava root meal. The corresponding increase in the crude protein value of cassava was due to the high protein content of the MOLM. The crude fat (4.57%) and ash (13.12%) observed in the moringa leaf increased their concentrations in the cassava root meal from 1.48% to between 3.12% and 3.85%, respectively. The ash content of 2.19% observed in maize was lower than the values recorded for the supplemented cassava root meal. Cassava supplementation with MOLM increased its gross energy content from 2.89 kcal/kg to between 2.99 kcal/kg and 4.38 kcal/kg. The gross energy content of 3.90 kcal/kg observed in maize was, however, higher than values recorded for the supplemented cassava root meal.

Table 2: Proximate chemical and gross energy composition of maize, moringa leaf meal and cassava root meals

Parameters	Maize	MOLM	CRM	1.5% MOLM+ CRM	3.0% MOLM+ CRM	4.5% MOLM+ CRM	6.0% MOLM+ CRM
Crude protein (%)	8.88	25.87	2.30	3.60	4.53	4.64	4.82
Fat (%)	2.4	4.57	1.48	1.69	1.81	2.12	2.18
Ash (%)	2.19	13.12	3.12	3.00	3.48	3.85	4.43
Crude fibre (%)	2.4	14.88	1.70	3.14	3.47	4.09	4.38
Moisture (%)	7.16	7.41	7.10	8.79	8.09	8.45	8.50
NFE (%)	76.97	34.15	84.30	79.78	78.62	76.85	75.69
G.E (Kcal/g)	3.9	3.65	2.89	2.99	3.04	3.07	3.11

Values are means of triplicate determinations; MOLM: - Moringa leaf meal; CRM: - Cassava root meal

Performance of broiler chickens fed diets containing cassava root meal supplemented moringa leaf meal (28-56 days)

Table 3 shows the growth performance of broiler chickens fed diets containing cassava root meal supplemented with moringa leaf meal.

The average daily weight gain of 56.56g recorded by the birds on a maize-based diet was not significantly ($P > 0.05$) different from that of birds fed a MOLM-supplemented cassava diet, except for birds on a 1.5%

MOLM-supplemented diet, whose value (44.92g) was also similar to that of birds fed a cassava root meal diet without MOLM supplementation. The feed conversion ratio was influenced (P <0.05) by the treatment, with the best values (2.42–2.48) recorded on birds in which the cassava root meal was supplemented with MOLM at 3.0–6.00%. The FCR value (2.68%) at 1.50% supplementation was not significantly different from that of the maize-based diet (2.64) and the cassava root meal diet without MOLM supplementation, which had a value of 2.79. The enzyme in the birds was capable of breaking down the fibre in the MOLM to release nutrients essential for the chickens' growth, resulting in an improvement in the average daily weight gain and feed conversion ratio observed in chickens fed MOLM-supplemented cassava root meal diets. It was also observed that improvement in the performance of chickens was not supported by the supplementation of cassava with the MOLM, beyond 4.6%. The current result agrees with the findings of (8) who reported no adverse effect on the performance of growing indigenous Senegal chickens fed a diet supplemented with MOLM.

Table 3: Performance of finisher broiler chickens fed diets containing cassava root meal supplemented MOLM

Parameters	Diets						
	Maize	Cassava + 0% MOLM	Cassava +1.5% MOLM	Cassava + 3.0% MOLM	Cassava +4.5% MOLM	Cassava +6.0% MOLM	± SEM
Initial weight (g/bird)	440.80	284.90	346.90	333.40	345.50	318.50	2.82
Final weight (g/bird)	2024.60	1504.86	1604.66	1798.70	1780.84	1734.18	5.21
Total wt. gain (g/bird)	1583.80	1219.96	1257.76	1451.80	1435.84	1415.68	4.52
Av. Daily wt. gain (g/bird)	56.56[a]	43.57[b]	44.92[b]	51.85[a]	51.28[a]	50.56[a]	0.85
Av. Daily feed intake (g/bird)	149.34	121.69	120.83	125.88	126.35	125.18	1.27
Feed conversion ratio	2.64[a]	2.79[a]	2.68[a]	2.42[ab]	2.46[ab]	2.48[ab]	0.15

SEM = Standard error of means; abc = Mean with different superscripts on the same row are significantly (P<0.05) different

CONCLUSION AND RECOMMENDATIONS

From the results of this study, the following conclusions were drawn: Supplementation of cassava root meal with MOLM could improve its chemical composition. ii). Replacement of maize with MOLM-supplemented cassava root meal could improve broiler chickens' performance, especially at the finisher phase. It was recommended that supplementation with 4.5% MOLM will bring more returns from investment to the farmer.

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Monogastric Animal Production: MGP 083

GROWTH PERFORMANCE AND HAEMATOLOGICAL INDICES OF BROILER CHICKEN FED DIETS SUPPLEMENTED WITH GRADED LEVELS OF BLACK SEED (*Nigella sativa*) MEAL

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ABSTRACT

A 49-day feeding trial was conducted to investigate the effect of graded levels of black seed. (Nigella sativa) meal on growth performance and haematological parameters of broiler chickens. A total of One hundred-and fifty-day old chicks were randomly allotted into five treatment groups of thirty chicks in a triplicate of ten (10) chicks each respectively in a Completely randomized design experimentation. Five diets were formulated to contain black seed meal (BSM) at $D_1$0% (control without inclusion), D_2 had inclusion of oxytetracycline whileD_3, D_4 andD_5had inclusion of BSM at 125g/kg, 250g/kg and 375g/kg respectively. Data collected on growth performance were weight gain, feed intake and feed conversion ratio were calculated. Blood samples were collected via the jugular vein of the broiler chickens for haematological analysis. Result obtained revealed that there was no significant (P>0.05) difference in growth performance of broiler chicken across the treatment means. Lymphocytes and Basophils were significantly (P< 0.05) influenced by the dietary inclusion of black seed meal among all haematological parameters assessed. Highest (P< 0.05) value for lymphocyte was recorder on D_3 (125g/kg BSM) followed by D_2 (oxytet inclusion) and D_5 (375g/kg BSM) while the least values were obtained in control and D_4 respectively. For basophil, treatment group D_4 had the highest (P< 0.05) value while the other treatment groups recorded the same significant values respectively. In conclusion, dietary inclusion of graded levels of black seed meal does not have detrimental effect on growth and poise no health threat on broiler chickens.

Keywords: Broiler chicken, black seed meal, oxytetracycline, growth performance, blood sample

DESCRIPTION OF PROBLEM

Phytogenic feed additives "phytobiotic" are assuming a position of prime importance in the poultry industry (1, 2, 3) and could be used in feed or water (4). Among the promising phytogenic immune-stimulants, *Nigella sativa* (*N. sativa*) is a miracle medicinal herb having a long history with a rich religious background (5, 6). *Nigella sativa* seeds are used for the treatment of some disorders and illnesses including fever, common cold, headache, asthma, various Gram-positive and Gram-negative microbial infections (7) and alleviation of adverse effects of heat stress (8), as well as to expel worms from the intestines. The possible biochemical active components of *N. sativa* and their pharmacological effects have been investigated (9,10). In the production of healthy food, supplementation of *N. sativa* seeds to poultry diets could be recommended as a natural growth promoter instead of antibiotics. Black seed (*Nigella sativa*) belongs to the family '*Ranunculacea'*. It is an annual herb of Mediterranean region, South and Central Asia and now also cultivated in Eastern Europe. The main active components of black seeds include thymoquinone, thymohydroquinone, dithymoquinone, thymol and carvacol which are important pharmacologically active substances (11, 12). Thymoquinone, representing 18.4–24% of the essential oil of black seeds possesses antibacterial, antioxidant, antihistaminic and anti-inflammatory activities (13). The seed content of these compounds was investigated by (14) and they reported the protein content was about 21%, fat 35.5%, ash 3.71% and the rest being total carbohydrates. Black seed has been widely used in traditional medicine as digestive and appetite stimulant (15). Hence, this study is conducted to investigate

the effect of graded levels of black seed (*Nigella sativa*) supplemented diets on growth performance and haematological indices of broiler chickens.

MATERIALS AND METHODS

Experimental location and sourcing of test ingredients: The experiment was carried out at the Poultry site of Federal College of Animal Health and Production Technology, Ibadan. The test ingredient was purchased from a reputable market in Ibadan Metropolis. The seed were cleaned of dirt's, air-dried, graded and grounded before incorporating into the feed according to the experimental layout.

Experiments diets and design: Five diets were formulated such that D_1 serves as the positive control with no inclusion, D_2 had oxytetracycline as negative control while D_3, D_4 and D_5 had 125g/kg, 250g/kg and 375g/kg of black seed meal respectively in a Completely Randomized Design (CRD).

Experimental birds and management: A total of One hundred and fifty (150) day old chicks were used for this experiment. The chicks were allotted into five dietary treatments of thirty chicks per treatment having three replicates of ten (10) chicks each. The chicks were raised on a deep litter system and were served diets according to the experimental layout. Feed and water were supplied adequately. Medication and vaccination were routinely and strictly adhered to.

Data Collection: Data collected on growth performance were feed intake, final weight, weight gain and feed conversion ratio were calculated.

Blood collection: At the end of the feeding trial, 2ml of blood was collected from the jugular vein of a bird in each replicate making three (3) birds per treatment for blood analysis and it was deposited into an EDTA for haematological analysis according to the routine method described by (16).

Statistical analysis: Data collected was subjected to One-way analysis of Variance (ANOVA) using SAS, (2005) package and significant means across the treatments were separated with Duncan Multiple Range Test.

RESULTS AND DISCUSSION

The result of the growth performance of broiler chickens fed diets supplemented with graded levels of black seed is presented on Table 1. The result obtained indicated that the inclusion of black seeds (*Nigella sativa*) does not significantly ($P>0.05$) influenced the growth performance of broiler chickens across the treatment group. Numerically, the treatment groups compare favourably with the control group except that birds on D_4 with inclusion of 250g/kg of BSM had a better feed conversion ratio which is an indication that birds in those group efficiently utilized feed and converted into muscle. This present study agrees with the findings of (17) that equally reported no significant effect on broiler body weight, feed consumption and carcass characteristic in their study on effect of supplemented black seed (*Nigella sativa*) on growth performance and carcass characteristic of broilers. However, there is contrary report between this present study and that of (18) on their study on effects of *Nigella sativa* on performance, blood profiles and antibody titer against Newcastle disease in Broilers. They reported significant effect in body weight gain of chickens on groups with lower doses between 1-8% of *nigella sativa* seed and a ($P< 0.05$) depressive effect on increased level of 16% inclusion. The feed efficiency ratio was also affected by level of *N. sativa* seeds and supplementation (T3 and T4) of the diet with 1%–2% *N. sativa* seeds had decreased FCR but 8%–16% increased FCR.

The result of the haematological parameters of broiler chickens fed diets supplemented with graded levels of black seed meal is presented in Table 2. The result revealed that there is significant ($P< 0.05$) in lymphocyte and basophil among all haematological parameters assessed which does not follow a definite pattern. Highest ($P< 0.05$) value for lymphocyte was recorder on D_3 (125g/kg BSM) followed by control group D_2 (oxytet inclusion) and D_5 (375g/kg BSM) while the least values were obtained in control group D_1

and D_4 respectively. For basophil, treatment group D_4 had the highest ($P< 0.05$) value while the other treatment and control groups recorded the same values respectively.

Table 1: Growth performance of broiler chicken fed diets supplemented with graded level of black seed meal (*Nigella sativa*)

Parameters	D_1 (0%)	D_2(Oxytet)	D_3(125g/kg)	D_4(250g/kg)	D_5(375g/kg)	SEM±
Initial weight (g/b)	215.20	220.27	220.13	219.53	220.03	1.98
Final weight (g/b)	2446.67	2443.33	2436.67	2533.33	2496.67	26.81
Weight gain	2231.00	2222.97	2216.53	2213. 80	2274.63	26.48
ADWG (g/b/d)	63.75	63.51	63.33	66.10	64.99	0.76
Feed Intake	4737.40	4743.50	4757.73	4747.73	4743.40	3.45
ADFI (g/b/d)	135.35	135.53	135.65	135.65	135.53	0.10
Feed conversion ratio	2.10	2.13	2.14	2.05	2.09	0.02

ADWG- Average daily weight gain, ADFI- Average daily feed intake, SEM- Standard error of mean

The insignificant values recorded for PCV, RBC and Hb in this study contradicts the finding of (18) whose report showed that supplementation of N. sativa seeds in the diet increases the values of RBC, PCV and Hb, and the group of chickens fed with 16% supplemented N. sativa seeds had the highest values and significantly ($p < 0.05$)differed from those of control groups (T0 and T1) as well as those of the treated groups (T2-T4) indicating that increasing effects of N. sativa seeds on hemogram parameters are dose-dependent. This present study also contradicts the findings of (19) who recorded significant difference in Hb, RBC and PCV in their study on Effect of Adding Crushed *Pimpinella Anisum*, *Nigella Sativa* Seeds and Thymus Vulgaris Mixture to Antibiotics-Free Rations of Vaccinated and Non -Vaccinated Male Broilers on Growth Performance, Antibody Titer and Haematological Profile. However, (18) also noted that Supplementation of N. sativa seeds affects leukogram parameters by decreasing WBC counts and lymphocytes and increasing heterophils, H/L ratio, monocytes, eosinophils, and basophils percentages from day 21 of age until the end of the experiment. This partially agrees with the finding of this study. Although the WBC is not significantly influenced by the inclusion of BSC in the diet but there is numerical reduction in values of WBC recorded across the treatment means. Lymphocyte percentage and their differences were significant in this study as noted by the same author.

Table 2: Haematological parameters of broiler chicken fed diets supplemented with graded level of black seed meal (*Nigella sativa*)

Parameters	D_1 (0%)	D_2 (Oxytet)	D_3 (125g/kg)	D_4 (250g/kg)	D_5 (375g/kg)	SEM±
PCV (%)	37.33	34.33	36.67	36.33	33.67	1.21
Haemoglobin (g/dl)	12.00	11.17	12.13	12.13	10.80	0.46
RBC ($x10^6$ ul)	8.75	7.56	8.19	8.35	10.76	0.61
WBC ($x10^9$ ul)	6.00	5.21	5.55	5.70	4.11	0.42
Lymphocyte (%)	32.00^b	37.67^{ab}	43.67^a	33.00^b	36.67^{ab}	1.47
Monocytes (%)	0.67	0.67	1.00	1.33	1.00	0.21
Eosinophil (%)	1.00	0.33	0.67	0.00	0.33	0.22
Basophil (%)	0.00^b	0.00^b	0.00^b	0.67^a	0.00^b	0.09
Platelet ($x10^9$/l)	33.83	28.70	32.07	33.70	28.10	1.78
MCV (fl)	14.47	15.07	15.07	14.63	15.60	0.31
MCH (pg)	43.28	45.39	45.52	43.56	35.28	1.79
MCHC (%)	32.07	32.55	32.84	33.14	32.04	0.33

ab means along the same row with different superscript are significantly ($P<0.05$) different

PCV: Pack cell volume; RBC: Red blood cell: WBC: White blood cell; MCV: Mean cell volume; MCH: Mean cell haemoglobin; MCHC: Mean cell haemoglobin concentration; SEM: Standard Error of Mean.

CONCLUSION

Dietary inclusion of graded levels of black seed meal as a supplement in their diets does not have detrimental effect on growth and poise no health threat on broiler chickens.

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Monogastric Animal Production: MGP 084

EFFECT OF GRADED LEVELS OF ONION (*Allium cepa*) PEEL MEAL AS AN ADDITIVE ON GROWTH PERFORMANCE AND CARCASS CHARACTERISTICS OF BROILER FINISHER CHICKEN

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ABSTRACT

A research to investigate the growth performance and carcass characteristics of broiler chickens fed diets containing graded levels of onion (Allium cepa) peel meal as additive at the Livestock Investigation Division of the National Veterinary Research Institute, Vom, Plateau State. A total of one hundred and fourty-four (144) unsexed four week-old broiler chickens were allocated to four treatments namely: T_1, T_2, T_3, and T_4 respectively, with twelve birds in each treatment serving as the replicate in a Completely Randomized Design (CRD). The parameters considered were feed intake, weight gain, feed conversion ratio, and carcass characteristics. The data obtained from the trial indicated that birds in T_1 (3,949.69) had the highest daily feed intake, while the least feed intake was observed in T_4 (3,701.14), but there were no significant differences among the means. The highest average daily weight gain was observed in T_1 (1,013.95) while the least was recorded in T_3 (843.26), with no significant differences among the treatments. The highest value of feed conversion ratio was observed in T_3 (4.46) while the least value was observed in T_4 (3.87, but which gave the best feed conversion ratio. For the carcass characteristics, T_1 (2,402.37) gave the highest live weight, while the least was observed in T_3 (2244.63), but with no significant differences among the treatments. For the dressing percentage, T_1 (75.82%) gave the highest percentage, while the least was observed in T_3 (63.74%) with no significant difference among the treatments. From results obtained in this study, it is concluded that onion (Allium cepa) peel meal contains valuable nutrients that can be utilized as additive in diets of broiler chickens. It is recommended that onion peel meal may be included in broiler chickens feed diets as additive at up to 0.45g/kg feed.

Keywords: Onion peel, additive, weight gain, carcass

DESCRIPTION OF PROBLEM[U40]

Broiler birds have been widely reported to be a good converter of feed to meat without any religious barriers (1). Several herbal sources have been tested and shown to effectively improve growth performance of livestock. *Zingiber officinale* (ginger) (2) *Allium sativum* (garlic) and *Allium cepa* (onion) (3) have been used in poultry production to improve their growth performance. However, reports on the effects of *Allium cepa* on the performance of the domestic chickens have been inconsistent (4). This study was conducted to obtain information on carcass characteristics of broiler chicken fed onion (*Allium cepa)* peel meal at graded levels.

MATERIALS AND METHODS

The experiment was carried out at the Poultry unit of the Livestock Investigation Division (LID) in National Veterinary Research Institute Vom, Plateau State. Vom is 1285m above sea level. It has a rainfall of 1328mm which begins in the month of April (5). Onion *(Allium cepa)* peel was obtained at Katako Market in Jos and properly shade dried at room temperature before it was milled using hammer mill. Proximate composition of the onion peel meal was determined by the standard methods described by (6). A total of 144 four-week old broiler chicks were randomly assigned to four (4) treatment groups (T_1, T_2, T_3, and T_4) with thirty-six birds per treatment, further subdivided into three (3) replicates of twelve (12) birds each in a Completely Randomized Design (CRD). T_1 served as control (0% onion peel meal) while T_2, T_3 and T_4 had the onion peel meal in their diets at 0.15g/kg, 0.30g/kg and 0.45g/kg respectively at the finisher phase. Necessary

vaccinations and prophylactic medications were adhered to. Clean drinking water was provided *ad libitum*, the trial lasted for four weeks.

Weight of the birds was taken weekly using a sensitive scale. The initial body weight and final body weight were used to calculate body weight gain. Feed intake was recorded on daily basis, data on feed intake was recorded. Weekly feed consumption was used to calculate daily feed intake and feed conversion ratio. The feed intake of the chickens was measured by subtracting the weight of the leftover from the feed offered and the difference was divided by the number of birds in a pen. At eight weeks of age, two (2) birds per replicate were randomly selected and slaughtered to determine the carcass characteristics as described by Aikpitanyi and Imasuen (7). **A**ll data gathered were organized, tabulated, and analyzed statistically using analysis of variance (ANOVA) while means were separated using Duncan's Multiple Range Test.

RESULTS AND DISCUSSION

Table 1 shows the phytochemical composition of onion (*Allium cepa*) peel meal. Table 2 shows the proximate composition of onion peel meal. Table 3 shows the growth performance of broiler finishers fed diets containing graded levels of onion peel meal. Table 4 shows the carcass characteristics of the broiler chickens fed onion peel meal as an additive[U41].

The average daily feed intake (g) in the various treatments were T_1 (3,949.69), T_2 (3,949.69), T_3 (3,737.97) and T_4 (3,701.14). The highest average daily feed intake (g) was observed inT_1 and T_2 (3,949.69) followed by T_3 (3,374.97) and T_4 (3,701.14). Values in T_1 and T_2 were similar while T_3 and T_4 were also similar, however T_4 (3,701) with 0.45g/kg onion peel meal had the least average feed intake. Values for average daily weight gain (g) for the various treatments were T_1 (1,013.95), T_2 (928.22), T_3 (843.26), T_4 (964.37). The highest average daily weight gain (g) was observed in T_1 (1,013.95), followed by T_4 (964.37) and T_2 (928.22) while the least value was observed in T_3 (843.26). However, the values showed no significance difference among the means. Values for feed conversion ratio were T_1 (3.90), T_2 (4.13), T_3 (4.46) and T_4 (3.87), thus the highest feed conversion ratio was observed in T_3 (4.46) and while the lowest and best feed conversion ratio was observed in T_4 (3.87), since it is considered that the lower the feed conversion ratio (FCR) the higher the efficiency. A study revealed that broilers fed 7.5g/kg onion extract had higher weight gain in general than 5g and 10g/kg feed and increased feed intake (8). The increased weight gain could be attributed to the pleasant flavour and taste of the onions[U42].

For carcass characteristics, the dressing percentage of birds recorded 75.82% for T_1, 69.46% for T_2, 63.74% for T_3 and 65.74% for T_4. There were no significant differences among the means. No significant differences were observed among the means for the drumsticks, breasts, wings and back. No significant differences were also observed among means for the head and shank of the birds, except the neck. For internal organs, the lungs, heart, gizzard, liver and gall bladder showed no significant differences. (9) reported similar range of values for Cobb broilers in Nigeria[U43].

Table 1. Phytochemical composition of Onion (*Allium cepa*) peel meal

Parameters	Presence
Saponins	+
Tannins	+
Flavonoids	-
Alkaloids	+
Cardiac glycosides	-
Steroids	+
Anthraquinones	-

KEY = - Negative + Positive

Table 2. Proximate composition of onion (*Allium cepa*) peel

Sample	Moisture	Crude protein	Crude fibre	Lipids	ASH	M.E	N.F.E	Calcium	Phosphurus
OPM	115.80	12.15	1.00	1.00	11.05	293.60	59.00	12.15	0.01

KEY: M.E= Metabolizable Energy**, N.F.E=** Nitrogen Free Extract OPM = Onion peel meal

Table 3. Growth performance of broiler finishers fed diets containing graded levels of onion peel meal

Parameters	Levels of onion peel meal inclusion (% or g/kg)				SEM
	T_1:0g/kg	T_2:0.15g/kg	T_3:0.30g/kg	T_4:0.45g/kg	
Initial weights (g/bird)	1,388.42	1,362.12	1,401.38	1,417.63	9.90
Final weights (g/bird)	2,402.37	2,290.33	2,244.63	2,382.00	34.85
Weight Gains (g/bird)	1,013.95	928.22	843.26	964.37	29.24
Feed Intake (g/bird)	3,949.69^{a}	3,814.72^{ab}	3,734.97^{b}	3,701.14^{b}	36.31
F C R	3.90	4.13	4.46	3.87	0.11

$^{a, b}$ Means in the same row with different superscripts are significantly different (P<0.05)

Table 4. Carcass characteristics of the broilers fed with onion peel meal

Parameters	Levels of onion peel meal inclusion (% or g/kg)				S EM
	T1:0g/kg	T2:0.15g/kg	T3:0.30g/kg	T4:0.45g/kg	
Live weights (g)	2402.37	2290.33	2244.63	2382.00	34.85^{NS}
Dressing %	75.82	69.46	63.74	65.74	2.74^{NS}
Carcass components expressed as % of live weight					
Drum Sticks	12.45	11.31	10.33	10.87	0.49^{NS}
Wings	8.59	7.89	7.49	8.18	0.28^{NS}
Back	10.82	10.62	10.05	10.44	1.02^{NS}
Breast	26.85	25.35	22.69	20.47	1.24^{NS}
Head	2.60	2.47	2.47	2.44	0.09^{NS}
Neck	5.19^{a}	4.48^{a}	3.88^{b}	4.46^{ab}	0.21*
Shank	4.06	3.87	3.91	4.32	0.19^{NS}
Gizzard	1.63	1.68	1.79	1.52	0.05^{NS}
Proventriculus	0.46	0.46	0.45	0.46	0.02^{NS}
Liver	2.06	1.93	2.36	2.38	0.12^{NS}
Heart	0.43	0.48	0.52	0.48	0.02^{NS}
Lungs	0.72	0.68	0.55	0.67	0.04^{NS}
Spleen	0.14	0.17	0.12	0.15	0.0^{NS}
Gall bladder	0.10	0.12	0.13	0.13	0.0^{NS}

NS: No significance
^{ab}: means in the same row with different superscripts are significantly different (p<0.05)
SEM: standard error of the mean

CONCLUSION AND RECOMMENDATIONS

From results obtained in this study, it is concluded that onion (*Allium cepa*) peel meal contains valuable nutrients that can be utilized as an additive in diet of broilers chickens. Onion at 0.45g/kg in diet had no adverse effect on their growth response, and seemed to have had positive effects on feed intake. Supplementation of onion peel meal up to 0.45g/kg in the diet of broilers is recommended for farmers since it gave lower feed intake with a resultant better feed conversion ratio. More research should be conducted on the health benefits and organoleptic properties of the resultant meat from the utilization of this hitherto unutilized feedstuff.

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Monogastric Animal Production: MGP 085

GROWTH PERFORMANCE OF WEANED HYBRID STRAINS OF HYLA (HYLA NG AND HYLA MAX) RABBITS *(Oryctolagus cuniculus)*

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ABSTRACT

The study aimed to evaluate the growth performance and predict the adult body weight of weaned Hyla NG and Hyla Max rabbits (Oryctolagus cuniculus) [U44]under controlled feeding conditions. A total of 32 rabbits, comprising 20 Hyla Max and 12 Hyla NG, were monitored from the 7th to the 15th week of age. Weekly body weight measurements, feed intake, feed conversion ratio (FCR), and feed conversion efficiency (FCE) were recorded and analyzed. The performance indices demonstrated that Hyla Max males had the highest final body weight (1.680 kg) and total body weight gain (0.908 kg), with a feed conversion ratio (FCR) of 4.40 and feed conversion efficiency (FCE) of 0.23. Hyla Max males, in particular, demonstrated consistent linear growth and more efficient feed utilization. Correlation and regression analyses revealed that body weight at week 13 was the best predictor of the post-weaning body weight. The regression equation derived from this study provides a practical tool for predicting the future growth of Hyla rabbits, which can aid in effective management and breeding strategies. The findings underscore the importance of selecting the appropriate rabbit strain for optimal growth and feed efficiency, contributing to the sustainability and profitability of rabbit farming.

Keywords: Body-weight prediction, growth performance, Hyla NG, Hyla Max.

DESCRIPTION OF PROBLEM

The human population growth in developed countries is stabilizing while that of developing countries including Nigeria is still increasing rapidly [1]. As a result of this, the demand for protein tends to increase. Therefore, to meet up with the protein requirement of this growing population, searching for more source of protein is imperative. In order to maximize food production and meet protein requirements in Nigeria, viable options need to be explored and evaluated [2]. Rabbits have immense potentials and good attributes which include high growth rate, high efficiency in converting forage to meat, short gestation period, high prolificacy, relatively low cost of production, high nutritional quality of the white meat (low fat, sodium and cholesterol levels). It also has a high protein level of about 20.8% and its consumption is without cultural and religious biases [3].

Rabbit farming in Nigeria boosts economic empowerment with low production costs and rapid multiplication. Investing in rabbit farming can yield high returns and provide valuable nutrition, especially with breeds like New Zealand white, California white, and Hyla suitable for the tropical environment. The focus is on the Hyla breed for they are often referred to as the broiler breed of rabbits. Growth in animals refers to physical development and size increase over time, crucial for livestock productivity. Monitoring growth helps in making right management decisions. Measuring body weight at regular intervals provides valuable information on growth patterns. Data collection on Hyla rabbits' growth aims to increase farmers' acceptance of the breed. Rabbits could be a cost-effective alternative to poultry like chickens. Investigating growth trends in Hyla rabbits in Nigeria is essential for understanding body weight, feed intake, and efficiency. This study evaluates the growth performance of weaned Hyla NG and Hyla Max rabbits under controlled feeding conditions.

The objective of this research was to evaluate the weekly body weight gain of growing Hylamax and Hylang over a period of 9 weeks post-weaning period. Also to determine the feed conversion ratio and the feed efficiency of the Hyla Max and Hyla NG rabbits.

MATERIALS AND METHODS

Experimental Rabbits and the Management

The experiment was carried out at the rabbitry unit of the Teaching and Research farm of Bowen University, Iwo, Osun state, Nigeria (7.6236° N, 4.1890° E). Thirty-two(32) weaned rabbits (20 Hyla Max and 12 Hyla NG) were sourced from a reputable farm in Ilesha, Osun State at 6 weeks of age and the experiment lasted for 9 weeks.

Before the arrival of the rabbits, repairs and fixing of the cages and pen, cleaning, fumigation disinfecting of pen and cages were carried out and strict hygienic practices were carried out on the farm. On arrival, feed, water and multivitamins were administered orally. Routine management practices were carried out daily and these practices involved checking the environment of the pen, mortality, alertness and activeness of the rabbits, sweeping and cleaning of the cages, feeding and watering. The feed was compounded and pelletized for ease of picking for the rabbits. The compounded feed consisted of maize, corn bran, wheat bran, soyabean meal, rice bran, crushed soya, groundnut cake, PKC industrial (Palm Kernel Cake), limestone, lysine, methionine, enzymes, toxin binder and premix. These growing rabbits were fed daily with the pelletized ration and water *ad libitum* in the morning and herbaceous pasture(*Tridax procumbens*, *Moringa oleifera* and Giant star grass) in the evening. Rabbits were reared in

Data collection and Statistical analysis

The body weight of the rabbits was taken weekly using a digital weighing scale and was recorded till the 8th week of the experiment according to sex and breed respectively.

Daily feed intake was also recorded with daily measurement of feed remaining and feed given, this was done for 8 weeks under controlled conditions, and body weight measurements were taken weekly from 7 to 15 weeks of age. Feed conversion ratio (FCR) is the mathematical relationship between the input of the feed that has been fed and the weight gain of a population. The FCR and feed efficiency (FE) were calculated. Correlation and regression analysis were performed to predict the body weight at 15 weeks based on earlier measurements.

The collected data were analysed using the pearson's coefficients of correlation (r) and it was achieved using Statistical Package for the Social Sciences v.20 software.The simple linear regression was analyzed in predicting the 16th week body weight of Hyla Max and Hyla Ng Male and Female Rabbits from 7, 9, 11, 13 and 15 weeks body weight. The regression equation is as follows;

$BWT = B_0 + B_1X_1 + \text{----------} + B_nX_n$----------*(Equation 1)*

Where BWT= Body Weight

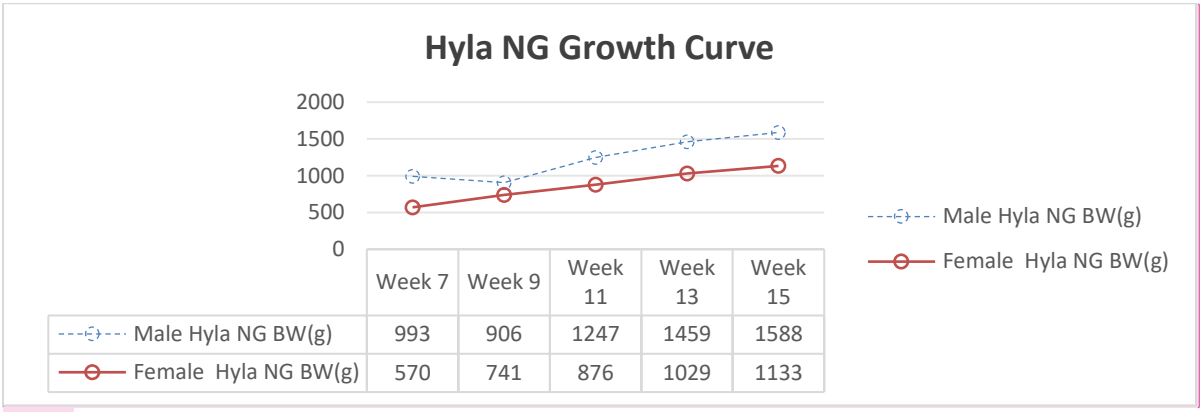
B_o= The Regression Intercept

B_1= The ith Partial regression coefficient of the ith week body weight

RESULTS AND DISCUSSION

Graphical representation of the Hyla NG growth rate patterns for male and female rabbits between week 7 and 15 were presented in figure1. The growth rate increased weekly for the female Hyla NG rabbit and the growth rate reduced in the first weeks for the male Hyla NG rabbit and increased periodically in the following weeks which is evident in the line graph in figure 1. The growth pattern of the male and female Hyla NG rabbit is significantly ($P<0.5$) different from each other between week 7 and week 15.

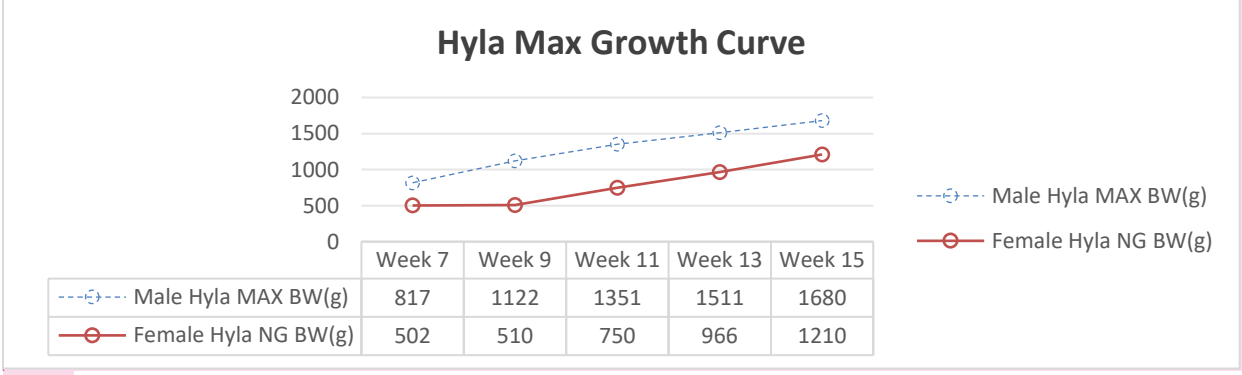
Graphical representation of the Hyla max growth rate patterns for male and female rabbits between week 7 and week 15 were presented in Figure 2. The growth rate for the male rabbits was increasing weekly which is evident in the linear increment of the graph in Figure 2. The growth rate of the female rabbits was increasing weekly which is evident in the linear increment of the graph.



	Week 7	Week 9	Week 11	Week 13	Week 15
Male Hyla NG BW(g)	993	906	1247	1459	1588
Female Hyla NG BW(g)	570	741	876	1029	1133

[U53]

Figure 1: Body weight of male and female of Hyla NG from week 7 to week 15



	Week 7	Week 9	Week 11	Week 13	Week 15
Male Hyla MAX BW(g)	817	1122	1351	1511	1680
Female Hyla NG BW(g)	502	510	750	966	1210

[U54]

Figure 2: Body weight of male and female Hyla Max from week 7 to week 15

Table 1 showed that the Hyla Max Male had higher final body weight and weight gain, indicating the better overall performance. This implies that the Hyla Max is very good at converting feed ingredients to more body weight.The initial body weight of Hyla Max male rabbits, which is 0.772 kg. This means that when these male rabbits were first weighed on arrival, they weighed 0.772 kg on average. The final body weight for the same group of rabbits is 1.680 kg, indicating that they gained 0.908 kg in total body weight.

The total feed intake for Hyla Max male rabbits is 4.00 kg, which is the amount of food they consumed during the study period. The feed conversion ratio for this group is 4.40, which means that for every 4.40 kg of feed consumed, they gained 1 kg of body weight.[U55]These observations of higher weight gain agreed with the observation of previous authors [4;5]. Growth rate and development in rabbit is breed dependent [5] and the interaction with environmental factors such as feed, health status amongst other factors.

Comparing the feed conversion ratio of New Zealand rabbits which is said to use 6.62 kg of feed to gain 1 kg of weight [6] which means that the Hyla Breed of rabbit is better at converting feed into body weight. Also comparing the growth of Hyla strains of rabbit (Max and NG) [7] Hyla Max rabbits had a better growth than the Hyla Ng rabbits.[U56]The feed conversion efficiency for Hyla Max male rabbits is 23%, which indicates how efficiently they converted feed into body weight gain. A higher efficiency value means that the rabbits were able to gain more weight with less feed.

Table 1[U57]**:** Performance Indices of Hyla Max and Hyla Ng Male and Female Rabbits

Parameters [U58]	**Hyla Max Male**	**Hyla Max Female**	**Hyla NG Male**	**Hyla NG Female**
Initial Body Weight (Kg)	0.772	0.543	0.924	0.497
Final Body Weight (Kg)	1.680	1.210	1.588	1.133
Total Body Weight gain (Kg)	0.908	0.667	0.664	0.636
Total Feed Intake (Kg)	4.00	3.70	4.01	3.50
Feed Conversion Ratio (FCR)	4.40	5.52	6.08	5.47
Feed Efficiency (FE)	0.23	0.18	0.16	0.18

CONCLUSION AND APPLICATION

Hyla Max rabbits are superior in growth performance and feed efficiency compared to Hyla NG rabbits according to this research. Week 13 body weight is a reliable predictor for week 15 body weight, aiding in better growth management. Future research should focus on optimizing feeding strategies and exploring other rabbit breeds for comparative analysis.

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BLOOD PROFILE OF GROWING RABBITS FED DIETS CONTAINING RESIDUES FROM THE PROCESSING OF TIGER NUT (*Cyperusesculentus*) MILK

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ABSTRACT

The study examined the blood profile of growing rabbits fed diets containing residues from the processing of tiger nut (*Cyperusesculentus)* milk. Thirty growing rabbits of mixed breeds and sexes used for the experiment were randomly allotted after weighing into 5 dietary treatment groups of 6 replicates per treatments in a Completely Randomized Design (CRD) experiment. The experiment lasted for 8 weeks. Diet 1: Control diet 0% inclusion of tiger nut milk residue (TNMR), Diet 2: 5% inclusion of TNMR, Diet 3: 10% inclusion of TNMR, Diet 4: 15% inclusion of TNMR, Diet 5: 20% inclusion of TNMR. Data were collected on haematology and serum biochemical indices. Data were analyzed using One-Way Analysis of Variance and means were separated by Duncan Multiple Range Test of the same software package at $P<0.05$. The results revealed that MCH concentrations were generally high among group of rabbits fed Tiger Nut Milk Residue Meal (TNMRM) in their diets. ALP, SGPT, Protein, Albumin, Urea and Creatinine were significantly ($P<0.05$) influenced by dietary treatment. PCV, RBC and Hb were lowest in rabbits fed 20% TGN (36.25%, 3.9910^{12}/L and 12.09mg/u) respectively. The values obtained for PVC, RBC and Hb are within the normal range for rabbits.It was concluded that the inclusion of 20%(TNMRM) had no detrimental effect on blood profile of growing rabbits fed diets containing residues from the processing of tiger nut (*Cyperusesculentus*) milk and by implication on health status.

Key words: Tiger nut, Rabbit, Haematology, and Diets.

DESCRIPTION OF PROBLEM

The rapid growth of rabbit industry has increased demand for rabbit feeds which has led to a considerable increase in prices of feedstuffs (1). These multifaceted challenges compelled the concerned researchers to look for alternative ingredients which can fill the gap.Tiger nut *(Cyperusesculentus*) is a monocotyledonous plant and belongs to the family *cyperacage* which is made up of 400 species (2). Tiger nut residues contain high amount of carbohydrate, fibre, soluble glucose and oleic acids (3), which make it a potential source of energy to poultry and livestock (4). Haematological components, which consist of red blood cells, white blood cells or leucocytes, mean corpuscular volume, mean corpuscular haemoglobin and mean corpuscular haemoglobin concentration are valuable in monitoring feed toxicity especially with feed constituents that affect the blood as well as the health status of farm animals (5). There is however dearth of information on how tiger nut milk residue as an alternative feed ingredient affects the blood profile of rabbits, thus the present study aims to fill this scientific information gap. The study investigated the blood profile of growing rabbits fed diets containing residues from the processing of tiger nut (*Cyperusesculentus*) milk meal.

MATERIALS AND METHODS

Location of Experiment: The experiment was carried out at the Rabbit Production Unit ofTeaching and Research FarmLadokeAkintola University of Technology, Ogbomoso, Oyo State, Nigeria.

Test Ingredient: Fresh tiger nuts (*Cyperusesculentus*) milk residues were collected from the local tiger nut production outlets and sundried to about 10-12% moisture before inclusion in the diets.
Experimental Diets: Five experimental diets were formulated as follows; Diet 1: Control diet 0% inclusion of tiger nut milk residue, Diet 2: 5% inclusion of Tiger nut milk residue, Diet 3: 10% inclusion of Tiger nut milk residue, Diet 4: 15% inclusion of Tiger nut milk residue, Diet 5: 20% inclusion of Tiger nut milk residue.
Experimental Animal and Management: Thirty growers of mixed breeds (Giant Black x New Zealand White) and sexes were used for the experiment. The animals were weighed and randomly divided into five (5) dietary treatments of six replicates in a Completely Randomized Design (CRD) experiment.
Data Collection and Analysis: Data were collectedon haematology and serum chemistry at 8 weeks of the experiment. They were analyzed statistically using one–way analysis of variance (ANOVA) of the general linear model of (6) and means were separated using Duncan's multiple range test of the same package.\

Table 1: Composition of Experimental diets

Ingredients (g/100g)	Diet 1 (Control)	Diet 2 (5% TNMRM)	Diet 3 (10% TNMRM)	Diet 4 (15% TNMRM)	Diet 5 (20% TNMRM)
Maize	38.00	33.00	28.00	23.00	18.00
*Fixed ingredients	62.00	62.00	62.00	62.00	62.00
Tiger nut milk residue	0.00	5.00	10.00	15.00	20.00
TOTAL	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated nutrient					
Dry Matter (%)	85.99	85.97	85.95	85.94	85.92
Crude Protein (%)	16.80	16.73	16.67	16.61	16.54
Metabolizable energy (Kcal/Kg)	2409.30	2393.35	2377.40	2361.45	2345.50
Ether Extract (%)	4.418	5.28	6.13	6.99	7.85
Crude Fibre (%)	10.31	10.90	11.49	12.08	12.66
Lysine (%)	0.68	0.67	0.66	0.64	0.63
Methionine (%)	0.67	0.66	0.65	0.64	0.63
Calcium (%)	1.17	1.17	1.18	1.18	1.19
Avail. Phosphorus (%)	0.63	0.63	0.64	0.65	0.65

*Fixed ingredients; Soya Bean Meal: 15.00Kg, PKC: 3.00Kg, Rice husk: 17.00Kg, Wheat offal: 15.30Kg, Corn Brown: 3.50Kg, Corn cobs: 4.00Kg, Bone meal: 3.00Kg, Lysine: 0.30Kg, Methionine: 0.25Kg, Salt: 0.25Kg, Premix: 0.30Kg

RESULTS AND DISCUSSION

The result of the haematological parameters of growing rabbits fed diets containing tiger nut (*Cyperusesculentus*) milk residues is presented in Table 2. The result obtained showed that PCV, RBC, Hh, Heterocytes, Lymphocytes and Monophils were significantly influenced by dietary treatment ($p<0.05$). The amount of PCV, RBC, Hb and heterophils present in the blood were highest in rabbits fed control diet 0% TNMRM (44.75%, $4.9110^{12}/_{L}$ and 14.74mg/μ) respectively while the lowest was recorded for those fed 20% TNMRM (36.25%, $3.9910^{12}/_{L}$ and 12.09mg/μ) respectively. The Packed Cell Volume (PCV) count (36.25-43.88%) obtained in the present study fell within the normal physiological range of (30.00-50.00%) reported by (7) for healthy rabbits, suggesting that TGN was tolerated across the treatment groups. This also agrees with the reports of (8).The red blood cell values obtained in this study falls within the normal range of 4.00-8.60($X10^{12}/_{L}$). (9)Opined that increased RBC values are associated with high quality dietary protein and with disease free animals.The highest value of haemoglobin observed in rabbits fed 5% TGN among those fed tiger nut residue in their diet in the present study suggest a good level of metabolism. This observation suggested that rabbits fed tiger nut residue in the present showed no signs of anaemia.The range for white blood cell (WBC) count obtained in this study ranged between 6.14-10.06 (x106/dl) and fell within the normal range for white blood cell (4.5-11(10g/l) reported by (10). The white blood cell (WBC) count was significantly ($p<0.05$) different among the treatments, with the highest in Diet 2. Higher WBC count may

explain the reason for disease resistance; animals with low white blood cells are exposed to high risk of disease infection, while those with high counts are capable of generating antibodies in the process of phagocytocis and have high degree of resistance to diseases (11).

Table 2: Haematological indices of growing rabbits fed diet containing tiger nut milk residue

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	SEM	P-Value
PCV (%)	44.75^{a}	43.88^{a}	39.13^{bc}	41.88^{ab}	36.25^{c}	0.83	0.02
RBCX10^{12}/$_{L}$	4.91^{a}	4.83^{a}	4.31^{bc}	4.66^{ab}	3.99^{c}	0.09	0.01
Hb (mg/µ)	14.74^{a}	14.73^{a}	13.08^{bc}	14.01^{ab}	12.09^{c}	0.28	0.02
MCH (pg)	30.00	30.54	30.31	30.07	30.27	0.09	0.30
MCV (fl)	91.12	90.96	90.71	89.91	90.80	0.23	0.53
MCHC (%)	32.93^{b}	33.58^{a}	33.42^{a}	33.45^{a}	33.33^{a}	0.07	0.01
WBC (103/µ L	7.31^{bc}	10.06^{a}	6.14^{c}	8.83^{ab}	7.48^{bc}	0.38	0.01
Heterophils (%)	21.38^{a}	17.75^{c}	19.88^{b}	20.25^{ab}	18.38^{bc}	0.35	0.03
Lymphocytes (%)	72.75^{c}	78.13^{a}	74.88^{bc}	74.63^{bc}	76.38^{ab}	0.52	0.02
Esinophils (%)	3.25	1.75	2.63	2.38	3.25	0.21	0.08
Monophils (%)	1.63^{b}	1.00^{c}	1.63^{b}	2.00^{a}	1.63^{b}	0.10	0.03
Basophils (%)	1.00	1.38	1.00	0.75	1.00	0.11	0.50
Platelet (X103/µL)	247.63	240.25	252.88	257.75	251.63	2.94	0.44

^{abc}Means along the same row with different superscripts are significantly different ($p<0.05$)
PC: Packed Cell Volume, WBC: White Blood Cell, Hb: Haemoglobin, RBC: Red Blood Cell, MCH: Mean Corpuscular Haemoglobin, MCV: Mean Corpuscular Volume, MCHC: Mean Corpuscular Haemoglobin Concentration
Diet 1: cont*rol diet*, Diet 2: diet containing 5% Tiger nut milk residue meal, Diet 3: diet containing 10% Tiger nut milk residue meal, Diet 4: diet containing 15% Tiger nut milk residue meal, Diet 5: diet containing 20% Tiger nut milk residue meal

The result of the serum enzymes of growing rabbits fed diets containing Tiger nut *(Cyperusesculentus)* milk residues is presented in Table 3. The result obtained showed that ALP, SGPT, protein, albumin, urea and creatinine were significantly ($p<0.05$) influenced by dietary treatment. Rabbits fed 5% TNMRM had the highest 68.58µ/L ALP while 45.54 µ/L ALP was obtained for those fed 15% TNMRM. The level of SGPT in growing rabbits fed 10 and 15% TNMRM (55.29µ/L and 50.74 µ/L) respectively are statistically similar but higher, than those fed 5% and 20% TNMRM with a lower and similar of 44.91µ/L and 44.04 µ/L respectively, however all the values obtained are within the recommended range by (12) and supported the report of (13).

Table 3: Serum biochemical indices of growing rabbits fed diets containing tigernut milk residue

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	SEM	P-Value
ALP (µ/L)	59.63^{b}	68.58^{a}	50.01^{c}	45.54^{d}	49.55^{c}	1.99	0.02
SGOT (µ/L)	35.15	34.43	28.04	35.74	34.01	1.10	0.17
SGPT (µ/L)	35.28^{b}	44.91^{ab}	55.29^{a}	50.74^{a}	44.04^{ab}	2.17	0.02
Protein (g/L)	56.45^{ab}	58.52^{a}	53.63^{b}	58.54^{a}	53.28^{b}	0.78	0.04
Albumin (g/L)	17.19^{b}	19.69^{a}	15.70^{c}	18.80^{ab}	17.53^{b}	0.39	0.01
Globulin (g/L)	39.26	38.82	37.93	39.74	35.75	0.73	0.49
CHOL (Mg/dL)	60.21	64.44	70.08	64.33	61.30	1.92	0.57
Urea (Mg/dL)	48.27^{b}	54.81^{a}	47.63^{b}	47.85^{b}	52.98^{ab}	1.06	0.07
Creatine (Mg/dL)	2.23^{a}	2.26^{a}	1.86^{b}	1.93^{b}	1.98^{b}	0.05	0.03

^{abc}Means along the same row with different superscripts are significantly different($P<0.05$)
ALP: Alkaline Phosphatase, SGOT: Serum Glutamic Oxalate Transaminase, SGPT: Serum Gluamic Pyruvic TransaminaCHOL: Cholesterol

Diet 1: con*trol diet*, Diet 2: diet containing 5% tiger nut milk residue meal, Diet 3: diet containing 10% tiger nut milk residue meal, Diet 4: diet containing 15% tiger nut milk residue meal, Diet 5: diet containing 20% tiger nut milk residue meal

CONCLUSION AND APPLICATION

It can be concluded that Tiger nut milk residue meal can be included in rabbit diets up to 20% without adverse effects on health status because the blood parameters examined were not negatively affected.
It is thereby recommended for farmers to adopt the inclusion level of 20% or more as investigated in this study.

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HAEMOTOLOGICAL INDICES OF GROWING RABBITS FED GRADED LEVELS OF DRIED DISCARDED CABBAGE LEAVES (*Brassica oleracea var. Capitata*) IN SEMI-ARID REGION OF MAIDUGURI, BORNO STATE

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ABSTRACT

This study evaluated the effects of adding graded levels of dried discarded cabbage leaves (DDCL) on the haematological parameters of growing rabbits. Seventy-five rabbits, aged seven to eight weeks, were divided into five groups and fed diets with DDCL levels of 0%, 5%, 10%, 15%, and 20% for 10 weeks. Each group had three replicates of five rabbits each, with *ad-libitum* access to feed and water. The haematological parameters measured were packed cell volume (PCV), haemoglobin (Hb), red blood cells (RBC), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), and white blood cells (WBC). Results showed no significant differences ($P>0.05$) in PCV, RBC, MCV, or WBC. Significant differences ($P<0.05$) were found in Hb, MCH, and MCHC. The study concluded that up to 20% DDCL in the diet does not negatively impact the haematological parameters of growing rabbits.

Keywords: Haemotology, Growing Rabbit, Discarded, Cabbage, Leaves

DESCRIPTION OF PROBLEM

The global population is projected to reach 16 billion by 2030 and 17.5 billion by 2040, increasing the demand for animal protein and creating a significant challenge for developing countries like Nigeria. Studies by (1,2) indicate that protein intake in these regions is below the FAO recommendation of 35 grams per person per day. To address this issue, focus is shifting towards animals that can efficiently use inexpensive or underutilized feed sources (2,3). Rabbit production is proposed as a solution due to rabbits' high reproductive rate, fast growth, low cost, and ability to utilize various feed sources, including waste (1). Despite these advantages, rabbit breeding in Nigeria is limited by high feed costs, which make up about 70% of production expenses (4). Research suggests that rabbits can thrive on alternative feed ingredients, highlighting the potential for using cost-effective feed sources. Adeyemi *et al.* (5) noted that using vegetable leaves in animal feed can reduce costs, as these leaves often have high protein and mineral content (6). Discarded cabbage (*Brassica oleracea var. capitata*), widely available in Nigeria, could be a viable non-conventional feed for rabbits. It contains beneficial nutrients but also compounds that can affect rabbit health, such as S-methyl-L-cysteine sulphoxide and glucosinolates. While cabbage has been used beneficially for other animals, limited research exists on its optimal inclusion in rabbit diets. This study aims to assess the impact of graded levels of dried discarded cabbage leaves on the haematological and biochemical indices of growing rabbits and determine the optimal dietary inclusion level.

MATERIALS AND METHODS

The study was conducted at the Livestock Unit of the Teaching and Research Farm, Department of Animal Production Technology, Ramat Polytechnic, Maiduguri. Maiduguri is located between latitude 11°5' and 12^0 North, longitude 13°09' and 14^0 East and at an altitude of 354 m above sea level. The area has a semi-arid tropical climate with a wide seasonal diurnal range of temperature. The hottest months are April and May with a temperature range between 39.4 and 40.1 ^{0}C under shade (7). Seventy-five New Zealand white rabbits, aged 6 to 7 weeks, were used in a 12-week feeding trial, preceded by a one-week adjustment period. The rabbits were individually weighed and divided into five groups, with each group replicated three times to ensure uniform average weight. The groups were randomly assigned to five different dietary treatments. Each rabbit were housed individually in a wire cage (33.0 x 38.0 x 45.0 cm) elevated 45 cm above the ground for ease of cleaning. Cages were equipped with plastic drinkers and metal feeding troughs. Experimental diets (mash form) and clean drinking water was available *ad-libitum* throughout the trial. Discarded cabbage leaves were sourced from the Moromoro market in Gamboru, Maiduguri, Borno State. The leaves were chopped into smaller pieces with a local knife to facilitate drying. They were dried at room temperature under a shed for 7-10 days until fully dried. The dried leaves were grounded through a 2-mm screen using grinding machine and analyzed for proximate composition. The ingredient composition and the calculated analysis of the experimental diets are shown in Table 1. The discarded cabbage leaves were incorporated at levels of 0, 5, 10, 15 and 20% in diets 1 (control), 2, 3, 4 and 5, respectively. The diets were formulated to supply 18% crude protein (CP) on dry matter basis. At the end of the experiment three (3) rabbits were randomly selected per treatment fasted overnight and used for blood analysis. Blood samples were collected via the vein into a labelled Ethylene diamine tetra acetic acid (EDTA) treated tubes for haematological analysis. The haematological indices determined include the pack cell volume (PCV), red blood cell (RBC), white blood cell (WBC), haemoglobin (Hb), mean corpuscular volume (MCV), mean corpuscular haemoglobin concentration (MCHC), mean corpuscular haemoglobin (MCH) and white differential counts which include lymphocytes, monocytes, eosinophils and neutrophils. MCV, MCH and MCHC were calculated. PCV was determined by micro haematocrit method, while WBC, RBC and Hb were determined by the improved Neubauer haematocytometer and cyanomethemoglobin respectively. The proximate composition of experimental diets and DDCL and the formulated diets were analysed according to AOAC (2000). The Data collected were subjected to analysis of variance (ANOVA) using General Linear Models Procedure of SAS (version 9.0) to compute means (±standard errors). The means were separated using the Duncan's multiple range tests.

Table 1: Ingredients Composition of the Experimental Diets

	Level of DDCL in the diets (%)				
Ingredients (%)	0	5	10	15	20
Maize	40.98	40.98	40.98	40.98	40.98
Wheat offal	17.00	17.00	17.00	17.00	17.00
DDCL	0.00	05.00	10.00	15.00	20.00
Groundnut cake	23.37	18.37	13.37	08.37	03.37
Fish meal	3.00	3.00	3.00	2.11	3.00
Groundnut haulms	13.00	13.00	13.00	13.00	13.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Common Salt (NaCl)	0.50	0.50	0.50	0.50	0.50
Premix*	0.15	0.15	0.15	0.15	0.15
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Analysis					
Crude protein (%)	18.61	18.31	18.27	18.11	18.06
Crude fibre (%)	13.21	14.67	15.79	16.88	17.57
Ash (%)	3.23	3.39	4.52	4.42	4.61
Metabolizable Energy (Kcal/Kg)	2567.67	2566.26	2469.73	2454.76	2443.12

** Premix (grow fast) manufactured by Animal Care Service Consult (Nig) Ltd. Lagos, Supplied the following per kg of premix: Vitamin A, 5000,00 IU; Vitamin D_3 800,000 IU; Vitamin E, 12,000 mg; Vitamin K, 1,5000*

mg; Vitamin B_1, 1,000 mg; Vitamin B_2, 2,000 mg, Vitamin B_6, 1,500 mg; Niacin, 12,000 mg; pantothenic acid, 20.00 mg; Biotin,10.00 mg; Vitamin B_{12}, 300.00 mg; folic acid, 150,000 mg; choline, 60,000 mg; manganese, 10,000 mg; iron;15,000 mg, zinc 800.00 mg; Copper 400.00 mg; Iodine 80.00 mg; cobalt 40 mg; selenium 8,00 mg.
DDCL= Dried Discarded Cabbage Leaves

RESULTS AND DISCUSSION

Table 2 presents the proximate composition of dried discarded cabbage leaves (DDCL) and experimental diets. DDCL contained 11.0% dry matter, 8.75% crude protein, 11.9% crude fibre, 16.7% ether extract, 1.89% ash, 25.6% nitrogen detergent fibre, and 23.1% acid detergent fibre. In comparison, the experimental diets ranged from 90.71% to 91.00% dry matter, 19.08% to 19.77% crude protein, 13.21% to 17.57% crude fibre, 3.80% to 4.20% ether extract, 3.23% to 4.61% ash, 27.54% to 29.48% nitrogen detergent fibre, and 17.09% to 19.22% acid detergent fibre. The crude protein in the diets decreased with higher DDCL inclusion. Despite this, the experimental diets' composition was within the NRC (8) and Ibrahim *et al.* (9) recommendations and aligns with findings by Abdullah et al. (10).

Table 3 shows the haematological responses of rabbits fed diets with graded DDCL levels. The values for PCV, Hb, RBC, MCV, MCH, and MCHC ranged from 42.00% to 44.08%, 10.61 to 12.10 g/dl, 7.02 to 7.52 ×10^6 /L, 30.66 to 31.92 fl, 17.68 to 19.90 pg, and 64.56% to 66.58%, respectively. WBC, lymphocytes, monocytes, neutrophils, basophils, and eosinophils ranged from 10.82 to 12.36 ×10^6 /L, 51.28% to 52.51%, 1.20% to 1.44%, 33.21% to 33.96%, 0.58% to 0.84%, and 4.11% to 5.07%, respectively. Except for RBC and Hb, all parameters were not significantly (P>0.05) affected by DDCL inclusion. All values were within the reference range by Ozkan *et al.* (11). The PCV above 30% indicates no anemia (12), and the RBC values slightly increased significantly from diet 1 to 5. Hb, MCH, and MCHC values reflect bone marrow efficiency in producing red blood cells (13). WBC and its differentials were not significantly affected by DDCL inclusion, consistent with Ahemen *et al.* (14) but differing from Jiwuba *et al.* (15).

Table 2: Proximate Analysis of DDCL and Experimental Diets

		Compositions				
Parameters	**DDCL**	**T1**	**T2**	**T3**	**T4**	**T5**
Dry matter	89.0	91.33	91.00	90.71	90.82	90.94
Crude protein	18.7	19.77	19.49	19.36	19.19	19.08
Crude fibre	18.1	13.21	14.67	15.79	16.88	17.57
Ether extract	4.97	3.8	3.86	3.93	4.0	4.2
Ash	7.04	3.23	3.39	4.52	4.42	4.61
Nitrogen detergent fibre	22.0	27.54	28.01	28.66	28.99	29.48
Acid detergent fibre	15.4	17.09	17.87	18.43	18.95	19.22

Table 3: Haematological parameters of growing rabbits fed graded levels of DDCL

	Treatments					
Parameters	**T1**	**T2**	**T3**	**T4**	**T5**	**SEM**
Pack cell volume(%)	42.00	43.90	44.08	43.91	43.22	7.18^{ns}
Haemoglobin(g/dl)	10.61^{c}	10.90^{b}	11.54^{ab}	11.62^{a}	12.10^{a}	1.44^{*}
RBC($\times10^6$/L)	7.02^{b}	7.10^{b}	7.33^{ab}	7.28^{ab}	7.52^{a}	0.36^{*}
MCV(fl)	30.66	30.92	30.09	31.85	31.92	6.21^{ns}
MCH(pg)	17.68	17.99	19.53	19.74	19.90	3.02^{ns}
MCHC(%)	64.56	64.91	66.23	66.42	66.58	5.91^{ns}
WBC($\times10^6$/L)	10.82	11.64	11.09	11.78	12.36	1.90^{ns}
Lymphocytes(%)	51.28	51.54	51.78	51.99	52.51	7.56^{ns}
Monocytes(%)	1.44	1.32	1.22	1.20	1.30	0.73^{ns}
Neutrophils(%)	33.21	33.42	33.68	33.84	33.96	4.91^{ns}
Basophils(%)	0.58	0.61	0.70	0.77	0.84	0.18^{ns}

Eosinophils(%)	4.11	4.49	4.54	4.96	5.07	1.33^{ns}

a,b,c= means bearing different superscripts within the same row are significantly different (P<0.05). ns= no significant difference WBC= White blood cells; MCV= Mean corpuscular volume; MCH= Mean corpuscular haemoglobin; MCHC= Mean corpuscular haemoglobin concentration; RBC= Red blood cell; WBC; White blood cell

CONCLUSION

The blood parameters measured showed significant differences. It could therefore be concluded with the fact that haematological parameters were within the normal range, DDCL could be efficiently utilized and tolerated by growing Rabbits up to 20% inclusion level without any harmful effect on the health status of the animal.

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Monogastric Animal Production: MGP 088

DOSE RESPONSE OF SEVEN-DAY OLD BROILER CHICKENS TO ADDITIVE FROM *CHROMOLAENA ODORATA* LEAF EXTRACT

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ABSTRACT

One hundred and fifty (150), day-old Ross 308 broiler chicks were used todetermine the seventh day performance of broiler chickens offered different doses of additive produced from *Chromolaena odorata* extract in drinking water. The chicks were divided into five groups of thirty (30) each and three replicates of 10 chicks each per group. The groups were randomly assigned to five doses of the additive in a completely randomized design (CRD) experiment as follows: T1 (0.00 ml) control, T2 (5.00 ml), T3 (10.00 ml), T4 (15.00 ml), and T5 (20.00 ml) each per litter of drinking water administered in the morning only. Feed and water were offered *ad libitum* during the 7 day duration of the study. Broiler chickens on T3 (10.00 ml) group had the highest final body weight (103.20 g) body weight gain (63.87 g), and feed conversion ratio (1.49) which were, however similar (P>0.05) to those in T1 (0.00 ml) and T2 (5.0 ml) group. Feed cost per kg body weight gain (₦555.05) was significantly (P<0.05) lower in T3 than other groups. Birds on the T4 (15.00 ml) and T5 (20.00 ml) had significantly poorer (p<0.05) final body weight (91.60g and 91.06 g), body weight gain (52.06and 51.67 g), respectively.Administration of 10.00 ml of additive produced from *C. odorata* leaf extract per litre of drinking water of broiler chicken would appear to improve important growth parameters of 7-day old broiler chickens.

Key words: *Chromolaena odorata*, broiler chicken, additive, leaf extract, drinking water.

DESCRIPTION OF PROBLEM

Phytogenic additives have been routinely used to attempt the improvement of feed utilization in broiler chickens even with balanced diet (1) in form of feed additives such as leaf meals or extracts, these include *Chromolaena odorata*. *Chromolaena odorata* (Siam weed, Christmas bush, Elizabeth weed, Independent weed or Awolowo)have multipurpose properties,the leaves are rich sources of protein and micro and macro minerals (2), with proximate composition of 18.7% crude protein, 11.7% crude fibre, 3.63% Ash, 1.01% ether extract and 65% nitrogen free extract (3), indicating high levels of essential primary nutrients (4). Broiler chickens however, show low tolerance to dietary fibre, and therefore high levels of leaf meal compromises nutrient digestibility and growth performance (5).

Extraction and isolation of specific components of the green leaf is therefore inevitable to overcome this drawbacks (6). Again, to use the extract continuously, there is the need for more efficient extraction, preservation and sweetening. This predicated the production of additive from *Chromolaena odorata*leaf extract by (7). This additive has not been evaluated at different doses in drinking water, particularly, at the early growth stage of broiler chickens.

MATERIALS AND METHODS

Additive produced from *Chromolaena odorata* leave extracts and Experimental Diet

The additive from *C. odorata* leave extract was produced by the microwave assisted extraction method using methanol as the medium of extraction, with sodium benzoate as preservative and Aspartame as sweetener (7).One experimental starter broiler diet was formulated and produced as follows: Maize, 50.0%; Soyabean meal, 32.0%; Whaet offal, 5.0%; Fish meal,4.0%; Bone meal, 2.0%; Oyster shell, 1.0%; Vitamin/mineral premix, 0.25%; Common salt, 0.25%; Methionine, 0.25% and Lysine, 0.25%. The calculated nutrient composition of experimental starter broiler chicken diet was Metabolisable energy, 2803.48 Kcal/kg; Crude protein, 23.20%; Ether extract, 4.032; Crude fibre, 4.532%, Calcium, 1.314; Phosphorus, 1.185; Methionine, 0.414; Lysine, 1.241

Experimental Design and Management of Experimental Chicks

One hundred and fifty, day-old Ross 308 broiler chicks were divided into five groups of thirty chicks each, the groups were replicated thrice with 10 birds per replicate on weight equalization basis. The groups were then randomly assigned to five doses of the additive in a completely randomized design (CRD) experiment as follows: T1 (0.00 ml) served as control treatment. T2 (5.00 ml), T3 (10.00 ml), T4 (15.00 ml), and T5 (20.00 ml) each per litter of drinking water administered in the morning. Feed and water were offered *ad libitum* and recommended vaccines were administered during this study which lasted for 7 days.Data on the initial body weight at day-old, final body weight at seven day-old, daily feed intake were obtained using an electronic scale, feed conversion ratio, feed cost per kg and feed cost per kg body weight gain were calculated and mortality recorded on replicable basis. On the seventh day of the study, 15 chicks (one chick per replicate) whose weight were closest to the mean of each treatment were selected, slaughtered, and eviscerated to determine the GIT length using a body measuring tape the full and empty gizzard and crop were also weighed using an electric scale.

Statistical Analysis

Means of data collected were organized and subjected to analysis of variance (ANOVA). Where means were significantly different, they were separated using the Duncan's New Multiple-range Test (DNMRT) (8).

RESULTS AND DISCUSSION

Seventh day performance of broiler chickens treated with additive produced from *Chromolaena odorata* leaves extracts

The results (Table 1) indicated that there were no significant (p<0.05) differences in initial body weight, feed cost per kg and mortality.

Final body weight and body weight gain: Chicks on T1, T2 and T3, produced similar (p>0.05) final body weight and body weight gain which were significantly(P<*0.05*) higher than those on T4 and T5. Chicks on T3 however recorded the highest values which differed fromthe report of (9) reported which indicated optimal valuewith water extracted additives.

Feed intake: Chicks on the control (T1) recorded the highest feed intake though the value was similar (P>0.05) to other treatments except T5 values. Feed intake did not follow any discernable pattern but T4 recorded the least feed intake which was comparable (P>0.05) to chicks on T2 and T5.

Feed conversionratio: Birds on T2, T3 and T4 recorded comparable (P>0.05) FCR however, those of T3 produced the best and significantly better FCR than those on the control. Birds on T5 recorded the poorest FCR though similar (P>0.05) to the control. It appears that 10.0mls of additive from *Chromlaena odorata*leaves extract is optimal for broiler chicks in their first week of growth. This result agrees with earlier reports that aqueous extracts and leave meals of phytogenic plants cold improve the performance of broiler chicken (9,10).

Internal Organ Weight and Gastrointestinal Tract Length of Seven day- old Broiler Chickens on Additive Produced from C*hromolaena odorata* Leaf Extract

This resultsis presented in Table 3.

Live weight: Chicks on T1, T2 and T3 recorded similar (p>0.05) liveweights. Chicks on T5 had the least liveweight while chicks in T3 recorded the highest liveweight.

Crop weight: Chicks on T4 and T5 recorded the least and highest full crop weights. Full crop weights were similar (P>0.05) among chicks on T1, T2 and T3. Empty crop weight indicated significantly (P<0.05) lower values (0.00 – 0.68%) among birds on additive than the control (1.32%). An empty crop stimulates a chicken appetite, and a full crop is a signal to the bird to stop eating. According to (12) crop fill rates are measured as an indirect means of assessing management during the brooding phase.

Table 1. Performance of seven-day old broiler chicken on additive from *Chromolaena odorata* leaf extract

Parameters	Dose of additive from *Chromolaena odorata* (mls)					SEM
	T1(0.0)	T2 (5.0)	T3 (10.0)	T4 (15.0)	T5(20.0)	
Initial body weight (g)	39.43	39.43	39.33	39.40	39.40	0.08
Final body weight (g)	102.07^{a}	100.33^{a}	103.20^{a}	91.60^{b}	91.06^{b}	2.01
Body weight gain (g)	62.64^{a}	60.90^{a}	63.87^{a}	52.06^{b}	51.67^{b}	2.03
Feed intake (g)	102.70^{a}	94.10^{ab}	95.30^{a}	76.03^{b}	84.93^{ab}	2.92
Feed conversion ratio	1.64^{b}	1.55^{ab}	1.49^{a}	1.55^{ab}	1.67^{b}	0.04
Feed cost per kg (₦)	373.35	373.35	373.35	373.35	373.35	0.01
Feed cost per kg body weight gain (₦)	612.29^{a}	579.94^{b}	555.05^{c}	578.69^{b}	624.74^{a}	13.80
Mortality (%)	0.00	0.00	0.00	0.00	0.00	0.00

^{abc} Means within a row with different superscript differ significantly ($p<0.05$)

Feed cost per kg body weight gain: Feed cost per kg body weight gain (₦) decreased significantly (p<0.05) with increasing dose of the additive up to T3, suggesting that the optimal dose of the additive per litre of water is 10mls.

Table 2. Internal organ weight and gastrointestinal tract length of seven-day old broiler chicken on additive produced from *Chromolaena odorata* leaf extract.

Parameters (% live weight)	Levels of additives per litre of water (mls)					
	T1 (0.0)	T2 (5.0)	T3 (10.0)	T4 (15.0)	T5(20.0)	SEM
Live weight (g)	100.00^{a}	96.67^{ab}	101.33^{a}	92.00^{b}	90.00^{b}	2.08
Full crop weight	3.31^{b}	4.72^{ab}	3.32^{b}	2.84^{c}	5.99^{a}	0.53
Empty crop weight	1.32^{a}	0.65^{b}	0.63^{b}	0.00^{c}	0.68^{b}	0.25
Full gizzard weight	8.68^{b}	9.07^{a}	8.54^{b}	8.75^{b}	9.66^{a}	0.35
Empty gizzard weight	5.77^{a}	5.56^{ab}	4.60^{b}	4.37^{b}	5.88^{a}	0.30
Gastrointestinal tract (cm)	41.00^{c}	47.73^{a}	40.67^{c}	42.50^{b}	43.50^{b}	1.20

^{abc} Means within a row with different superscripts differ significantly ($p<0.05$)

Gizzard weight: Full and empty gizzard weights were highest for chicks on T5 and lowest on those in T3.. There was however no discernable pattern for the empty gizzard. Full gizzard weights were comparable (P>0.05) among chicks of T1, T3 and T4 while the empty gizzard showed similarity among chicks in T2, T3 and T4. The gizzard aids digestion by particle reduction chemical degradation of nutrients and regulation of feed flow (13) making it important in improving performance.
Gastrointestinal tract (GIT) length: Birds on the T1 and T3 recorded significantly (P<*0.05*) shorter GIT length than other groups. The length of the GIT is a very important indicator of the capacity of the chick to process feed (14).

CONCLUSION AND APPLICATION

Results obtained in this study indicated that 10mls of additive produced from leave extract of *Chromolaena odorata* per litre of water produced the highest final body weight and body weight gain, best feed conversion ratio and lowest fed cost per kg bodyweight gain among chicks raised to 7 days. It is recommended that

additive produced from *Chromolaena odorata* leave extract by microwave assistance using methanol as media could be added to the drinking water of broiler chicken at 10 mls per litre up to seven days of age.

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HEAMATOLOGY AND SERUM BIOCHEMISTRY OF GROWING RABBITS FED GRADED LEVELS OF CLOVE (*Syzygium aromaticum*) MEAL.

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ABSTRACT

The experiment evaluated the health condition of rabbits whose diets were supplemented with clove. 24 rabbits, averagely weighing 2.5kg at six to eight months were used for the experiment. The rabbits were weighed individually and randomly assigned into 4 treatments in a completely randomized design and were individually caged with each buck serving as a replicate. Commercial feed was gotten from the market and clove was added at graded levels of 0g/kg, 2g/kg, 4g/kg and 6g/kg as T1, T2, T3 and T4 respectively. All data were analyzed using Statiscal Package for Social Sciences (SPSS 2016). Significant difference among means was separated using Tukey. Results obtained from Heamatological study showed Packed cell volume, Red blood cell, white blood cell and lymphocyte were all significant ($P<0.05$) falling within the recommended values, with Monophils, Eosinophils and Basophils having no significant ($P>0.05$) difference. The serum biochemical result showed significant ($P<0.05$) differences in Total Bilirubin, Conjugated Bilirubin, AST, ALT, ALP and total protein while Albumin and Globulin showed no significant ($P<0.05$) differences. It was therefore concluded that clove was not deleterious to the health of rabbits animal and therefore recommended at 2g/kg of feed for proper production.

Key words; Rabbit, clove, hematology and serum biochemistry

INTRODUCTION

The rabbit, (*oryctolagus cuniculus*) is a valuable intermediate species that falls between ruminant and non-ruminant animals. It can adequately utilize feed that is high in cellulose when fed in rations that contain less than 20% grain (15). They are important livestock that contribute to the production of meat and protein in Nigeria due to their rapid growth rate, high potential for reproduction, and capacity to use forage (11). The feed efficiency of rabbits is slightly lower than that of poultry due to their simple biological characteristics, short breeding cycle, high prolificacy, and high feed conversion efficiency (9).

The inappropriate use of antibiotics in livestock production has resulted in multiple drug resistance, antimicrobial resistance, and hazardous residues in livestock products. This has spurred research into creating feed additives that are safer and more natural, enhancing productivity, boosting immunity, and lowering mortality and other illnesses in both humans and animals (4).

Plants and their extracts are being used in animal nutrition as appetizers, digestive and physiological stimulants and antioxidants for the prevention and treatment of certain pathological conditions due to the presence of phytochemicals in them (7).

Clove (*Syzygium aromaticum*) has a number of recognized medicinal benefits, such as reducing pain, enhancing digestion, guarding against internal parasites, and having antifungal properties (6). Among all the spices, clove (*Syzygium aromaticum*) continues to attract interest because of its strong antioxidant and antimicrobial properties (17). A wide range of physiologically active substances, including polyphenols, catechin, epicatechin, epigallocatechin, epicatechin gallate, and 7 apigallocatechin-3 gallate (20), are also present in clove. These substances all exhibit high levels of free radical scavenging activity (21). Therefore, it is essential to identify feed ingredients linked to a lower risk than in-feed antibiotics in order to lower animal mortality and enhance the quality of animal products. This has prompted a thorough search for substitutes, including phytogenic plants (18; 13). Herbs have garnered attention as alternative additives in the hunt for alternatives to antibiotic growth promoters (AGP), which the European Union currently prohibits (12).

MATERIALS AND METHODS

The experiment was conducted at the Rabbit unit of Professor Abdul Lawal Saulawa Teaching and Research farm of the Department of Animal Science, Faculty of Agriculture Federal University Dutsin-Ma, Kastina State. The laboratory evaluation was conduction at the laboratory of the Department of Animal science.

Experimental animals and management

For the experiment, 24 rabbits, weighing 2.5 kg on average at six to eight months of age, were used. Each rabbit was weighed separately, and using a completely randomized design, they were divided into 4 treatments at random. Each rabbit had its own cage with unlimited access to food and water. Throughout the experiment, all management procedures were closely followed. Commercial feed was purchased from the market, and before feeding the rabbit for six weeks, clove powder was added and properly mixed at graded levels of 0g/kg, 2g/kg, 4g/kg, and 6g/kg as T1, T2, T3, and T4, respectively.

Measurement of blood parameters

Blood collection

On week six of the study, blood samples were taken from each replicate. Using the technique described in (19), the jugular vein was punctured, allowing blood to freely flow into sterile, labeled universal bottles. Each treatment group's pooled samples were split into two groups. For the hematological profile, a 10 ml sample was first collected over labeled sterile universal bottles containing 1.0 mg/ml ethylene diamine tetra-acetic acid (EDTA). Samples for Serum chemistry were determined after another 10 ml of blood samples were drawn into plain bottles (without EDTA) and centrifuged at 2500 ×g for 15 minutes.

Determination of haematological profiles and serum chemistry

Haemoglobin concentration (Hb) was estimated using the cyanomethaemoglobin method (14). Packed cell volume (PCV), red blood cell count (RBC), and lymphocyte were determined using a Wintrobe micro-haematocrit tube according to (16). Differential counts of monotrophils, lymphocytes, eosinophils and basophils were determined according to (10).

Serum parameters were determined following standard procedures. Total serum protein, albumin and globulin were determined by the bromocresol purple method (3). Alanine serum transaminase (ALT) and Aspartate serum transaminase (AST) were analyzed spectrophotometrically using the Randox® diagnostic cholesterol kit. Alkaline phosphatase (ALP) activity was measured calorimetrically using commercial clinical diagnostics kits (ELItech, France).

RESULTS AND DISCUSSION

The results showed significant ($P<0.05$) differences in Pcv, Hb, Rbc, Wbc and Lymphocyte. Similar values were recorded across the treatment in Pcv and Hb, having 33.33% and 12,67g/dl respectively at T2. It was observed that the valve obtained fall within the standard range of Pvc (30-40%) according to (8) and Hb (10-13g/dl) for 1-3 months and (10-17g/dl) for adults (5). Wbc and Rbc were also significant ($P<0.05$) with Wbc being highest at T3 and Rbc at T4. All other treatments were observed to be similar and fell within the

same range. Lymphocytes were significant (P<0.05) with highest at T3. Monophils, Eosinophil and Basophil were not significant (P>0.05) and statistically the same. The blood serum biochemical parameters indicated significant (P<0.05) differences in total bilirubin, conjugated bilirubin, AST, ALT, ALP and total protein among the group levels. This result is supported by (2,1) who fed varying levels of water spinach, pigeon pea seed meal to rabbits and obtained the same result as both in haematological and serum biochemical parameters.

Table 1: Haematological parameters of growing rabbits fed graded levels of clove

Parameter	T_1	T_2	T_3	T_4	p – value
PCV (%)	30.67 ± 1.16^{ab}	33.33 ± 1.53^{a}	30.67 ± 2.08^{ab}	27.00 ± 2.00^{b}	0.014
Hb (g/dl)	10.67 ± 1.16^{ab}	12.67 ± 1.53^{a}	8.87 ± 0.81^{b}	7.93 ± 0.40^{b}	0.003
WBC ($\times 10^9$/l)	6.63 ± 0.55^{ab}	6.20 ± 0.26^{b}	12.30 ± 1.53^{a}	6.97 ± 0.25^{b}	0.000
RBC ($\times 10^{12}$/l)	60.00 ± 3.00^{a}	60.00 ± 2.00^{b}	52.33 ± 2.51^{b}	62.33 ± 2.51^{a}	0.006
Lymphocyte (%)	38.67 ± 1.53^{ab}	37.67 ± 2.52^{ab}	44.00 ± 4.00^{a}	34.33 ± 4.04^{b}	0.036
Monophils (%)	1.67 ± 0.58^{a}	2.67 ± 0.58^{a}	2.67 ± 0.57^{a}	1.67 ± 0.57^{a}	0.095
Eosinophils (%)	0.33 ± 0.57^{a}	2.00 ± 1.00^{a}	0.67 ± 0.58^{a}	1.33 ± 0.58^{a}	0.080
Basophils (%)	0.67 ± 0.58^{a}	0.33 ± 0.58^{a}	1.00 ± 0.00^{a}	0.33 ± 0.58^{a}	0.363

Means with different superscript on the same row differ significantly (P<0.05), Hb - Heamoglobin, RBC - Red blood cells, WBC - white blood cells, PCV - packed cell volume.

Table 2: Serum biochemical indices of growing rabbits fed graded levels of clove

Parameter	T_1	T_2	T_3	T_4	significant – value
Total Bilirubin (mol/l)	1.00 ± 0.00^{b}	1.33 ± 0.58^{b}	1.33 ± 0.58^{b}	9.67 ± 0.58^{a}	0.000
Conjugated Bilirubin (µl)	0.00 ± 0.00^{a}	0.00 ± 0.00^{a}	0.00 ± 0.00^{a}	0.67 ± 0.58^{a}	0.052
SGOT (AST) (µl)	8.00 ± 0.00^{b}	10.67 ± 1.16^{a}	11.00 ± 1.00^{a}	12.00 ± 0.00^{a}	0.001
SGPT(ALT) (µl)	11.00 ± 1.00^{ab}	12.00 ± 0.00^{a}	9.67 ± 0.58^{b}	10.00 ± 0.00^{b}	0.004
ALP (µl)	124.67 ± 5.03^{c}	160.33 ± 1.53^{ab}	169.67 ± 1.53^{a}	1.53 ± 6.2^{b}	0.000
Total Protein (g/l)	6.00 ± 0.00^{b}	7.00 ± 0.00^{ab}	7.00 ± 0.00^{ab}	8.33 ± 1.58^{a}	0.035
Albumin (g/l)	3.67 ± 0.58^{a}	4.00 ± 0.00^{a}	4.00 ± 0.00^{a}	4.00 ± 0.00^{a}	0.441
Globulin (g/l)	1.67 ± 0.58^{a}	2.33 ± 0.58^{a}	2.67 ± 0.58^{a}	2.33 ± 0.57^{a}	0.268

Means with different superscript on the same row differ significantly (P<0.05), ALP- Alkaline Phosphatase, AST Aspartate Transaminase, ALT Alanine Transaminase,

CONCLUSION AND RECOMMENDATION

The findings showed that clove can be fed to rabbit 2g/kg inclusion level without any detrimental effect on the haematological, biochemical and general wellbeing of the rabbit

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Monogastric Animal Production: MGP 090

EFFECT OF TURMERIC AND BLACK PEPPER SUPPLEMENTATION ON GROWTH PERFORMANCE AND COST BENEFIT ANALYSIS IN BROILER CHICKENS

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ABSTRACT

Indiscriminate use of antibiotics in livestock and poultry farming has caused emergence of new pathogenic strains and resistance to other strains. This situation warranted the development of alternative safe growth promoters and immunity enhancers in livestock production. Phytogenic additives in animal and bird feed is a centuries-old practice. Thus, this study investigated the efficacy of turmeric (Curcuma longa) and black pepper (Piper nigrum) as a natural growth promoter poultry feed additive. The study was designed on 112 day old chicks, assigned into four groups. Control group (T1) kept on basal diet only and groups T2, T3 and T4 fed with 0.5g/kg[Ma60], 0.5g/kg black pepper and 0.5g/kg turmeric +0.5g/kg black pepper respectively on top of the basal diet for 42 days in a completely randomized design (CRD). Each dietary group consisted of four replicates with 7 birds. Body weight, feed intake, cost Analysis were investigated. The growth performance result revealed that there were significant (P<0.05) differences in final weight [Ma61]while initial weight, weight gain, feed intake and feed conversion ratio were not statistically (P>0.05) affected. The cost analysis showed significance (P<0.05) differences in total feed cost per kilogram and total feed cost per kilogram weight gain. It could be concluded that T4 had the best final weight [Ma62]values followed by T3, also economically, T4 and T3 diet had less total feed cost per kilogram diet.

Keywords: Tumeric, Black pepper, Growth performance, Phytobiotics[Ma63]

INTRODUCTION[Ma64]

Dietary antibiotic growth promoters have played a key role in animal and poultry production. However, most of these antibiotics have been banned in many countries, particularly the European Union, because of public health concern regarding their residues in the animal products and the development of antibiotic resistance in bacteria (1.; 2). Presently, there is an increasing of interest to find non-synthetic alternatives for antibiotics between the scientists. Phytogenic feed additives such as herbs and spices are commonly incorporated into the diets of agricultural livestock, particularly swine and poultry, to improve flavor and palatability, therefore enhancing productive performance (3). Herbs and spices are well identified to exert potent antimicrobial properties in vitro against various pathogens, and as alternative feeding strategy to replace antibiotic growth promoters (4; 5; 6; 7). However, our knowledge regarding their modes of action and aspects of their application is still limited.

Black pepper (*Piper nigrum*) is a flowering vine extracted from the core of a pepper plant, and belongs to the family Piperaceae, genus Piper and species Piper nigrum. Black pepper has been shown to be rich in glutathione peroxidase and glucose-6-phosphate dehydrogenase (8). The antioxidant and radical scavenging properties of black pepper seeds have been well documented (9). Furthermore, it is an active alkaloid modulate benzopyrene metabolism through cytochrome P450 which is essential for metabolism and transport of xenobiotics and metabolites (10), enhances thermogenesis of lipid (11), and increases the flow of digestive juice (12).

Turmeric (Curcuma longa[Ma65]) is an extensively used spice, food preservative and coloring material which has biological actions and medicinal applications (5). The active and main ingredient found in turmeric is curcumin, which was found to have antioxidant (13) and antibacterial activities (14). Additionally, (15) proved the protective effect of turmeric as feed additives on aflatoxin induced mutagenecity and hepato-carcinogenicity Specific collaborative effects of herbal mixture on chicken performance have not received much attention (17). Brenes and Roura (18) suggested that certain interactions of botanicals need to be examined because of the complexity regarding the number and variability of bioactive compounds.

MATERIALS AND METHODS

EXPERIMENTAL SITE

The experiment was conducted at the Professor Lawal Abdu Saulawa, Livestock Teaching and Research Farm, Federal University Dutsin-ma (FUDMA), in the Sudan Savannah ecological zone. The area lies between latitude 12°27'18'N and Longitude 7°29'29E, and 605 meters above sea level. With an annual rainfall of 700mm, spread from May to September. The mean annual temperature range is from 29°-31°C. The highest air temperature normally occurs in April to May and lowest in December through February. Evapotranspiration is generally high throughout the year. The highest amount of evaporation occurs during the dry season. The vegetation of the area is the Sudan Savannah type which combines the characteristics species of both Guinea and Sahel Savannah. The farm is located at the outskirt of Dutsinma town, approximately 4km from the take-off campus

EXPERIMENTAL DESIGN AND MANAGEMENT OF BIRDS

One hundred and twelve (112), day old broiler chicks were mass brooded for 7 days after which they were weighed and adjusted for weight then allotted to four treatments consisting of 7 chicks per replicate and 4 replicates per treatment. T1 was basic diet while T2 was have 0.5 gram/kg of Tumeric, T3 was 0.5 gram/kg of black pepper, and T4 was 0.5 gram/kg of turmeric+ 0.5 gram/kg black pepper. The design of the experiment was a Completely Randomized Design (CRD).

The birds were reared on deep litter system with feed and water provided during the experimental period and the experiment was lasted for 5 weeks.

Table 1: Composition of the experimental Diet

Feed Ingredient	Starter	Finisher
Maize	54.00	57.00
Soyabean meal	35.00	32.00
Fish meal	2.65	2.30
Soya oil	4.00	2.50
Dicalcium phosphate	1.50	1.50
Premixes	0.25	0.25
Limestone	2.00	2.00
Methionine	0.20	2.00
Lysine	0.20	0.20
Salt	0.20	0.25
Total	100	100
Calculated Analysis		
Crude protein (%)	22:40	2080
Metabolizable Energy (Kcal/kg)	3010	28.97
Fat g/kg	35.20	35.04
Crude fibre g/kg	36.59	35.10
Calcium g/kg	13.36	12.92
Total phosphorus g/kg	7.15	6.82
Non-phytate p, g/kg	3.86	3.79
Ca:NPP	3.46	3.41

Composition of premix per kg of diet: Vitamin A, 12500 I.U; vitamin D3, 255000 I.U; vitamin K3, 2mg; vitamin B1, 3mg; vitamin B2, 5.5mg; calcium pantothenate, 11.5mg; vitamin B12, 0.025mg; choline, chloride, 500mg; folic acid, 1mg; biotin, 0.08mg; manganese, 120mg; iron, 100mg, zinc, 80mg; copper, 8.5mg; iodine, 1.15mg; cobalt, 0.3mg; selenium, 0.12mg; anti-oxidant, 120mg. Over the top inclusion of 0.5g, 0.5g and 0.5g+ 0.5g were added for tumeric, black pepper and turmeric and black pepper respectively.

SOURCE OF EXPERIMENTAL BIRDS.

One hundred and twelve (112) of Ross 308 were purchase from OLAM Integrated Farm Hatchery for this study.

DATA COLLECTION

Growth Performance

Initial weight of birds was taken before the commencement of the trail, final weight were taking on the date of termination of the experiment. Feed intake were recorded by subtraction the left over from the feed offered, weight gain were calculated by subtraction initial weight from final weight. Feed conversion ratio was calculated by dividing feed intake over body weight gain of the birds and recorded accordingly.

Feed Cost Analysis

Total cost of feed were calculated by summing the cumulative expenses occur in different diet formulation
Cost of Feed per KG (CF/Kg) = Total cost of feed in treatment ÷ Total feed produce in Kg
Total cost of feed per Kilogram weight gain = Total cost feed ÷ Weight gain

STATISTICAL ANALYSIS

The Data that was obtained from the experiment was subjected to the analysis of variance (ANOVA) using SAS (2012) software package. Significant differences among treatment means will be [Ma66]compared using Duncan's multiple range test.

RESULT AND DISCUSSION

Effect of Turmeric and black pepper on Growth performance of Broiler Chicken

The result on the effect of turmeric and black pepper on growth performance of broiler chicken were presented in table 4.2[Ma67] below. The result revealed that there were no significant (P>0.05) differences in initial weight of chickens and this may be attributed to homogenous nature of birds weight and weight balancing before the commencement of this trail to reduce the possibility of experimental error. The result on final weight revealed that there were significant (P<0.05) differences where birds in T4 had the highest final weight of 1235g followed by T1 (1225g) followed by T3 (1215g). [Ma68]

Table 2: Effect of Tumeric and black pepper on Growth performance of Broiler Chicken

Parameter	T1	T2	T3	T4	SEM	LOS
Initial weight (g)	460.8	462.9	466.4	462.2	3.52	NS
Final weight (g)	1225^{a}	1155^{b}	1215^{a}	1235^{a}	21.21	*
Wight gain (g)	764.2	715.0	748.6	772.8	41.0	NS
Feed intake (g)	3900	3775	3875	3875	91.9	NS
FCR	2.550	2.655	2.590	2.505	0.175	NS
TFC/Kg (₦)	397.2^{b}	400.1^{a}	397.1^{b}	397.1^{b}	0.046	*
TFC/Kg WG	957^{b}	970^{b}	1064^{ab}	1179^{a}	69.9	*
TCF/Kg/Bird	62.72	57.14	59.60	59.10	4.18	NS

^{abc} = Mean with different superscript differs significantly, FCR= Feed conversion ratio, TFC/Kg = Total feed cost/kg, TFC/Kg WG = Total feed cost/kg weight gain, TCF/Kg/bird = Total cost of feed/kg/bird, SEM = Standard error means, LOS = Level of significance.

The result revealed that there were significant (P<0.05) differences in total feed cost per kg diet in which T2 had higher feed cost ₦400.1 followed by T1 (₦397.2) while T3 and T4 had a similar feed cost of ₦397.1

each[Ma69]. The result were however, showed that total feed cost per kg weight gain indicated significant (P<0.05) differences where T4 had the highest value followed by T3, T2 while T1 [Ma70]had the lowest total feed cost per Kg weight gain. Tumeric and black pepper supplementation were found not statistically (P>0.05) influenced weight gain of the birds across the treatment groups, however there are considerable numerical variation were birds in T4 had the highest weight gain value (772.8g) while lowest value were recorded in T2 (715.0g).The result further showed that there were no significant (P>0.05) differences in feed intake and feed conversion ratio.

CONCLUSION

Based on the findings from this research it can be concluded that Turmeric and black pepper can safely be added to the poultry diet at the inclusion level of up to 0.5g/kg individually and combined without any detrimental effect on the performance of broiler finisher.[Ma71]

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Monogastric Animal Production: MGP 091

EFFECT OF FERMENTED PHYTOGENICS BLEND EXTRACTS ON GROWTH PERFORMANCE AND CARCASS CHARACTERISTICS OF FINISHER BROILERS

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ABSTRACT

The experiment evaluates effect of fermented phytogenics blend extracts on growth performance and carcass characteristics of finisher broilers. Total of one-hundred and twenty birds were used for the trial that lasted 42 days. The phytogenic blend extracts were mixed with drinking water at; Treatment 1 (control) with synthetic drugs; antibiotics and coccidia, treatment 2, contained 10 ml of blend extract in 1 litre of water, treatment 3 contained 20 ml in 1 litre, treatment 4 contained, 30 ml in 1 litre and treatment 5, 40 ml in 1 litre for three consecutive days in a week. Results, Highest total weight gain value of 2758.60g was recorded for treatment 4 with 30 ml/1 litter while least value of 2596.46g was recorded from treatment 2 that received 10ml /litter. Survivability was impaired in treatment 4 with value of 91.67%. Least ($P<0.05$) value of 1.92 was recorded from T4 and thus accepted to have utilize the diet better. Significant higher ($P<0.05$) dressing percentage value of 71.69% was recorded from T5 that received highest dosage concentration of fermented phytogenic blends of ginger and garlic. Values recorded for primal cuts of economic importance like drum stick, thigh and breast muscle were significantly ($P<0.05$) higher for the groups that received phytogenic blends when compare to the control group with least values. The study concludes that fermented phytogenic blend extracts of ginger and garlic improved growth performance and higher carcass yield when compared to the control with medications.

Keywords; Blend, Extract, Fermented, Performance, Phytogenics

DESCRIPTION OF PROBLEM

Pathogenic alternative is to maintain a low mortality rate, a good level of animal yield while preserving environment and consumer health. Much research has been carried out to look for natural agents with similar beneficial effects of growth promoters and there is indeed a number of non- therapeutic alternatives that can substitute antibiotic use. Among these, the most popular are probiotics, enzymes, organic acids, immunostimulants, bacteriocins, bacteriophages, phytogenic feed additives, phytocides, nano particles and essential oils **(1)**. Alternative growth promoters such as phytogenic plants are added to poultry diets to improve utilization of nutrients. Their positive effects can be expressed through improved feed intake, body weight gain, feed conversion ratio (FCR) and stimulation of body immunity. Some herbs can support the digestive enzymes action; improve feed intake, feed conversion ratio (FCR) and carcass yield **(2)**. One of the natural alternatives to antibiotic which has been found to increase performance in poultry is ginger **(3)**. Herbs such as garlic are a commonly used spice which has been reported to have beneficial effects on the physiology and growth performance of chickens **(4)**.

MATERIALS AND METHODS

The experiment was carried out at the Poultry Unit Teaching and Research Farm, Federal College of Agriculture Ishiagu, Ebonyi State, Nigeria. One kilogram (1kg) each of ginger rhizomes and one kilogram (1kg) of garlic were separately trodden into small pieces using electric blender and was fermented in 500mls of beer in non-metallic jar for 24 hours. After 24 hours 350grams of organic brown sugar was added to give the microbes energy to continue the fermentation process that lasted 10 days. On the 11th day, active ingredients in the fermented samples therein were arrested with 500mls alcohol with minimum 40% concentration and allow to ferment for another 10 days. After the 10th day, the mixtures were extracted using a cheese cloth and now mixed together (v/v) to get ginger - garlic extract blends as described by **(5)**. The phytogenic extract blends were mixed in the birds drinking water at; Treatment 1 was the control (with synthetic drugs; antibiotics and coccidia), treatment 2 contained 10 ml of the blend extract in 1 litre, treatment 3 contained 20 ml in 1 litre, treatment 4 contained 30 ml in 1 litre) and treatment 5 contained 40 ml in 1 litre for three consecutive days in a week **(6)**. Two (2) diets were formulated for starter and finisher stages respectively based on the nutritional requirement of the birds and as recommended by **(7)** the diets composition is as shown in Table 1.

Total of one-hundred and twenty (120) day old broiler chicks (Ross - 308 strain) were used for this experiment. The birds were randomly group into five (5) treatments of three (3) replicates and each replicate contained eight (8) birds, which makes it a total of twenty-four (24) birds per treatment. The trial commenced on the first week and lasted for forty-two days (42 days). The experiment was laid down in a completely randomized design (CRD). At the end of the experiment data were collected for carcass analysis. Data collected were analyzed by one-way analysis of variance using SPSS (23) software and means were compared using Duncan's Multiple Range Test of the same package and considered significant if $P<0.05$.

Table 1: Composition of Experimental Broiler Diets

Ingredients	Starter	Finisher
Maize	55.00	57.00
Soy oil	1.50	2.00
Soybean	36.00	28.50
Wheat offal	2.15	7.20
Fish	3.00	2.50
Dicalcium Phosphate	0.60	0.20
Limestone	1.00	2.00
Salt	0.25	0.20
Premix	0.25	0.30
Methionine	0.25	0.10
Total	**100.00**	**100.00**
Calculated values		
ME (kcal/kg)	3199.09	3201.94
Crude protein (%)	22.52	20.12
Ether extract (%)	3.65	3.64
Crude fibre (%)	4.16	4.20
Lysine (%)	1.27	1.09
Methionine (%)	0.55	0.41
Calcium (%)	1.01	1.04
Phosphorus (%)	0.57	0.46

ME = Metabolizable Energy

RESULTS AND DISCUSSION

Highest and significant ($P<0.05$) total weight gain value of 2758.60g was recorded for treatment 4 with 30 ml of fermented ginger and garlic concentration in 1 litter of water while least value of 2596.46g was

recorded from treatment 2 that received 10ml /litter. Average total feed intake value per bird was highest in the control group (treatment 1) while least feed intake was recorded from treatment 4 with 5604.49g per bird. One hundred percent (100%) survivability was recorded across the treatment groups except in treatment 4 where survivability was 91.67%. Water intake decreased ($P<0.05$) progressively as extract concentration increased across the treatment groups (4200.00mls – 2850.00mls). Highest ($P<0.05$) feed conversion ratio value of 2.36 was recorded from the control group while least value of 1.92 was recorded from treatment 4 and thus accepted to have utilize the diet better. Improved feed efficiency recorded from the groups that received fermented ginger and garlic extract concentrations in the present study corroborates the report of **(8)** that reported reduction in feed conversion ratio in broiler birds using phytogenic plants. Higher survivability observed in the present study has earlier been reported in broiler birds by **(9)** using phytogenic blends of scent leaf, ginger and garlic.

Table 2: Effect of Phytogenic Blends on Growth Performance of Finisher Broiler

Parameters	T1	T2	T3	T4	T5	SEM
Initial body weight (g)	160.21^{ab}	157.29^{bc}	165.00^{a}	153.96^{c}	159.38^{abc}	**0.98**
Final body weight (g)	2771.66^{bc}	2753.75^{c}	2858.33^{ab}	2912.56^{a}	2782.92^{bc}	**15.43**
Total weight gain (g)	2611.15^{bc}	2596.46^{c}	2693.33^{ab}	2758.60^{a}	2623.54^{bc}	**15.64**
Av. daily weight gain (g)	373.07^{bc}	370.92^{c}	384.52^{ab}	394.09^{a}	374.79^{bc}	**2.23**
Av. total feed intake (g)	6549.79^{a}	6016.87^{bc}	6271.66^{ab}	5604.49^{d}	5839.79^{cd}	**70.85**
Av. daily feed intake (g/d)	109.85^{bc}	109.19^{c}	113.27^{ab}	115.74^{a}	110.34^{bc}	**0.63**
Average water intake (ml)	4200.00^{a}	3816.67^{b}	3416.67^{c}	3233.33^{c}	2850.00^{a}	**99.28**
Survivability (%)	100.00^{a}	100.00^{a}	100.00^{a}	91.67^{b}	100.00^{a}	**0.64**
Feed conversion ratio	2.36^{a}	2.16^{b}	2.19^{b}	1.92^{c}	2.10^{b}	**0.02**

^{abc} Means with similar superscripts along the same row are not significantly ($P > 0.05$) different

Table 3: Effect of Phytogenic Blends on Carcass and Organ Characteristics of Finisher Broiler

Parameters	T1	T2	T3	T4	T5	SEM
Live weight (g)	2746.67^{c}	2853.33^{b}	2933.33^{ab}	2916.67^{ab}	2966.67^{a}	**16.07**
Bled weight (g)	2248.67^{a}	2223.33^{a}	2049.67^{c}	2146.67^{b}	2214.67^{a}	**37.62**
Defeathered wt (g)	2178.00^{b}	2359.00^{a}	2335.00^{a}	2244.00^{ab}	2340.33^{a}	**17.76**
Eviscerated wt (g)	1910.60^{bc}	2057.73^{a}	2005.97^{ab}	1880.50^{c}	2010.00^{ab}	**15.61**
Carcass wt (g)	1790.80^{c}	1823.63^{c}	1973.57^{b}	2061.00^{ab}	2126.57^{a}	**22.46**
Dressing %	65.19^{bc}	63.82^{c}	67.36^{b}	70.68^{a}	71.69^{a}	**0.54**
Primal Cuts						
Drum stick	258.80^{b}	270.20^{ab}	288.90^{a}	282.70^{a}	274.37^{ab}	**2.82**
Thigh	287.20^{bc}	287.27^{bc}	330.73^{a}	282.43^{c}	302.47^{b}	**3.27**
Breast Muscle	581.00^{c}	674.40^{b}	583.73^{c}	662.00^{b}	718.43^{a}	**8.63**
Wing	194.40^{c}	198.60^{bc}	208.27^{b}	234.47^{a}	210.00^{b}	**2.46**
Back	345.17^{b}	374.67^{a}	366.93^{ab}	282.70^{c}	274.37^{c}	**6.98**
Neck	121.06^{c}	132.13^{b}	144.13^{a}	128.30^{bc}	129.30^{b}	**1.43**
Shank	73.66^{b}	72.43^{b}	91.97^{a}	85.23^{a}	73.40^{b}	**4.90**
Head	29.93^{a}	30.23^{a}	34.77^{a}	14.07^{b}	37.90^{a}	**1.70**
Heart	8.73^{c}	10.40^{b}	11.63^{ab}	12.00^{a}	10.67^{ab}	**0.22**
Gizzard (close)	43.03^{b}	41.03^{b}	44.03^{b}	41.83^{b}	51.77^{a}	**0.72**
Gizzard (empty)	29.77^{bc}	29.00^{c}	30.87^{bc}	33.47^{ab}	35.37^{a}	**0.59**
Liver	33.67^{d}	37.73^{c}	38.63^{bc}	40.17^{a}	38.83^{b}	**0.34**
Gut length	216.00^{a}	218.67^{a}	218.33^{a}	212.67^{ab}	209.33^{b}	**0.87**

^{abc} Means with similar superscripts along the same row are not significantly ($P > 0.05$) different

Values recorded for primal cuts of economic importance viz drum stick, thigh and breast muscle were significantly (P<0.05) higher for the groups that received phytogenic blends when compare to the control group with least values. The result of the present study with progressive increase in carcass weight disagree with report of **(10)** that there are no indications of significant beneficial effects of phytogenic feed additives in terms of carcass yield. This study corroborates the results of **(11)** that supplementation with plant extracts enhanced the breast muscle proportion of the eviscerated carcass by only 1.2% when compared with the control group.

CONCLUSION AND APPLICATION

From the result of the present study, it could be concluded that fermented phytogenic blend extracts of ginger and garlic resulted in superior growth performance and higher carcass yield when compared to the control group that received synthetic medications. Improvement in performance observed for the groups that were offered phytogenic blends ascertained the ethno-medicinal potency of both ginger and garlic. However, the bioactive compounds in the plants (ginger and garlic) that resulted in the positive results obtained in this study might have been made available (extracted, undenatured and entrapped) through the processing method of fermentation.

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Monogastric Animal Production: MGP 092

EFFECT OF PHYTOGENICS BLEND EXTRACTS ON HAEMATO-SERUM OF FINISHER BROILERS

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ABSTRACT

The experiment evaluates effect of phytogenic blend extracts on haematology and serum biochemistry of finisher broilers. Total of one-hundred and twenty birds were used for the trial that lasted 42 days. The phytogenic blend extracts were mixed with drinking water at; Treatment 1 (control) with synthetic drugs; antibiotics and coccidia, treatment 2, contained 10 ml of blend extract in 1 litre of water, treatment 3 contained 20 ml in 1 litre, treatment 4 contained, 30 ml in 1 litre and treatment 5, 40 ml in 1 litre for three consecutive days in a week. The experiment was laid down in a completely randomized design (CRD). Results; haematological parameters evaluated were significantly ($P<0.05$) influenced by the dosage concentration of fermented phytogenic blends except white blood cell. Highest haemoglobin value of 7.76g/dl was recorded for T5 while least value of 5.95g/dl was recorded for T2. Red blood cell value of 2.33 $x10^6$µ/l was recorded for T5 while least value of 1.72 $x10^6$µ/l was recorded for T3. Total serum protein, globulin and high density lipo-protein values increases significantly ($P<0.05$) as dosage concentration increases while values recorded for urea, cholesterol, triglyceride, low density lipo-protein, aspartate aminotransferase, alkaline aminotransferase, alkaline phosphatase all decreases as dosage concentration reduces across the treatments. It was concluded that fermented phytogenic blend of ginger and garlic extracts has no deleterious effect on the health of the broiler birds when compared with the control group.

Keywords; Blend, Fermented, Haematology, Phytogenics, Serum.

DESCRIPTION OF PROBLEM

In pursuit of improved chicken health and the need to fulfil consumer expectations in relation to food quality, poultry producers commonly utilize natural feeding supplements, mainly herbs **(1)**. Garlic (*Allium sativum*) was reported by **(2)** to possess allicin, alliin, dithiin, ajoene, diallylsulfide, and S-allylcysteine. Ginger (*Zingiber officinale*) contains compounds such as gingerdoine, gingerdiol and gingerol **(3)**. Garlic (*Allium sativum*) may be a useful additive in poultry nutrition, due to its antioxidant, antibacterial, anti-inflammatory, antiseptic, anti-parasitic and immuno-modulatory properties **(4)**. Garlic has been reported to possess anti-oxidative potentials which may help to lower or prevent incidences of cancer development in body tissues as reported by **(5)**. Serum biochemical parameters have been reported to provide valuable information on the immune status of the animal **(6)**. Haematology is the scientific study of the natural functions and disease of blood. Haematological indices are those factors in the blood whose level is usually determined in order to assess the degree of well-being of animal which also provides valuable information on the immune status of animals as reported by **(7)**. According to **(8)**, both parameters can help to provide further information to support results obtained in growth performance studies in broiler chickens.

MATERIALS AND METHODS

The experiment was carried out at the Poultry Unit Teaching and Research Farm, Federal College of Agriculture Ishiagu, Ebonyi State, Nigeria. One kilogram (1kg) each of ginger rhizomes and one kilogram (1kg) of garlic were separately trodden into small pieces using electric blender and was fermented in 500mls of beer in non-metallic jar for 24 hours. After 24 hours 350grams of organic brown sugar was added to give the microbes energy to continue the fermentation process that lasted 10 days. On the 11th day, active ingredients in the fermented samples therein were arrested with 500mls alcohol with minimum 40% concentration and allow to ferment for another 10 days. After the 10th day, the mixtures were extracted using a cheese cloth and now mixed together (v/v) to get ginger - garlic extract blends as described by **(9)**. The phytogenic extract blends were mixed in the birds drinking water at; Treatment 1 was the control (with synthetic drugs; antibiotics and coccidia), treatment 2 contained 10 ml of the blend extract in 1 litre, treatment 3 contained 20 ml in 1 litre, treatment 4 contained 30 ml in 1 litre) and treatment 5 contained 40 ml in 1 litre for three consecutive days in a week **(10)**.

Two (2) diets were formulated for starter and finisher stages respectively based on the nutritional requirement of the birds and as recommended by **(11)** the diets composition is as shown in Table 1. Total of one-hundred and twenty (120) day old broiler chicks (Ross – 308 strain) were used for this experiment. The birds were randomly group into five (5) treatments of three (3) replicates and each replicate contained eight (8) birds, which makes it a total of twenty-four (24) birds per treatment. The trial commenced on the first week and lasted for forty-two days (42 days). Data were collected on Haematological indices and serum biochemistry. The experiment was laid down in a completely randomized design (CRD). Data collected were analyzed by one-way analysis of variance using SPSS (23) software and means were compared using Duncan's Multiple Range Test of the same package and considered significant if $P<0.05$.

Table 1: Composition of Experimental Broiler Diets

Ingredients	Starter	Finisher
Maize	55.00	57.00
Soy oil	1.50	2.00
Soybean	36.00	28.50
Wheat offal	2.15	7.20
Fish	3.00	2.50
Dicalcium Phosphate	0.60	0.20
Limestone	1.00	2.00
Salt	0.25	0.20
Premix	0.25	0.30
Methionine	0.25	0.10
Total	**100.00**	**100.00**
Calculated values		
ME (kcal/kg)	3199.09	3201.94
Crude protein (%)	22.52	20.12
Ether extract (%)	3.65	3.64
Crude fibre (%)	4.16	4.20
Lysine (%)	1.27	1.09
Methionine (%)	0.55	0.41
Calcium (%)	1.01	1.04
Phosphorus (%)	0.57	0.46

ME = Metabolizable Energy

RESULTS AND DISCUSSION

All parameters evaluated were significantly (P<0.05) influenced by the dosage concentration of fermented phytogenic blends of ginger and garlic extract except white blood cell. Highest (P<0.05) packed cell volume value of 28.99% was recorded for treatment 5 that received highest dosage concentration while least value of 25.95% was recorded for T1 (control) that received synthetic drugs; antibiotics and coccidia. Highest haemoglobin value of 7.76g/dl was recorded for treatment 5 while least value of 5.95g/dl was recorded for treatment 2. Significant (P<0.05) and highest red blood cell value of 2.33 x10^6µ/l was recorded for treatment 5 while least value of 1.72 x10^6µ/l was recorded for treatment 3. Values recorded for mean corpuscular parameters did not follow any definite order.

Haematological indices are a reflection of the effects of dietary treatments on the animal in terms of the type, quality and amounts of the feed ingested and available for the animal to meet it's physiological, biochemical and metabolic necessities **(12)**. The packed cell volume values obtained in the present study showed that birds in all treatments were in the normal range of 22-33%, according to **(13). (14)** opined that since packed cell volume is responsible for transporting absorbed nutrients, and oxygen, an increased level could lead to better transportation and thus resulting in an increased primary and secondary polycythemia. Higher haemoglobin concentration recorded in the present study for groups that received higher dosage concentration of ginger and garlic has earlier been reported by **(15)** where phytogenic extract has significantly (P<0.05) increased haemoglobin values compared to the control group. Lower haemoglobin concentration had been reported **(16)**, the latter due this decreases in Hb to the presence of some hemolytic bioactive constituents or their metabolites in garlic. The values of 17.97 – 25.33 x 10^6µ/l observed for white blood cells were in normal range 9 – 34 x10^6µ/l reported by **(13)**. White blood cell values lie between the normal range of clinical birds and thus informs that the birds are capable of generating antibodies in the process of phagocytosis and have high degree of resistance to diseases and enhance adaptability to local environmental and disease prevalent conditions according to **(14)**.

Table 2: Effect of Phytogenic Blend Extracts on Haematology of Finisher Broilers

Parameters	T1	T2	T3	T4	T5	SEM
Packed Cell Volume (%)	25.95^{c}	27.14^{b}	28.92^{a}	27.79^{b}	28.99^{a}	**0.22**
Haemoglobin (g/dl)	6.50^{c}	5.95^{d}	6.75^{c}	7.16^{b}	7.76^{a}	**0.11**
Red Blood Cell (x10^6µ/l)	2.13^{b}	1.90^{c}	1.72^{d}	2.21^{ab}	2.33^{a}	**0.04**
White Blood Cell (x10^3µ/l)	22.57	22.58	22.51	22.51	22.72	**0.08**
Mean Corpuscular Volume (fl)	125.66^{b}	146.37^{a}	154.89^{a}	128.47^{b}	153.47^{a}	**2.62**
MCH (pg/cell)	21.77^{b}	23.00^{a}	22.57^{a}	22.58^{a}	22.51^{a}	**0.09**
MCHC (pg/cell)	305.23^{d}	313.39^{cd}	392.45^{a}	324.09^{bc}	334.13^{b}	**5.42**

^{abcd} Means with similar superscripts along the same row are not significantly (P > 0.05) different
MCH = Mean Corpuscular Haemoglobin
MCHC = Mean Corpuscular Haemoglobin Concentration

Table 3: Effect of Phytogenic Blend Extracts on Serum Biochemistry of Finisher Broilers

Parameters	T1	T2	T3	T4	T5	SEM
Total protein (g/dl)	3.12^{a}	3.24^{c}	3.63^{b}	4.00^{a}	4.00^{a}	**0.04**
Albumin (g/dl)	1.77^{a}	1.77^{d}	1.82^{c}	1.93^{a}	1.88^{b}	**0.01**
Globulin (g/dl)	1.35^{a}	1.64^{d}	1.82^{c}	2.04^{b}	2.12^{a}	**0.03**
Urea (mg/dl)	10.59^{a}	9.45^{b}	9.38^{c}	8.38^{d}	6.96^{c}	**1.13**
Creatinine (mg/dl)	0.91^{a}	0.87^{b}	0.84^{d}	0.85^{c}	0.71^{a}	**0.00**
Cholesterol (mg/dl)	132.66^{a}	118.90^{b}	115.48^{c}	110.30^{d}	105.30^{e}	**1.38**
Triglyceride (mg/dl)	160.15^{a}	155.53^{ab}	148.35^{bc}	146.95^{bc}	140.89^{c}	**1.74**
HDL (mg/dl)	159.52^{c}	168.41^{b}	169.44^{b}	171.04^{b}	179.95^{a}	**1.66**
LDL (mg/dl)	45.69^{a}	45.35^{a}	41.11^{ab}	37.27^{b}	37.98^{b}	**0.87**
Aspartate Aminotransferase (u/l)	84.13^{a}	82.58^{b}	81.39^{c}	80.80^{d}	80.73^{d}	**0.22**
Alkaline Aminotransferase (u/l)	49.43^{a}	47.72^{b}	45.67^{c}	45.36^{c}	43.65^{d}	**0.28**

Alkaline Phosphatase (u/l)	62.32[a]	60.19[b]	60.16[b]	58.45[c]	58.38[c]	**0.23**

[abc] Means with similar superscripts along the same row are not significantly (P > 0.05) different

Total protein, globulin and high density lipo-protein values increases significantly (P<0.05) as dosage concentration increases while values recorded for urea, cholesterol, triglyceride, low density lipo-protein, aspartate aminotransferase, alkaline aminotransferase, alkaline phosphatase all decreases as dosage concentration increases across the treatments. Progressive decline in serum cholesterol and triglycerides in this research corroborates the report of **(17)** that garlic supplementation lowered serum cholesterol and triglycerides while it also increases total protein and high-density lipoprotein level. **(18)** stated that certain compounds in garlic can inhibit cholesterol synthesis, resulting in the lowering of serum cholesterol, triglycerides and increase in HDL level. The result of this research might have been influenced by the active ingredients in garlic and ginger that has ability to reduce the total cholesterol by inhibiting the synthesis of harmful LDL cholesterol and by increasing beneficial HDL cholesterol in the blood.

CONCLUSION AND APPLICATION

From the result of the present study, it was concluded that fermented phytogenic blend of ginger and garlic extracts has no deleterious effect on the health of the broiler birds when compared with the control group that received synthetic medications; antibiotics and coccidiostat. However, Treatment 4 and 5 that received higher dosage concentration seems to record an improved health status. Hence higher dosage concentration of either 30ml or 40ml per litter of water is recommended for usage in broiler production. Furthermore, the potency of ginger and garlic blend extract should be further assessed using other poultry birds.

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Monogastric Animal Production: MGP 093

EFFECTS OF MONKEY POD (*Albizia saman*, Jacq. Merr.) LEAF MEAL-BASED DIETS ON PERFORMANCE AND CARCASS TRAITS OF BROILER CHICKENS

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ABSTRACT

The Monkey pod (*Albizia saman*) is rich in bioactive compounds with potential antioxidant and hepatoprotective properties, offering a promising solution to mitigate the negative impacts of high-energy diets. Therefore, this study was conducted to evaluate the effect of monkey pod leaf meal supplemented diets on the performance and carcass characteristics of broiler chickens. Two hundred (200) unsexed one- day old Ross 308 broiler chicks were randomly assigned to five dietary treatments with five replicates of eight birds each in a completely randomized design. Treatment 1 was low fat diet (basal diet) without supplementation while treatment 2 had high fat diet without choline chloride. Treatment 3 contained high fat diet with choline chloride, while treatments 4 and 5 were supplemented with 1.5% and 3.0% *Albizia saman* leaf meal, respectively in a study that lasted for 42 days. Performance indices were evaluated. At day 42, two birds per replicates were sacrificed for carcass evaluation. Data were subjected to ANOVA at 5% significance level. The results showed that birds fed with high fat diet without choline supplementation had the highest weight (2163.40 g/b) compared to those on the basal (1936.67 g/b) and 1.5% *Albizia saman* leaf meal supplementation (1812.71g/b) diets. A lower feed conversion ratio was recorded in birds fed high fat diet without choline supplementation (1.15) compared to other treatments. The back (17.63%, 14.59%) and thigh (9.88%, 11.84%) weights of birds that received high fat without or with choline supplementation, respectively, were similar to other treatments. It can be concluded that supplementing broiler chickens diets with *Albizia saman* leaf meal at 1.5% inclusion improved the performance and carcass traits of the birds.

Keywords: Plant leaf meal, Growth response, Carcass yield, Broiler chicken

DESCRIPTION OF PROBLEM

High-energy ration is necessary in broiler production for rapid growth and metabolism. Energy sources like animal fat, soyabean oil or both are recommended to use at 2-5% inclusion level in broilers rations for optimal growth (1, 2). However, this could lead to excessive deposition of fat in adipose tissues with resultant negative effect on the liver which could cause a fatty liver syndrome (3). In order to circumvent the occurrence of fatty liver syndrome in poultry production, choline chloride has been employed to improve fat utilization (4). But it has been reported that 70% of the synthetic choline (choline chloride) supplemented in poultry diet was not absorbed in the gastrointestinal tracts of the birds, but rather converted to a toxic (trimethylamine) substance by intestinal bacteria (5), which is poisonous to the birds tissues when absorbed by small intestine into the blood stream (6). However, it has been reported that many medicinal plants contain significant level of choline and they can be supplemented as substitute to synthetic choline compound in poultry nutrition (7). These medicinal plants are less hygroscopic, do not produce deleterious compound in the intestinal tracts compared to synthetic choline, and also has synergistic effect with other molecules available in the nutrients. Monkey pod (*Albizia saman*), a leguminous multi-purpose has been reported to have natural compounds that possess antioxidant properties, which can help in reducing oxidative stress and protecting cells from damage caused by free radicals (8).

MATERIALS AND METHODS

Experimental site and preparation of test materials: The study was conducted at the Poultry unit, Teaching and Research farm, University of Ibadan, Ibadan, Oyo state, Nigeria.
The *Albizia saman* leaves were collected from *Albizia saman* trees growing around, University of Ibadan campus. The leaves were further dehydrated for 14 days to decrease the moisture content and to facilitate easy milling and also prevent it from getting mold. The leaves were then milled by hammer mill to produce meal.

Experimental animal, experimental design and management
Two hundred (200) unsexed one-day old (Ross 308 strain) commercial broiler chickens purchased from a reliable hatchery were used for the study. The chicks were randomly allotted into five treatments with five replicates 8 birds each in a completely randomized design. The chicks were reared in a deep litter for a feeding trial that lasted for 42 days. The experimental diets were formulated to meet the nutrient requirements (9) for broiler chickens {CP: 23.74%, 2951.51.00 ME (Kcal/kg) for Pre-starter diet, CP: 21.12%, 3000.25 ME (Kcal/kg) for Starter diet and, CP: 19.01%, 3095.33 ME (Kcal/kg) for Finisher diet} respectively, Birds had access to the experimental diets and water *ad libitum.*

Experimental layout
Treatment 1: Positive control (Low fat basal diet, without supplementation)
Treatment 2: Negative control (High fat diet without choline)
Treatment 3: High fat basal diet with choline chloride (different levels of choline chloride (1700mg/kg, 1600mg/kg, 1500mg/kg)
Treatment 4: High fat basal diet + 1.5% *Albizia saman* leaf meal supplementation
Treatment 5: High fat basal diet + 3.0% *Albizia saman* leaf meal supplementation

Data Collection
Growth parameter: Weekly body weight and feed consumption of the birds in each replicate were recorded. These values were used to estimate the feed conversion ratio and body weight gain.

Carcass Yield: On day 42, two birds from each replicate were randomly selected for carcass assessment.

Statistical Analysis: Data obtained were analyzed using analysis of variance (ANOVA) of SAS (10) and significant difference among means was separated using Tukey's HSD at 5% probability level.

RESULTS AND DISCUSSION

Table 1 shows the overall performance, no significant variation observed ($P>0.05$) in feed intake and liveability of the birds on the experimental diets. However, birds fed with high fat diet without choline supplementation had the highest weight (2163.40 g/b) compared to those on the basal (1936.67 g/b) and 1.5% *Albizia saman* leaf meal supplementation (1812.71g/b) diets. A similar trend was observed in the average daily weight gain of the birds. A lower feed conversion ratio was recorded in birds fed high fat diet without choline supplementation (1.15) compared to other treatments. The lower growth performance observed with the birds fed high fat diets supplemented with 3.0% of *Albizia saman* leaf meal may be caused by low feed consumption and the birds' incapability to utilise the dietary nutrients due to anti-nutritional factors like saponin and tannins that may affect digestion and absorption of nutrients. This agrees with the result linked to impaired growth performance caused by dietary anti-nutrients reported by Kumar *et al*. (11). The results of the present study also aligns with Donkoh *et al*. (12) on anti-nutrients effects of tannins in dried cashew nut testa using laboratory rats.

The result of carcass yield of broiler chickens fed *Albizia saman* leaf-meal based diets is presented on Table 2. Diet had no significant influence on the weight of drumstick across the treatment groups. The dressed weight of birds on high fat + choline (1693.4g) was significantly higher ($P<0.05$) that those on the basal diet

(1355.2g). The back (17.63%, 14.59%) and thigh (9.88%, 11.84%) weights of birds that received high fat without or with choline supplementation, respectively, were similar to other treatments. Gregg *et al.* (13) reported no effect of supplemental dietary choline on the carcass characteristics of broiler chickens.

Table 1: Overall growth performance indices of broiler chickens fed diets supplemented with *Albizia saman* leaf meal (d 0-42)

Parameters	TI (Basal diet)	T2 (High fat – choline)	T3 (High fat + choline)	T4 (High fat + 1.5% AS)	High fat + 3.0% AS	SEM	P value
Initial wt (g/b)	42.70	43.51	43.81	44.13	43.80	0.60	0.5091
Final wt (g/b)	1936.67^{b}	2163.40^{a}	1981.43^{ab}	1976.88^{ab}	1812.71^{b}	51.10	0.0023
Wt gain (g/b)	1893.99^{b}	2119.89^{a}	1937.62^{ab}	1932.75^{ab}	1768.92^{b}	51.04	0.0023
ADWG (g/b)	45.10^{b}	50.47^{a}	46.13^{ab}	46.01^{ab}	42.12^{b}	1.22	0.0023
ADFI (g/b)	61.14	58.23	60.10	62.92	58.58	2.34	0.6168
FCR	1.36^{a}	1.15^{c}	1.30^{b}	1.37^{a}	1.39^{a}	0.04	0.0049

$^{a,b.c}$ Means on the same row with different superscripts are significantly (P<0.05) different. AS: *Albizia saman*
Initial wt: Initial weight, Final wt: Final weight, Wt gain: weight gain, ADFI: Average Daily Feed Intake, ADWG: Average Daily Weight Gain, FCR: Feed Conversion Ratio, SEM: Standard Error of Mean.

Table 2: Selected carcass traits of broiler chickens fed *Albizia saman* leaf meal supplemented diets

Parameters	T1(basal diet)	T2 (High fat - choline)	T3 (High fat + choline)	T4 (High fat+1.5% AS)	T5(High fat + 3.0%AS)	SEM	P-value
Live weight (g)	1843.0^{b}	2250.2^{a}	2279.8^{a}	2053.4^{ab}	2043.6^{ab}	93.01	0.0219
Dressed wt (g)	1355.2^{b}	1650.2^{ab}	1693.4^{a}	1506.6^{ab}	1529.2^{ab}	73.37	0.0317
Drumstick (%)	11.37	9.63	9.86	9.79	10.12	0.43	0.0603
Back (%)	14.90^{ab}	17.63^{a}	14.59^{b}	16.18^{ab}	15.35^{ab}	0.66	0.0275
Thigh (%)	10.14^{ab}	9.88^{b}	11.84^{a}	10.24^{ab}	11.00^{ab}	0.43	0.0278

$^{a,b.}$Means on the same row with different superscripts are significantly (P<0.05) different. AS: *Albizia saman,* wt: weight, expressed as %live weight

CONCLUSION AND APPLICATION

It can be concluded that supplementing broiler chickens diets with *Albizia saman* leaf meal at 1.5% inclusion improved the performance and primal cuts of the birds.

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EGG QUALITY CHARACTERISTICS OF LATE-LAY BIRDS FED DIET SUPPLEMENTED WITH CHELATED ORGANIC TRACE MINERAL BLENDS

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ABSTRACT

A 80-weeks experiment was conducted to evaluate the effects of diet supplemented with chelated organic trace mineral blends on the egg quality characteristics of late-lay birds. The experiment involved a total of five hundred (500) one- day old pullet chicks randomly allotted to five (5) dietary treatments consisting of positive control, recommended level of inorganic trace minerals in the premix 16, 64, 64 mg/kg of Cu, Zn and Mn (T1), negative control, basal diet with 0.0, 0.0,0.0 mg/kg of Cu, Zn and Mn i.e. premix free of Cu, Zn and Mn (T2), diets with 16, 64, 64 mg/kg of chelated Cu, Zn and Mn, 100% higher than the manufacturer's recommendation (T3), diets with 8, 32, 32 mg/kg of chelated Cu, Zn and Mn, at the manufacturer's recommendation (T4) and diets with 4, 16, 16 mg/kg of chelated Cu, Zn and Mn at 100% lower than the manufacturer's recommendation (T5) respectively. Each treatments was replicated ten times with 10 birds per replicate. Egg quality characteristics were evaluated as response criteria in the experiment. All data obtained were subjected to One-way Analysis of Variance in a Completely Randomized Design. At the late-lay phase, egg weight, egg length, egg width and haugh unit were significantly ($P<0.05$) improved with birds fed T3. A significant ($P<0.05$) increase in percentage albumen, albumen height, percentage yolk and yolk height were observed for birds fed T3 at the late-lay phase.The study concluded that supplementation of chelated trace mineral blends at 100% higher than manufacturer's recommended level in the diets of egg-type chickens resulted in an improved laying performance in respect to the egg quality characteristics of the early-lay birds.

Keywords: Layers, Chelated Trace mineral Blends, Copper, Zinc, Manganese, Egg Quality, Late-lay

INTRODUCTION

Trace minerals, such as Zn, Mn and Cu, are involved in a wide variety of physiological processes, making them essential for optimal bird growth and health (8). They act as catalysts in many enzyme and hormone systems (7) and, as a result, influence growth, bone development, feathering, enzyme structure and function, and appetite (6). These elements are involved in myriad of metabolic and physiological processes which are critical to the general well-being of man and animals. Organic Trace Minerals (OTM) have been hypothesized to have a higher bioavailability than inorganic salts (1) though their effects on the long term use for pullets has not been documented, its use in premix formulation has been suggested as a potential solution to mitigating mineral pollution. This implies that OTM may be added at a much lower concentration in the diet than ITM, without causing any negative effect on production performance and potentially reducing mineral excretion (4).

MATERIALS AND METHODS

Experimental site

The experiment was carried out at the Poultry Unit, Directorate of University Farms (DUFARMS), and Animal Nutrition Laboratory, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria. All birds used in these experiments were provided proper care and management without unnecessary discomfort, and the study protocols were in accordance with the Animal Care Use and Review guidelines of the Federal University of Agriculture, Abeokuta.

Test Ingredients

The chelated organic Zn/Cu/Mn used were obtained from Novus Intl., USA and trace mineral (Cu, Zn and Mn) free premix was formulated at Rotinol, Gbonogun, Odo Eran, Abeokuta, Ogun State.

Diets and feeding management

The egg-type chicken diet that was used in this study was formulated to meet the nutrient requirements of the birds at all phases (5). Premix was formulated based on breed specification (without Cu, Zn and Mn dietary supplementatio n in the control diet) and supplemental levels was defined based on the manufacturer's (Novus Inc.) recommended level of inclusion in diet.

Data Collection

Egg Quality Assessment

Fifteen eggs (3 per replicate) from each treatment were sampled at ten weeks of early laying period. Quality assessment was done within 24 hours of lay on external (egg weight, egg length, egg breadth and egg shape index) qualities and internal (albumen height, albumen weight, yolk weight, shell weight, shell thickness sand Haugh unit) qualities.

RESULTS AND DISCUSSION

External and Internal qualities of laying chickens fed diets supplemented with chelated organic trace mineral blends (30weeks in lay, Late-lay birds)

Effect of dietary supplementation of chelated organic trace mineral blends on the external and internal egg quality of laying chickens is presented in Table 1 and 2. Birds fed with diet supplemented with chelated organic trace minerals at 100% increase in manufacturer's recommendation had a superior ($p<0.05$) egg width (54.52 mm) and eggshell thickness (0.65 mm) as compared to the other treatment groups. Control groups and chelated supplementation at 100 % lower than recommended level also showed a similar trend for eggshell thickness. Haugh unit was affected ($p<0.05$) with chelated trace mineral supplementation with birds fed diet supplemented with chelated organic traced mineral blends at 100% higher than manufacturer's recommendation had the best haugh unit (99.72**).** For the internal qualities, all parameters measured were significantly ($p<0.05$) influenced by trace mineral supplementation. The observation was similar to those reported by (10) when he fed layers with diet containing Zn and Se bound to an organic molecule. Higher egg mass obtained as a result of chelated trace minerals supplementation indicated that trace minerals supplementation increased HDEP and egg weight. This could have been as a result of chelation which prevented negative interaction between the trace minerals and other nutrients in the gastrointestinal tract of the birds. This was in line with the report of (6). Higher egg weight observed in groups fed diet supplemented with CTMB at 100 % higher than recommended level (T3) indicated that the combination of chelated Cu, Zn and Mn at 16, 64, 64 mg/kg respectively was sufficient enough to support an increase in egg weight. It could also be that the amino acid released from the ligands of the chelates were adequate thereby causing an increase in the albumen weight and hence, the egg weight. This agrees with the report of (7) when the authors fed diet supplemented with organic Mn to laying hens. The higher eggshell weight could have also contributed to this. The better egg length and width observed in treatment 3 could have resulted from the bigger egg size recorded in this group. This was in accordance to the work of (8) who reported a higher egg weight in layers when the combination of organic Mn, Zn and Se was fed to the birds. Increased eggshell thickness was obtained with birds fed on diets supplemented with chelated organic trace mineral blends at 100 % lower than the recommended level (4, 16, 16 mg/kg of Cu, Zn and Mn respectively) not sufficient enough to cause an increase in the eggshell thickness. Increased dietary trace minerals which led to an improvement in the eggshell thickness could be attributed to the influence of these trace minerals in the

formation of eggshell and eggshell membrane thereby resulting in eggs with better quality shells. This is in line with (6) who stated that the dietary supplementation of layer diets with organic trace minerals improved eggshell quality, provided organic Mn and Zn are added adequately in combination.

Table 1: Effect of chelated organic trace mineral blends on the external egg quality of laying chickens (30 weeks in lay)

Parameters	T1	T2	T3	T4	T5	SEM	P-value
Egg weight (g)	62.15^{bc}	61.72^{c}	68.26^{a}	65.83^{b}	64.36^{bc}	0.34	0.310
Egg width (mm)	54.42^{c}	53.76^{bc}	54.52^{a}	54.08^{b}	53.61^{c}	0.15	0.217
Egg length (mm)	68.41^{bc}	67.32^{c}	68.26^{a}	69.26^{b}	67.26^{c}	0.07	0.135
Egg shape index	1.42	1.39	1.41	1.42	1.42	0.00	0.776
Haugh unit	92.72^{c}	96.29^{b}	99.72^{a}	97.81^{b}	94.67^{b}	0.52	0.569
Percentage eggshell	10.59	10.52	10.42	10.60	10.53	0.04	0.375
Eggshell thickness (mm)	0.58^{c}	0.63^{b}	0.65^{a}	0.62^{b}	0.60^{c}	0.00	0.171

^{a,b,c} Means with different superscripts in a row are significantly (P<0.05) different
T1 – Recommended levels for inorganic trace minerals supplementation
T2 – Supplementation at zero level for Cu, Zn and Mn, respectively
T3 – Chelated supplementation at 100 % higher than manufacturer's recommendation
T4 – Chelated supplementation at manufacturer's recommendation
T5 – Chelated supplementation .at 100 % lower than manufacturer's recommendation

Table 2: Effect of chelated organic trace minerals on the internal egg quality of laying chickens (30 weeks in lay)

Parameters	T1	T2	T3	T4	T5	SEM	P-value
Percentage albumen	72.50^{c}	73.60^{b}	74.62^{a}	73.86^{ab}	73.36^{bc}	0.12	0.305
Albumen height (mm)	7.55^{d}	8.39^{bc}	9.31^{a}	8.76^{b}	8.34^{c}	0.09	0.218
Yolk colour	8.75	8.72	8.85	8.82	8.80	0.02	0.016
Yolk height (mm)	18.27^{c}	18.84^{b}	19.53^{a}	19.16^{a}	18.64^{b}	0.08	0.312
Percentage yolk	35.68^{a}	34.65^{bc}	33.88^{c}	34.42^{bc}	34.81^{b}	0.15	0.285
Yolk width (mm)	51.00^{b}	50.57^{b}	51.70^{a}	50.83^{b}	50.85^{b}	0.07	0.182
Yolk Index	0.51^{c}	0.53^{ab}	0.54^{a}	0.53^{ab}	0.52^{ab}	0.00	0.127

^{a,b,c,d} Means with different superscripts in a row are significantly (P<0.05) different
T1 – Recommended levels for inorganic trace minerals supplementation
T2 – Supplementation at zero level for Cu, Zn and Mn, respectively
T3 – Chelated supplementation at 100 % higher than manufacturer's recommendation
T4 – Chelated supplementation at manufacturer's recommendation
T5 – Chelated supplementation .at 100 % lower than manufacturer's recommendation

CONCLUSION AND RECOMMENDATION

Chelated trace minerals supplementation at 100 % higher than recommended level improved both internal and external egg qualities in layers at the late-lay phase.

Chelated Cu, Zn and Mn can be used in the diet of egg-type chickens at 16, 64, 64 and 8, 32, 32 mg/kg respectively so as to improve egg qualities in laying phases.

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EFFECT OF DIETARY SUPPLEMENTATION OF CLOVE (*Syzygium aromaticum*) POWDER ON HAEMATOLOGICAL PARAMETERS OF COBB-500 BROILER CHICKENS

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ABSTRACT

The prohibition of antibiotic growth promoters in poultry diets was necessitated by the escalation of antibiotic resistance and the hazardous nature of its remnants in animal health. Extensive studies have been conducted to explore alternative solutions, focusing on phytobiotic exploration. Therefore, this study aimed to investigate the effect of clove powder supplementation on various haematological parameters in broiler chickens. The experiment was conducted at the Poultry Unit of the Teaching and Livestock Research Farm, Bayero University, Kano, Nigeria. Clove powder purchased from Kurmi Market, Kano, was incorporated into the formulated feed at different inclusion levels (0.6% and 0.8%). Ninety day-old COBB-500 strain chicks were randomly assigned to three treatment groups, with each treatment consisting of three replicates. The experiment lasted for seven weeks. Blood samples were collected at the 7th week from the wing vein and subjected to hematological analysis at the Humane Diagnostic and Nutritional Laboratory. Statistical analysis using one-way ANOVA at 5% level of significance indicated that clove powder supplementation had no significant effect ($P > 0.05$) on White Blood Cell Count (WBC), Red Blood Cell Count (RBC), Haemoglobin (Hb), Lymphocytes (LYM), Monocytes (MON), Pack Cell Volume (PCV), Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH), Mean Corpuscular Haemoglobin Concentration (MCHC), and Red Blood Cell Distribution Width (RDW) among the treatments. The values obtained were within the normal ranges for a healthy chicken. Further research may be needed to explore the potential effects of clove powder on other aspects of broiler health and performance.

Key words: Antibiotics, Phytobiotics, Supplementation, Haematology, Clove

DESCRIPTION OF PROBLEM

Poultry refers to domesticated birds raised for meat, eggs, and sometimes ornamental feathers, are known for their efficient conversion of diverse feed sources into high-quality animal protein (1). Chickens, categorized into single-purpose (layers for eggs, broilers for meat), dual-purpose, and multipurpose breeds, play an important role in the poultry industry (2). Broilers being a major source of meat for the growing global population, exploring alternative strategies to enhance their health and productivity is crucial (3). In animal production, haematological and biochemical indices are important parameters that can be used to determine the health, metabolic status as well as welfare of animals. These parameters are involved in the diagnosis of diseases, nutritional deficiencies and metabolic disorders where reference values serve as a standard to judge good health (4). Evaluating the hematological parameters of these birds is essential as it provides insights into their health, physiological status, and potential response to dietary or environmental changes (5). Hematology serves as a vital tool for assessing the impact of management practices on broiler chickens' overall well-being and productivity, making it a key focus in poultry research (6).

Throughout history, antibiotics have been widely used in poultry feed to ensure the proper growth and minimize pathogenic microorganisms' effects. Nevertheless, the increasing fears over antimicrobial resistance and residues in meat and eggs have resulted to a worldwide switch towards low levels of antibiotics use within poultry industry (7). As a result of this advancement, alternatives to antibiotics such

as herbs, medicinal plants and spices are being pursued. Cloves (*Syzygium aromaticum*) renowned for their versatility, contain a range of biologically active components such as eugenol, eugenyl acetate and β-caryophyllene (8). European Union banning the use of antibiotics in animal feed was put into action, which necessitates a closer look at clove powder with relatively strong evidence emerging as an alternative to other antimicrobial compounds (9).

The objective of the study is to evaluate the effect of clove powder on haematological parameters of broiler chicken which includes: White blood cell (WBC), Red blood cell (RBC), Haemoglobin (Hb), Lymphocyte (LYM), Monocyte (MON), Pack Cell Volume (PCV), Mean corpuscular volume (MCV), Mean corpuscular haemoglobin (MCH), Mean corpuscular haemoglobin concentration (MCHC) and Red blood cell distribution width (RDW).

MATERIALS AND METHODS

Experimental Site

The study was conducted at the Poultry unit of Teaching and Livestock Research Farm (latitude 11°59'1.59" longitude 8°25'24.97") of the Department of Animal Science, Faculty of Agriculture, New Campus Complex, Bayero University, Kano, Nigeria. The area is characterized by tropical dry and wet climate. The wet season usually occurs from May to September, while the dry season is from October to April, with an annual rainfall and temperature ranging between 787mm to 960mm and 21^0C to 39^0C respectively (10).

Experimental Animals

The experimental birds were sourced from a reputable dealer. A total of ninety (90) day-old broiler chicks of COBB-500 strain were used in the experiment.

Experimental Diet and Design

The clove was purchased from Kurmi Market, Kano. It was then milled into fine powder using spice milling machine. The clove powder was added to the formulated standard diets at 0.6 and 0.8 % inclusion levels. The chicks were divided into three treatment groups. Each treatment comprised 30 chicks and was randomly subdivided into 3 replicates, with 10 chicks per replicate. Each treatment group was assigned to each of the diet as follows: 0% clove meal, (T1, control), 0.60% clove meal (T2), 0.80% clove meal (T3) in a completely randomized design (CRD).

Data Collection

Blood samples were collected from the wing vein in EDTA bottles for haematological analysis. The samples were sent to a specialized laboratory for analysis, which included measurements of various haematological parameters such as red and white blood cell counts, hemoglobin levels, and hematocrit. These parameters were assessed to determine the impact of dietary supplementation with clove powder on the health and physiological status of the Cobb-500 broiler chickens (11).

Statistical Analysis

Data collected was subjected to one way analysis of variance (ANOVA) using SPSS V21. Values for the parameters are expressed as mean ± standard error of the mean. Statistical significance was set at $P < 0.05$.

RESULTS AND DISCUSSION

Table 1 presents data on various hematological parameters of broiler chickens fed clove powder under three different treatments. These parameters include White Blood Cell Count (WBC), Red Blood Cell Count (RBC), Hemoglobin (Hb), Lymphocytes (LYM), Monocytes (MON), Packed Cell Volume (PCV), Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH), Mean Corpuscular Hemoglobin Concentration (MCHC), and Red Blood Cell Distribution Width (RDW). The p-values indicate the level of significance for differences observed among the treatments. The WBC counts for treatments 1, 2, and 3 are 23.533 ± 0.465 (10^3/µl), 24.067 ± 0.611 (10^3/µl), and 24.217 ± 0.831 (10^3/µl), respectively, with a p-value

of 0.342 indicating that the differences observed in WBC counts among the treatments are not statistically significant at a level of ($\alpha = 0.05$). RBC counts for treatments 1, 2, and 3 are 5.610 ± 0.408 (10^6/µl), 5.827 ± 0.756 (10^6/µl), and 5.830 ± 0.451 (10^6/µl), respectively, with a p-value of 0.862, indicating that there is no significant difference in RBC counts among the treatments.

For the Hb levels, treatments 1, 2, and 3 are 11.333 ± 0.213 (g/dl), 12.000 ± 0.288 (g/dl), and 12.667 ± 0.310 (g/dl), respectively, with a p-value of 0.530 indicating that the observed differences in Hb levels among the treatments are not statistically significant. LYM percentages range from 37.000 ± 1.300% to 38.367 ± 2.079%, while MON percentages range from 12.567 ± 1.193% to 12.833 ± 0.929% across treatments. The p-value of 0.555 for LYM and 0.789 for MON indicates no significant differences among the treatments. PCV values for treatments 1, 2, and 3 are 35.600 ± 0.505%, 37.567 ± 0.269%, and 37.700 ± 0.337%, respectively. The p-value of 0.384 suggests that the differences in PCV among treatments are not statistically significant. MCV values for treatments 1, 2, and 3 are 97.367 ± 0.808 (fL), 106.700 ± 10.359 (fL), and 109.700 ± 3.666 (fL), respectively. The p-value of 0.677 indicates no significant differences. MCH values for treatments 1, 2, and 3 are 45.633 ± 1.021 (pg), 45.233 ± 2.122 (pg), and 45.033 ± 1.331 (pg), respectively, with a p-value of 0.793, and MCHC values for treatments 1, 2, and 3 are 32.000 ± 0.211 (g/dl), 33.000 ± 0.320 (g/dl), and 33.667 ± 0.432 (g/dl), respectively, with a p-value of 0.429. RDW values for treatments 1, 2, and 3 are 9.033 ± 0.451%, 9.467 ± 0.955%, and 9.267 ± 0.890%, respectively, with a p-value of 0.701 indicating that the differences in RDW among treatments are not statistically significant.

Table 1: Haematological Parameters of Broiler Chickens Fed Clove Powder Supplemented Diet

BLOOD PARAMETERS	CLOVE POWDER INCLUSION LEVEL (%)			P-value
	0.0	0.6	0.8	
WBC (10^3/µl)	23.533±0.465	24.067±0.611	24.217±0.831	0.342
RBC (10^6/ µl)	5.610±0.408	5.827±0.756	5.830±0.451	0.862
Hb (g/dl)	11.333±0.213	12.000±0.288	12.667±0.310	0.530
LYM (%)	37.000±1.300	38.033±1.002	38.367±2.079	0.555
MON (%)	12.567±1.193	12.333±0.577	12.833±0.929	0.789
PCV (%)	35.600±0.505	37.567±0.269	37.700±0.337	0.384
MCV (fL)	97.367±0.808	106.700±10.359	109.700±3.666	0.677
MCH (pg)	45.633±1.021	45.233±2.122	45.033±1.331	0.793
MCHC (g/dl)	32.000±0.211	33.000±0.320	33.267±0.432	0.429
RDW (%)	9.033±0.451	9.467±0.955	9.267±0.890	0.701

Note: WBC: White Blood Cell Count, RBC: Red Blood Cell Count, Hb: Haemoglobin, LYM: Lymphocytes, MON: Monocytes, PCV: Pack Cell Volume, MCV: Mean Corpuscular Volume, MCH: Mean Corpuscular Haemoglobin, MCHC: Mean Corpuscular Haemoglobin Concentration, RDW: Red Blood Cell Distribution Weight. Data are presented as mean ± standard error of the mean.

Bounous and Stedman (12) reported that the non-significant differences among all the treatment groups suggest that clove powder had no effect on the hematological indices. The WBC counts for treatments 1, 2, and 3 were 23.533 ± 0.465 (10^3/µl), 24.067 ± 0.611 (10^3/µl), and 24.217 ± 0.831 (10^3/µl), respectively were within the normal range of (12.0 - 30.0 x 10^3/µl). The values obtained for PCV, Hb, MCH, and MCHC were within the ranges as classified by Bounous and Stedman (12) and Makama *et al.* (13) for broiler chickens. RBC revealed that the blood collected from treatments 1, 2, and 3 were 5.610 ± 0.408 (10^6/µl), 5.827 ± 0.756 (10^6/µl), and 5.830 ± 0.451 (10^6/µl), respectively, were within the range considered normal as classified by Makama *et al.* (13) for broiler chickens. An elevated RBC count called erythrocytosis, may occur due to dehydration, or certain diseases.

The values obtained for LYM and MON in all treatments showed that the LYM range were within the normal range of (20-50%), according to Merck's Manual (14). An increase above the normal range may indicate

that the broiler birds had some health issues that made their bodies produce more lymphocytes. LYM are involved in the protection of the body from viral infection and harmful germs. MON range was within the normal range (0-30%) according to Merck's Manual (14). Elevated monocyte levels may suggest a chronic infection or inflammation in broilers. Chronic infections can lead to reduced growth rates, increased mortality, and economic losses in broiler production.

The results showed that the MCV values in treatments 1, 2, and 3 were 97.367 ± 0.808 fL, 106.700 ± 10.359 fL, and 109.700 ± 3.666 fL, respectively. These values fall within the normal range of 90-140 fL according to Bounous and Stedman (12). Elevated MCV levels may indicate macrocytic anemia, which can result from nutritional deficiencies, liver disease, or certain genetic conditions (15). The RDW showed that all the treatments were within the normal range (7-11%), according to Merck's Manual (14). A high RDW could be the indication of nutrient deficiency and it could also indicate microcytic anemia (16).

All the haematological parameter were not significantly ($p < 0.05$) different among different treatment groups, this is line with Adegoke *et al.* (17) where their values for Hb and RBC were higher in birds fed turmeric diet when compared with those of the other diet groups.

CONCLUSION AND APPLICATION

In conclusion, various levels of clove powder inclusion do not significantly affect blood parameters (WBC, RBC, Hb, LYM, MON, HCT, MCV, MCH & MCHC). The study provides details into the potential effects of clove powder on broiler chicken haematology, the lack of statistically significant differences in most parameters suggests that the observed variations may not be practically significant.

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Monogastric Animal Production: MGP 096

INFLUENCE OF AQUEOUS *Chromolaena odorata* LEAF EXTRACT ON SERUM BIOCHEMICAL AND HAEMATOLOGICAL INDICES OF BROLER CHICKENS

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ABSTRACT

A Six weeks (42-day) trial was conducted to evaluate the effects of Aqueous *Chromolaena odorata* (Siam weed) leaf extract (ACOLE) on the hematology and serum biochemical indices of broiler chickens. A total of 200 day old broiler chicks were randomly allotted into four (4) treatment groups of 50 birds, consisting five replicates of ten birds per replicate in a completely randomized design. Aqueous *Chromoleana odorata* leaf extract was administered in their water served on daily basis at 0, 5, 10 and 15mL/L to represent four treatment groups; T_1, T_2, T_3 and T_4 respectively. At the end of the study, blood samples were collected into plain bottles for serum biochemical indices and bottles containing anti –coagulant for hematological parameters. All data collected were subjected to one-way analysis of variance. The results obtained showed that there were no significant ($P>0.05$) differences on all parameters measured for hematology except for the platelets which had the least value of $18.30x10^4$/L for the control treatment and $22.23 x10^4$/L for treatment four (T_4) which had the highest inclusion level of ACOLE .There was significant ($P<0.05$) difference in the Aspartate Transaminase(AST) and Triglycerides which had the least value of 63.63(uL) for treatment three (T_3) and 100.85(uL) as the highest value in treatment two(T_2)for the AST and 65.90(mmol/L) least value in treatment 2(T_2) and 118.78(mmol/L) as the highest value in treatment three(T_3) for the triglycerides in the serum biochemical indices. Conclusively, the administration of ACOLE had no detrimental effects on the blood of broiler chickens.

Keywords: Siam weed, Aqueous extract, Serum biochemical indices, Hematological indices

DESCRIPTION OF PROBLEM

The Poultry industry's role in producing animal protein effectively within the shortest possible time cannot be overemphasized due to its rapid growth and prolificacy (1). Dietary protein, especially animal protein, is critically limiting in the diets of the developing nation (2). Some of the problems limiting poultry production in Nigeria are the high cost of feed, diseases, heat stress, and poor reproductive rate (low fertility and hatchability). Broiler production is one of the fastest source of animal protein all over the world and this can be contributed to high feed utilization, feed efficiency and fast growth of the birds(2). It has been demonstrated that tropical plants containing certain phytochemicals are possible sources of vital nutrients to livestock's in the tropics.(3) *Chromolaena odorata* (siam weed), – previously known as Eupatorium odorata is a perennial shrub which belongs to the family Asteraceae. The plant contains pharmacologically important phytochemicals such as alkaloids, flavonoids, tannins, saponins, glycosides and phenolic compounds with essential antimicrobial activities (4). Hence, the need to evaluate its effectiveness in protecting and upholding the health status of broiler chickens is what this study seeks to evaluate.

MATERIALS AND METHODS

Experimental site and duration: The experiment was carried out at the Teaching and Research Farm of the Federal College of Animal Health and Production Technology, Ibadan, Oyo State. The experiment lasted for six (6) weeks.

Experimental Animals and their management: Two hundred (200) one-day old broiler chicks were randomly allotted into four dietary treatments of fifty birds each with five replicates of ten birds each in a

completely randomized design. The birds were fed *ad libitum with* commercial feed (Crude protein 23% starter and 19% finisher, metabolozable energy 3000 kcal/kg starter and 3200 kcal/kg) ; chicks were allotted into four treatment groups at the first day of age and aqueous *Chromolaena odorata* leaf extract (ACOLE) was administered to the birds via their cool clean drinking water according to the treatment specification.

Experimental Layout
Treatment 1: 0mL, Control (prophylactic measures were taken)
Treatment 2 :5mL inclusion of aqueous *Chromolaena odorata* leaf extract per litre of water
Treatment 3 :10mL inclusion of aqueous *Chromolaena odorata* leaf extract per litre of water
Treatment 4 : 5mL inclusion of aqueous *Chromolaena odorata* leaf extract per litre of water

Source and Preparation of the test ingredients
Fresh *Chromolaena odorata* (Siam weed) leaves were obtained from the farm premises of the College, leaves were properly rinsed and allowed to drain off water. Thereafter, the juice from the leaves was squeezed out by hand, and the extract was filtered and weighed before mixing with the water as indicated in the experimental layout.

Data collection
At the end of the experiment 5mls of blood was collected from five birds from each treatment and this was shared at 2.5mls each into two sample bottles. One was a plain bottle for Serum biochemical analysis and the other was bottles containing EDTA (Ethylene Diamine tetra acetic acid) for hematological analysis. Some of the parameters measured for serum biochemistry include: Total Protein, Albumin, Alanine Transaminase (ALT), Aspartate Transaminase (AST) while parameters for hematology include, packed cell volume (PCV), hemoglobin (Hb), among others. The blood samples were taken to the laboratory for analysis using standard procedures.

Statistical Analysis: All data collected were subjected to one-way Analysis of Variance (ANOVA) using (5) and significant means were separated using Duncan's multiple range test (DMRT) of the same statistical package at a significance level of (P< 0,05)

RESULTS AND DISCUSSION

Table 1 shows the influence of *chromolena odorata* leaf extract on the haematology of the blood of broiler chickensadministered ACOLE. There was significant($p<0.05$) difference only on the platelets which had the least value of $18.30x10^4$/L for the control treatment and $22.23 x10^4$/L for treatment four (T_4) which had the highest inclusion level of ACOLE. All other parameters measured did not show significant difference ($p>0.05$). The platelets whose main function is blood clothing had the highest value in treatment 4 which had the highest inclusion level of the leaf extract. This result was in tandem with the reports of (7) who reported the same trend for the platelets of broiler chickens fed *chromoleana odorata* leaf meal in their diets

Table 2 reveals the effects of ACOLE on the serum biochemistry of broiler chickens. There was significant ($p<0.05$) difference in the Aspartate transaminase and in the triglycerides, with values ranging from (63.63 – 100.85uL) for the AST and (65.90 – 118.78uL) for the triglycerides. There was no significant ($p>0.05$) difference in all other parameters measured for the serum biochemistry. There was a reverse relationship between the AST and triglycerides with an inclusion of 10ml/litre of water ACOLE, showing the highest value for triglyceride (118.78mmol/L) and the lowest value for AST (63.63uL), while treatment 2 with 5ml/litre of water ACOLE had the highest value for AST (100.86uL) and the lowest value for triglyceride (65.90mmol/L). This result is in contrast with the results of (7) who reported no significant ($p>0.05$) difference in the AST and Triglyceride that was significant in this study in his own study of broiler chickens fed diets containing *chromoleana odorata* leaf meal. These results obtained was in agreement with the reports of (8) who reported non- significant effects of COLM on the cholesterol concentration of laying hens. However, a reduction in cholesterol was noticed for rats administered *chromoleana odorata* leaf extract as reported by (9).

Table 1: Hematology of broiler chickens administered aqueous *Chromolaena odorata* leaf extract

Parameters (%)	T_1	T_2	T_3	T_4	SEM
PCV (%)	30.33	26.00	28.00	25.67	0.92
Hb (g/dL)	9.47	8.40	9.07	8.30	0.32
RBC (mL)	4.51	3.62	4.14	3.81	0.18
WBC ($x10^3$)	17.33	18.08	16.33	14.20	1.03
PLT($x10^4$)/L	18.30^b	21.50^{ab}	20.80^{ab}	22.23^a	0.60
LYM(%)	64.00	60.33	64.33	59.33	1.09
Neutrophil(%)	30.00	33.00	28.33	34.00	1.18
Mon(%)	2.67	3.67	2.67	3.00	0.21
EOS(%)	2.67	3.00	4.67	3.67	0.48

^{a,b} superscripts along the row denotes significant differences. T_1 = 0mL/Litre, T_2 = 5mL/Litre,T_3 = 10mL/Litre T_4 = 15mL/Litre. PCV- Packed cell volume, Hb- Haemoglobin, RBC- Red blood cells, WBC- White blood cells, PLT-Platelets, LYM-Lymphocytes, MON- Monocytes, and EOS- Eosinophylls.SEM- Standard error of means.

Table 2: Serum biochemistry of broiler chickens administered aqueous *Chromolaena odorata* leaf extract

Parameters	**T_1**	**T_2**	**T_3**	**T_4**	**SEM**
Cholesterol (mg)	42.26	60.42	47.37	39.07	4.91
Glucose (mg/dL)	248.07	190.82	210.87	241.21	12.26
Total Protein (mg)	3.26	3.46	2.25	2.47	0.22
Globulin (g/dL)	1.52	1.79	0.75	0.91	0.22
Aspartate Transaminase (uL)	84.89^{ab}	100.86^a	63.63^b	87.15^{ab}	5.40
Alanine Transaminase (uL)	24.83	23.28	22.23	19.90	0.88
Alkaline Phosphate (uL)	57.67	47.33	57.00	59.33	3.23
Triglyceride (mmol/L)	78.70^a	65.90^b	118.78^a	90.73^b	6.88
Corticosteroid (mg)	0.42	0.40	0.43	0.44	0.02
Urea (mmol/L)	6.47	5.55	5.45	5.25	0.23
HDL (mmoL/L)	36.34	39.79	41.96	26.04	3.32
LDL (mmoL/L)	23.45	12.55	15.86	19.43	1.994
Vit C (mcg)	7.67	8.03	7.87	6.43	0.39
Vit K (mcg)	0.04	0.04	0.05	0.03	0.00

^{a,b},superscripts along the same row denotes significant differences. T_1 = 0mL/Litre, T_2 = 5mL/Litre T_3 = 10mL/Litre, T_4 = 15mL/Litre.HDL- High Density Lipoprotein, LDL- Low Density Lipoprotein.

CONCLUSION:

It was therefore concluded that the inclusion of Aqueous *chromolaena odorata* leaf extract had significant differences in some parameters but in total it did not have any detrimental effects on the growth and development of the broiler chickens.

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Monogastric Animal Production: MGP 097

ANTIOXIDANT STATUS AND PROXIMATE COMPOSITION OF STORED EGGS LAID BY HENS FED DIETARY TURMERIC AND CLOVE

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ABSTRACT

Eighty 18 weeks-old, grower birds of ISA-Brown strain were used to evaluate antioxidant status and proximate composition of stored eggs laid by hens fed dietary turmeric and clove. The birds were randomly divided into 5 treatment groups of 4 replicates, and each replicate contained 4 birds. Five experimental diets were formulated for the study as follows: Basal diet without test ingredients was the control. Basal diet supplemented with 0.1% clove bud powder (CBP) and 0.25% turmeric rhizome powder (TRP) was denoted as T1. The T2 was basal diet that contained 0.2% CBP and 0.25% TRP. Basal diet containing 0.1% CBP and 0.5% TRP was tagged T3. Basal diet plus 0.2% CLP and 0.5% TP was T4. The result showed that crude protein contents of stored eggs laid by hens fed diets T1 (22.65%), T3 (22.06%) and T4 (22.65%) were similar with the control (23.09%). [AL73]The crude protein of the stored eggs laid by hens fed diet containing 0.2% CBP and 0.25% TRP (T2) was the lowest (20.94%). Dietary treatment had significant (P=0.054) increased superoxide dismutase, SOD, (6.00U/mg protein) in eggs stored for 5 weeks from laying hens fed diet supplemented with 0.1% CBP and 0.25% TRP (T1). [AL74]The lowest SOD (2.33U/mg protein) was recorded for stored eggs from laying hens fed 0.1% clove and 0.5% turmeric diet. It was concluded that, dietary supplementation of 0.1% clove bud powder and 0.25% turmeric rhizome powder produced eggs (which was stored for 5-weeks) with improved antioxidant status thus suggestive of better preservation.

Keywords: Clove, Turmeric, Antioxidant status, proximate composition, Superoxide dismutase.

DESCRIPTION OF PROBLEM

Egg is a rich source of protein, lipids, vitamins, phosphorus and other nutritionally important substances. They are easily digestible and are a source of raw materials for agro-allied industries that utilize them in the production of food, drinks, baking, and confectionary and in the propagation of viruses in vaccine production (1). Immediately eggs are laid, the internal quality of eggs begins to deteriorate due to loss of moisture, carbon dioxide and entrance of bacteria via the eggshell pores (2). Thus, one of the challenges of the poultry industry is to provide the consumers with eggs with the best possible quality (3). The health of chicken and its products could be improved by incorporation of supplements such as herbs and spices in poultry diets (4). The use of herb and spices may be used to address the egg quality loss because of long storage during the marketing of eggs from farm to the consumers. Examples of these herbs and spices include cloves and turmeric.

Clove (*Syzygium aromaticum*) is a dried flower bud belonging to the Myrtaceae family and thought to be one of the spices that, because of its antioxidant and antimicrobial qualities, can replace chemical preservatives in many foods, particularly in meat processing (5). Turmeric (*Curcuma longa*) rhizome, a well-known spice, and traditional medicinal herb has gained recognition for its diverse bioactive compounds and potential health benefits (6). Among these compounds, *curcumin*, the principal polyphenolic curcuminoid, has been the subject of extensive scientific investigation. *Curcumin* is renowned for its antioxidant, anti-inflammatory, and antimicrobial properties, which have led to its exploration as a dietary supplement in various animal species, including broiler chickens (7). Mohammadi *et al*. (15) has reported on singly application of these spices[AL75], therefore this present study aims to evaluate the synergistic actions of the bioactive ingredients in clove and turmeric.

MATERIALS AND METHODS

Site of the Experiment: The experiment was conducted at Layer Unit, Teaching and Research Farm of LAUTECH, Ogbomoso, Oyo State, Nigeria.

Preparation of Test Ingredients: Clove buds were purchased from Oja Jagun market in Ogbomoso, Oyo State. Turmeric rhizomes were sourced from Teaching and Research Farm, LAUTECH. Turmeric rhizomes were sliced into 2mm pieces, and sundried until constant weight is achieved. Dried sliced turmeric was ground in a mechanical grinder and sieved using a 1mm mesh to obtain turmeric powder (TRP). The dried clove materials were pulverized into fine powder using a mechanical blender to obtain clove powder (CBP).

Experimental diets, Birds and Management

Five experimental diets were formulated for the study. Basal diet contained 50% maize, 15.8% maize offal, 3% wheat offal, 18% SBM, 3% fishmeal, 0.1% methionine, 0.25% salt, 0.25% vitamin premix, 1.8% bone meal, 7.8% limestone. Basal diet was characterized by 2739.90 kcal ME/kg and 16.97% CP. Basal diet without test ingredients served as the control. Basal diet + 0.1% clove bud powder (CBP) and 0.25% TRP (T1); Basal diet + 0.2% CBP and 0.25% TRP (T2). Basal diet + 0.1% CBP and 0.5% TRP (T3). Basal diet + 0.2% CBP and 0.5% TRP (T4). Eighty (80) 18 weeks old, grower birds of ISA Brown strain were used for the study. Hens day production was at 20% when the experimental diets were introduced to the birds. These birds were randomly divided into 5 treatment groups of 4 replicates per treatment. Each replicate contained 4 birds. Normal management procedure was observed during the study. All necessary medication and vaccination were administered appropriately. Completely Randomized Design (CRD) was adopted for the study and a 2x2 factorial arrangement for CBP and TRP [AL76]was also used. The two factors were CBP (at 0.1 & 0.2%) and TRP (at 0.25 & 0.50%). The two inclusion levels are in the brackets. A period of 12 weeks was observed for the study.

Data Collection

Antioxidant Assay of Stored Eggs: On the 42nd day of the experiment, 8 fresh eggs were selected from each treatment (2 eggs per replicate), making a total of 40 eggs that were used for the determination of antioxidant enzymes and metabolite. The eggs were stored for 35 days. The whole egg homogenate was assayed for contents of glutathione peroxidase (GPx), superoxide dismutase (SOD) and malondialdehyde (MDA) according to the procedures as described by (8). The activities of antioxidant enzymes and the content of MDA were expressed as units per milligram of protein for egg.

Proximate composition of stored eggs: Eight (8) fresh eggs were selected from each treatment (2 eggs per replicate), making a total of 40 eggs that were used for the determination of proximate composition of 5weeks stored eggs according to (9).

Statistical Analysis

Data collected were analyzed using One-Way Analysis of Variance (ANOVA) of SAS (10) software package. The main and interaction effects were assessed using 2x2 factorial ANOVA.[AL77] Duncan's option of the same software was used to compare the means. A probability of 5 percent was considered significant.

RESULTS AND DISCUSSION

The proximate composition of clove bud powder (CBP) and turmeric rhizome powder (TRP) in (Table1) revealed similar nutritional content (13.27% CP, 6.7% crude fibre, 3.4% crude fat and 89.8% dry matter for clove bud and turmeric rhizome contained 11.68% CP, 6.6% crude fibre, 3.4% crude fat and 88.8% dry matter)[AL78]. However, TRP had higher ash content than CBP (10.6% versus 4.6%). The 11.68% CP of turmeric rhizome powder and 13.27% CP for CBP were higher than the findings of Adebisi *et al*. (11) who showed that turmeric powder had 7.09±0 .04% CP and clove powder had 5.87±0.02% CP. The 10.3% ash content in turmeric powder in this study was higher than 6.29% ash observed by Adebisi *et al*. (11).

The proximate composition of 5 weeks stored eggs is shown in Table 2. The crude protein contents of stored eggs laid by hens fed diets T1, T3 and T4 were similar with the control (22.65, 22.06, 22.65 and 23.9% respectively). The crude protein of laying hens fed diet containing 0.2% CBP and 0.25% TRP (T2) was the lowest. The interaction effect of clove and turmeric had significant (P=0.001) impacted negatively on crude protein of 5-week stored eggs (T2) as increase in clove bud from 0.1% to 0.2% (when turmeric inclusion was 0.25%) decreased CP content of stored eggs. However, when 0.2% clove with 0.5% turmeric was supplemented to experimental diet (T4), the CP of stored eggs increased (revealing positive interaction). The highest moisture content in eggs was observed from hens fed diet supplemented with 0.2% clove and 0.25% turmeric (T2). The interaction of clove and turmeric also had a significant (P=0.016) effect on the moisture content. The crude protein in eggs stored for 5 weeks observed in hens fed experimental diets was lower than reports of previous authors. Akinwumi *et al*. (12) reported 40%, 33.80% and 34.77% crude protein for eggs laid by hens fed diet containing clove when stored for 0, 2 and 4 weeks respectively. Dudusola (13) suggested that crude protein of egg decreased with increasing storage time. The antioxidant status of 5weeks stored eggs is shown in Table 3. Dietary treatment significantly (p=0.054) increased superoxide dismutase (6.00U/mg protein) in eggs stored for 5 weeks from laying hens fed diet supplemented with 0.1%CBP and 0.25% TRP (T1). Meanwhile, the lowest SOD (2.33U/mg protein) was recorded for eggs from laying hens fed 0.1% clove and 0.5% turmeric diet (T3). The main effect of turmeric significantly P=0.017) increased malondialdehyde concentration (MDA) of 5 weeks stored eggs as hens fed 0.5%TRP had higher MDA than those fed 0.25%TRP. Furthermore, the highest superoxide dismutase was observed in eggs from laying hens fed diet supplemented with 0.1% clove and 0.25% turmeric (T1). This observation agreed with the finding of Zhao *et al*., (14) who observed increased SOD activity and decreased MDA concentration in egg yolk of laying hens fed diets supplemented with ginger powder at 15g/kg. The highest SOD activity and relatively low MDA concentration observed in laying hens fed diet supplemented with 0.1% CBP and 0.25% TRP (T1) suggested that the antioxidant capacity of clove and turmeric rhizome powder were effective to maintain a strong preservative status for eggs stored for 5 weeks.

Table 1: Proximate composition (%) of eggs stored for 5 weeks laid by hens fed dietary turmeric and clove

Parameters	Control	T1	T2	T3	T4	P value	SEM
Clove →		0.1%	0.2%	0.1%	0.2%		
Turmeric →		0.25%	0.25%	0.5%	0.5%		
Crude protein	23.09[a]	22.65[a]	20.94[b]	22.06[a]	22.65[a]	0.005	0.83
Ether extract	2.35	2.60	2.60	2.35	2.25	0.934	0.16
Ash	1.67	1.61	1.36	1.36	1.51	0.671	0.16
Moisture	72.90[b]	73.07[b]	75.11[a]	74.23[ab]	73.60[ab]	0.029	0.91
Factorial ANOVA (P-Value of the main and interaction effects on the measured parameters)							
	Clove			Turmeric		Clove*Turmeric	
Crude protein	0.080			0.080		0.001	
Ether extract	0.893			0.428		0.893	
Ash	0.658			0.681		0.265	
Moisture	0.182			0.730		0.016	

[ab] Means along the same row with different superscripts are significantly different (P< 0.050).

CONCLUSION AND APPLICATION

It was concluded that, dietary supplementation of 0.1% clove bud powder and 0.25% turmeric rhizome powder improved antioxidant status of eggs stored for 5 weeks. Thus prolong the shelf life of eggs up to 5weeks.

Table 3: Antioxidant status of eggs stored for 5 weeks laid by hens fed dietary turmeric and clove

Parameters	Control	T1	T2	T3	T4	P value	SEM
Clove →		0.1%	0.2%	0.1%	0.2%		
Turmeric →		0.25%	0.25%	0.5%	0.5%		
MDA (nmol/mg)	2.73	2.61	2.53	3.30	3.23	0.810	0.22
SOD (U/mg)	4.75^{ab}	6.00^{a}	5.00^{ab}	2.33^{b}	4.75^{ab}	0.054	0.97
GPx(x10^3, µmol/mg)	3236.67	2146.67	3515.00	3880.00	2385.00	0.504	0.88

Factorial ANOVA (P-Value of the main and interaction effects on the measured parameters)

	Clove	Turmeric	Clove*Turmeric
MDA (nmol/mg)	0.791	0.017	0.985
SOD (U/mg)	0.191	0.118	0.023
GPx (x10^3, µmol/mg)	0.932	0.686	0.066

^{ab} Means along the same row with different superscripts are significantly different (P< 0.050).
MDA = Malondialdehyde, SOD= Superoxide dismutase GPx = Glutathione peroxidase[AL79]

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PERFORMANCE OF EGG LAYING PULLETS EXPOSED TO VARYING LIGHT INTENSITIES AT THE EARLY LAYING PHASE

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ABSTRACT

Influence of lighting intensity on the performance of laying hens at the early laying phase was studied. Isa Brown pullets (n=120), aged 18 weeks, were randomly allocated to four different treatments of light intensity: T1= Control, T2= 9, T3= 13.5, and T4= 18lux, of blue colour, in a completely randomised design. The birds were exposed to four hours of artificial lighting of the different intensities, in addition to the natural daylength. Egg production was recorded daily, while body weight was recorded weekly. Data were analysed using descriptive statistics and analysis of variance at $\alpha_{0.05}$. Findings showed that feed intake, feed conversion ratio, and hen-day egg production (HDEP) of the pullets were not affected by the varying light intensities they were exposed to ($p>0.05$). Although the HDEP value for the control treatment was low (60.63%). The egg mass across the treatment groups differed significantly ($p<0.05$) when compared with the control treatment (34.21). Thus, exposure of laying chickens to varying levels of light intensity, could not be used for enhancing the performance of pullets.

Keywords: Pullets, daylength, feed intake, egg mass, hen-day egg production, ISA brown.

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INTRODUCTION

Light is a very important environmental factor that influences the behaviour, egg production and quality, and health of laying hens (1). Therefore, artificial illumination is widely used to enhance or increase the reproductive performance of laying hens in modern poultry houses (2). The physiological action of light occurs when it is percepted by the eye and converted to nerve impulses, which are sent to the brain. Light stimulates the gonadal cycle, eventually causing the start of lay by animating the nerve centre zone through the eyes or the pineal organ to deliver gonadotropin-releasing hormone, which invigorates the front pituitary to deliver follicle-stimulating hormone and luteinising hormone (4). Light is able to stimulate the release of sexual hormones, speed up, or delay sexual development, and stimulate egg laying. These hormones are responsible for the production of significant sex steroid hormones such as testosterone, oestrogen, and progesterone (5). Several studies have been conducted to evaluate the effects of various types of light sources on the performance, behaviour and financial aspects of poultry birds (6, 7, 8). Proper lighting is very important for the development and normal functioning of the reproductive system and the overall growth of poultry birds. (9), Therefore, the use of artificial lighting with varying durations, colours, and intensities is widely adopted in poultry houses in order to enhance the performance and productivity of the laying birds (10).

The primary sense organs in poultry are their eyes, and vision is an important area where birds are affected. A lot of research studies have assessed the influence of different light sources on poultry performance, behaviour, and reproduction (6, 8). Poultry birds are able to detect light using both the photoreceptors in the retina of the eyes and the photosensitive cells in their brains (hypothalamic or extra-retinal photoreceptors). The growth and behavioural responses in poultry are primarily affected by the photoreceptors located in the retina, whereas, the photosexual responses are mainly controlled by the extra-retinal light receptors. (3). Light exposure stimulates the release of reproductive hormones in laying hens. These hormones play a crucial role in regulating the sexual maturation and egg-laying cycles in these birds (11). A study carried out

by (12) found that stimulating the retinal photoreceptors had an inhibitory effect on the reproductive function of broiler hens, while stimulating the extra-retinal photoreceptors had an activating effect on their reproductive performance in breeder hens.

Proper lighting regimes are crucial for the optimization of egg production and performance in laying hens. Thus, there is a need for suitable lighting conditions to be employed in poultry production in Nigeria. The current knowledge of photoperiod (duration of light exposure) and light intensity effect on the behaviour and performance of laying hens is quite extensive (5). However, information on importance of lighting colour, as well as its combination with light intensity, is still limited. Therefore, this study was aimed at assessing the effects of lighting intensity on performance of laying hens.

MATERIALS AND METHODS

Experimental Site

The experiment was carried out at the Poultry Unit, Teaching and Research Farm, University of Ibadan, Ibadan, Nigeria, which lies between longitude 7°27.05N and 3°53.74 of the Greenwich Meridian East, at an altitude 200m above sea level. The average temperature and relative humidity of the location are between 23-42℃ and 60-80%, respectively.

Experimental Design and Animal Management

Isa Brown pullets (n=120), with proven records of medication and vaccination schedule, from 14 weeks old were used for this experiment. The pullets were raised in a conventional cage house, with each cell in the three-tier cage measuring 40 × 41 × 32 cm. The pullets were allotted to varying levels of light intensities (9, 13.5, and 18lux), to receive artificial light in their respective intensity for additional four hours (6.30-10:30pm daily) and the control group were allotted natural photoperiod. The design of the experiment was a completely randomized design. Each treatment was replicated five times. The pullets were fed isonitrogenous and isocaloric feed for the duration of the study.

Data Collection

Pullets were weighed just after their arrival. Weekly body weight was recorded and the average weight per bird (each replicate was weighed as a whole, then the average weight was calculated) was calculated after each week. Feed intake (g) and feed conversion ratio were calculated weekly as indicated by the formulae below:

$$\text{Feed intake/bird} = \frac{\text{Feed offered} - \text{Leftover}}{\text{Birds per replicate}}$$

$$\text{Feed Conversion Ratio} = \frac{\text{Feed Intake}}{\text{Egg mass}}$$

Statistical Analysis

Data were subjected to descriptive statistics and analysis of variance using the Statistical Package for Social Sciences (SPSS) version 16.0 (IBM Corp., Armonk, NY, USA). Means across groups were separated with Duncan Multiple Range Test option of the same software. Results were expressed as mean ± standard deviation, while the level of significance was set at $\alpha_{0.05}$.

RESULTS AND DISCUSSIONS

The effects of lighting intensities on performance parameters in laying birds at the early laying phase are as shown in Table 1. Feed intake of the pullets was not significantly affected ($p>0.05$) by the varying light intensities. Thus, this finding showed that varying intensities of light do not have any influence on feed intake. This finding correlated with those of Ahmad *et* al (13) that light intensity had no influence on feed consumption by broiler chickens. When compared with the control (34.21), the egg mass at various light

intensities differed significantly ($p<0.05$). This suggests that varying light intensities affects egg mass. In this study, varying light intensities did not affect the FCR significantly ($p>0.05$). This finding aligned with those of Zhao *et al*. (14) that photoperiods and light intensities did not influence feed conversion ratio of broiler chickens. There was also no significant difference in HDEP across the treatment groups, although the control group had the lowest value (60.63).

Table 1. Performance Indices of Egg Laying Pullets Exposed to Different Lighting Intensity

Parameters	Control	9lux	13.5lux	18lux	SEM
Feed Intake	112.58	111.92	116.09	112.45	0.77
Egg Mass	34.21^{b}	36.90^{ab}	44.45^{a}	37.46^{ab}	1.68
Feed Conversion Ratio	3.34	3.06	2.62	3.09	0.14
Hen-Day Egg Production	60.63	76.67	76.00	71.33	2.93

^{abc}Means of treatments along the same row with different superscripts are significantly different ($p<0.05$)
SEM=Standard Error of Means.

CONCLUSION AND RECOMMENDATIONS

Findings from this study suggests that varying intensities could not be used for enhancing the performance of pullets. However, further studies should be undertaken to ascertain the influence of varying light intensities on performance of laying hens at different seasons.

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Monogastric Animal Production: MGP 099

GROWTH PERFORMANCE OF COMMERCIAL BROILER CHICKENS FED THREONINE AND PRECURSOR OF CREATINE-SUPPLEMENTED DIETS

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ABSTRACT

Threonine is the third limiting amino acid in poultry while Guanidino Acetic Acid (GAA) is a precursor of creatine and is more stable and less expensive. This study evaluated the performance responses of commercial broiler chickens fed threonine (ThreAMINO®) and precursor of creatine (CreAMINO®) supplemented feeds. 240 Arbor-Acres-plus one-day-old broiler chicks were randomly assigned to five treatments of four replicates, and twelve birds per replicate in a completely randomized design experiment that lasted forty-two days. T_1 (two feeding phases without feed additive), T_2 (three feeding phases without feed additive), T_3 (three feeding phases with ThreAMINO® included at the rate of 0.1, 0.08, and 0.05% for starter, grower, and finisher phases respectively), T_4 (three feeding phases with CreAMINO® included at the rate of 0.06% for starter, grower, and finisher) and T_5 (three feeding phases with the combination of ThreAMINO® (0.1, 0.08, and 0.05%) and CreAMINO® (0.06%) for starter, grower, and finisher phases respectively). Data obtained were subjected to a One-Way analysis of variance using SAS at $p \leq 0.05$. Broilers fed a combination of ThreAMINO® and CreAMINO® throughout the three feeding phases (T_5) had the best FCR (2.32), lowest feed cost per kg weight gain (₦1744.74), and the highest apparent profit (₦1755.22). Daily feed intake was highest for ThreAMINO®, T_3 (118.12g), and lowest for T_5 (103.07g).

ThreAMINO® and CreAMINO® (GAA) synergistically optimized growth performance and maximized profit.

Keywords: Threonine, Creatine, Amino Acids, Poultry production, Performance.

DESCRIPTION OF PROBLEM

It has been established that feed is the biggest single expense in any intensive system or class of poultry production accounting for not less than 70% of total production cost (1). Protein and energy sources constitute the larger proportion of this cost. Broiler chickens require unrestricted access to quality feed for health, productivity, and welfare; hence the cost of feed is a critical determinant of the affordability of broiler meat and the profitability of broiler operation.

Threonine is usually known as the third limiting amino acid for broilers, after methionine and lysine, in corn-soybean meal-based diets (2) and it has an important role in the structure and function of the gastrointestinal tract (3). Unfortunately, despite the obvious benefits of threonine in broiler production, the broiler farmers in Nigeria have alienated this key ingredient from their formulation, and even the popular commercial feed manufacturers have not been considering its usage.

Creatine is naturally synthesized mainly in the liver and kidney of avian from guanidino acetic acid (GAA). Guanidino acetic acid is synthesized in the liver and kidney from arginine and glycine then acted upon by the enzyme transamidinase and subsequently methylated by S-adenosyl-methionine to creatine (4). The need for creatine is age-dependent and higher amounts are needed by growing animals for muscle growth than the adults (5). GAA also plays an important role as an energy carrier in the cells (6), because of its ability to

spare arginine, which is considered to be the fifth limiting amino acid in typical corn-soybean diets for broilers (7). However, the amount that is synthesized could be insufficient to meet the demand of the fast-growing broilers requirement for cellular energy metabolism (8). Hence, the present study was aimed at evaluating the growth performance responses of commercial broiler chickens fed threonine (ThreAMINO®) and precursor of creatine (CreAMINO®) supplemented feeds.

MATERIALS AND METHODS

Experimental Site

The research was carried out at the Broiler rearing house, Poultry Unit of Teaching and Research Farm, Faculty of Agricultural Sciences, Ladoke Akintola University of Technology, Ogbomoso, Nigeria.

Test Ingredients

Threonine as ThreAMINO® serves for the adequate supply of the essential amino acid threonine and it contains 98.5 % Feed Grade of L-Threonine. ThreAMINO® was fed at 0.1, 0.08, and 0.05% in the feed for the starter, grower, and finisher of the broiler diet respectively.

Creatine (as CreAMINO®) is a premixture of guanidinoacetic acid (GAA) 96 % granulated with starch. Guanidinoacetic acid is approved in Europe as an additive belonging to the category of nutritional additives and the functional group "amino acids, their salts, and analogues". CreAMINO® was fed over the entire growth period of broilers at 600 g/ton (0.06%) of feed based on the manufacturer's recommendation.

Source of the Test Ingredient

ThreAMINO® and CreAMINO® are the trade names for threonine and Guanidino (Acetic Acid the precursor of Creatine) manufactured by Evonik Animal Nutrition, Germany. They were supplied through their West African Regional office in Accra Ghana for the experiment.

Formulation of Experimental Diets

The experimental diets were formulated according to the Arbor Acres Plus broiler nutritional specifications (9) for As-Hatched Broilers (unsexed) targeting a live weight of 1.70 – 2.4kg in six (6) weeks. The experimental phases and nutritional specifications are presented in Table 1.

Table 1: Experimental phases and Nutritional specifications

Description	Starter	Grower	Finisher
Feeding duration (days)	0 – 10	11 – 24	25 – 42
Energy (kcal/kg)	3000.00	3100.00	3200.00
Crude protein (%)	23.00	21.50	19.50
Calcium (%)	0.96	0.87	0.79
Available phosphorus (%)	0.48	0.44	0.40

Source: (15).

Experimental Design, Treatments, and Distribution of Birds

Two hundred and forty (240) unsexed day-old Arbor Acres strain of broiler chickens, purchased from Farm Support Poultry Breeders Limited, a reputable hatchery from Ibadan Oyo State Nigeria were used for the experiment. The birds were inspected for any deformities and abnormalities such as lameness, crooked legs and beaks, pasty vents, and unhealed navels, and the healthy chicks were randomly divided into five (5) treatment groups of four (4) replicates each with twelve birds in each replicate and label as T1, T2, T3, T4, T5 (Table 2). The experimental design for this research was Completely Randomized Design (CRD).

Experimental Birds and Management

Identical brooding and management procedures were provided to all birds in the different treatments throughout the duration of the study. The birds in the different treatments were fed with their corresponding rations throughout the duration of the study. *Ad libitum* feeding regime was practiced with the provision of clean fresh drinking water to the birds throughout the study. The experiment lasted for forty-two (42) days and the best management practices in broiler production and management were optimally observed as stated in the (9).

Table 2: Experimental Layout

Treatment	Descriptions
Treatment 1 (T_1)	Negative Control has two phases of feeding without any test feed additive
Treatment 2 ($T_{2)}$	Positive Control has three phases of feeding without any test feed additive
Treatment 3 (T_3)	The first test diet has three phases of feeding with ThreAMINO® feed additive.
Treatment 4 (T_4)	The second test diet has three phases of feeding with CreAMINO® feed additive
Treatment 5 (T_5)	The third test diet has three phases of feeding with the combination of ThreAMINO® and CreAMINO® feed additives.

Data Collection

Daily feed intake was measured using the differences between the weight of feed offered and that of the leftovers collected the following morning. Body weight gain was determined by the difference between two consecutive weights (1-week interval), while the feed conversion ratio was calculated using the relationship between feed intake and daily weight gain. Mortality was recorded as it occurred. Financial benefit was computed using the cost of dietary ingredients (₦/kg), cost of diet per kg, total feed intake, and total weight gain. All data collected were subjected to a one-way analysis of variance (ANOVA) using the General Linear Model of SAS (10) and the means were compared using Duncan's Multiple Range Test of the same statistical package.

RESULTS AND DISCUSSION

The overall growth performance characteristics of broilers fed diets supplemented with ThreAMINO® and CreAMINO® as shown in Table 3 revealed the final live weights and daily weight gains were not significantly different ($P > 0.05$).

Table 3: Performance Characteristics of Broilers Fed Diets Supplemented with ThreAMINO® and CreAMINO®

Parameters	T_1	T_2	T_3	T_4	T_5	SEM	P-value
Initial Live Weight (g)/bird	44.17	44.65	44.63	44.85	44.75	0.15	0.63
Final Live Weight (g)/bird	1959.71	1937.13	1984.38	1943.35	1938.92	92.72	0.46
Daily Weight Gain (g)/bird	45.61	45.05	45.96	45.20	45.10	0.30	0.86
Daily Feed Intake (g)/bird	112.56^{b}	113.65^{b}	118.12^{a}	112.91^{b}	103.07^{c}	0.43	0.03
Feed Conversion Ratio	2.50^{a}	2.54^{a}	2.59^{a}	2.53^{a}	2.32^{b}	0.02	0.01
Feed Cost/Kg (₦/kg)	743.08^{e}	744.58^{d}	749.09^{b}	748.30^{c}	752.04^{a}	0.02	0.03
Feed Cost/KgWG (₦)	1857.69^{a}	1891.23^{a}	1940.15^{a}	1898.19^{a}	$1,744.74^{b}$	2.41	0.02
Feeding Cost (₦)/bird	3640.53^{b}	3663.56^{b}	3850.00^{a}	3679.13^{b}	$3,382.91^{c}$	3.42	0.03
Revenue/Live Chicken (₦)	5193.23	15133.39	5258.61	5,149.88	5138.22	2.89	0.72
Apparent Profit (₦)	1552.70^{b}	1469.83^{c}	1408.61^{c}	$1,470.74^{c}$	$1,755.22^{a}$	3.01	0.04

^{a,b,c,d,e} Means in the same row with different superscripts are significantly different ($p<0.05$)
WG – Weight gain
T_1 = -ve Control T_2 = +ve Control
T_3 = +ve Control + ThreAMINO® only T_4 = +ve Control + CreAMINO® only
T_5 = +ve Control + ThreAMINO®+CreAMINO®

The daily feed intake ranged from 103.07g in T_5 to 118.12g in T_3, showing significant differences (Table 3), this was contrary to (11), who observed no significant differences in feed intake when creatine was fed to broilers. However, there was no significant difference in the feed intake of birds when creatine was fed alone in the diet when compared to that of control birds, which in a way supports the findings of (11). The lowest feed intake was observed in T_5 where ThreAMINO® and CreAMINO® were combined in the diet. Birds on the ThreAMINO® diet alone recorded the highest ($p<0.05$) feed intake of 118.12g, which corroborates the

findings of (12) who reported that threonine had a significant effect on feed intake. However, this finding is not consistent with the results of the study by (13), who reported that feed intake from 21 to 42 days of age did not differ ($p>0.05$) among treatments ($p \leq 0.089$) when broilers were fed low crude-protein threonine supplemented diets.

The results of the feed conversion ratio also showed no significant ($p>0.05$) difference for the control diets (T_1, T_2) and the diet containing CreAMINO® alone (T_4) which corroborates the finding of (11), while there was a significant difference in FCR for diet having the combination of ThreAMINO® and CreAMINO® (T_5). (15) observed no significant improvement in the feed conversion ratio in broilers with the supplementation of threonine to broiler diet compared with the broilers without threonine, which was also consistent with the result of this study for the diet containing only threonine.

The use of Threonine (ThreAMINO®) and Guanidinoacetic acid (CreAMINO® as creatine) did not significantly affect the weight gain of the broilers. This was contrary to the findings of (15), who reported that supplementation of creatine to a corn-soybean meal-based diet significantly improved weight gain compared with the broilers fed control diet. The weight gain in this experiment corroborates the findings of (16), who reported that supplementation of creatine in broilers' diets did not significantly affect the weight of birds.

Although the feed cost per kilogram for T_5 (ThreAMINO® plus CreAMINO®) was the highest, the daily feed intake was the lowest (103.07g) while daily weight gain was higher (45.10g) compared to positive control (T_2), it also has the lowest FCR value. Hence, birds in Diet 5 were the best in terms of feed utilization thus yielding the highest apparent profit of ₦1755.22

CONCLUSION AND RECOMMENDATIONS

i. The synergy of ThreAMINO® and CreAMINO® produced a significant reduction in feed consumption and feed conversion ratio without significant difference in weight gained but with comparatively lowest feeding cost and highest apparent profit compared to other treated groups.
ii. Due to continuous improvement in genetic potential and management practices for poultry production, the dietary requirement for Threonine might be changing. Hence, a need for continuous research to determine the optimum supplementation level that will be appropriate for broiler chickens in the country and other Sub-Sahara West African countries.

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Monogastric Animal Production: MGP 100

PERFORMANCE OF RABBITS FED DIETS CONTAINING DIFFERENT LEVELS OF FERMENTED JACKFRUIT SEED MEAL AS A SOURCE OF ENERGY DURING THE BREEDING PHASE.

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ABSTRACT

The study was designed to evaluate the feeding value of graded levels of rumen digesta filtrate fermented jackfruit meal on the performance of rabbits. The jackfruit bunches were harvested, seed separated and washed in readiness for fermentation. The rumen digesta filtrate prepared from rumen digesta was used to ferment jackfruit seed for 48 hours and the fermented sample was analysed for its proximate composition before feed formulation. Five breeder rabbit rations were formulated to supply 17% crude protein and 2900 kcal/kg of metabolizable energy. Thirty rabbits consisting of five males and 25 females were weighed and distributed into five groups of five females and one male. Groups were randomly allotted to one of the five experimental groups in a completely randomized design and fed to sexual maturity at 20 weeks. Does were weighed and introduced to the bucks of the same treatment for mating. The experiment lasted for 30 days within which four parities were obtained across the breeding groups. The crude protein value of 8.8% observed in maize was similar ($p>0.05$) to 7.00% in fermented jackfruit seed meal (FJFSM). Rabbits on 25% FJFSM recorded the highest average litter size at birth (6.25), average kitten weight (200.80g) at three weeks, and average kitten weight (265.00g) at weaning. Rabbits fed 50% FJFSM diet had a higher litter weight at birth and at weaning. It was therefore suggested that 50% of maize should be replaced by the fermented jackfruit seed meal for optimum reproductive performance of rabbits during gestation and lactation periods.

Keywords:

DESCRIPTION OF PROBLEM

The majority of the Nigerian population can no longer consume traditional animal products like poultry meat, eggs, milk, beef, mutton, pork, and fish due to the astronomical increase in the cost of these products which is attributed to the high cost of production. The high cost of production has also been attributed to a rise in the price of feeds which constitute about 85% of the entire cost of production. Nigeria is experiencing a shortage in maize supply owing to the intensifying effects of climate change, worsening insecurity, and several disruptions in the food supply chain. As a result, there has been a sudden and speedy rise in the prices of maize. The average prices of maize in the country have surged by 110.9 per cent to N480,000 per tonne in August from N227,500 per tonne in June 2023 the highest monthly surge on record, according to the Poultry Association of Nigeria (1).

One way of solving the problem of animal protein insufficiency in Nigeria is the intensification of the production of animals with a low rate of concentrate feed consumption and encouraging the utilization of non-conventional feed resources, particularly from tree crop origin. The rabbit's rapid rate of reproduction, with a short gestation period, ranging between 28-32 days, has made its production a wise choice for Nigerians as a means of alleviating protein food shortages (2, 3). Jackfruit bean meal is potentially, a good source of carbohydrate and can be used as a substitute for maize in rabbits' and grasscutters' diets. According to Tutyathan *et al.* (4), jackfruit seed meal contains 6.6 to 11% crude protein, 82% nitrogen-free extract, 0.4% fat, 1.5% crude fibre, 78% Starch, and 1.25-1.50% ash. Although rabbits can survive on all forage diets, optimum performance can only be ensured in a mixed feeding regime involving forage and formulated feeds (5).

The presence of these anti-nutrients in the jackfruit seed beans has been reported to cause growth depression, poor feed utilization and mortality (6). Processing methods such as chemical detoxification, boiling, roasting, fermentation, soaking or the combination of two or more of these methods have been utilize in eliminating the anti-nutrient (7), without significant improvement in the nutritional value of jackfruit bean meal. Effiong *et al.* (8) noted that incubating rumen digesta filtrate anaerobically for 48 hours, increased the population of bacteria, protozoa and fungi, which are known to produce enzymes, capable of degrading fibre and certain anti-nutrients. These authors reported a significant reduction in the crude fibre level of rumen digesta filtrate fermented earth ball meal relative to water fermented sample meal. There is no information in the literature stating the feeding value of rumen filtrate fermented jackfruit meal, hence the need for this research. The study was designed to evaluate the feeding value of graded levels of rumen digesta filtrate fermented jack fruit bean meal on the growth and reproductive performance of rabbits.

MATERIALS AND METHOD

Location of the study

This research was carried out at the Rabbitary unit of the Animal Science Teaching and Research farm, University of Calabar, Calabar, Nigeria, located between latitude 04.37° N and longitude 08.20°E.

Preparation of the experimental materials and feed formulation.

The jackfruit bunches were harvested from the home garden and cut open into two to expose the seeds. The seeds were separated from the pulp and washed in clean water in readiness for fermentation. The rumen digesta was collected immediately after slaughtering the cattle at Akim abattoir in Calabar municipality and conveyed to the laboratory in an air-tight polythene bag. The rumen digesta filtrate was prepared by rapidly submerging the rumen digesta into distilled water in a capped plastic container at the rate of 1kg of digesta per litter of water. The mixture was vigorously centrifuged using a metallic rod to dislodge the microbes, residues were filtered out and the filtrate was incubated for 48 hours under room temperature (26°C) in a capped bucket.

Forty-eight (48) hours incubated rumen filtrate was added to a capped plastic bowl containing cracked jack fruit and allowed to ferment for 48 hours, with the plastic container covered properly to minimize air penetration. At the end of the fermentation process, the filtrate was drained off and the fermented seeds were rinsed with fresh clean water, sun-dried by spreading on the concrete floor, milled using a hammer mill with 2mm mesh, and stored in an air-tight container prior to feed formulation. A representative sample of the fermented jackfruit seed meal was taken for proximate analysis, prior to feed formulation. Based on the proximate composition of the feed ingredient, five breeder rabbit rations (Table 1) were formulated to apply 17% crude protein and 2900 kcal/kg of metabolizable energy. Diet 1 (control) contained maize as an energy source, while diets 2 to 5 had maize in the control diet replaced with rumen digesta filtrate fermented jackfruit seed meal at 25, 50, and 75 100%, respectively.

Experimental animals and management

A total of thirty (30) hybrid, rabbits with the ages range between 15 to 16 weeks old, consisting of five (5) males and twenty-five (25) females, raised under the same experimental condition were used for the experiment. The rabbits were weighed and distributed on weight equalization basis into five groups of five females and one male. Groups were randomly allotted to one of the five experimental diets described earlier in a completely randomized design and fed to sexual maturity at twenty (20) weeks. The animals were housed individually in a wooden cage, measuring 120x60x50cm in a two-tier hutch. Concentrates and water were provided in concrete crocks with an equal quantity of experimental diet offered across the groups.

At sexual maturity, Does were weighed and introduced to the bucks of the same treatment for mating. After successful mating, does were returned to their cages and the mating dates were recorded. Pregnancy diagnoses were done by palpation and weight method at 12 days post-mating. Does were supplied wooden nesting boxes on the 25th day of pregnancy, and kindling occurred on the 31±2day post-mating. The experiment lasted for 30 days within which four parities were obtained across the breeding groups.

Data Collection and Analysis

Feed intake was recorded daily. Weight gain during pregnancy was achieved by weighing individuals does weekly during the gestation period. Litter size at birth and weaning were obtained by counting the number of the kitten at respective stages, while litter weights were obtained by weighing the kitten across the treatment at birth and weekly till weaning. Milk yield was calculated using the formula 1.8 x (live weight of kitten at twenty-one days-live weights at birth) (9). The results were subjected to one-way analysis of variance, using a Completely Randmized Design (CRD) and significant means were compared using Duncan's New Multiple Range Test of the (10) software packages.

RESULTS AND DISCUSSION

Proximate composition of maize and jackfruit seed meal

The results of the proximate composition of maize and rumen filtrate fermented jackfruit seed meal are presented in Table 2. The proximate composition showed the crude protein value of 8.8% observed in maize was not significantly ($p>0.05$) different from 7.00% recorded for the rumen digesta filtrate fermented jackfruit seed meal. The fermented jackfruit seed meal was also similar to maize in its ether extract and nitrogen-free extract contents, but superior to maize in ash content. The gross energy content of 3.86Kcal/kg observed in the fermented jackfruit seed meal suggests that the content can be used as an alternative energy source in livestock feed.

Growth performance of rabbits during the breeding period

The result of the growth performance of rabbits fed diets containing graded levels of jackfruit seed meal as an energy source during the breeding period is presented in Table 3. Variation in the average weekly feed intake, weight gain and the feed conversion ratio between rabbits fed the control diet and those on graded levels of fermented jackfruit seed meal diets was not significant ($p>0.05$). Non-significant relationship among the treatment groups in these parameters implies that the rabbits were efficient in utilizing the nutrients in the jackfruit seed meal to satisfy their requirement during gestation (foetus development) and milk synthesis. The average weekly weight gain range (46.27 to 58.58g) observed in this research was lower than values (220.40 to 382.82g) reported by Effiong *et al.* (11) for breeder rabbits fed diets containing orange pulp meal as an energy source. The differences in the rate of gain may be attributed to the individual rabbits in converting feeds to flesh. Environmental differences may also have been responsible for the differences reported.

Reproductive performance of breeder rabbits fed diets containing fermented jackfruit seed meal.

The results of the reproductive performance of breeder rabbits fed diet containing jackfruit meal as an energy source are presented in Table 4. The average litter size at birth ranged from 3.75 for rabbits fed diet containing 25% fermented jackfruit seed meal to 6.25 for those on diet containing 50% jackfruit seed meal. Variation in the average litter size at birth differed ($p<0.05$) significantly among the treatment groups, although rabbits on diets containing 50%, 75% and 100% fermented jackfruit seed meals were statistically ($p>0.05$) similar to those placed on the control diet. Similarities in the average litter size at weaning between rabbits fed control diet and those on treatment diets imply that relevant nutrients were supplied by the test ingredient to the gestating rabbits to enhance the increase in the number of eggs released and sustain the rabbits throughout the gestation periods. The average litter size at birth did not follow any trend; for instance low average litter size of 3.75 observed among breeder rabbits on 25% fermented jackfruit seed diet may not have been attributed to the treatment effect, but rather as a result of chance.

The observed average litter size at birth (3.75 – 6.25) in this experiment was higher than values (4.00 – 5.00) reported by Iyeghe- Erakpotobor *et al.* (12) for rabbits fed diets with different levels of protein, maize-milling waste based diets and concentrated to forage (*Stylosanthes hamata*) combinations, respectively.

The average kitten weight at birth ranged from 41.5g for the rabbits fed the control diet to 52.80g for those placed on diet with 75% fermented jackfruit seed meal. Variation in the average litter weight at birth was not ($p>0.05$) between the treatment diets. The implication of this is the treatment diets were capable of

supplying nutrients to meet the requirement of the gestating rabbits, as evidenced in the weight appreciation during pregnancy and lactation. The average kitten weight at birth reported in this experiment was similar to those reported by Hasanat *et al.* (2006), and Effiong *et al.* (2024) for rabbits fed diets containing different levels of protein concentrate supplemented diet and orange pulp meal. Rabbit fed diet containing 25% fermented jackfruit seed meal recorded a significantly ($p<0.05$) higher average kitten weight (200.80g) at three weeks relative to those fed control (196.20g) and other treatment diets. The average kitten weight at weaning followed the same trend as that of three weeks in that rabbits fed diet containing 25% fermented jackfruit seed meal recorded a significant ($p<0.05$) higher average kitten weight (265.00g) relative to those on control and other treatment diets. The higher growth rate of kittens on 25% fermented jackfruit seed meal diet was more likely caused by the lower number of pups per litter and consequently less competition for milk resulting in heavier individual pup weight.

The kittens' mortality observed in this work was not attributed to the treatment effect, but rather due to environmental effects including the inexperience of does, especially at first parity. Some of the does fail to sheath furs into the kindling boxes, while few kindled outside the kindling boxes, causing the kitten to be exposed to early pneumonia.

Table 1: Gross composition of experimental diet fed to breeding rabbits

	Replacement levels of fermented jackfruit seed meal				
Ingredients	**0%**	**25%**	**50%**	**75%**	**100%**
Maize	50.00	37.50	25.00	12.50	0.00
Jackfruit seed meal	0.00	12.50	25.00	37.50	50.00
Soybean	16.00	16.00	16.00	16.00	16.00
Palm kernel cake	20.00	20.00	20.00	20.00	20.00
Wheat offal	9.50	9.50	9.50	9.50	9.50
Bone meal	3.00	3.00	3.00	3.00	3.00
Salt	0.25	0.25	0.25	0.25	0.25
Vitamin/mineral premix*	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Analyzed value					
Crude protein (%)	17.00	17.21	17.41	17.62	17.81
Crude fibre (%)	5.25	5.33	5.41	5.51	5.64
Met. Energy (Kcal/kg)	2926	2838	2750	2663	2575

*Vitamin/mineral premix containing the following per kg. Vitamin A 10,000000IU; Vitamin D3 2,000000IU; Vitamin E 10,000IU; Vitamin K 2,000mg; Thiamine 1,500mg; Riboflavin B 4,000mg; Pyridoxine B6 1,500mg; Anti-oxidant 125g; Niacin 15,000mg; Vitamin B12 10mg; Pantothenic acids 5,000mg; Biotin 50mg; Choline chloride 400g, Manganese 80g; Zinc 20g; Iron 50g; Copper 20g; Iodine 1.5g; Selenium 200mg; Cobalt 200mg; Folic acid 500mg; Vitamin C 100mg

parameters	**Dry matter**	**Crude protein**	**Crude fibre**	**Ether extract**	**Ash**	**Nitrogen Free Extract**	**Gross energy (Kcal/kg)**
Fermented Jackfruit	85.85±0.002	7.10±0.002	3.11±0.001	5.74±0.005	5.61±0.003	64.30±0.006	3.858±0.004
Maize		8.80±0.001	2.20±0.04	5.70±0.01	1.45±0.12	77.88±0.22	3.94±0.42

Table 3: Growth performance of does fed fermented jackfruit bean meal during the breeding period

Parameters	0%	25%	50%	75%	100%	± SEM
Initial weight(g)	1825.00	1712.00	1802.00	1830	1775.00	111.30
Final weight gain(g)	2207.00	2066.00	2180.00	2242.00	2068.00	111.10
Total weight gain(g)	690.00	633.00	688.00	602.00	602.00	143.90
Average daily weight gain(g)	53.10	48.67	52.90	58.58	46.27	11.07
Average daily feed intake(g)	552.91	567.79	549.33	567.94	533.69	10.89
Feed conversion ratio	10.41	11.67	10.38	9.70	11.53	2.49

Means with different superscript on the same row are significantly (P<0.05) different
SEM: Standard error of mean

Table 4: Reproductive performance of breeders rabbits fed different levels of jackfruit bean meal

	Percentage levels of fermented jackfruit seed meal					
Parameters	**0**	**25**	**50**	**75**	**100**	**±SEM**
Av. Litter size at birth	7.75^{a}	5.75^{b}	8.25^{a}	8.50^{a}	7.00a	0.50
Av. kitten weight at birth(g)	41.50	48.50	51.50	52.80	44.20	3.99
Av. litter size at weaning	6.00	5.25	6.50	7.52	6.00	0.29
Av. kitten weight at 3 weeks(g)	149.20^{b}	200.80^{a}	140.00^{b}	109.00^{bc}	133.20^{b}	2.46
Av. kitten weight at weaning(g)	196.20^{b}	265.00^{a}	195.00^{b}	176.00^{b}	190.50^{b}	2.73
Milk yield (g)	127.15^{b}	179.66^{a}	104.43^{b}	66.38^{c}	105.02^{b}	2.73
Survival rate (%)	69.56	86.66	72.00	64.00	66.67	1.26

Means with different superscript on the same row are significantly (P<0.05) different
SEM: Standard error of mean

CONCLUSION AND APPLICATION

From this study, it was concluded that the dietary replacement of maize with the fermented jackfruit seed meal had no negative impact on the performance of breeder rabbits during gestation and lactation periods. It was therefore suggested that 75% of maize should be replaced by the fermented jackfruit seed meal for optimum reproductive performance of rabbits during gestation and lactation periods.

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Monogastric Animal Production: MGP 101

NUTRITIONAL EVALUAION OF ROSELLE (*Hibiscus sabdariffa* L.) SEED USING SODIUM HYDROXIDE (NaOH) AND LYE WATER

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ABSTRACT

This study compares the effect of sodium hydroxide and lye water processing methods to enhance the nutrients quality of Roselle seed. In this study the effect of processing methods on the proximate compositions and mineral contents of Roselle seed were evaluated. Three different processing methods were evaluated, each has three replicates. There were assigned to 4 treatments, T_1 = control (untreated Roselle seeds), T_2 = sodium hydroxide treated Roselle seeds, T_3 = lye water treated Roselle seeds, and T_4 = combination of sodium hydroxide and lye water treated Roselle seeds. The prepared samples were subjected to laboratory analysis. The outcomes for this investigation on Roselle seed revealed that processing methods had significant ($P<0.05$) effect on the proximate compositions of Roselle seed except on ether extract contents. This shows that Roselle seed is a dense mineral source and confirmed that Roselle seed is a rich source of nutrients. The mineral compositions of the Roselle seed obtained showed that there were significant ($P<0.05$) differences in the values of Potassium (K), zinc (Zn), manganese (Mn), calcium (Ca) and Copper (Cu) compared with the control. Combination of sodium hydroxide and Lye water treated Roselle seeds (T_4) was statistically superior to others in term of Cu. while sodium hydroxide treated Roselle seeds (T_2) affect the value in Ca. The combination of sodium hydroxide and lye water treatment is considered for increasing crude protein content of roselle seed.

Keyword: Roselle seed, Processing Methods, Proximate, Minerals

INTRODUCTION

In recent years, there has been a growing interest in exploring alternative sources of nutrients and evaluating their potential applications in various industries, including the food and health sectors. One such promising source is the roselle seed, derived from the plant species *Hibiscus sabdariffa.* Roselle seeds have gained attention due to their rich nutritional composition and potential health benefits (9). To harness the nutritional potential of roselle seeds effectively, it is crucial to employ appropriate extraction methods that can optimize nutrient extraction and preserve their bioactive compounds; among the various extraction techniques, the use of alkaline solutions such as sodium hydroxide (NaOH) and lye water has gained prominence (4). The utilization of sodium hydroxide and lye water as extraction agents for nutritional evaluation of roselle seeds holds great promise. By exploring these extraction techniques, we can gather valuable information regarding the nutritional composition and potential bioactive compounds present in roselle seeds, paving the way for their incorporation into various food and health products (11). This study aims to evaluate the nutritional composition of Roselle seeds using sodium hydroxide and lye water as extraction agents.

MATERIALS AND METHODS

Experimental site: The study was conducted at Department of Animal Science laboratory, Federal University Dutse. Dutse is the capital city of Jigawa State. The site is located latitude 11^0 N 13^0 N and longitudes 8^0 E 10^0 35' E, at an altitude of 485m above sea level. Jigawa state has an estimated land size of 23,154 km^2 (6). The state is situated within the Sudan Savannah vegetation zone, but there are traces of Guinea savannah in the southern part of the state .The regions are characterized by a long dry season of 7-8 months. (10).

Experimental Materials: The Roselle seeds used in the research were purchased from neighboring market near Federal University Dutse teaching and research farm. The collected seeds were cleaned by winnowing and hand picking of stones and debris. The cleaned Roselle seeds were subjected to three processing methods: T_1= Untreated Roselle seeds (Control), T_2 Sodium hydroxide treated Roselle seeds, T_3 Lye treated Roselle seeds and T_4 Combination of Lye and sodium hydroxide treated Roselle seeds.

Processing Methods of the Roselle Seed
Untreated Roselle seed: The untreated Roselle seeds serve as the control (T_1).
Sodium hydroxide treatment: The Roselle seeds were treated with NaOH at 6%. 250g of Roselle seeds were soaked in 500ml plastic container containing the NaOH solution at 6% for 24hrs.The seeds were removed washed and sun dried for 72h. The dried treated seeds were stored in an airtight container, as described by (7). Seeds treated with sodium hydroxide represent treatment (T_2).
Lye water treatment: Lye water was prepared by passing water over gray ash in a barrel. The ash was sieved to remove pieces of charcoal and other impurities. The sieved ash was then place in a plastic container with holes plugged with sieved cloth at the base of the container. Hot water was poured on the ash and a brown liquid dripped at base of the container. This brown liquid represents the lye water that was used in this research. Roselle seeds were placed in a muslin cloth and then soaked in the lye water for 18hrs. The seeds were removed and sun-dried for 7days as reported by (3). The dried treated seeds were stored in an airtight container. Seeds treated with lye water represent experiment treatment (T_3).
Lye water and sodium hydroxide treatment: The Roselle seeds were treated with Lye water and NaOH at 6%. 250g of Roselle seeds were soaked in 500ml plastic container, containing the Lye water and NaOH solution at 6% for 24hrs. The seeds were removed, washed and sun dried for 72h. The dried treated seeds were stored in an airtight container, described by Ibrahim *et al.,* (2016). Lye water and Sodium hydroxide treated seeds represent experiment treatment (T_4).

Determination of proximate composition: Representative samples of the differently processed Roselle seeds were collected for proximate analysis. Dry matter, crude protein, crude fibre, ether extract and ash, were analyzed according to (2).

Determination of mineral composition: Atomic Absorption Spectrometer was used to determine the content of the macro minerals of the Roselle seed such as Calcium (Ca), magnesium (Mg), potassium (K) and micro minerals copper (Cu), zinc (Zn) and manganese (Mn).

Statistical analysis: The data generated from this research were analyzed using One-way Analysis of Variance (ANOVA), Procedure of Statistical Analytical system (12). Duncan's Multiple Range Test ($p<0.05$) to study the difference between means was employed.

RESULTS AND DISCUSSION

Effect of treatment methods on proximate composition of the Roselle seed
The result of proximate composition of various processed Roselle seeds was presented in Table 1. The results show significant ($P>0.05$) different among the treatments on parameters evaluated except for ether extract. The values of EE obtained in T_4 (17.0 %) was statistically superior ($P<0.05$) to other treatments.

Effect of treatment methods on mineral composition of Roselle seed

Table 2 shows the mineral composition of various processed Roselle seeds. The result in this study indicates that there is significance (P>0.05) different in the values of calcium 1222 ppm to 1940 ppm (Ca), copper (Cu) and potassium (K), meanwhile, the values of magnesium 2536 ppm to 2561 ppm (Mg), zinc 2.11 ppm to 2.52 ppm (Zn) and manganese 1.65 ppm to 1.83 ppm (Mn) shows no significant (p<0.05) difference among the minerals evaluated.

Table 1: Proximate compositions of various processed Roselle seeds

Parameter (%)	T1	T2	T3	T4	SEM	LOS
DM	94.40[b]	88.90[c]	94.90[a]	95.10[a]	1.48	*
CP	10.61[b]	8.42[c]	6.53[c]	12.90[a]	0.75	*
CF	32.33[b]	39.00 [a]	40.33[a]	42.33[a]	1.48	*
EE	14.66	15.66	16.66	17.00	0.40	NS
ASH	3.66[b]	3.00[b]	3.66[b]	4.00 [a]	0.14	*

[abc:] means of different superscript are significantly different, DM-Dry matter, CP-Crude protein, CF-Crude fibre, EE-Ether extract, SEM- Standard Error of means, LOS-Level of significance, *-Significant, NS- not significant.

Table 2: Some macro and micro mineral composition of various processed Roselle seeds

Minerals (ppm)	T_1	T_2	T_3	T_4	SEM	LOS
Macro						
Ca	1940[a]	1222[c]	1299[b]	1456[a]	1.61	*
Mg	2551	2561	2541	2536	5.54	NS
K	409.40[a]	382.10[b]	466.00[a]	398.70[a]	18.20	*
Micro						
Zn	2.52	2.12	2.11	2.12	0.10	NS
Mn	1.83	1.65	1.75	1.79	0.03	NS
Cu	1.15[a]	1.02[b]	0.98[c]	1.27[a]	0.06	*

[abc:] means of different superscript are significantly different, Ca-Calcium, Mg-magnesium, K-Potassium, Zn-Zinc, Mn-manganese, Cu-Copper, SEM- Standard Error of means, LOS-Level of significance

Proximate composition of various processed Roselle seeds

The result of proximate composition showed that Roselle seeds are a rich source of valuable nutrients (8). The dry matter values obtained in this study ranges was a bit higher to the results reported by (13). The crude protein obtain in the study was in lower than the value (19.07%CP) reported by (1). This implies that lye water and NaOH treatment has positive effect on roselle seed. The values of ether extract were lower compared to 21% reported by (9). The crude fibre obtained was significantly superior compared to values reported by (9) which state that Roselle seed contain 20% crude fibre. The values of ash in this study were lower than values 22.61% reported by (1).

Mineral composition of various processed Roselle seed

The calcium, Magnesium (Mg) and potassium (K) content obtained in this research was slightly higher to the values 1054ppm to 1920ppm (Ca), 1850 to 2083ppm (Mg), and 30.52ppm to 272.7ppm (K) reported by (9). The outcome for copper (Cu), manganese (Mn) and zinc (Zn) were lower compared with the findings reported by Abdurrahman *et al.,* (2021).

CONCLUSION

The results obtained in this study revealed that different processing methods have effect on the proximate composition of the treated Roselle seeds, except in the mean values of ether extract. Similarly, the mean

values of magnesium (Mg), was not affected on various processing methods of the seed unlike the other minerals elements.

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Monogastric Animal Production: MGP 102

EFFECT OF NATURAL AND SYNTHETIC FEED ADDITIVES ON HAEMATOLOGY AND SERUM BIOCHEMICAL PROFILE IN LAYERS

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ABSTRACT

Antibiotics usage may obstruct normal reproductive function and further cause bacteria resistant to diseases in chickens. If such resistant bacteria are ingested by humans or are transferred to them through chicken products, this could be dangerous. A total of 240 point of cage (12 weeks old) Isa brown pullets were divided into 5 treatments in a completely randomized Design (CRD), and each treatment was further sub-grouped into 4 replicates consisting of 12 birds. 8 weeks was used for the experiment. The dietary treatments were; (T1) control, basal diet + garlic powder (3g/kg feed) (T2), basal diet + synbiotic powder (0.25g/kg feed) (T3), basal diet + organic acidifier (1g/kg feed) (T4), basal diet + synthetic antibiotic (T5). Feed and water were supplied *ad libitum*. Blood samples was collected for haematology and serum biochemical responses. Data generated were subjected to one-way Analysis of Variance (ANOVA) using SAS. Birds on T2, T3, T4, and T5 had a significantly ($p<0.05$) higher values for packed cell volume, haemoglobin, mean corpuscular volume and mean corpuscular haemoglobin than birds on control. All serum biochemical parameters were not significantly ($p>0.05$) influenced by the test ingredients. In conclusion, garlic (*Allium sativum*) demonstrated superior effects on haematological parameters compared to other treatment in the experimental birds.

Keywords: Haematology, antibiotics, garlic, *ad libitum*, and serum

DESCRIPTION OF PROBLEM

Poultry meat and egg production, still pain from great losses due to food contamination with harmful bacteria and their influences also on the poultry performance, such as decrease weight and increase of mortality rate (1). For many years, antibiotic growth promoters (AGP) have been incorporated into poultry diets because of their favourable effects on growth rate, feed consumption, and feed efficiency, however, they are notorious for bacterial resistance and their negative impacts on the consumers' health (2). Due to increasing concerns about antibiotic resistance, the poultry industry is seeking AGP alternatives that enhance growth, support intestinal health, and have antimicrobial properties.

Phytogenic supplements are plant-derived products used in feeding poultry to maintain performance of livestock species (3). Garlic is recognized for its antioxidant and antimicrobial properties, along with various other benefits (4). Currently, natural feed additives like probiotics, prebiotics, and medicinal plants are used in poultry diets to improve performance and immune response. Organic acid lowers intestinal pH, enhancing the solubility, digestion, and absorption of feed ingredients. (5). Acetic acid is one of organic acids which used to inhibit harmful microbial content in gut, modifying pH level and enhancing feed efficiency (6). Thus, more effective and economical feeding strategies are needed to enhance poultry health and performance.Therefore, this study was carried out to examine the effects of garlic, symbiotic and organic acidifier on blood haematology and serum biochemical parameters in layers.

MATERIALS AND METHODS

Experime ntal site

The experiment was conducted at the Poultry Unit of Institute of Food Security, Environmental Resources and Agricultural Research (IFSERAR) Farm, Federal University of Agriculture, Abeokuta (FUNAAB), Ogun State, Nigeria.

Experimental procedure

Fresh Garlic *(allium sativum)* was sourced from open market in Abeokuta metropolis. Garlic cloves were minced and oven dried at 70°C until a constant weight and was then grounded into powder and included in the basal diet. Synbiotic powder, organic acidifier powder and antibiotics powder were bought from a reputable veterinary pharmacy. Garlic powder was mixed with the feed at 3g per kg feed. Synbiotic powder (Innovad Lummance), organic acid powder (Formycine Gold Px) and antibiotics powder (Keproceryl) were used according to the manufacturer's recommended doses.

Experimental birds and management

A total of 240 twelve-week-old Isa Brown pullets were purchased for the research. After a two-week acclimatization period, they were assigned to 5 treatments, each with 4 replicates of 12 birds, in a Completely Randomized Design. The treatments are as follows: Control diet, Basal diet + Garlic powder. Basal diet + Synbiotic powder, Basal diet + Organic acidifier powder and Basal diet + Synthetic antibiotic. The composition of the basal diet is shown in Table 1.

Table 1: Gross composition (%) of diets

Ingredients	Growers (Kg)
Maize	42.00
Soybean Meal	5.00
Fish Meal	-
Groundnut cake	7.30
Palm Kernel Cake	15.00
Wheat Offal	26.00
Bone Meal	2.00
Oyster Shell	2.00
Lysine	0.10
Methionine	0.10
Vit/Min Premix	0.25
Salt (NaCl)	0.25
Total	100.00
Determined analysis (%)	
Crude Protein	15.58
Crude Fibre	5.47
Ether Extract	4.08
Ash	3.60
Calcium	1.35
Phosphorus	0.37
Lysine	0.63
Methionine	0.36
Energy (Kcal/Kg)	2,477.55

Blood Analysis

At 20 weeks, two birds per replicate were randomly selected for blood collection. 5ml of blood were drawn from each bird's jugular vein. 2ml were placed in EDTA bottles for hematological analysis (PCV, RBC, Hb, WBC), and 3ml in plain bottles for serum metabolite assessment (Creatinine, Urea, Glucose, total protein, etc.).

Statistical analysis

All data collected were subjected to Analysis of Variance (ANOVA) in a Completely Randomized Design (CRD) using Statistical Analysis Software (SAS 2012). Significant ($p<0.05$) means among variables were separated using Duncan Multiple Range Test of the software.

RESULT AND DISCUSSION

Effect of diets containing garlic, synbiotic, organic acidifier and synthetic antibiotics on haematology of egg-type chickens at week 20

The effect of dietary inclusion of garlic powder, synbiotic powder, organic acidifier and synthetic antibiotics on haematological response of layers is shown in table 2. It was observed that PCV and HB were significantly higher in birds on garlic diet, while it is reduced in birds on the control diet. The MCV and MCH were highest in birds fed diets containing garlic. However, it was reduced in birds on the control diet.

The values of packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), and haemoglobin (HB) in hens fed test ingredients were higher than those in the control diet. Haematological indices for PCV in the present study, though significantly different ($p<0.05$) among treatments, are not within the range of 22.00 – 35.00% except the control which recorded 33.00%. This result differed from 29.56 - 32 and 28.75 -29.33 % (7; 8) respectively. All the experimental diets except the control exceeds the range of 22.0-35.0 % reported by (9; Bounous & Stedman, 2000) for PCV. This could be due to the inclusion rate of each test ingredients. While the haemoglobin fell within the range of 7-13g/dl reported by **(**Bounous & Stedman, 2000**).** Similar to our findings, (11) found that Hb and PCV% increase in broiler fed diet supplemented with phenyl acetic.

Table 2: Effect of diets containing garlic, synbiotic, organic acidifier and synthetic antibiotics on haematology of egg-type chickens at week 20

Parameters	Control	Garlic	Synbiotic	Organic Acidifier	Synthetic Antibiotics	SEM
PCV (%)	33.00^{b}	39.00^{a}	36.00^{ab}	35.75^{ab}	35.75^{ab}	0.70
RBC(x 10^{12}/L)	3.95	2.78	2.80	3.38	3.25	0.17
Hb (g/dL-1)	9.50^{b}	11.63^{a}	10.43^{ab}	10.58^{ab}	10.68^{ab}	0.24
WBC(x 10^{3}/µL)	12.18	13.55	13.25	12.80	13.50	0.33
Heterophyl (%)	32.75	29.25	31.00	30.00	31.25	0.54
Lymphocyte (%)	65.75	69.00	68.25	69.25	67.75	0.53
Eosinophil (%)	0.50	0.50	0.00	0.00	0.25	0.099
Basophil (%)	0.25	0.75	0.25	0.25	0.25	0.11
Monocyte (%)	0.75	0.50	0.50	0.50	0.50	0.11
MCV (fL)	85.00^{b}	142.03^{a}	141.23^{a}	108.54^{ab}	111.54^{ab}	6.91
MCH (pg)	24.42^{b}	42.39^{a}	41.01^{a}	32.23^{ab}	33.26^{ab}	2.10
MCHC (g/dL)	28.77	29.83	28.95	29.55	29.84	0.19

$^{a,b;}$ Means bearing different superscript in a row differ significantly ($P<0.05$)

PCV = Packed Cell Volume, RBC = Red Blood Cell, Hb = Haemoglobin, WBC = White Blood Cell, MCV = Mean corpuscular volume, MCH = Mean corpuscular haemoglobin, MCHC = Mean corpuscular haemoglobin concentration.

Effect of diets containing garlic, synbiotic, organic acidifier and synthetic antibiotics on serum biochemistry of egg-type chickens at week 20

The effect of the dietary inclusion of garlic powder, synbiotic powder, organic acidifier and synthetic antibiotics on serum biochemistry of layer birds is presented in Table 3. The result revealed that all serum biochemical parameters were not significantly ($P>0.05$) affected by the diets.

This result is consistent with (11), who showed that supplementing with 25 mg/kg, 75 mg/kg, or 100 mg/kg of garlic extract (allicin) did not substantially change the concentrations of total protein and albumin when

compared to the control group. Additionally, no change in blood total cholesterol was observed, which is in line with findings published by (12), who reported that synbiotic supplementation to laying hens diet did not result in any change in serum total cholesterol levels. Conflicting results have been reported regarding the effects of organic acids on serum biochemical indices. A decrease in total protein and triglycerides after administering organic acids to broilers, along with an increase in cholesterol concentration as documented by (13). However, our findings are consistent with those of (14), who found no significant differences in the serum biochemical indices examined following organic acid supplementation.

Table 3: Effect of diets containing garlic, synbiotic, organic acidifier and synthetic antibiotics on serum biochemistry of egg-type chickens at week 20

Parameters	Control	Garlic	Synbiotic	Organic Acidifier	Synthetic Antibiotics	SEM
Protein (g/dl)	6.98	6.80	7.18	7.20	6.38	0.19
Globulin (g/dL)	2.45	2.33	2.63	2.53	2.70	0.12
Albumen Conc(g/dl)	4.55	4.48	4.55	4.68	3.68	0.16
Cholesterol(mg/dl)	131.08	133.63	137.55	136.73	134.73	2.18
Glucose(g/dl)	85.38	70.43	83.03	85.23	90.83	3.04
Creatinine (mg/dl)	2.41	1.69	2.65	2.28	1.22	0.30
Urea(mg/dl)	26.65	25.10	25.88	25.70	33.35	1.55
Triglycerides(mg/dl)	164.20	102.95	150.18	107.93	112.15	10.29
VLDL (mg/dL)	32.85	20.60	30.05	21.58	22.45	2.06
LDL(mg/dL)	39.30	45.20	43.03	46.08	44.90	1.47
HDL(mg/dL)	58.93	67.80	64.53	69.10	67.38	2.21

VLDL = Very low density lipoprotein, LDL = Low density lipoprotein, HDL = High density lipoprotein

CONCLUSION

It can be concluded from the result of the study that; Garlic (*Allium sativum*) demonstrated superior effects on haematological parameters compared to other treatment in the experimental birds.

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Monogastric Animal Production: MGP 103

PHYSICAL CHARACTERISTICS OF BONE OF BROILER CHICKEN FED DIETS WITH OR WITHOUT SUPPLEMENTAL VITAMIN-MINERAL PREMIX IN DIFFERENT HOUSING SYSTEMS

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ABSTRACT

Effects of supplemental dietary vitamin-mineral premix (VMP) and Housing Type (HT) on bone properties of finisher broiler chickens were assessed in this study. Arbor Acres broiler chicks (n=200) at one-day old were randomly allotted to four treatments, each treatment was replicated five times, a replicate had ten chicks. They were initially brood for four weeks in a deep litter (DL) open sided pen and were offered standard starter and grower feed with water *ad-libitum*. At week 5, they were grouped equally into four treatments; T1- with VMP in DL, T2- without VMP in DL, T3- with VMP in cage, T4- without VMP, such that each group weights were similar. The finishers experimental diets were fed to the respective birds in cage and DL for another four weeks. At week 8, selected chicken were sacrificed, dissected, deboned and dried. Except for femur length, femur robusticity index, tibia length and tibia bone density, other physical indices of bones were significantly higher ($p<0.05$) for T1 than T2. The HT had no significant effects ($p>0.05$) on femur and tibia physical attributes except for femur bone weight and femur Seedor index which were significantly higher ($p<0.05$) for T1 and T2. Effect of interaction of VMP and HT were significant ($p<0.05$) for all the physical bone indices in T1 compared to other groups (T2, T3 and T4) except for femur length, seedor index, femur robusticity, tibia weight, tibia length and tibia bone density. Therefore, the bone physical characteristics of broiler chickens were mostly influenced by the HT and dietary supplement of VMP.

Keywords: Vitamin-mineral supplementation, Seedor index, Bone robusticity, Femur bone, Tibia bone, Bone strength.

INTRODUCTION

Broiler chicken production represents a cornerstone of the global poultry industry which is an integral component continually evolving to meet the ever-growing demands of the world's burgeoning human population [3]. Proper nutrition plays an indispensable role in achieving optimal growth performance and skeletal health [4]. Among the critical dietary components, vitamin and mineral premixes have emerged as an important area of interest due to their pivotal role in enhancing broiler health and productivity [1]. In contemporary poultry production, bone-related issues have become a significant focal point due to their diverse implications on avian welfare, productivity, and the enduring economic viability of the industry [8]. Studies in broiler chicken production [3,7] has demonstrated that significant production costs could be reduced by eliminating vitamin-mineral premixes from the diets of broiler finishers without adversely affecting skeletal framework. Withdrawal of vitamin-mineral premix at 14-21 days of age of broiler chicken adversely affect the bone integrity and bone health of broiler chicken as reported [7]. Other studies [3,7] showed that broiler chickens could be raised with diets without supplemental vitamins and minerals after day 28 of husbandry until finishing, without any detrimental effects on bone health. Available reports about vitamin-mineral premix withdrawal in broiler chickens on performance, Immunocompetence and carcass characteristics [3,1,6] have been reported. This study aims to evaluate the combined impact of dietary vitamin-mineral premixes (VMP) and different housing systems on physical bone characteristics of broiler

chicken. This study was aimed at assessing the implications of supplemental VMP and different HT on bone characteristics of broiler chicken.

MATERIALS AND METHOD

The study, conducted at the Teaching and Research Farm, University of Ibadan, Nigeria, involved raising 200 Abor Acre broiler chicks from day-old to eight weeks. The chicks were initially brood for four weeks in a deep litter open sided pen and were offered standard starter and grower feed with water *ad-libitum*. At week 5 the chicks were randomly assigned to four treatment groups with fifty chickens per group, each group replicated five times with ten chickens per replicate. The treatments were as follows: T1 – basal diet with VMP on deep litter; T2 – basal diet without VMP on deep litter; T3 – basal diet with VMP in cage; and T4 – basal diet without VMP in cage. At week 8, two birds per replicate, closest to the mean group weight, were selected, tagged, and slaughtered after an overnight feed deprivation. Bones from the left tibia and femur were processed by boiling and air-drying to remove tissues. Morphometric parameters measured included bone weights, lengths, weight/length indices, robusticity indices, and bone strength and density. The experimental finisher diet had specific compositions with calculated metabolizable energy and crude protein levels. The study used a completely randomized design and data were analyzed using ANOVA with means separated by Duncan's Multiple Range Test at $\alpha = 0.05$.

RESULTS

Physical Characteristics

The main effects of dietary supplemental of VMP and HT on physical parameters of Femur and tibia bones of finisher broiler chicken as shown in (Table 1). There was significant difference ($p<0.05$) in femur bone weight, femur bone weight/length index, tibia bone weight, tibia bone weight/length index and Tibia Robusticity index. There were significant differences ($p<0.05$) in femur bone weight and femur bone weight/ length index of finisher broiler chicken for T1 and T2 and T3 and T4 had lower femur bone weight (12.00g) and femur bone weight /length index (154.527mg/mm) compared with the ones raised under deep litter system. The interaction effects (Table 2) shows that there were no significant interactions between supplemental VMP and HT for tibia bone weight, femur length, femur robusticity index, tibia length, tibia bone strength and tibia bone density. Finisher broiler chickens for T1 had the highest femur bone weight, femur bone weight/length index, tibia bone weight/ length index, similarly had the least tibia robusticity index.

DISCUSSION

The present study demonstrates the improvement in bone quality with the supplementation of a vitamin-mineral premix in conjunction with different housing systems for finisher broiler chickens. Specifically, finisher broiler chickens fed with a vitamin-mineral supplemented diet and housed in a deep litter system (T1) exhibited a higher Sedor index, indicating stronger bones, greater bone weight, and a lower robustness index, which signifies enhanced bone strength, compared to other treatments [6]. This observed bone improvement may be attributed to the synergistic effects of vitamins D and K, which facilitate bone formation and osteocalcin production [9]. Osteocalcin, a non-collagenous protein produced by osteoblasts, plays a crucial role in aligning biological apatite parallel to collagen fibrils, thereby contributing to bone quality. Furthermore, the housing system can significantly influence bone quality, including bone mass and strength, through activity and physical exertion [5]. Broiler chickens housed in a deep litter system, which allows for greater movement and flight opportunities, demonstrate higher bone weight compared to those housed in cages (T3, T4). This suggests that the increased physical activity associated with the deep litter system contributes positively to bone development and overall skeletal health. The results revealed a significant interaction effect on femur and tibia bone with birds raised on deep litter with vitamin-mineral premix supplementation (T1) demonstrating the highest values for both femur bone weight (g) and femur bone weight/length index (mg/mm) compared to all other groups ($P<0.05$). Similarly, tibia weight (g), tibia bone weight/length index (mg/mm) and tibia bone strength were significantly higher in the T1 group

compared to the remaining groups ($p<0.05$). However, the tibia robusticity index, which can be an indicator of bone compactness, was significantly lower ($p<0.05$) in the T1 group compared to all others. While a lower index suggests stronger bone. These findings suggest that the observed changes in bone weight and robusticity index is related to improved bone strength under the conditions of this study.

Table 1: Main effect of dietary supplementation of vitamin-mineral premix and housing system on physical parameters of femur and tibia bones of broiler chicken

Parameters	Supplemented	Non-supplemented	SEM	Deep Litter	Cage	SEM
Femur Bone weight (g)	13.80[a]	11.70[b]	0.49	13.50[a]	12.00[b]	0.58
Femur Length (mm)	78.10	76.60	2.12	77.10	77.60	1.86
Femur Bone weight/length index mg/mm	176.54[a]	152.81[b]	4.98	174.82[a]	154.53[b]	6.42
Femur Robusticity index mm/mg³	3.08	3.38	0.08	3.25	3.21	0.06
Tibia Bone weight (g)	19.10[a]	16.40[b]	0.68	18.10	17.40	0.75
Tibia Length (mm)	107.70	106.60	1.17	106.00	108.30	1.42
Tibia Bone weight/length index mg/mm	177.23[a]	152.82[b]	4.26	169.54	160.51	5.67
Tibia Robusticity index mm/mg³	4.05[b]	4.21[a]	0.09	4.07	4.19	0.08
Tibia Bone Strength (kgf)	55.77[a]	51.72[b]	2.34	54.38	53.11	2.78
Tibia Bone Density (g/cm³)	1.38	1.48	0.16	1.41	1.45	0.19

SEM - Standard error of means. [abc]-Means in the same row with different superscripts are significantly different ($p<0.05$)

Table 2: Interaction effect of dietary vitamin-mineral premix supplementation and housing system on physical parameters of femur and tibia bones of broiler chicken

	Deep litter		Cage		
Parameters	T1	T2	T3	T4	SEM
Femur Bone weight (g)	15.20[a]	11.80[b]	12.40[b]	11.60[b]	0.458
Femur Length (mm)	78.00	76.20	78.20	77.00	0.815
Femur Bone weight/length index mg/mm	194.85[a]	154.79[b]	158.22[b]	150.83[b]	5.37
Femur Robusticity index mm/mg³	3.15	3.34	3.01	3.41	0.09
Tibia Bone weight (g)	19.80	16.40	18.40	16.40	0.58
Tibia Length (mm)	105.60	106.40	109.80	106.80	0.89
Tibia Bone weight/length index mg/mm	186.82[a]	152.26[b]	167.63[b]	153.39[b]	5.046
Tibia Robusticity index (mm/mg³)	3.92[b]	4.20[a]	4.16[a]	4.21[a]	0.041
Tibia Bone Strength (kgf)	56.41[a]	55.12[a]	53.63[b]	49.79[b]	2.01
Tibia Bone Density (g/cm³)	1.33	1.49	1.43	1.47	0.05

SEM - Standard error of means. [abc]-Means in the same row with different superscripts are significantly different ($p<0.05$)

CONCLUSION

These findings suggest that a combination of vitamin-mineral premix supplementation and deep litter housing might promote greater bone mass quality in broiler chickens.

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URBAN AGROFORESTRY: INTEGRATION OF SNAIL PRODUCTION STRATEGY

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ABSTRACT

Urban agroforestry systems that include productive trees, shrubs, and arable crops with free ranging snails may offer an alternative solution to the problem of food insecurity in a deregulated economy. The study was carried out in Ode-Irele, Ondo state, Nigeria. Data on urban agroforestry tree and shrub cover was collected within $10m^2$plots. Data on snails within urban agroforestry system was collected two times at the onset of the raining season. Collected data was analyzed using descriptive statistics. Findings of the study show that the urban agroforestry system is associated with 32 species of trees and shrubs, while arable crops constitute 25 species. The results further indicated that the urban agroforestry is associated with 25 species of arable crops. The results on snails show that 13 different species of land snails are associated with the urban agroforestry system. Species abundance was highest for *Achatina achatina, followed by Achatina fulica, Lissachatinafulica, Archachatina marginata ovum, Archachatina marginata suturalis, Archachatina marginata albino, Archachatina marginata suturalis, and Archachatina marginata xxl* among the giant land snails. Among the small land snails, species abundance was highest for *Limicolaria aethiops,* followed respectively by *Limicolaria aethiops albino, Limicolaria numidica, Limicolaria flammea, Limicolaria agathina,* and *Limicolaria aurora.* Free ranging snails can be incorporated into urban silvopastural agroforestry system, as an alternative solution with potential to overcome the critical barrier of food insecurity.

Keywords: Agroforestry, food, insecurity, snails, urban,

INTRODUCTION

In the face of global food production challenges, devising means of enhancing food security cannot be under-estimated. To surmount the challenge of food insecurity, agroforestry especially in the urban setting has the capacity to blend forestry and agricultural practices. Also, agroforestry can enhance the diversification of income streams (1). Urban agroforestry refers to the incorporation of trees and other perennial crops into urban, sub-urban, and other community spaces. Typically, three basic sets of components which include woody perennials, herbaceous plants (agricultural/arable crops) and animals are managed in all agroforestry systems. Evidence suggests that agroforestry can sustainably increase production per unit of land area while maintaining or enhancing other economic, social, and environmental services (2). Based on available scientific evidence, agroforestry can facilitate the migration of wildlife such as snails to more favorable conditions (1). Silvopasture is a form of agroforestry that can rely on fewer external inputs, maximize use of space, or diversify farm's revenue streams with livestock such as snails which are mini livestock.

Problem Statement and Justification

With the many benefits of urban agroforestry, landscape designers and urban planners are encouraged to use multifunctional landscape approach to integrate food production into the structure of the city (3,4). Despite the growing awareness about the practice of urban agroforestry, this type of agriculture is yet to be fully integrated into the urban environment (2). To overcome the challenge of food insecurity, agroforestry in the urban setting has the capacity to blend forestry and agricultural practices. Agroforestry-induced diversification of income streams can help safeguard agricultural production under the many uncertainties from shifting markets (1).

MATERIALS AND METHOD

The study was carried out in Ode-Irele, Ondo state, Nigeria. Data on urban agroforestry tree and shrub cover was collected within 15 plots measuring $10m^2$. Data on snails within urban silvopastural agroforestry canopy was collected two times at the onset of the raining season. Collected data was analyzed using descriptive statistics.

RESULTS AND DISCUSSION

Species Abundance and Diversity of Arable/Agricultural Crops

The results on diversity and relative abundance of tree with shrubby plants and arable crops show that the urban agroforestry system is associated with 32 species of trees and shrubs, while arable crops constitute 25 species (Table 1). These results show that with the diversified tree, shrub, and arable crops strata, urban silvopastural agroforestry could become sources of income for the varieties of products that they can produce. The diversity of trees, shrubs and arable crops in the urban agroforestry can be integrated into any number of urban landscapes, including urban farms (2), which can also provide a more favourable condition for the rearing of snails (1).

Table 1: Relative Abundance of Trees with Shrubs and Arable Crops

S/N	Common Name	Scientific Name	Total (n= 15)	Number of plots	Mean	Common Name	Scientific Name	Total (n= 15)	Number of plots	Mean
	Perennial Trees					**Arable Crops**				
1	Cashew	*Anarcadium occidentale*	3	3	1	Water yam	*Dioscorea alata*	14	2	7
2	African Native Pear	*Dacryodes edulis*	4	4	1	White yam	*Dioscorea rotundata*	40	5	8
3	Pawpaw	*Carica papaya*	19	9	2	Cocoyam	*Xanthosoma sagittifolium*	59	7	66
4	Oil palm	*Elaeisguinensis*	4	4	1	Pineapple	*Ananas comosus*	103	9	11
5	Guava	*Psidium guajava*	3	3	1	Nigerian spinach	*Celosia argentea*	25	3	8
6	Sour soup	*Annona muricata*	4	3	1	Pumpkin	*Cucurbita pepo*	5	2	3
7	Moringa	*Moringa oleifera*	3	2	2	Fireweed	*Crasscocephalumcrepidioides*	14	1	14
8	Leucaena	*Leucaena leucocephala*	7	4	2	Sugar cane	*Saccharium officinarum*	2	1	2
9	Plantain	*Musa parasidiaca*	52	5	10	Garden egg	*Cucumis sativus*	7	2	4

10	Sweet orange	*Citrus sinensis*	4	4	1	African arrowroot	*Canna indica*	18	2	9
11	Lime	*Citrus aurantifolia*	3	3	1	Trifoliate yam	*Dioscorea dumentorum*	11	2	6
12	Pepper fruit	*Uvariodendron mirabile*	5	5	1	Bryophyllum	*Bryopyllumpinnatum*	13	3	7
13	Mango	*Mangifera indica*	5	5	1	Fluted pumpkin	*Telfaria occidentalis*	12	3	4
14	White butterfly	*Clerodendron volubile*	24	7	3	Soft cane	*Thaumatococcosdanieli*	30	2	15
15	Cocoa	*Theobroma cacao*	6	5	1	Jute mallow	*Cochorusolitorius*	19	1	19
16	Coconut	*Cocos nucifera*	6	5	1	Waterleaf	*Talinum triangulare*	154	7	22
17	Tangerine	*Citrus reticulate*	2	2	1	Gale-of wind	*Phylantusamarus*	30	2	15
18	Kola	*Cola acuminate*	3	3	1	Tree spinach	*Cnidoscolusaconitifoli*	4	1	4
19	Combretum	*Combretum spp*	3	1	3	Green Amaranth	*Amaranthus hybridus*	144	2	72
20	African star apple	*Chrysophylum albidum*	1	1	1	African egg plant	*Solanum macrocarpon*	45	3	15
21	Avocado pear	*Persea Americana*	3	3	1	Tomato	*Lycopersicum esculentum*	52	3	17
22	Bitter leaf	*Vernonia amygdalina*	2	2	1	Okra	*Abelmoschus esculentus*	9	1	9
23	Chewing stick	*Masularia acuminate*	2	2	1	Pepper	*Capsicum annuum*	38	2	19
24	European/common pear	*Pyrus physalis*	1	1	1	African spinach	*Basella alba*	3	1	3
25	Phalsa	*Grewia spp.*	2	2	1	Yellow yam	*Dioscorea cayenesis*	11	1	11
26	Banana	*Musa sapientus*	13	2	7					
27	Bokonisa	*Beilschmiediamannii*	1	1	1					
28	Kola	*Cola nitida*	1	1	1					
29	Scent leaf	*Ocimumgratissimum*	16	3	5					

30	Grape	*Citrus paradise*	1	1	1
31	Breadfruit		1	1	1
32	Scent leaf (Small leaves)	*Ocimumba silicum*	34	2	17

Species Abundance and Diversity of Snails in Urban Agroforestry

Species abundance and diversity of snails in urban silvopastural agroforestry system is presented in Table 2. The results show that 13 different species of land snails are associated with the urban silvopastural agroforestry. Species abundance was highest for *Achatina achatina,* followed respectively by *Achatina fulica, Lissachatina fulica, Archachatina marginata ovum, Archachatina marginata suturalis* among the giant land snails. Among the small land snails, species abundance was highest for *Limicolaria aethiops,* followed respectively by *Limicolaria aethiops albino, Limicolarianumidica.* The number of different species of snails associated with the urban silvopastural agroforestry is a pointer to the fact that forestry and agricultural practices can be blended for income diversification. These results support the fact that under many uncertainties from shifting markets especially in a deregulated economy, agroforestry-induced diversification of income streams can help safeguard agricultural production (1) to solve the problem of food insecurity.

Table 2. Species Abundance and Diversity of Snails

S/No	Snail Species	Abundance		Total	Mean
		Plot 1	Plot 2		
	Giant Land Snails				
1	*Archachatina marginata ovum*	12	23	35	18
2	*Archachatina marginata albino*	11	6	17	9
3	*Archachatina marginata xxl*	6	4	120	5
4	*Archachatina marginata suturalis*	8	19	17	9
5	*Achatina achatina*	183	205	388	194
6	*Achatina fulica*	115	195	310	155
7	*Lissachatinafulica*	72	51	123	98
	Small Land Snails				
8	*Limicolaria aethiops*	45	61	106	53
9	*Limicolaria aethiops albino*	21	27	48	24
10	*Limicolaria flammea*	11	18	29	15
11	*Limicolaria aurora*	7	3	10	5
12	*Limicolaria numidica*	13	21	34	17
13	*Limicolaria agathina*	13	5	18	9

CONCLUSION AND APPLICATION

From the findings of this study, it can be concluded that free ranging snails can be incorporated into urban agroforestry. Urban agroforestry systems that include productive trees, shrubs, and arable crops with free ranging snails may, therefore offer an alternative solution with potential to overcome the critical barrier of food insecurity.

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EGG LAYING PERFORMANCE AND EGG QUALITY PARAMETERS OF JAPANESE QUAILS *(Coturnix Coturnix Japonica)* FED DIETS CONTAINING RAW AND PARBOILED RICE HUSK MEALS

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ABSTRACT

A total number of 324 Japanese quails were used to determine the egg laying performance and egg quality characteristics of laying quails when fed diets containing varying levels of raw and parboiled rice husk meals. The experiment consisted of nine (9) treatments, with three (3) replicates per treatment, and with each treatment containing twelve (12) birds. The treatments consisted of ten isonitrogenous and isocaloric diets thus: R0, R3, R6, R9, R12 and P0, P3, P6, P9 and P12 respectively. R0 and P0 were the same in composition and served as the controls for both the raw and parboiled rice husks. Control diet had 0 % raw and 0 % parboiled rice husks inclusion levels, whereas treatments R3, R6, R9 and R12 had raw rice husk, while treatments P3, P6, P9 and P12 had parboiled rice husk. Each of the raw and parboiled rice husk treatments contained 3 %, 6 %, 9 % and 12 % rice husks inclusion levels respectively. The experimental design model adopted was based on a 2 x 5 factorial arrangement, and the hens were fed the experimental diets for nine weeks. Results showed that parboiling improved the nutritional profile of rice husk, by increasing its crude protein content (from 10 to 11 %), ash content (from 18 to 20 %), and reducing its crude fibre content (from 44.67 to 38.67 %). Birds fed the PRH diets had significantly ($P<0.05$) higher HDP than those fed RRH at week 3 and week 5. Also, by Week 5, quails on a diet with 6 % inclusion level of rice husk produced eggs at significantly ($P<0.05$) higher rates (74.35 %) than those on other levels, though comparable to those on the control diet (70.52 %). Hence, PRH should be incorporated into the diets of laying Japanese quails at the dietary level of 6 % for optimum hen day production.

Keywords: Parboiled rice husk, egg laying performance, Japanese quails.

DESCRIPTION OF PROBLEM

The existing acute shortage of animal protein in the country, coupled with the rising demand for these animal protein sources, points to the poultry egg and meat as a quick remedy for bridging the gap (1). Therefore, to widen the scope of protein consumption, there is the need to search for other reliable, relatively cheaper, affordable and underutilized livestock species. Among the available livestock species, the Japanese quail readily comes to focus (2). One major challenge faced by the poultry industry is the problem of high cost of feed which can be up to 65-70 % of the total cost of poultry production. Therefore, there is need to source for alternative and inexpensive sources of feed ingredients to reduce the total cost of production (3).

Rice (*Oryza sativa*) is the second largest most cultivated cereal crop in the world, and the by-products resulting from rice processing for human consumption are potential feedstuffs to compound poultry and other livestock diets. Rice husk can be seen heaped at virtually all rice processing areas or rice millers' factories, wasting away. Quantities of it are burnt into ashes or used either in dry or wet forms as manure for compost making. However, rice husk has the potential of serving as alternative energy source for livestock. Though, it is rich in crude fibre (between 30 - 40 %) and has some anti-nutritional factors; so, poultry birds utilize it less efficiently. Parboiling rice husk has been shown to improve its digestibility and utilization by poultry birds (4). This study is aimed at evaluating the egg laying performance and egg quality characteristics of laying quails fed diets containing raw and parboiled rice husk meals at varying levels.

MATERIALS AND METHODS

Experimental Site

This research was carried out at the Department of Animal Production Teaching and Research Farm of the Federal University of Technology, Minna, Niger State. Minna, which lies between latitude 9º 28′ N and 9º 37′ N and longitude 6º 23′ E and 6º 33′ E, and has a temperature range of 38º to 42º C, with lowest temperature in August and highest in March. It has a mean annual rainfall range of between 1000 mm – 1500 mm. Minna is within Southern Guinea Savannah Ecological Zone (5).

Processing of rice husk and the formulation of the experimental diets

Both the raw and parboiled rice husks were obtained from the local rice mills located in Gidan Kwano, opposite Federal University of Technology Main Campus gate, along Minna - Bida Road in Minna, Niger State. They were then weighed and sundried for about three to five hours, depending on the sunlight intensity, to about ten percent (10 %) moisture content. The residues from the rice husk and other impurities were further removed using winnowing plates, either metallic or plastic plates and incorporated into the experimental diets as shown in Table 1. The experiment consisted nine (9) treatments, with three (3) replicates per treatment, and with each treatment containing twelve (12) birds. The treatments consisted of ten isonitrogenous and isocaloric diets thus: R0, R3, R6, R9, R12 and P0, P3, P6, P9 and P12 respectively. R0 and P0 were the same in composition and served as the controls for both the raw and parboiled rice husks. Control diet had 0 % raw and 0 % parboiled rice husks inclusion levels, whereas treatments R3, R6, R9 and R12 had raw rice husk, while treatments P3, P6, P9 and P12 had parboiled rice husk. Each of the raw and parboiled rice husk treatments contained 3 %, 6 %, 9 % and 12 % rice husks inclusion levels respectively. The experimental design model adopted was based on a 2 x 5 factorial arrangement.

Management of the experimental birds

A total of 650 Japanese quails at fourteen (14) days of age, of mixed sex, sourced from the Poultry Department of the National Veterinary Research Institute (NVRI) Vom - Kuru, Jos in Plateau State, Nigeria. They were placed on starter mash for one week, and grower mash was given for the next three weeks. At the end of the growing phase (6 weeks of age), all the quail birds were sexed. 324 females (hens) were allotted into galvanized cages and fed the experimental diets *ad libitum* for nine weeks; with constant supply of clean drinking water All the male quails sexed were disposed of accordingly as emphasis of the study was on the laying phase.

Data collection

Data were collected daily on egg number. This was used to calculate the hen day production (HDP) using the formula of (6). The egg length and egg width were measured periodically, using the Vernier Callipers (in cm), and used to calculate the egg shape index (egg width divided by egg length). Other parameters measured included the yolk height and albumen height (in mm, using the tripod micrometer), yolk weight and albumen weight and shell weight (in g, using the Mettle weighing balance) and the egg shell thickness (in mm, using the Micrometer Screw Gauge).

Chemical analysis

The raw and parboiled rice husks were subjected to proximate analysis based on the procedures of (7).

Data analysis

Data collected were analyzed using the Statistical Analytical System (SAS 2000 Package; Version 16.0). The difference between the treatments means were separated using the Duncan's Multiple Range Tests as contained in the Package.

RESULTS AND DISCUSSION

The result of the effect of parboiling on the nutritional profile of raw rice husk is presented in Table 2. This suggests that the parboiling process improved the nutritional profile of rice husk, resulting in increased protein content (from 10 to 11 %) and reduced fibre content (from 44.67 to 38.67 %). This agrees with the

findings of (8) when native rice husk (NRH) was fermented with oyster mushroom (*Pleurotus ostreatus*). The authors discovered that fermentation significantly increased (P<0.05) the CP contents of NRH while the DM and ash values were not affected (P>0.05). This also agrees with the report of (9) who tried to improve the bioavailability of nutrients of rice husk through solid-state fermentation with the fungus, *Trichoderma viridii*. The CP of rice husk increased from 3.06 % to 6.04 %, CF reduced from 36.50 % to 20.25 % while NDF reduced from 69.43 % to 53.18 %.

The result of hen day production (HDP) of laying Japanese quails fed varying levels of RRH and PRH is shown in Table 3, while the egg quality parameters are presented in Table 4. Birds fed the PRH diets had significantly (P<0.05) higher HDP than those fed RRH at week 3 and week 5. Also, by Week 5, quails on a diet with 6 % inclusion level of rice husk produced eggs at significantly (P<0.05) higher rates (74.35 %) than those on other levels, though comparable to those on the control diet (70.52 %). These results are in agreement with the findings of (10), who reported significant differences in total egg production of Japanese quails fed different levels of dietary rice bran with or without phytase supplementation. As regards egg quality parameters, no significant differences (P>0.05) were found in all measured parameters, including egg length, egg width, egg weight, albumen height, albumen weight, yolk height, yolk weight, egg shell thickness, and egg shell weight between laying quails fed RRH and PRH diets. This suggests that the inclusion of graded levels of RRH and PRH in the diet of laying Japanese quails did not affect their egg quality

Table 1: Ingredient composition of the experimental diets fed to quail birds at the laying phase

Ingredient (%)	**R0**	**R3**	**R6**	**R9**	**R12**	**P0**	**P3**	**P6**	**P9**	**P12**
Maize	51.10	49.10	47.00	46.00	40.00	51.10	49.10	47.00	46.00	40.00
Soybean meal	28.20	30.20	28.20	29.20	29.20	28.20	30.20	28.20	29.20	29.20
Rice husk	0.00	3.00	6.00	9.00	12.00	0.00	3.00	6.00	9.00	12.00
Maize offal	8.00	5.00	6.10	3.10	6.10	8.00	5.00	6.10	3.10	6.10
Fish meal	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Bone meal	2.50	2.00	2.00	2.00	2.00	2.50	2.00	2.00	2.00	2.00
Limestone	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Methionine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
*Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Palm Oil	0.50	1.00	1.00	1.00	1.00	0.50	1.00	1.00	1.00	1.00
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Calculated Analysis										
ME(Kcal/kg)	2826	2816	2769	2730	2618	2826	2816	2769	2730	2618
C/Protein (%)	20.48	21.02	20.10	20.08	20.42	20.48	21.02	20.10	20.08	20.42
C/Fibre (%)	4.76	6.67	6.75	7.70	8.96	4.76	6.67	6.75	7.70	8.96
Methion (%)	0.72	0.73	0.70	0.70	0.70	0.72	0.73	0.70	0.70	0.70
Lysine (%)	1.02	1.05	0.97	1.00	1.02	1.02	1.05	0.97	1.00	1.02
Calcium (%)	3.13	3.15	3.16	3.14	3.17	3.13	3.15	3.16	3.14	3.17
Phospho (%)	0.69	0.61	0.59	0.58	0.61	0.69	0.61	0.59	0.58	0.61

*Premix applied at 2.5 kg/tonne contained: Vit. A (7 500.00 IU), Vit. D (500.00 IU), Vit E. (1, 000 IU), Vit B. (375 mg). Vit. B (12 mg) Vit B6 (150 mg). Vit. B_{12} (12.5 mg), Vit K (15 mg). Vit. C (10 mg) and folic acid (150 mg), Ca (12.5 mg) Se (8.0 mg) Fe (32.mg) Mg (0.8 mg), Mo (0.25 mg). Chlorine (250 mg) pathogenic acid (14 mg). Methion = Methionine; Phospho = Phosphorus; C = Crude; ME = Metabolizable energy; R = Raw; P = Parboiled

Table 2: Proximate composition of raw and parboiled rice husks

Composition	RRH	PRH
Moisture (%)	6.00	7.00
Dry matter (%)	94.00	93.00
Ash (%)	18.00	20.00
Crude protein (%)	10.00	11.00
Crude fibre (%)	44.67	38.67
Ether extract (%)	6.50	5.00
Nitrogen free extract (%)	13.83	11.00
Metabolizable energy (Kcal/kg)	1,558	1,623

RRH = Raw Rice Husk; PRH = Parboiled Rice Husk

Table 3: Mean and interaction effects of method of processing and level of inclusion of rice husk on hen day egg production of Japanese quails

Parameters	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9
Method of processing									
Raw	3.61	39.05	47.75^{b}	58.32	69.28^{b}	83.65	85.72	85.94	86.53
Parboiled	3.27	41.66	52.41^{a}	56.81	71.79^{a}	82.73	84.99	87.31	85.06
P-value	0.5246	0.1426	0.0209	0.4197	0.0436	0.5153	0.3188	0.4236	0.0605
LS	NS	NS	*	NS	*	NS	NS	NS	NS
Level of inclusion									
0%	4.00	41.08	52.13	59.28	70.52^{ab}	81.70	85.28	87.52	85.19
3%	3.37	36.16	53.37	59.33	70.18^{b}	82.39	85.33	88.70	86.42
6%	4.04	44.35	47.42	55.66	74.35^{a}	85.04	86.85	82.88	87.85
9%	3.17	39.49	50.06	58.10	68.65^{b}	83.14	84.22	86.58	84.73
12%	2.63	40.70	47.42	55.48	68.98^{b}	83.68	85.09	87.44	84.81
P-value	0.4131	0.0846	0.1904	0.5102	0.0408	0.621	0.2688	0.2669	0.0681
LS	NS	NS	NS	NS	*	NS	NS	NS	NS
Interaction									
Raw x 0	4.42	40.87	55.56	61.17$^{a\,b}$	73.57	84.65	84.85	87.83	87.52
Raw x 3	2.78	35.32	57.00	63.89^{a}	70.39	80.27	85.81	89.39	86.24
Raw x 6	4.11	45.6	48.03	51.48^{g}	78.06	85.83	88.71	78.93	88.27
Raw x 9	3.57	43.65	53.48	60.71^{b}	67.46	84.51	84.32	87.32	85.32
Raw x 12	3.17	42.87	47.97	54.36^{f}	69.45	83.01	84.92	86.23	85.33
Parboiled x 0	3.57	41.29	48.70	57.38^{c}	67.46	78.76	85.71	87.21	82.87
Parboiled x 3	3.97	37.00	49.74	54.76^{f}	69.97	84.52	84.85	88.02	86.61
Parboiled x 6	3.97	43.11	46.81	59.84^{bc}	70.64	84.24	84.99	86.82	87.42
Parboiled x 9	2.78	35.32	46.65	55.49^{e}	69.84	81.78	84.12	85.84	84.13
Parboiled x 12	2.09	38.54	46.86	56.59^{d}	68.51	84.35	85.27	88.66	84.28
P-value	0.65	0.3914	0.6719	0.0539	0.0743	0.2252	0.3162	0.3732	0.3071
LS	NS	NS	NS	*	NS	NS	NS	NS	NS

^{abc}Means in the same column with different superscripts are significantly different ($P < 0.05$).
LS = Level of Significance; * = Statistically significant at 5 %; NS = Not significant at 5 % α-level.

CONCLUSION AND APPLICATION

From the findings in this study, it can be concluded that parboiled rice husk (PRH) should be incorporated into the diets of laying Japanese quails at the dietary inclusion level of 6 %, for optimum hen day production. Hence, quail farmers, animal nutritionists and animal scientists are encouraged to use parboiled rice husk when formulating diets and rations for laying quails, instead of using raw rice husk

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Microlivestock and Aquaculture: MLA003

FISH PRODUCTION AS STRATEGIES FOR YOUTH EMPOWERMENT IN NIGERIA SOUTH EAST REGION NIGERIA

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ABSTRACT

Fish Production, the culture of fish as one of the aquatic organisms, has tremendous capacity to stimulate economic development in the South East region through youth empowerment. The youths are one of the greatest asset that any nation can have and therefore, need to be empowered. They serve as an indicator of a nation's development and sustainability. The youth have been described as the greatest investment for a country's development. They form the bedrock of economic development all over the world and play important roles in employment, income and social changes, especially in evolutionary economy like Nigeria. This paper is concerned with the possibilities of fish business as a tool for entrepreneurship development and reduction of youth unemployment in South East region of the country, which will ultimately lead to sustainable development of the region.

***Key* words:** Youth Development, Aquaculture, South East, Fish.

INTRODUCTION

Fish contributes a significant amount of animal protein to the diet of many people in Nigeria. It is widely accepted, readily available, and relatively cheaper when compared with protein from other animal sources (Ugwumba and Ugwumba, 2003; Gabriel *et al*., 2007). Fish is mainly derived from three source: wild (capture fisheries), importation (frozen fish) and aquaculture (fish farming). Aquaculture refers to the culture of aquatic organisms with major emphasis on fish has shown tremendous growth in the last two decades, exhibiting about 30-50% annual growth in production (Akinrotimi *et al*., 2007; FDF, 2010). It is now generally believed that, aquaculture has the greatest potential and remain the only viable alternative in meeting the growth demand for fish, and empowerment for the teeming youth population.

Youth-hood can be defined as that phase or period of life in which one passes from childhood to maturity. In Nigeria, the youth usually fall into the 18-35 years age bracket. (Abdullahi, 2008). Generally, youth are one of the greatest assets that any nation can have and therefore, need capacity development and empowerment. They serve as a good measure of the extent to which a country can reproduce as well as sustain itself. The youth have been described as the greatest investment for a country's development (National Youth Policy of Nigeria, 2001; Oduwole 2015). In Nigeria, like other developing countries, fish production is still carried out using some measure of physical strength, which declines in age. The youths have qualities that can promote all the sub-sectors of agriculture (Adelodun, 2015). For fish production to reach its full potential there should be considerable and active participation of a large number of youth in this sector. Therefore, this paper reviewed the possibility as a youth empowerment tools, which will lead to reduction of unemployment among the youths of South East.

Concept of Youth Development

The National Youth Development Policy (2001) asserts that, the youth are the foundation of society; their energies, inventiveness, character and orientation define the pattern of development and security of a nation. The Youth form a segment of the national population that is sensitive, energetic, active, and the most productive phase of life as citizens. The youths are also most volatile and yet the most vulnerable segment of the population in terms of social-economic, emotion and other aspects (Anasi, 2010). The youth have

gained a wide currency and have been variously classified into such age brackets as 15-24 years (World Bank and United Nations); 15-20 years (Bello-Kano, 2008). Moreover, in the Nigerian context, the National Youth Development policy (2001) defines youth as people aged between 18 and 35. And they constitute "all young males and females aged 18-35 who are citizens of the Federal Republic of Nigeria" (Oduwole, 2015).

Poverty and Youth Restiveness

Poverty is generally considered as one of the major causes of food insecurity, and poverty alleviation is essential to improve access to food. The World Bank defines poverty as a multi-dimensional phenomenon, encompassing to satisfy basic need, lack of control over resources, lack of education and skills, poor health, malnutrition, lack of shelter, poor access to water and sanitation; vulnerability to shock, violence and crime, lack of political freedom and voice (World Bank, 2000). In many South East communities, several people including the youth are living in abject poverty. They are often times exploited and short-changed by people who can afford to buy their crops, which leads to the disintegration of traditional communities and increasingly marginalized rural societies. Hence, there is massive rural-urban migration to the major cities, especially among the young school leavers seeking greener pastures. Some who choose not to migrate, with a deep sense of marginalization by the government and multinationals react by engaging in anti-social and criminal acts as robbery of different magnitude, piracy, scamming and kidnapping. This has created a lot of societal disorder and problems which have degenerated into chaotic situations, as the level of agitation and social unrest in the region has risen tremendously in recent times. Every sector of the economy has been adversely affected. There is need for an alternative venture that the people in these regions especially the youths should profitably engage in; and fish farming seems to be the best option (Akinrotimi *et al*., 2005; Ayanwu *et al*., 2007).

Business Opportunities in Fish Production for Youth Empowerment

These business opportunities available in aquaculture according to Uzukwu (2015) include but not limited to:

Fingerlings Production: The production of fish fingerlings is the basis for the sustainable fish farming industry. One fish fingerling sells at between N70 and N90, depending on the size and species. Fingerlings production business is very profitable and bring quick returns.

Table Size Fish Production: Table fish which is fish reared for consumption is in high demand across the country. It is sold in almost all markets. One kilogramme (kg) of table fish is sold at between N3,800 and N5000 in most parts of the country

Broodstock Production: Broodstock production which involves rearing of parent stock is also important for the sustenance of the fish farming industry. A good stock of broodstock is required for the production of fingerlings. One kilogramme (kg) of *Clarias gariepinus* broodstock cost about N8,000.

Fish feed production: Fish feed is very important in fish farming business. About 80-85% of cost of fish production is expended on feed alone. Imported fish feed is very expensive (N48,000/15kg) making is difficult for farmers to break even in the shortest possible time. Locally produced fish feed is cheaper (N15,000/15Kg).

Fishmeal Production: production of fish feed requires the procurements of fish feed ingredient such as carbohydrates, protein, lipid/oil and mineral concentrates. Available in our animal raw material markets and are in huge quantities of flake, dust fish or feather meals or use of animal blood from abattoir or slaughter house which can be processed to protein source raw material meal. A well - developed fish feed industry in Nigeria requires that somebody should be specialized in processing flake fish (visceral) which is guttered from processing clusters, into fishmeal.

Consultancy Services: Those with grounded practical knowledge and skill can serve as consultants to other fish farms.

Fish farm (Pond/Tank) construction: Fish holding facilities are very important in the business of fish production. There is need to develop expertise in the art of fish farm construction. Those who do so will surely reap bountiful return.

Marketing of fish/fishery products: Everybody may not be involved in the tangible production of fish feed or fish feed ingredients. Some individuals may be involved in the sales and marketing of fish, fish feed or fish feed ingredients produced by others.

Fish processing: Youth can also be involved in the area of value additions to the fish. Value addition here, may entail fish processing and smoking, production of fish barbecue, grills, fish pie, fish roll, fish biscuit etc.

Strategies to Improve Youth Participation in Fish production

Entrepreneurship development: Entrepreneurship is more than simply "starting a business." It is a process by which individuals identify opportunities, allocate resources, and create value. This creation of value is often through the identification of unmet needs or through the identification of opportunities for change. It is the act of being an entrepreneur which is seen as "one who undertakes innovations with finance and business acumen in an effort to transform innovations into economic goods hence Entrepreneurs see "problem" as "opportunities," and take action to identify the solutions to those problems and the customers who will pay to have those problems solved.

Provision of grants, loans and credit facilities: Government should help in the provision of grants, loan and credit facilities through SME for youth's engagement in fish farming.

Institutional Training and manpower development: Youth should be adequately encouraged to apply to study agricultural related courses, admitted into school, trained in innovations in agro business.

Provision of some incentives: Incentives such as starter packs which include inputs such as feed, fingerlings, ponds, oven, grill stand etc should be given to the youth so as to stimulate their interest in fish business.

Development of aquaculture participatory program: This can also go a long way in encouraging the youths through follow up and monitoring of their performance in other areas of aquaculture.

CONCLUSION

The potential of fish production as viable tools for business in youths' empowerment cannot be overemphasized. It has the capacity for empowerment of the youths in South East. With the current very high upsurge in unemployment rate in the country which is leading to so many crimes from the youths, there is need to stimulate the youth participation in fish business activities. This will not only reduce the rate of unemployment but also enable aquaculture sector reach its full potential thereby contributing to food security and economic development of the region. The above strategies if carefully assessed and implemented could go a long way in reducing the tension in the region, thereby making it governable and enhancing economic activities which are gradually grinding to a halt as a result of youth restiveness.

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Microlivestock and Aquaculture: MLA004

CONSUMER ATTITUDES TOWARDS PROBIOTIC-ENHANCED CATFISH IN SOME LOCAL GOVERNMENT AREAS IN LAGOS STATE

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ABSTRACT

This study assesses consumer knowledge of probiotic-enhanced catfish in Lagos State, Nigeria, focusing on market acceptance and willingness to pay. A multi-stage sampling technique was used to select the sample population, distributing 180 questionnaires across three Local Government Areas. Regression analysis revealed significant factors influencing consumer knowledge, including gender (coefficient: -0.344, $p < 0.01$), age, marital status, education, household size, income, and occupation (coefficient: 0.560, $p < 0.01$). Correlation analysis showed a positive relationship between consumers' willingness to purchase probiotics and their perceptions of health benefits (coefficient: 0.191, $p < 0.01$) and price (coefficient: 0.239, $p < 0.01$). The findings will shape a sustainable and eco-friendly aquaculture industry in Nigeria by informing the development of locally sourced probiotic strains, cost-effective solutions, and safe production methods. The study recommends tailored educational programmes, sustainable practices, and marketing strategies to navigate consumer behavior complexities and promote probiotic-enhanced catfish in a deregulated market.

Keywords: Probiotics, Enhanced Catfish, Consumer Attitudes, Market Acceptance, Deregulated Economy.

DESCRIPTION OF PROBLEM

The global probiotic market has experienced rapid growth since the 1980s, driven by increasing consumer demand for functional foods that promote gut health and immunity. With a current market size of $44.8 billion and an expected reach of $55 billion by 2025, probiotics have become staple products in the functional food industry (1). Probiotic products, which contain beneficial live microorganisms that regulate intestinal microbial balance, are the most sought-after type of functional food globally (2). Regional preferences for probiotic products vary, with Western European countries favoring probiotic yogurt and supplements, while Eastern European countries prefer traditionally fermented milk products (3). In Turkey, fermented milk-based probiotic products, such as yogurt, ayran, and kefir, dominate the market, with an annual value of approximately $460 million (4, 5).

In Nigeria, the demand for probiotic products is also increasing, driven by the growing awareness of the health benefits of probiotics and the increasing availability of probiotic products in the market (6). Nigeria's aquaculture industry offers a substantial market opportunity for probiotic-enhanced fish, with a production capacity of 1.32 million metric tons in 2020, making it Africa's second-largest producer of farmed fish (7). Despite this, the industry grapples with disease outbreaks, low productivity, and limited market access (8, 9). Fortunately, probiotics provide a sustainable and environmentally friendly solution, promoting gut health, immunity, and disease resistance in fish (10,11.12.13, 14).

The demand for probiotic-enhanced food keeps increasing, but utilization of probiotics in Nigerian aquaculture remains limited due to several factors, including a lack of awareness and knowledge among fish farmers, high costs, and the absence of probiotics specifically designed for Nigerian fish species and environmental conditions (8, 9). Furthermore, the availability of locally sourced probiotic strains, cost

implications, efficacy, and safety are critical considerations for the adoption of probiotics in Nigerian aquaculture (8, 9).

This research delves into the attitudes of consumers in Lagos State, Nigeria, towards probiotic-enhanced catfish, with a specific focus on market acceptance and willingness to pay. The study focusses on three Local Government Areas (LGAs) - Shomolu, Surulere, and Lagos Mainland to achieve the key objectives. The study seeks to assess the level of consumer knowledge about probiotic-enhanced catfish in Lagos State, Nigeria. Secondly, it aims to examine the factors influencing consumer knowledge of probiotic-enhanced catfish. Thirdly, it investigates the relationship between consumer perceptions of health benefits and price concerning probiotic-enhanced catfish. Lastly, the research determines the factors influencing consumers' willingness to purchase probiotic-enhanced catfish. The findings of this study will provide insights into the market potential for probiotic-enhanced catfish in Nigeria and it will inform marketing strategies and product development in the country's economy. Additionally, this study will explore the challenges and opportunities of probiotic utilization in Nigerian aquaculture, including the availability of locally sourced probiotic strains, cost implications, efficacy, and safety. By addressing these knowledge gaps, this study will contribute to the development of a sustainable and environmentally friendly aquaculture industry in Nigeria.

MATERIALS AND METHODS

This study employed multi-stage sampling technique to select the sample population. In the first stage, three Local Government Areas (LGAs) – Shomolu, Surulere, and Lagos Mainland - were selected from Lagos State. In the second stage, six Local Council Development Areas (LCDAs) were chosen from the selected LGAs. Specifically, Shomolu and Bariga were selected from Shomolu LGA, Surulere and Itire-Ikate from Surulere LGA, Lagos Mainland and Yaba from Lagos Mainland LGA. In the third and final stage, 30 questionnaires were allocated to each of the selected LCDAs, resulting in a total of 180 questionnaires distributed across the specified areas. This sampling technique ensured a representative sample of consumers from different LGAs and LCDAs within Lagos Mainland, providing a comprehensive understanding of consumer attitudes towards probiotic-enhanced catfish.

Estimation Techniques and Model Specification

The probit model estimates the probability of the dependent variable taking a particular value (usually 1) given the independent variables. The probit model is represented as:

$$P(Y=1|X) = \Phi(\alpha 0 + \alpha 1X1 + \alpha 2X2 + \ldots + \alpha kXk)$$

Where:

P(Y=1|X) is the probability of the dependent variable being 1 (success) given the independent variables X1, X2, Xk.
Φ is the cumulative distribution function (CDF) of the standard normal distribution.
α0, α1…, αk are the coefficients to be estimated.
X1, X2…, Xk are the independent variables.

The model parameters (coefficients) are estimated using maximum likelihood estimation (MLE).

The Probit regression approach examines the relationship between consumer knowledge of probiotic-enhanced catfish (KNW) and various predictor variables. The binary nature of the dependent variable (1 for 'yes' and 0 for 'no') signifies the dichotomous outcome under investigation.

KNW represents Knowledge of probiotic-enhanced catfish, GEN is Gender of the respondents, AGE denotes Age of the Respondents, MAS represents Marital Status, EDU is Educational Level of the respondents, HHS

denotes Household Size, INC is the Income Level, OOC is the Occupation and SOI denotes sources of information.

The model in a functional form is specified as:

KNW = f(GEN, AGE, MAS, EDU, HHS, INC, OCC, SOI)

The model in an empirical form is specified as:

$P(KNW=1/IV) = \alpha 0 + \alpha 1GEN + \alpha 2AGE + \alpha 3MAS + \alpha 4EDU + \alpha 5HHS + \alpha 6INC + \alpha 7OCC + \alpha 8SOI + \mu$

This model examines the relationship between consumer knowledge of probiotic-enhanced catfish and various predictor variables, providing insights into the factors that influence consumer knowledge.

RESULT AND DISCUSSION

Table 1 examines the level of consumer knowledge about probiotic-enhanced catfish in Lagos State, Nigeria. The findings reveal that 65% of respondents lack understanding of the potential benefits of probiotic-enhanced catfish for human consumption, indicating a significant gap in awareness or knowledge (15). This finding highlights the need for education and awareness campaigns to inform consumers about the benefits of probiotic-enhanced catfish.

Table 1: Knowledge of Probiotic-Enhanced Catfish

Variable	Category	Freq. (%)
Do you understand the other potential benefits of probiotic-enhanced catfish for human consumption?	Yes	63 (35)
	No	117 (65)
	Total	**180 (100)**

The results of the regression analysis in table 2 shows that gender, age, marital status, education qualification, household size, income, and occupation are significant factors influencing consumer knowledge of probiotic-enhanced catfish. Females are less likely to accept new ideas compared to males, with a coefficient of -0.344 ($p < 0.01$) (15, 16). As age increases, the probability of having knowledge also increases, with coefficients ranging from 0.747 ($p < 0.01$) for those below 35 years to 0.337 ($p < 0.01$) for those between 45 and 54 years (17). Married individuals and those with larger household sizes are less likely to possess knowledge, with coefficients of -0.172 ($p > 0.05$) and -0.261 ($p < 0.01$), respectively (18). Individuals with higher education qualifications and those engaged in farming or trading are more likely to possess knowledge, with coefficients ranging from 0.142 ($p < 0.05$) for Diploma/ND/NCE holders to 0.560 ($p < 0.01$) for farmers (20). The regression analysis reveals that various demographic and socioeconomic factors significantly influence consumer knowledge of probiotic-enhanced catfish, this is in line with previous studies (21, 22).

The results in table 3 shows that perceptions of health benefits and price are significant factors influencing willingness to purchase, with coefficients of -0.148 ($p < 0.01$) and -0.283 ($p < 0.01$), respectively (17, 26). Consumers are sensitive to pricing, and demographic and socioeconomic factors also play crucial roles (16, 19). For instance, females are less to be willing to purchase compared to males, with a coefficient of -0.125 ($p < 0.05$) (15). Younger age groups, especially those below 35 years and 35 to 44 years, are associated with a higher probability of willingness to purchase, with coefficients of 0.464 ($p < 0.01$) and 0.334 ($p < 0.01$), respectively (17). Married individuals have a negative impact on willingness to purchase, with a coefficient of -0.434 ($p < 0.05$) (18). Those with educational qualifications like Diploma/ND/NCE and HND/BSc, are

positively associated with willingness to purchase, with coefficients of 0.488 ($p < 0.01$) and 0.364 ($p < 0.05$), respectively (19).

Table 2: Knowledge of Probiotic-Enhanced Catfish and Other Factors

Variable (DV=KNW)		dy/dx	aster	Delta-method Std. Err.	z	(P>z) Pval
Gender (Ref. Category: Male)	Female	-0.344	***	0.023	-14.660	0.000
Age (Ref. Category: 50 years and above)	Below 35 years	0.747	***	0.057	13.190	0.000
	35 – 44 years	0.473	***	0.066	7.160	0.000
	45 – 54 years	0.337	***	0.083	4.070	0.000
Marital Status (Ref. Category: Single)	Married	0.172		0.112	1.530	0.125
	Others	-0.241	**	0.102	-2.370	0.018
Edu. Qualification (Ref. Category: MSC/MPHIL)	Diploma/ND/NCE	0.142	**	0.068	2.110	0.035
	HND/BSc	-0.040		0.065	-0.610	0.540
Household Size (Ref. Category: Below 2 Member)	2 – 5 Members	-0.065		0.059	-1.110	0.267
	6 – 9 Members	-0.261	***	0.060	-4.350	0.000
Income (Ref. Category: N75,000 and above)	Below N30,000	0.230	*	0.125	1.840	0.066
	N30,000 - N49,000	0.117	***	0.119	0.980	0.326
	N50,000 - N74,000	-0.099	***	0.151	-0.650	0.514
Occupation (Ref. Category: Civil Servant)	Farming	0.560	***	0.151	3.720	0.000
	Trading	0.374	**	0.144	2.590	0.010
	Artisans	0.170		0.171	0.990	0.321
Sources of Information (Ref. Category: Veterinarian or recommendations)	Family and Friend	0.632	***	0.077	8.150	0.000
	Online reviews and ratings	0.496	***	0.072	6.930	0.000
	Scientific studies	0.348	***	0.077	4.520	0.000
	Product packaging and labels	0.222	*	0.121	1.830	0.067
Observations		180				
Pseudo R2		0.738				
P-value		0.000				
Chi-square test		197.32				

Source: Field Survey, 2023; Note: KNW = Knowledge of probiotic-enhanced catfish to Pay, *** p<0.01, ** p<0.05, * p<0.1

Table 3 Willingness to Pay, Perceptions of Health Benefit and Price of probiotic-enhanced catfish

Variable (DV = WTP)		dy/dx	aster	Delta-method Std. Err.	z	(P>z) pval
Health Benefit	HBE	-0.148	***	0.047	-3.160	0.002
Health Benefit	PRC	-0.283	***	0.077	-3.660	0.000
Gender (Ref. Category: Male)	Female	-0.125	**	0.050	-2.510	0.012
Age (Ref. Category: 50 years and Above)	Below 35 years	0.464	***	0.107	4.330	0.000
	35 – 44 years	0.334	***	0.108	3.110	0.002
	45 – 54 years	0.131		0.126	1.050	0.296
Marital Status (Ref. Category: Single)	Married	-0.434	**	0.209	-2.080	0.038
	Others	0.215		0.210	1.020	0.307
Edu. Qualification (Ref. Category: MSC/MPHIL)	Diploma/ND/NCE	0.488	***	0.156	3.120	0.002
	HND/BSc	0.364	**	0.156	2.340	0.019
Household Size (Ref. Category: Below 2 Member)	2 – 5 Members	-0.282	***	0.107	-2.640	0.008
	6 – 9 Members	-0.425	***	0.103	-4.140	0.000
Income (Ref. Category: N75,000 and above)	Below N30,000	0.409	**	0.178	2.300	0.021
	N30,000 - N49,000	0.201		0.176	1.140	0.252
	N50,000 - N74,000	0.039		0.181	0.210	0.830
Occupation (Ref. Category: Civil Servant)	Farming	0.262		0.208	1.260	0.207
	Trading	0.041		0.214	0.190	0.850
	Artisans	0.024		0.210	0.110	0.911
Observations		180				
Pseudo R2		0.454				
P-value		0.000				
Chi-square test		69.12				

Source: Field Survey, 2023; Note: WTP = Willingness to Pay, HBE = Perception of Health Benefit of probiotic-enhanced catfish, PRC = Perception of Price of probiotic-enhanced catfish, *** p<0.01, ** p<0.05, * p<0.1

CONCLUSION

This study on consumer attitudes towards probiotic-enhanced catfish in Lagos State, Nigeria, reveals a significant knowledge gap among consumers. Demographic and socioeconomic factors, such as gender, age, and education, influences consumer knowledge and willingness to purchase probiotic-enhanced catfish. Some educated fellows in the society and marketing strategiescan increase market acceptance and willingness to pay for probiotic – enhanced catfish. Efforts should focus on educating females, married individuals, and those with lower educational qualifications, while highlighting health benefits and competitive pricing probiotic – enhanced catfish. This study provides valuable insights for stakeholders to develop effective marketing strategies and increase market penetration in a deregulated economy.

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HEALTH RISK ASSESSMENT OF TRACE METAL CONTAMINANT IN MUSCLE TISSUE OF AFRICAN CATFISH

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ABSTRACT

The study was conducted to assess the health risk of trace metal contaminant in muscle tissue of wild and cultured African Catfish, *Clarias gariepinus*. The results detailed the metal concentrations, revealing that all metals except iron were below the FAO/WHO recommended permissible levels. Notably, iron levels in wild *C. gariepinus* (2.615±0.10 mg kg^{-1}) and cultured (3.301±0.31 mg kg^{-1}) were higher than the recommended 0.05 mg mg kg^{-1}, potentially influenced by sediment iron content and pond water sources. Analysis of daily metal intake (DMI) and health risk index (HRI) revealed that consumers of wild and cultured *C. gariepinus* in Wudil are not exposed to high doses of trace metals (Cd, Co, Cr, Cu, Mn, Pb, and Zn) across all age categories, with levels consistently below FAO/WHO acceptable limits. For instance, DMI results indicated daily Cd intake ranging from 0.0006 to 0.0016 mg kg^{-1} day^{-1} for wild *C. gariepinus* consumers and 0.0008 to 0.0010 mg kg^{-1} $day^{-1}$for cultured ones, resulting in HRI ratios below one (1) for each age category. These findings suggest that the population studied is not at significant risk of trace metal exposure from consuming *C. gariepinus*.

Keywords*:* African catfish, estimated daily intake, food safety, risk assessment, trace metal, Wudil.

INTRODUCTION

Fish is the cheapest source of animal protein consumed by the average Nigerian and accounts for about 50% of the total animal protein intake (USAID,2014). African catfish (*Clarias gariepinus*), which make up the bulk of aquaculture production in Nigeria, is a widely consumed freshwater fish species in many parts of Africa, serving as an essential source of protein and essential nutrients for millions of people. However, increasing industrialization, urbanization, and agricultural activities have led to the discharge of various pollutants, including trace metals, into aquatic ecosystems, raising questions about the safety of consuming fish from both wild and cultured sources (Onyidoh *et al*., 2018).

In recent years, there has been a growing concern over the presence of trace metal contaminants in aquatic environments and their potential impacts on human health and the environment (Kolarova and Napiórkowski, 2021). Trace metals, under certain accumulated concentrations may become toxic and has the potential of causing severe damages to various ecosystems, especially in aquatic systems (Onyidoh *et al*., 2018). Health risk assessment plays a crucial role in evaluating the potential risks posed by trace metal contaminants in fish and informing regulatory measures to protect public health.

Several studies have shown that accumulated heavy metals in captured fishes have been and remain an area of concern (Abalaka, 2015; Abdulrahman *et al*., 2018; Sani *et al*., 2020). However, there is a dearth of information on safety assessments of trace metals accumulation in cultured and pond raised catfish in Kano State. The present work seeks to compare the levels of trace metal contamination and associated health risks between wild-caught and cultured African catfish to assess the influence of aquaculture practices and environmental conditions. By addressing the knowledge gaps in this field, this study seeks to support informed decision-making and promote sustainable aquaculture practices in Nigeria and beyond.

MATERIALS AND METHODS

Sample collection and preparation

Wet samples were obtained from River Wudil and commercial fish farm in Wudil for wild and cultured of *C. gariepinus* respectively. Wudil LGA of Kano is located between latitude 11º49'N and longitude 8º5'1, with an area of 362km² (140 sq. miles) and a population of 185,189 (Isma'il and Abubakar, 2015). The samples were washed with distilled deionised water to remove any adhering contamination. The specimens were then transported to the Department of Fisheries and Aquaculture, Bayero University, Kano for further analysis.

Analytical procedures

Trace metals such as Cd, Co, Cr, Cu, Mn, Pb, Zn and Fe were determined using atomic absorption spectrometer (model: CELiL, CE2021 U.K) according to standard methods. Daily intake of metals (DIM), health quotient (HQ), health risk index (HRI), and total health quotient (THQ) for all the metals were determined using the formula specified in equations (I)– (IV) according to standard methods described by Akinsorotan *et al.* (2022)

$$Daily\ intake\ of\ metals\ (DIM) = \frac{(\text{Cmetal} \times \text{Dfish} \times \text{Cfactor})}{Bo} \qquad (1)$$

Where C_{metal} = Concentration of heavy metal in Fish, D_{fish} = Daily nutritional intake of fish, B_o = Average Body Weight. Cfactor = Conversion of fresh fish to dry constant weight. Thus, in this study the C_{factor} was calculated as 0.352 using the above formula, where the daily nutritional requirement was 100g for adults (18 years and above with average body weight of 70kg), 80g for teenagers (6 – 18 years, with mean body weight of 48kg) and 60g for children (less than 6 years, with average body weight of 19kg), as recommended by Portier et al. (2007).

$$Health\ Risk\ Index\ (HRI) = \frac{\text{DIM}}{\text{RfD}} \qquad (II)$$

A HRI value of one (1) and less depicts a safe level and considered acceptable, however, any value above 1 is a potential heavy metal risk. RfD is the reference daily dose (mgkg-1d–1) while Bo is the mean bodyweight of the population.

Statistical analysis

Data were analysed with the aid of SPSS version 20, expressed in means and standard deviations.

RESULTS AND DISCUSSION

The concentration of trace metal in wild and cultured Africa catfish and their associated human health risk for adults, teenagers, and children are presented in Tables 1 and 2. All the metals except iron were below the permissible level recommended by FAO/WHO (Food, and Agricultural Organisation/World Health Organisation, 2011). Specifically, Fe in wild *C. gariepinus* (2.615±0.10 mg kg^{-1}), and cultured (3.301±0.31mg kg^{-1}) and were higher than the recommended 0.05 mg kg^{-1}. The high level of Fe may be attributed to the sediment iron content and the water supplying the ponds. *Clarias gariepinus* can bioaccumulate trace metals in bottom sediments being bottom dwellers (Sani *et al*., 2020). Despite potential bioaccumulation of trace metals by *C. gariepinus*, the iron levels recorded were lower than those reported for other catfish species in the region. The iron content recorded in this study was not up to 68.7 mg kg^{-1} reported in sharp-tooth catfish in River Niger, Nigeria (Ekere *et al*., 2018). Iron, essential for various physiological functions, showed elevated levels possibly due to its role in oxygen transport. However, excessive iron intake can lead to adverse health effects such as increased pulse rate and blood coagulation.

The analysis of daily intake of metal (DIM) and health risk index (HRI) showed that the population of wild and cultured *C. gariepinus* consumers in Wudil are not exposed to high doses of trace metals (Cd, Co, Cr, Cu, Mn, Pb and Zn) in all individual age category, as they were all below the FAO/WHO acceptable limits. For instance, the DMI results showed individuals' daily loading of Cd to be 0.0006 - 0.0016 $mg.kg^{-1}$ day^{-1} and 0.0008 - 0.0010 $mg.kg^{-1}$ day^{-1} for the wild and cultured *C. gariepinus* respectively. These recordings corresponded to HRI ratio of less than one (1) in each of the age category. Relative to the recommended

daily intake values, as specified in this study, the results justify that the individuals are not exposed to any high dosage of Cd with the consumption of fish muscles. Same is applicable to other trace metals investigated in this study. However, the DIM and HRI recorded in this study were higher than the results reported in farmed *C. gariepinus* (Burchell, 1822) in Zaria, Kaduna State, Nigeria (Onyidoh *et al*., 2018). Similarly, the present result corresponds to the report of Kortei *et al*. (2020), where human health risk assessment from trace metal exposure through the consumption of *C. anguillaris* from Ankobrah and Pra basins for both children and adults showed no significant non-carcinogenic adverse health risk to humans since all calculated values for Hazard Quotient (HQ) were<1.

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Table 1: Daily Intake and Health Risk Index of Individual's Responses for trace metals in Muscle Tissue of wild African catfish

Trace Metal	Mean±SD ($mg.kg^{-1}$)	Individual Category	DIM ($mg.kg^{-1}$ day^{-1})	HRI
		Adult (18 years and above)	0.0016	0.9128
Cd	0.011±0.75	Teenager (6-17years)	0.0013	0.9274
		Children (1-5 years)	0.0010	0.9557
		Adult (18 years and above)	0.0006	0.0193
Co	0.004±0.23	Teenager (6-17years)	0.0005	0.0154
		Children (1-5years)	0.0003	0.0116
		Adult (18 years and above)	0.0059	0.0040
Cr	0.041±0.31	Teenager (6-17years)	0.0047	0.0032
		Children (1-5years)	0.0036	0.0024
		Adult (18 years and above)	0.0035	0.0869
Cu	0.024±0.22	Teenager (6-17years)	0.0028	0.0695
		Children (1-5years)	0.0021	0.0521
		Adult (18 years and above)	0.0164	0.1169
Mn	0.113±0.50	Teenager (6-17years)	0.0131	0.0935
		Children (1-5years)	0.0098	0.0701
		Adult (18 years and above)	0.0012	0.2896
Pb	0.008±0.03	Teenager(6-17years)	0.0009	0.2317
		Children (1-5years)	0.0007	0.1738
		Adult (18 years and above)	0.0211	0.0705
Zn	0.146±0.52	Teenager (6-17years)	0.0169	0.0564
		Children (1-5years)	0.0127	0.0423
		Adult (18 years and above)	0.3786	0.5409
Fe	2.615±0.10	Teenager (6-17years)	0.3029	0.4327
		Children (1-5years)	0.2272	0.3246

CONCLUSION

The levels of all examined trace metals (Cd, Co, Cr, Cu, Mn, Pb, Zn, excluding iron) in both wild and cultured *C. gariepinus* were found to be below the permissible levels set by FAO/WHO (2011). Moreover, the risk assessment analysis of human health status regarding trace metal contamination indicated no significant risk of human exposure when consuming *C. gariepinus* in relation to the FAO/WHO permissible limits. However, it is advised to enhance aquaculture practices for cultured fish throughout the region, and environmental regulatory measures should ensure proper treatment of industrial wastes before discharge into water bodies to further mitigate the risk of contamination.

Table 2: Daily Intake and Health Risk Index of Individual's Responses for trace metals in Muscle Tissue of the cultured Catfish

Trace Metal	Mean±SD ($mg.kg^{-1}$)	Individual Category	DIM ($mg.kg\text{-}1\ day^{-1}$)	HRI
		Adult (18 years and above)	0.0008	0.7903
Cd	).009±0.31	Teenager (6-17years)	0.0010	0.9425
		Children (1-5 years)	0.0008	0.7819
		Adult (18 years and above)	0.0025	0.0849
Co	).029±0.51	Teenager (6-17years)	0.0034	0.1120
		Children (1-5years)	0.0025	0.0840
		Adult (18 years and above)	0.0005	0.0004
Cr	).006±0.23	Teenager (6-17years)	0.0007	0.0005
		Children (1-5years)	0.0005	0.0003
		Adult (18 years and above)	0.0099	0.2481
Cu	).113±0.10	Teenager (6-17years)	0.0131	0.3272
		Children (1-5years)	0.0098	0.2454
		Adult (18 years and above)	0.0086	0.0615
Mn	).098±0.12	Teenager (6-17years)	0.0114	0.0811
		Children (1-5years)	0.0085	0.0608
		Adult (18 years and above)	0.0013	0.3293
Pb	).015±0.50	Teenager(6-17years)	0.0017	0.4344
		Children (1-5years)	0.0013	0.3258
		Adult (18 years and above)	0.0224	0.0746
Zn	).255±0.13	Teenager (6-17years)	0.0295	0.0985
		Children (1-5years)	0.0222	0.0738
		Adult (18 years and above)	0.2899	0.4141
Fe	3.301±0.31	Teenager (6-17years)	0.3824	0.5463
		Children (1-5years)	0.2868	0.4097

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Microlivestock and Aquaculture: MLA006

DIETARY ADMINISTRATION IMPACT OF AFRICAN CATFISH (*Clarias gariepinus)* JUVENILES FED DIFFERENT GRADED LEVELS OF PHYTOADDITIVES (*Cyperus esculentus* AND *Myristica fragrans)* SUPPLEMENTED DIETS

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ABSTRACT

The study investigated the efficacy of tiger nut *Cyperus esculentus* (TNT) and nutmeg *Myristica fragrans* seed (NMS) singularly or in combination on the growth performance of Clarias *gariepinus* juveniles. The experimental diets composed of control (0%), TNT 2 (0.5%), TNT 3 (1.0%), TNT 4 (2%), NMS 5 (0,5%), NMS 6 (1.0%), NMS 7 (2%), TNT + NMS (1%) 8 and CHRL 9 (30 mg/kg). The fish (11.80 ± 0.02g) were replicated twice with 20 fish per replicate and were fed twice daily for 56 days. Phytochemical screening of tiger nut *Cyperus esculentus* and nutmeg *Myristica fragrans* seed and biological evaluation such as Mean weight gain (WG), percentage weight gain (PWG), and specific growth rate (SGR) were measured. Data were analyzed using descriptive statistics and ANOVA at p = 0.05. The result of the phytochemical screening of *Cyperus esculentus* and *Myristica fragrans* seed revealed the presence of alkaloids, saponins, tannins, steroids, phenols, and flavonoids in both nutmeg and tiger nut seeds while anthocyanin was absent in the *Cyperus esculentus* and *Myristica fragrans*. *Clarias gariepinus* fed TNT 2 (0.5%) had a significantly higher WG, PWG and SGR of 28.86 ±16.68, 245.4±41.36 and 0.84±0.33 respectively than the other treated groups. Fish fed with tiger nut and nutmeg seeds in singular or in combination form enhanced weight gain and feed conversion ratio of *C. gariepinus* juveniles. Therefore, tiger nut *C. esculentus* and nutmeg *M. fragrans* seeds could be used as dietary ingredients in the diets of *C. gariepinus* juveniles to enhance productivity in fish farming.

Keyword: *Clarias gariepinus; Cyperus esculentus; Myristica fragrans;* Chloramphenicol; Phytochemical screening

INTRODUCTION

Aquaculture is the fastest-growing food-producing industry in the world (1). Fish is a vital source of high-quality protein, providing approximately 16% of the animal protein consumed by the world's population (2). It is a particularly important and cheap protein source in regions where livestock is relatively scarce and expensive. It is estimated by FAO that about one billion people worldwide rely on fish as their primary source of animal protein (2). Over the years, humans have used fish protein as a food source and many health benefits are associated with eating fish. Studies around the world shows that natural plants have growth-promoting properties (3).

Myristicaceae, the nutmeg family of the *magnolia order* (*Magnoliales*) best known for the fragrant, spicy seeds of nutmeg (*Myristica fragrans*) contains 15 other genera and about 380 species of evergreen trees found throughout moist tropical lowlands. A fleshy covering, known as an aril, surrounds the fluted seed, which has much endosperm (starchy nutritive tissue for the developing embryo). Nutmeg is found to have

health detoxify the body, boost skin health, alleviate oral conditions, reduce insomnia, aphrodisiac properties, prevents leukaemia and improve blood circulation (4). Tiger nut (*Cyperus esculentus)* belongs to the family *Cyperaceae* (5). There are varieties of tiger nut tubers easily identified based on the tubers. They are; the yellow, brown and black variety. Only two of the varieties, yellow and brown are commonly seen in most local markets in Nigeria. The yellow variety is further grouped into two, the large yellow variety and the small yellow variety (6). The health benefits of tiger nut include; promoting digestion, lowering blood sugar levels, improving heart health, aphrodisiac properties and boosting immunity. The aim of this study was, therefore, to evaluate the growth performance of tiger nut (*Myristica fragrans*), and nutmeg (*Cyperus esculentus*) seed-fed supplemented diets both singularly or in combination in *Clarias gariepinus* juveniles.

MATERIALS AND METHODS

Collection and Identification of Tiger Nut and Nutmeg Seeds

Tiger nut and nutmeg seeds were purchased from Isikan Market in Akure, Ondo State. They were identified at the Department of Biological Sciences (Botany Programme), Olusegun Agagu University of Science and Technology, Okitipupa, where a voucher specimen was deposited for reference purposes.

Preparation of Plant Materials

The dried tiger nut and nutmeg seed obtained were ground into fine powder using a fabricated hammer mill and stored at (40 ^{0}C) until required.

Formulation and Preparation of Experimental Diet

Nine experimental diets were formulated at 40% crude protein, 14% ash, 5% crude fibre, 7% ether extract, 8% moisture, and 26% nitrogen-free extract using Pearson's square method to determine individual ingredient contribution at g/100g diet. Each ingredient (fish meal, soybean, blood meal, maize, wheat bran, rice bran, vitamin-mineral premix, starch, vegetable oil, and Di-calcium phosphate) was weighed using a sensitive weighing balance. Tiger nut and nutmeg seed were incorporated at different inclusion levels of 0%, 0.5%, 1%, and 2% respectively as a partial replacement for vitamin-mineral premix. The dry ingredients were mixed thoroughly using the manual method. Each diet was treated separately. Water was added and the result was a dough that was extruded/pelleted through a 2 mm pelleting machine to form a noodles-like strand which was manually broken into suitable sizes for the *Clarias gariepinus*. The pelleted diets were oven-dried at 60 ^{0}C and stored in airtight nylon at room temperature to prevent mycotoxin formation until required.

Experimental System, Procedure and Feeding Trials

The experiment was carried out in eighteen plastic experimental tanks (50 x 34 x 27cm) for 8 weeks in the Fisheries and Aquaculture Laboratory of Olusegun Agagu University of Science and Technology, Okitipupa, Ondo State. The water level was maintained at a volume of 40 litres throughout the experimental period. Water in each tank was replaced every three (3) days throughout the experiment to maintain relatively uniform physiochemical parameters and also to prevent fouling of the result from feed residues. The source of water was from the institution borehole. Each treatment has two replicates, 20 fishes per replicate with a mean initial weight of 11.80 ± 0.02g and uniform–sized were selected from 450 juveniles. *Clarias gariepinus* juveniles were acclimated for seven days in plastic tanks before the experiment and thereafter, weighed and distributed in an experimental tank. The experiment lasted for 8 weeks during which *C. gariepinus* was fed at 3% body weight daily. The diet per day was divided into two; 1.5% given in the morning by 8.00 – 9.00 and 1.5% in the evening by 5.00 pm. Measurement of the weight changes was performed fortnightly and the feeding rate was adjusted fortnightly according to the new body weight.

Determination of Phytochemical Screening of Tiger Nut and Nutmeg Seeds

The phytochemical screening (saponins, tannins, steroids, terpenoids, alkaloids, polyphenols, anthocyanin, flavonoids, phenols, and phytate) of tiger nuts and nutmeg seeds were obtained using quantitative techniques as described by (7).

Statistical Analysis
Data were statistically analysed using one–way analysis of variance (ANOVA), using SPSS version 20. Duncan's Multiple comparisons among means were made when significant F = values were observed at p = 0.05.

RESULTS

Phytochemical screening of Tiger nut and Nutmeg seeds
The results revealed that saponins, phenols, alkaloids, steroids, and tannins were present in both seeds but occurred in different concentrations while glycoside, phytate and polyphenol were present in tiger nut but absent in Nutmeg. The different phytochemical components present in each plant were recorded and their level of metabolite concentrations was recorded as detected in low amount (+), moderate amount (++) and not detected (-) (Table 1).

Growth Performance and Nutrient Utilization of *C. gariepinus* fed with the experimental diet for 8 weeks
The treated groups showed better performance when compared to the control in terms of survival rate, specific growth rate, weight gain, condition factor, and feed conversion ratio as shown in Table 2

DISCUSSION

The phytochemical analysis revealed the presence of alkaloids, steroids, phenols, saponins, tannins, and flavonoids. This result was similar to the report of (8) (9). The presence of these metabolites revealed that phenolic compounds comprised of tannin and flavonoids act as antioxidants and free radical scavengers (10). The result of the growth performance revealed a general increase in the growth of *C. gariepinus* juveniles fed all the experimental diets. The treated groups, TNT 2 had the best weight gain, percentage weight gain and specific growth rate when compared to the control and other treated groups. This study was similar to the findings of (1) (11) who reported better weight gain, specific growth rate and nitrogen metabolism in *C. gariepinus* juveniles fed drumsticks, onion bulb and walnut leaves supplemented diets respectively. The survival rate of the fish-fed tiger nut and nutmeg seeds were relatively similar and there was no significant difference ($p > 0.05$) among the dietary groups. Condition factors are used to assess the health status of a fish, the lower the values the better the health condition of the fish, this present study shows the treated groups had better values than the control. There were significant differences ($p < 0.05$) among the dietary groups. The results of this study were in agreement with the report of (11) who observed better condition factors in the *C. gariepinus* juveniles fed onion bulb and walnut leaves supplemented diets compared to the control.

Table 1: Result of Phytochemical Parameters present in Tiger nut and Nutmeg seeds

Phytochemical	Nutmeg seed	Tiger nut seed
Alkaloids	+	+
Saponins	++	+
Terpenoids	++	-
Steroids	+	+
Phenols	++	++
Flavonoids	++	+
Glycosides	-	+
Phytate	-	+
Polyphenols	-	+
Anthocyanin	-	-
Tannins	+	+

Table 2: Growth performance and nutrient utilization of *C. gariepinus* fed with the experimental diets for 8 weeks

Parameters	IBW	FBW	WG	PWG	SGR	FCR	SR	ICF	FCF
Control (0%)	11.80± 0.71[a]	34.42± 2.45[a]	25.62± 2.45[a]	200.6±3 4.42[a]	0.58± 0.78[a]	1.96± 0.50[a]	90.00± 0.00[a]	0.01± 0.0[a]	0.90± 0.00[b]
TNT2 (0.5%)	11.80± 0.71[a]	40.66± 16.68[a]	28.86± 16.68[a]	245.4±4 1.36[a]	0.84± 0.33[a]	2.09± 0.64[a]	77.50± 0.00[a]	0.01± 0.0[a]	0.55± 0.11[a]
TNT3 (1.0%)	11.80± 0.71[a]	32.29± 2.93[a]	20.46± 2.93[a]	176.0±2 4.87[a]	0.38± 0.45[a]	2.00± 1.73[a]	80.00± 4.07[a]	0.01± 0.0[a]	0.42± 0.03[b]
TNT4 (2%)	11.80± 0.71[a]	36.93± 1.04[a]	25.13± 1.04[a]	212.92± 5.58[a]	0.80± 0.00[a]	4.07± 0.92[a]	90.00± 0.00[a]	0.01± 0.0[a]	0.51± 0.16[b]
NMS5 (0.5%)	11.80± 0.71[a]	33.93± 0.66[a]	22.13± 0.66[a]	187.50± 0.38[a]	0.70± 0.00[a]	2.57± 0.79[a]	90.00± 0.00[a]	0.01± 0.0[a]	0.49± 0.04[b]
NMS6 (1.0%)	11.80± 0.71[a]	27.42± 0.04[a]	15.62± 0.14[a]	132.38± 6.64[a]	0.60± 0.00[a]	3.22± 1.28[a]	90.00± 0.00[a]	0.01± 0.0[a]	0.24± 0.01[a]
NMS7 (2%)	11.80± 0.71[a]	34.11± 10.22[a]	22.31± 10.22[a]	189.06± 21.81[a]	0.70± 0.02[a]	1.92± 0.43[a]	82.50± 10.61[a]	0.01± 0.0[a]	0.49± 0.03[b]
(TNT+NMS8) (1%)	11.80± 0.71[a]	28.32± 2.52[a]	16.56± 2.57[a]	140.34± 40.39[a]	0.55± 0.07[a]	2.63± 0.71[a]	82.50± 10.61[a]	0.01± 0.0[a]	0.43± 0.11[b]
CHRL9 (30 mg/kg)	11.80± 0.71[a]	39.58± 4.77[a]	27.78± 4.77[a]	235.42± 6.32[a]	0.55± 0.07[a]	3.97± 3.07[a]	80.00± 0.00[a]	0.01± 0.0[a]	0.44± 0.01[b]

IBW = Initial body weight, FBW = Final body weight, WG = Weight gain, PWG = Percentage weight gain, SGR = Specific growth rate, FCR = Feed conversion ratio, SR = Survival rate, ICF = Initial condition factor, FCF = Final condition factor, CHRL = Chloramphenicol, weight gain = final body weight - initial body weight; weight gain (%) = 100 (final body weight - initial body weight)/initial body weight; specific growth rate (SGR) = 100 (loge final body weight - loge initial body weight)/time (days); feed conversion ratio (FCR) = dry weight of feed fed (g)/fish weight gain (g); Survival rate (%) = Initial Number of Fish Stocked – Mortality/ Initial Number of Fish stocked × 100; Condition factor (k) = 100W/L3, Where: W= weight of fish (g); L=standard length (cm)

CONCLUSION

Tiger nut and nutmeg seed appeared to provide a substantial and stimulating effect on the parameters assayed. Hence, tiger nut and nutmeg seed as shown to be good primary ingredients in the diet of *C. gariepinus*. It is therefore concluded that the inclusion of tiger nut and nutmeg meal-based diet will enhance productivity in fish farming.

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Microlivestock and Aquaculture: MLA007

ECONOMICS OF PRODUCTION OF JAPANESE QUAILS (*Coturnix coturnix japonica*) FED ENZYME (KINGZYME®) SUPPLEMENTED DIETS

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ABSTRACT

A 21-day feeding trial to evaluate the effect of exogenous enzyme (Kingzyme ®) supplementation on the economics of finisher Japanese quails (Coturnix coturnix japonica) production was conducted using one hundred and fifty (150), three (3) weeks old mixed sexes, Japanese quails were used in this study. The birds were randomly assigned to five dietary treatment groups, T_1, T_2, T_3, T_4 and T_5 with enzyme supplementation at 0, 150, 200, 250 and 300 g/ton, respectively. The treatment groups were replicated three times with ten (10) birds per replicate in a Complete Randomized Design. The birds were housed in deep litter pens and all necessary routine management practices were observed. The economics of production data were collected on feed intake, cost feed per kg, total cost of feed consumed, total weight gain, feed cost/ kg weight gain, revenue and cost of saving percentage. The cost of feed increased as the levels of enzyme supplementation increased. There was improvement in the weight gain, feed cost/kg weight gain in the enzyme supplemented treatments, the accrued revenue was increased with enzyme supplementation with birds on diet containing 150 g/tonn of feed having the highest value. The cost of saving percentage showed improvement with enzyme supplementation compared with birds on control diet. Birds on diet containing 150 g/tonn of diet recorded highest value of 9.9%. It was concluded that supplementation of finisher quail diets with exogenous enzymes (Kingzyme®) enhanced economic gains with improved cost saving at 150 g/ton. Therefore, 150g/ton kingzyme® supplementation to quail diets is recommended.

Key words: quails, exogenous enzyme, economics and production

DESCRIPTION OF THE PROBLEM

In a developing nation like Nigeria, there exists a shortfall in the availability of animal protein sources, leading to a consumption of merely 8.6 g of animal protein per day per individual, a stark contrast to the 53.3g consumed in developed countries [1].

Japanese quails are a popular choice in alleviating the protein deficit challenge. This is due to their unique characteristics of fast growth, early sexual maturity, high rate of egg production, short generational interval, short incubation period and very robust diseases resistant capability. Despite this, high cost and inadequate utilization of feed has limited their production. However, [2] stated that, it is highly essential to add feed additives such as enzyme in order to improve feed efficiency of quails to produce meat economically; as the addition of the enzyme improve digestibility and bioavailability of nutrients. Enzymes are involved in all anabolic ad catabolic pathways of digestion and metabolism which helps in improved feed conversion ratio FCR [3].

The supplementation of exogenous enzymes has been reported to enhance feed intake, feed conversion ratio (FCR) and nutrient utilization in livestock. Thus, leading to reduced cost of animal protein sources. Previous studies have indicated that the incorporation of specific enzymes into animal diet can enhance the digestion

and absorption of complex nutrients, resulting in reduced cost of production, improved farmers' income among others. [4]. Therefore, the study was carried out to investigate the effect of enzyme (Kingzyme®) supplementation in the diets of economics of Japanese quails' production.

MATERIAL AND METHODS

Experimental site

The feeding trial was carried out at the Poultry Unit of the Teaching and Research Farm of the College of Animal Science, Joseph Sarwuan Tarka University, Benue State, Nigeria. Makurdi is located in the Guinea Savannah Zone of Nigeria on latitude $7^0$43'N and longitude $8^0$53'E. The average minimum temperature is 23^0C and maximum temperature is 36.9^{o}C, mean monthly relative humidity is 74%. The mean annual rainfall is 1105mm; the mean monthly temperature is 35.06 ^{o}C [5].

Experimental design and management of birds

One hundred and fifty (150), three (3) weeks old mixed sexes, Japanese quails were used for this study. The birds were purchased from National Veterinary Research Institute, Vom, Plateau State. They were randomly allotted to five dietary treatment groups, T_1, T_2, T_3, T_4 and T_5. The treatment groups were replicated three times with ten (10) birds per replicate in a Complete Randomized Design.

The birds were housed in deep litter pens and all necessary routine management practices were observed. Clean/fresh Water and feed were provided *ad libitum* for the 21 days of the experimental period. The diets were formulated to meet the nutrient requirements of the finisher birds (Table 1) according to the National Research Council requirements (1994). The results obtained were statistically analyzed using one-way analysis of variance (ANOVA) using SPSS version 20.0 and significance of differences among treatments was determined using Duncan multiple range test.

Experimental diets

Five (5) isonitrogenous and isocaloric diets were formulated according to the nutritional recommendation of NRC as T_1 (control), T_2, T_3, T_4 and T5 with enzyme supplementation at 0, 150, 200, 250 and 300 g/ton, respectively.

Measurement of performance parameters: The weights of the experimental animals were taken weekly using an electronic kitchen scale. Body weight gain was calculated at the end of the experiment by subtracting the initial weight from the final weight. The feed conversion ratio was determined by dividing the feed intake by the weight gain. Feed intake was taken every day, by subtracting the left over from the daily feed given.

Economics of production. The cost per kilogram of each experimental diet was calculated based on the prevailing prices of feed ingredients in Makurdi. To calculate the cost per kilogram of feed, the price/kg of each ingredient was multiplied by the quantity in Kg of that ingredient in 1 kg of feeds and these values for all ingredients were summed. The cost of the feed consumed was realized by multiplying the cost of 1 kg of feed by the total feed consumed. Feed cost per kg was determined by dividing total cost of feed consumed by weight gain. Revenue obtained from the sales of the birds was realized by multiplying the weight gain by the cost of live body weight (₦4,500/kg). The cost of saving percentage was expressed as the difference between the revenue of the control treatment and the other treatments.

RESULTS AND DISCUSSION

Economics of production of finisher quails fed diets containing supplemented graded levels of enzyme is presented in Table 2. Results showed that enzyme inclusion increased the feed cost per kg (₦) and was noticed to be lower (₦411.00) in the control group. The highest feed cost per kg (₦419.69) was observed in treatment 5 (300 g/ton) while the lowest feed cost (₦411.00) was on birds fed control diet. The weight gain of birds increased on birds fed diets supplemented with enzyme compared with those on control group. Birds on diet fed 150 g/ton of feed had highest total weight gain of (91 g) while those on control diet had the lowest

(82 g) value for total weight gain. The accruable revenue was observed to be highest on birds fed diet containing 150 g/ton of feed. These results indicated that, supplementation of quail diets with kingzyme® increased economic return in quail production. The cost of saving percentage is expressed in relative to the control group, it was observed to increase with enzyme inclusion and gave better return at 150 g/ton with profit margin of 9.9%. Improved cost of saving percentage on the production of the birds may probably be due to better digestion, absorption, utilization and improved feed conversion that resulted to the weight gains of the birds. The result of this study collaborate findings of [6, 7, 8] who reported improved growth performance and appreciable profit margin in starter broiler chicks fed diets supplemented multi enzyme (xylanase, amylase and protease).

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TABLE 1: INGREDIENTS AND NUTRIENT COMPOSITION OF EXPERIMENTAL FINISHER QUAIL DIETS

	Levels of enzyme supplementation (g/ton of feed)				
Ingredients	0	150	200	250	300
Maize	44.00	44.00	44.00	44.00	44.00
Full- Fat Soyabean	48.40	48.40	48.40	48.40	48.40
BDG	2.00	2.00	2.00	2.00	2.00
Rice offal	2.00	2.00	2.00	2.00	2.00
Bone ash	2.00	2.00	2.00	2.00	2.00
Dicalciumphosphate	0.50	0.50	0.50	0.50	0.50
L-Lysine	0.20	0.20	0.20	0.20	0.20
DL-Methionine	0.20	0.20	0.20	0.20	0.20
Salt	0.20	0.20	0.20	0.20	0.20
V/M Premix	0.20	0.20	0.20	0.20	0.20
	Calculated proximate nutrient composition				
ME (Kcal/kg)	2950.00	2950.00	2950.00	2950.00	2950.00
Crude protein (%)	21.00	21.00	21.00	21.00	21.00
Crude fibre (%)	5.00	5.00	5.00	5.00	5.00
Ether extract (%)	10.58	10.58	10.58	10.58	10.58
Calcium (%)	1.08	1.08	1.08	1.08	1.08
Phosphorous (%)	0.79	0.79	0.79	0.79	0.79
L-Lysine (%)	1.39	1.39	1.39	1.39	1.39
DL-Methionine (%)	0.51	0.51	0.51	0.51	0.51

TABLE 2: ECONOMICS OF FINISHER QUAILS PRODUCTION FED DIETS SUPPLEMENTED WITH GRADED LEVELS OF ENZYME

	Levels of enzyme supplementation (g/ton of feed)				
Ingredients	0	150	200	250	300
Feed intake (g)	234.8	252.54	252.52	263.76	253.30
Cost of Feed/kg (₦)	411.00	413.69	415.69	417.69	419.69
Total cost of feed	96.50	104.47	104.97	110.97	108.40
Total weight gain (g)	82.00	91.00	88.00	89.00	89.00
Feed cost/kg gain	1.18	1.12	1.20	1.24	1.22
FCR	2.90	2.80	2.90	2.96	2.90
Revenue (₦)	369.00	409.50	396.00	400.50	400.50
Cost of saving (%)	--	9.90	6.18	7.86	7.80

CONCLUSION AND RECOMMENDATION

Based on the result of the study, it was concluded that supplementation of finisher quail diets with exogenous enzymes (Kingzyme®) enhanced economic gains with improved cost of saving at 150 g/ton. Therefore, 150 g/ton kingzyme® supplementation to quail diets is recommended

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Microlivestock and Aquaculture: MLA008

EFFECT OF EXOGENOUS ENZYME (KINGZYME®) SUPPLEMENTATION ON THE GROWTH PERFORMANCE OF JAPANESE QUAILS (*Coturnix coturnix japonica*)

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ABSTRACT

A 21-day feeding trial study was conducted to evaluate the effect of exogenous enzyme (Kingzyme ®) supplementation on the growth performance of finisher Japanese quails (Coturnix coturnix Japonica). One hundred and fifty (150), three (3) weeks old mixed sexes, Japanese quails were used in this study. The birds were randomly assigned to five dietary treatment groups: T_1, T_2 , T_3 , T_4 and T_5 with enzyme supplementation at 0gram/ton, 150gram/ton, 200gram/ton250gram/ton and 300grams/ton, respectively. The treatment groups were replicated three times with ten (10) birds per replicate in a Complete Randomized Design. The birds were housed in deep litter pens and all necessary routine management practices were observed. The growth performance data were collected on initial weights, final weights, weight gain, feed intake and feed conversion ratio. The data were statistically analyzed using one-way analysis of variance (ANOVA) with SPSS version 16.0 and significant differences among treatments was determined using Duncan multiple range test. There were no significant differences ($P>0.05$) across the treatment groups for Initial weight, final body weights, and average daily weight gains. However, there was a significant difference ($P<0.05$) in the feed conversion ratio (FCR) in response to enzyme supplementation, with T_2 having the lowest numerical value, but statistically similar to T3. Based on the results of the study, it was concluded that finisher quail diets supplemented with enzyme (Kingzyme ®) do not have significant effect on the feed intake, weight gain but significantly improved the feed gain ratio. Therefore, supplementation of quail diet with 150 grams/ton Kingzyme ® is recommended for optimal performance.

Key words: Japanese quails, feed intake, weight gain, feed conversion ratio and exogenous enzyme

DESCRIPTION OF THE PROBLEM

In a developing nation like Nigeria, there exists a shortfall in the availability of animal protein sources, leading to a consumption of merely 8.6g of animal protein per day per individual, a stark contrast to the 53.3g consumed in developed countries [1]. This is quite low compared to the FAO recommended 35g per head per day [2]. This challenge is often associated with productive and health consequences. This calls for an urgent solution to off-setting or ameliorating the imbalance. This can be feasible through the promotion of livestock industry especially the poultry sub-sector.

Japanese quails are a popular choice in alleviating the protein deficit challenge; this is due to their unique characteristics of fast growth, early sexual maturity, high rate of egg production, short generational interval, short incubation period and very robust to diseases resistant capability. However, high cost and inadequate utilization of feed has limited their production. The supplementation of exogenous enzymes has been reported to enhance feed intake, feed conversion ratio (FCR) and nutrient utilization in quails. Previous studies have indicated that the incorporation of specific enzymes into animal diet can enhance the digestion and absorption of complex nutrients, resulting in elevated growth rate, improved feed conversion efficiency, and enhanced nutrient utilisation [3; 4]. This study aimed to explore the influence of exogenous enzyme

supplementation on the growth performance of Japanese quails, evaluating key parameters such as feed intake, body weight gain and feed conversion ratio.

MATERIAL AND METHODS

Experimental site
The feeding trial was carried out at the poultry unit of the Teaching and Research Farm of the College of Animal Science, Joseph Sarwuan Tarka University, Benue State, Nigeria.

Experimental design and management of birds
One hundred and fifty (150), three (3) weeks old mixed sexes, Japanese quails were used for this study. The birds were purchased from National Veterinary Research Institute Vom, Plateau State. They were randomly allotted to five dietary treatment groups, T_1, T_2, T_3, T_4 and T_5. The treatment groups were replicated three times with ten (10) birds per replicate in a Complete Randomized Design.

The birds were housed in deep litter pens and all necessary routine management practices were observed. Clean/fresh Water and feed were provided *ad libitum* for the 21 days of the experimental period. The diets were formulated to meet the nutrient requirements of the finisher birds (Table 1) according to the National Research Council requirements (1994). The data obtained were statistically analyzed using one-way analysis of variance (ANOVA) using SPSS version 20 and significant differences among treatments was determined using Duncan multiple range test.

Experimental diets
Five (5) isonitrogenous and isocaloric diets were formulated according to the nutritional recommendation of NRC as T1 (control), T2, T3, T4 and T5 with enzyme supplementation at 0gram/ton, 150gram/ton, 200gram/ton, 250gram/ton and 300grams/ton respectively.

Measurement of performance parameters: The weights of the experimental animals were taken weekly using an electronic kitchen scale. Body weight gain was calculated at the end of the experiment by subtracting the initial weights from the final weights. The feed conversion ratio was determined by dividing the feed intake by the weight gain. Feed intake was taken weekly by subtracting the left over from the daily feed given.

Statistical Analysis
Analysis of variance (ANOVA) in SPSS version 20 set at 95% confidence limit was used for the statistical analysis to determine the level if significance between the various treatments. While Duncan Multiple Range Test was used for the mean separation.

RESULTS AND DISCUSSION

Table 1 shows the gross composition of the experimental diets fed to the finisher quails, which were isonitrogenous and isocaloric. The results for the effect of exogenous enzyme supplementation on the growth performance of Japanese quails is shown in table 2. There was no significant difference ($P>0.05$) in the initial weight, final weight, weight gain, daily weight gain. However, a significant difference ($P<0.05$) was observed in the feed conversion ratio. The improved feed conversion ratio could be as a result of the action of the enzyme that causes improved nutrient availability and utilization. The result of this present study agrees with findings of [5] who conducted a study on effect of supplementation of palm kernel meal with and without enzyme on the performance of japanese quail (Coturnix coturnix japonica) and reported that body weight gain, and feed intake were not influenced by enzyme supplementation. Whereas better ($P<0.01$) FCR was observed in diets with 15% PKM with enzyme supplementation.

TABLE 1: INGREDIENTS AND NUTRIENT COMPOSITION OF EXPERIMENTAL FINISHER QUAIL DIETS

Ingredients	**Diets**				
	T_1	**T_2**	**T_3**	**T_4**	**T_5**
Maize	44.00	44.00	44.00	44.00	44.00
Full- Fat Soyabean	48.40	48.40	48.40	48.40	48.40
BDG	2.00	2.00	2.00	2.00	2.00
Rice offal	2.00	2.00	2.00	2.00	2.00
Bone Ash	2.30	2.30	2.30	2.30	2.30
Dicalciumphosphate	0.5	0.5	0.5	0.5	0.5
L-Lysine	0.20	0.20	0.20	0.20	0.20
DL-Methionine	0.20	0.20	0.20	0.20	0.20
Salt	0.20	0.20	0.20	0.20	0.20
V/M Premix	0.20	0.20	0.20	0.20	0.20
Kingzyme®	-	*0.15*	*0.20*	*0.25*	*0.30*
Total	100	100	100	100	100
Calculated values					
M.E Kcal/kg	2950.00	2950.00	2950.002950.00		2950.00
C.P	21.00	21.00	21.00	21.00	21.00
C.F	5.00	5.00	5.00	5.00	5.00
EE	10.58	10.58	10.58	10.58	10.58
Ca	1.03	1.03	1.03	1.03	1.03
P	0.79	0.79	0.79	0.79	0.79
L-Lysine	1.39	1.39	1.39	1.39	1.39
DL-Methionine	0.51	0.51	0.51	0.51	0.51

TABLE 2: GROWTH PERFORMANCE OF FINISHER QUAILS

Parameters	**T1**	**T2**	**T3**	**T4**	**T5**	**SEM**	**P-Value**
Initial Weight (g)	57.00	57.00	57.00	57.00	56.50	1.42	0.98
Feed Intake(g)	11.18	12.03	12.02	12.54	12.30	0.42	0.94
Total Weight gain(g)	79.00	91.00	88.00	88.50	87.00	1.89	0.37
Daily Weight gain(g)	3.76	4.33	4.19	4.16	4.14	3.79	0.48
FCR	2.97^{a}	2.77^{b}	2.86^{ba}	2.96^{a}	2.97^{a}	0.03	0.03

Similar result was obtained by [6] who conducted a study on the supplementation of Novizyme in different graded levels in layers diet and reported no significant (P>0.05) effects in all the performance parameters measured.

[7] evaluated the effect of feed-grade enzyme supplementation in diets with varying levels of energy on the performance of growing Japanese quail and found that the added enzyme did not improve growth rate, feed intake or feed efficiency of birds

CONCLUSION AND APPLICATION

Based on the findings of the study, it was concluded that finisher quail diets supplemented with enzyme (Kingzyme ®) do not have significant effect on the feed intake, weight gain but in turn significantly improved the feed gain ratio. Therefore, supplementation of quail diet with 150 grams/ton Kingzyme® is recommended for optimal performance.

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Microlivestock and Aquaculture: MLA009

EFFECT OF DIET SUPPLEMENTATION WITH SUNDRIED WATERMELON (*Citrullus lanatus*) PEEL MEAL ON GROWTH, FEED UTILIZATION, BODY COMPOSITION AND SURVIVAL IN *Clarias gariepinus* JUVENILES

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ABSTRACT

Rising demand and expensive nature of conventional feed ingredients used in fish diets have resulted in a continuous search for cheaper alternative feed resources. This study assessed the effect of supplementing diet with sundried watermelon (*Citrullus lanatus*) peel meal (WMPM) as an additive on the growth, feed utilization, body composition and survival of the African catfish, *Clarias gariepinus*. Six isonitrogenous diets were formulated at 40% crude protein level in which WMPM was added at 0%, 20%, 40%, 60%, 80% and 100% levels and designated as Diets 1, 2, 3, 4, 5 and 6 respectively. Diets were administered twice daily (7:00 – 7:30 am and 17:00 – 17:30 pm) at 5% body weight to 360 *C. gariepinus* juveniles inside eighteen plastic bowls for 8 weeks. Mean weight gain (MWG), specific growth rate (SGR), feed conversion ratio (FCR), protein intake (PI) and percentage survival (PS) were determined. Data obtained were analyzed using analysis of variance (ANOVA) at $p<0.05$. Final carcass crude protein (53.12 - 63.44%) significantly exceeded the initial value (53.08%). Apart from the fish reared on the control diet, the fish fed Diet 2 (20% WMPM-based diet) had the highest MWG (23.99 ± 0.15 g), SGR (3.49± 0.01%/day), FCR (0.96), PI (9.09) and PS (85%) while those placed on Diet 6 (100% WMPM-based diet) had the lowest values of these growth indices. This study indicated that up to 20% diet supplementation with watermelon peel meal effectively improved growth and feed utilization in *C. gariepinus* while higher supplementation beyond 20% level caused progressively reduced growth and feed utilization.

Key words: *Clarias gariepinus*, *Citrullus lanatus*, nutrition, feed conversion, growth

DESCRIPTION OF PROBLEM

Rapid human population growth without a consistently corresponding increase in animal protein production has been identified as one of the main challenges facing developing countries including Nigeria **[1]**. Inadequate consumption of animal protein among most Nigerians has been documented **[2]**. The daily animal protein intake is less than 10 g which is markedly below the value of 35 g per day recommended by the Food and Agriculture Organization **[3]**. This wide margin between the recommended protein intake and the average human consumption rate has necessitated a continuous demand for animal protein by the Nigerian populace. This growing demand for the required protein production can be satisfied through fish culture **[1]** because fish products constitute about 22% of animal protein supply in sub-Saharan Africa and 40% of animal protein consumption in Nigeria **[4]**. In order to maximize nutritional and economic benefits, research efforts have concentrated on increasing the utilization of unconventional agricultural and/or plant by-products to replace conventional feed ingredients. Incorporation of agricultural or plant by-products such as leaf and peel meals in aquaculture feed production is fast attracting global attention owing to their enormous availability, nutrient contents and economic feasibility **[5]**.

Watermelon (*Citrullus lanatus*) peel is a typical plant by-product which has not been commonly utilized as fish feed. The peels are usually scraped off the inner fleshy pulp (mesocarp), discarded indiscriminately as a waste and dumped in landfills, rivers or on unregulated grounds. Large quantities of these peels are known to aggravate environmental pollution and thereby constitute serious hazards to human health. Moreover, there is less competition on the use of these peels by man, livestock and industries. It is also cheap to buy

and available in all geo-political areas of Nigeria and the tropics, a quality which makes it a good candidate for fish feed production.

The nutritive value of watermelon peel has hitherto not been effectively harnessed. Hence, there is scanty available literature information on its utilization in fish feed production. Therefore, this study aimed to assess the effect of sun-dried watermelon peel meal as an additive on the growth, feed utilization, body composition and survival of *C. gariepinus* juveniles.

MATERIALS AND METHODS

Study location

This eight-week feeding trial was conducted in the Fish Nutrition Research Laboratory of the Department of Fisheries and Aquaculture Technology, Olusegun Agagu University of Science and Technology, Okitipupa, Ondo State, Nigeria.

Collection and processing of fresh watermelon peels into watermelon peel meal

Twelve kilograms (12 kg) of fresh watermelon peels used for this study were collected from several watermelon vendors within Okitipupa Local Government Area, Ondo State, Nigeria where they were discarded as waste. The peels were rinsed in clean water, sun-dried for 14 days, milled into a powdery form (meal) and stored in an air-tight container prior to use.

Formulation and preparation of experimental diets

Other ingredients were purchased from a reputable feed mill and ground separately into a powdery form. Six iso-nitrogenous (40% crude protein) diets were formulated as shown in Table 1. Sun-dried watermelon peel meal (WMPM) was added as a feed additive at graded levels of 0 (control diet without WMPM), 20, 40, 60, 80 and 100% in the diets which were respectively designated as Diet 1, Diet 2, Diet 3, Diet 4, Diet 5 and Diet 6. Each diet was prepared by thoroughly mixing the ingredients inside a mixer (Hobart A-2007 Model, Hobart Ltd, London, UK) while palm oil and warm water were added to homogenize the dry mixture into a uniform paste. Each diet paste was steam-pelleted through a 2-mm die Hobart pelletizer (A-2007 Model, Hobart Ltd, London, UK). The pellets were sufficiently sun-dried for three days, cooled to room temperature and kept in separate air-tight containers prior to use.

Experimental design and fish handling procedure

This study adopted a completely randomized design comprising six treatments with three replicates each. A total of 400 *C. gariepinus* juveniles were bought from a reliable fish hatchery in Okitipupa, Ondo State, acclimated to the experimental conditions in four fiberglass tanks (1 m × 1 m× 0.5 m) for 7 days and manually fed twice daily with 2 mm Aler Aqua feed to visual satiation. At the start, 360 uniform-sized fish (initial mean weight: 3.97±0.28 g) were weighed in batches on a high-precision scale (OHAUS LS, Model 2000) and randomly assigned into 18 plastic aquaria (50 × 40 × 40 cm^3) at twenty fish per aquarium containing 25 litres of water each. The fish were fed manually twice daily (07:00 - 08:00 and 17:00 - 18:00 hrs) at 5% body weight in two equal rations. Water temperature in the aquaria was read with mercury-in-glass thermometer, dissolved oxygen values measured through Hydrolab Model "Multi 340I/SET" while pH values were determined using pH meter (Jenway 3015 pH meter). Fish in each aquarium were batch-weighed weekly and weight changes recorded accordingly.

Proximate analysis of experimental diets and fish carcass composition

Eight grams (8 g) of each diet sample, six pre-experimental fish specimens and four post- experimental fish specimens per treatment were randomly collected and kept frozen to determine the proximate composition of diets and whole-fish carcass. The proximate parameters analyzed included crude protein, crude lipid, crude fibre, total ash, moisture content and nitrogen-free extract **[6]**.

Table 2: Gross ingredient composition (g/100g diet) of experimental diets

Dietary Ingredients	0% WMPM Diet 1 Control	20% WMPM Diet 2	40% WMPM Diet 3	60% WMPM Diet 4	80% WMPM Diet 5	100% WMPM Diet 6
Watermelon peel meal	0.00	5.00	9.99	14.99	19.98	24.98
Yellow maize	24.98	19.98	14.99	9.99	5.00	0.00
Groundnut cake	22.35	22.35	22.35	22.35	22.35	22.35
Fish meal	22.35	22.35	22.35	22.35	22.35	22.35
Soybean meal	22.35	22.35	22.35	22.35	22.35	22.35
Shrimp meal	2.00	2.00	2.00	2.00	2.00	2.00
Vitamin premix	1.00	1.00	1.00	1.00	1.00	1.00
Vegetable oil	1.00	1.00	1.00	1.00	1.00	1.00
Table salt	1.00	1.00	1.00	1.00	1.00	1.00
Cassava starch	3.00	3.00	3.00	3.00	3.00	3.00
Total (g)	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Biological evaluation of feed utilization and fish growth response

Fish growth response and feed utilization indices were evaluated according to Adesina and Agbatan **[7]** as follows:

$$\boldsymbol{Mean\ weight\ gain\ (MWG)} = (W_2 - W_1)\ g$$

where: W_1 = initial mean weight (g); W_2 = final mean weight (g)

$$\boldsymbol{Percentage\ weight\ gain}(\%) = \frac{Mean\ weight\ gain(g) \times 100}{Initial\ mean\ weight\ (g)}$$

$$\boldsymbol{Feed\ intake}\ (\boldsymbol{g}) = WFI_1 + WFI_2 + WFI_3 + WFI_4 + \ldots\ldots WFI_n$$

where: WFI= weekly feed intake of fish per treatment (g); 1, 2, 3, 4,……..n= first week to the last week of the experimental duration

$$\boldsymbol{Feed\ conversion\ ratio}(\boldsymbol{FCR}) = \frac{Mean\ feedintake(g)}{Mean\ weightgain(g)}$$

$$\boldsymbol{Specific\ growth\ rate}(\%/\mathbf{day}) = ((\text{Ln Wf} - \text{Ln Wi}) \times 100)/(t\ (days))$$

where: Ln W_f = natural logarithm of the fish final weight; Ln W_i= natural logarithm of the fish initial weight; t= experimental duration in days.

$$\textbf{Protein intake}\left(g\ of\ protein\ in\ 100\ g\frac{diet}{fish}\right) = \frac{feed\ intake \times \%\ crude\ protein\ in\ diet}{100}$$

$$\textbf{Protein efficiency ratio}\ (PER) = \frac{Mean\ weight\ gain}{Mean\ protein\ intake\ (g\ of\ protein\ in\ 100\ g\ of\ diet/fish)}$$

$$\textbf{Nitrogen metabolism}\ (NM) = (0.549 \times (Wi + Wf)\ t)/2$$

where: W_i= initial mean weight of fish; W_f= final mean weight of fish; t= experimental period in days; 0.549 = metabolism factor

$$\textbf{Percentage survival, PS}(\%) = \frac{Final\ number\ of\ fish\ harvested \times 100}{Initial\ number\ of\ fish\ stocked}$$

Statistical analysis

The data obtained on proximate indices, feed utilization, growth and carcass composition of *C. gariepinus* juveniles were analyzed through one-way analysis of variance (ANOVA) using the SPSS Statistics 22.0 version (IBM, USA). Differences among the treatments were determined using Tukey's multiple range tests and were considered as being statistically significant at $p < 0.05$ **[8]**. All the data presented in this study were expressed as means of triplicate values ± standard deviation.

RESULTS AND DISCUSSION

Proximate composition of sun-dried watermelon peel meal-based diets fed to *C. gariepinus* juveniles

Table 2 shows the result of the proximate analysis of the experimental diets. Crude protein values (39.51 – 40.59%) of the diets were nearly uniform and revealed no significant difference ($p > 0.05$). These values satisfy the protein requirements of *C. gariepinus* fingerlings and support the assertion of **[9]** that the ideal growth rate and feed conversion efficiency in *C. gariepinus* could be attained within 38 - 42% dietary protein. The present values also corroborate 39.40 – 41.40% and 43.97 – 44.28% respectively reported by **[10]** and **[9]** for melon peel meal-based diets. The observed values of crude lipid, total ash, crude fibre, moisture and nitrogen-free extract contents indicated significant difference ($p<0.05$). Crude lipid values (15.41 – 22.06%) exceed 4.15 – 4.37% and 5.50 – 6.50% respectively previously reported for melon peel meal-based diets **[11, 10]** while nitrogen-free extract values (12.08 – 21.10%) are much below 24.60 – 31.45% and 31.56 – 32.86% respectively documented by **[11, 10]** for melon peel meal-based diets.

Carcass proximate composition of *C. gariepinus* juveniles fed graded levels of sun-dried watermelon peel meal-based diets

Chemical composition of the experimental fish carcass (Table 3) followed an irregular trend and showed significant ($p < 0.05$) variations among the treated fish. This suggests that addition of sun-dried watermelon peel meal affected their body composition. Crude protein values (53.12 – 63.44%) obtained in the post-experimental fish carcasses were significantly ($p<0.05$) higher than 53.08% in the pre-experimental fish carcass, an observation corroborating the report of **[10]** on *C. gariepinus* fingerlings fed melon seed peel meal-based diets. This result suggests enhanced synthesis of tissue protein in the experimental fish **[12]** as reflected in fish growth and weight gain **[13]**. Likewise, the values of the crude lipid, total ash, nitrogen-free extract and moisture contents observed in the experimental fish carcass showed significant variations ($p<0.05$). Besides, the moderately high carcass lipid content suggested improved lipid synthesis in the fish **[13]** which could be associated with an increase in the dietary crude lipid content.

Table 3: Proximate composition of graded levels of sun-dried watermelon peel meal-based diets fed to *C. gariepinus* juveniles

Dietary treatments	Crude protein	Crude lipid	Total ash	Crude fibre	NFE	Moisture
Diet 1	40.59±2.02	17.67±1.62^{b}	12.43±1.12^{b}	6.08±0.72^{b}	18.96±1.61^{b}	4.32±0.23^{c}
Diet 2	39.51±1.75	22.06±2.01^{a}	12.69±0.71^{b}	7.46±0.03^{a}	12.08±1.04^{d}	6.22±0.15^{a}
Diet 3	39.78±2.03	15.41±1.81^{c}	11.50±0.56^{c}	7.23±0.01^{a}	21.10±2.03^{a}	5.00±0.04^{b}
Diet 4	39.73±2.51	18.31±0.93^{b}	12.35±1.40^{b}	7.78±1.47^{a}	14.97±0.81^{c}	6.87±1.02^{a}
Diet 5	40.02±1.62	16.82±1.31^{c}	11.65±0.81^{c}	6.59±0.76^{b}	18.92±1.72^{b}	6.64±0.82^{a}
Diet 6	39.81±2.52	17.21±1.25^{b}	15.75±0.34^{a}	6.54±0.52^{b}	16.26±1.82^{bc}	4.44±0.01^{c}
P-value	$p < 0.05$	$p < 0.05$	$p < 0.05$	$p < 0.05$	$p < 0.05$	$p < 0.05$

Means with different letters on the same column differ significantly ($p < 0.05$) (Tukey's multiple range tests).

Table 4: Carcass composition of *C. gariepinus* juveniles fed graded level of sun-dried watermelon peel meal based-diets

Dietary treatments	Crude protein	Crude lipid	NFE	Total ash	Moisture
Initial values	53.08±2.03^{c}	14.46±1.03^{b}	12.63±1.04^{a}	14.72±2.01^{a}	5.08±0.14^{a}
Diet 1	63.44±1.02^{a}	9.96±0.72^{d}	11.21±0.76^{ab}	11.15±1.08^{c}	4.24±0.01^{b}
Diet 2	61.18±2.04^{ab}	12.92±1.44^{c}	9.59±0.91^{b}	12.32±0.92^{c}	3.99±0.23^{b}
Diet 3	53.12±1.09^{c}	20.56±2.08^{a}	7.94±1.11^{c}	14.25±1.04^{a}	4.13±0.63^{b}
Diet 4	53.77±1.11^{c}	15.18±1.36^{b}	12.48±1.16^{a}	13.19±0.87^{b}	5.38±0.71^{a}
Diet 5	60.24±2.01^{b}	12.68±0.93^{c}	10.05±1.31^{b}	12.96±1.04^{b}	4.07±0.48^{b}
Diet 6	61.16±2.10^{ab}	14.62±1.51^{b}	8.17±0.82^{c}	12.67±0.76^{b}	3.38±0.67^{c}
P-value	$p < 0.05$	$p < 0.05$	$p < 0.05$	$p < 0.05$	$p < 0.05$

Means with different letters on the same column differ significantly ($p < 0.05$) (Tukey's multiple range tests).

Growth response and feed utilization in *C. gariepinus* juveniles fed sun-dried watermelon peel meal-based diets

Table 4 shows the growth and feed utilization indices which revealed significant variations ($p < 0.05$) among the fish groups exposed to the various diets. Acceptability of the diets progressively significantly ($p < 0.05$) diminished from the fish fed Diets 1 to 6 and was inversely proportional to the increase in the inclusion level of sun-dried watermelon peel meal. Mean weight gain (MWG) and specific growth rate (SGR) were highest (24.63 g and 3.53%/day) in the fish fed Diet 1 (Control), closely followed by those fed Diet 2 (23.99 g and 3.49%/day) and lowest (18.02 g and 3.05%/day) in the fish fed Diet 6 respectively. The MWG values are lower than 37.38 – 48.27 g reported by **[10]** on *C. gariepinus* fingerlings but surpass as well as reflect better growth compared to 9.10 – 23.97 g observed by **[11]** on *Oreochromis niloticus* juveniles fed melon seed peel meal-based diets. Also, the SGR values (3.05 – 3.53 %/day) surpass and reflect better growth compared to 1.4 – 1.56 %/day recorded for *C. gariepinus* fingerlings [**10]**. The reduced growth beyond 20% sun-dried watermelon peel meal inclusion probably resulted from reduced digestion and utilization of diets at higher levels which could be associated with residual anti-nutrients in the diets as reported by Adewolu **[14]**. Fakunle et al **[15]** stated that toxic components or anti-nutrients in most plant by-products may irritate the digestive tract and cause reduced feed intake and growth. Furthermore, Nwanna et al **[16]** stated that very high inclusion levels of unconventional carbohydrate sources have often resulted in poor fish growth.

Feed conversion ratio (FCR) values (0.91 – 1.16) recorded in this study indicate efficient feed utilization by the experimental fish and closely harmonize with 0.5 – 2.36 reported in the past related studies involving melon seed peel and watermelon peel meals **[17, 11, 10].** According to De Silva **[18]**, the ideal FCR values range between 1.2 and 1.8 for fish fed adequately prepared diets. The values of protein intake (PI)

progressively diminished from the fish fed Diets 1 to 6 while those fed Diets 1 – 3 had significantly ($p < 0.05$) higher values (9.00 – 9.34) than 6.94 – 8.34 in those fed Diets 4 – 6. The values of protein efficiency ratio (PER) (2.60 – 2.76) significantly ($p < 0.05$) differed and revealed an irregular trend. Percentage survival (PS) was high (70.0% - 85.5%) and varied significantly ($p < 0.05$) across the treatments. These survival values closely align with 82.22 – 100% earlier reported for *C. gariepinus* fingerlings and *O. niloticus* juveniles fed similar diets **[11, 10].** Such high level of survival indicates that feeding *C. gariepinus* juveniles with sun-dried watermelon peel meal did not cause serious fish mortality. Moreover, it signifies considerable acceptability of the experimental diets by fish which could be attributed to careful fish handling, proper feed processing, suitability and non-toxicity of sun-dried watermelon peel meal inclusion in *C. gariepinus* diet.

Table 5: Growth response and feed utilization indices of *C. gariepinus* juveniles fed sun-dried watermelon peel meal-based diets

Parameters	0% WMPM Diet 1 (control)	20% WMPM Diet 2	40% WMPM Diet 3	60% WMPM Diet 4	80% WMPM Diet 5	100% WMPM Diet 6	P-value
Mean initial weight (g)	3.97 ±0.21^{a}	3.95 ±0.32^{a}	3.96 ±0.14^{a}	3.97 ±0.24^{a}	3.98 ±0.41^{a}	3.99 ±0.37^{a}	$p < 0.05$
Mean final weight (g)	28.60 ±2.01^{a}	27.94 ±1.14^{a}	23.51 ±0.72^{c}	26.99 ±1.43^{b}	26.01 ±0.68^{b}	22.01 ±1.34^{d}	$p < 0.05$
Mean weight gain (g)	24.63 ±1.63^{a}	23.99 ±2.15^{a}	19.55 ±1.23^{c}	23.02 ±1.42^{ab}	22.03 ±2.47^{b}	18.02 ±0.84^{c}	$p < 0.05$
Percentage weight gain (%)	620.40 ±5.73^{a}	607.34 ±4.85^{b}	488.75 ±6.94^{d}	579.85 ±4.51^{c}	553.52 ±3.91^{c}	451.63 ±6.19^{e}	$p < 0.05$
Specific growth rate (%/day)	3.53 ±0.05^{a}	3.49 ±0.21^{a}	3.18 ±0.01^{c}	3.42 ±0.02^{b}	3.35 ±0.03^{b}	3.0 5±0.12^{c}	$p < 0.05$
Total feed intake (g)	460.00 ±5.65^{a}	460.00 ±3.75^{a}	452.60 ±4.35^{b}	420.00 ±3.75^{c}	402.60 ±4.65^{cd}	348.60 ±2.85^{d}	$p < 0.05$
Mean feed intake (g)	23.00 ±2.07^{a}	23.00 ±1.63^{a}	22.63 ±4.25^{a}	21.00 ±2.32^{b}	20.13 ±1.65^{b}	17.43 ±2.36^{c}	$p < 0.05$
Percentage survival rate (%)	70.00 ±2.00^{b}	85.00 ±1.34^{a}	85.00 ±2.17^{a}	70.00 ±2.50^{b}	75.00 ±1.67^{b}	85.50 ±2.50^{a}	$p < 0.05$
Feed conversion ratio	0.93 ±0.18^{b}	0.96 ±0.07^{b}	1.16 ±0.03^{a}	0.91 ±0.63^{b}	0.91 ±0.12^{b}	0.97 ±0.10^{b}	$p < 0.05$
Nitrogen metabolism	500.67 ±4.53^{a}	490.21 ±3.92^{a}	423.99 ±3.23^{c}	475.91 ±5.61^{ab}	462.38 ±4.54^{b}	399.67 ±5.07^{d}	$p < 0.05$
Protein efficiency ratio	2.64 ±0.14^{b}	2.64 ±0.14^{b}	2.17 ±0.23^{b}	2.76 ±0.01^{a}	2.73 ±0.03^{a}	2.60 ±0.12^{b}	$p < 0.05$
Protein intake	9.34 ±1.21^{a}	9.09 ±0.81^{a}	9.00 ±0.67^{a}	8.34 ±1.01^{b}	8.06 ±0.73^{b}	6.94 ±0.59^{c}	$p < 0.05$

Means with different letters on the same row differ significantly ($p < 0.05$) (Tukey's multiple range tests).
WMPM = watermelon peel meal

CONCLUSION AND APPLICATION

The results from this study showed that the juveniles fed Diet 1 (control diet without sun-dried watermelon peel meal) exhibited superior growth and feed utilization which were marginally followed by those fed Diet 2 (20% sun-dried watermelon peel meal inclusion). It was observed that further inclusion of sun-dried watermelon peel meal as a feed additive in *C. gariepinus* juveniles' diet above 20% caused progressively reducing growth and feed utilization. The study, therefore, revealed that higher inclusion levels of sun-dried watermelon peel meal reduced growth and feed utilization in *C. gariepinus.* Other processing methods

should be explored to increase the utilization of watermelon peel meal, reduce the cost of fish feed production and thereby maximize aquaculture profitability.

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Pasture and Range Management: PRM001

NUTRIENT COMPOSITION OF MANCHURIAN WILD RICE (*ZIZANIA LATIFOLIA*) HAY

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ABSTRACT

The study was carried out to assess the chemical composition of Manchurian wild rice (MWR) hay. It was conducted at the Animal Nutrition Laboratory, Department of Animal Production, Adamawa State University, Mubi. Fresh MWR were obtained from Hong Local Government Area of Adamawa State and shed-dried for five days, bagged and brought to the lab. The hay was oven dried and milled using laboratory hammer mill into powder form. Then it was packed in seal polythene bags for chemical analysis. The results showed that the hay contained 93.47% DM, organic matter 91.37%, crude protein content 8.13%, ether extract 1.96%, nitrogen free extract 44.26%, neutral detergent fibre 63.63%, and acid detergent fibre 36.22%. In conclusion, the nutrient constituent of MWR hay revealed that it contained adequate nutrients surface for it to serve as a roughage diet for ruminant animals.

Keywords: crude protein, dry matter, hay, Manchurian wild rice, nutrients.

DESCRIPTION OF PROBLEM

Manchurian wild rice (*Zizania latifolia*) is considered as a crop and has received little or no attention from researchers in recent times. It normally inhabits water banks, road side ponds, shallow rivers and streams, thereby causing water body shrinkage and this gradually led to drying up of same water (1). It has the ability of invading water bodies for its survival, which eventually dries up and contributes to the greenhouse effect (2). Eradication of Manchurian wild rice (MWR) is unlikely as its seeds and vegetative parts have been reported to survive in soil for at least 30 years (3) and it is resistant to herbicides (4). Similarly, due to the increase in demand in urban areas for cheap and nutritious animal feeds especially where people are not involved in its primary production, the demand for a grass like MWR will likely make an impact in the feed resource market because it is cheap and readily available especially in riverine areas and areas where there is high rainfall. When used as a roughage in animal diets, it might supply a cheap feed material vis-à-vis dealing with the issue of invading our water bodies or reducing the issue of shrinking rivers or lakes.

Even though less research has been done on the MWR itself in the area of animal nutrition, at the moment, there is paucity of data on the chemical composition of the grass. There is also limited research on MWR as animal feed in this region. Thus, the present study wants to analyse the chemical composition of MWR and its feasibility for use as animal feed for economic benefit of farmers.

MATERIALS AND METHODS

Study location: The study was conducted at the Animal Nutrition Laboratory, Department of Animal Production, Adamawa State University, Mubi. The region is a part of Nigeria's northern guinea savannah. At about 560 meters above sea level, Mubi has a tropical climate geo-located between Latitude 10°16.6'6.9" north of the equator and Longitude 13°16'1.2" east of Greenwich meridian (5).
Source and processing of MWR hay: The MWR hay was obtained from Kuva-Gaya village in Hong Local Government Area, Adamawa State. It was harvested fresh (at this stage, the moisture content is above 60% while the DM content is less than 40%) from the rivers and streams in the locality. The grass was then shade-

dried for five days. This is to remove the moisture and covert the MWR to hay. It converts the fresh grass from as-fed basis to DM basis. The grass now hay was bagged and brought to the study area. It was shredded using local roller milling machine to smaller particle size of about five to eight millimetre in length. It was then pulverised using laboratory hammer mill into powder. The powered MWR was oven dried to obtain the DM content. This second drying will remove the residual moisture in the MWR hay (usually above 90%). After oven drying, the sample was sealed in an airtight plastic bag awaiting the commencement of the analysis.

Proximate analysis and fibre component: the sealed sample of the MWR hay was subjected to proximate composition determination as described by AOAC (6). The cell wall constituent was determined using the methods of Van Soest *et al.* (7). The analysis was conducted in the Animal Nutrition Laboratory, Department of Animal Production, Adamawa State University, Mubi.

RESULTS AND DISCUSION

The chemical composition of MWR hay was shown in Table 1. The DM composition was 93.47%. The observed result was close to the findings of Umar *et al.* (8) who recorded a DM value of 91.34%. This is an indication that the MWR hay had available DM which translates into available nutrients for grazing animals when fed. The organic matter in MWR hay recorded was 91.37%. This finding was consistent with the report of Umar *et al*. (8) who published a lower value of 90.00% compared to the present results. This implies that MWR hay might have great impact to the development of animal well-being due to the presence of more organic nutrients (9). The crude protein in MWR hay was observed to be 8.13% which was lower than the findings of Williams and Ojo (10) who reported a crude protein value of 12.00%. But it was within the range (6–8%) attributed to commonly available annual or perennial grasses for grazing animals in Nigeria (11).

Table 1: Chemical composition of Manchurian wild rice hay

Parameters	Composition (%)
Dry matter	93.47
Organic matter	91.37
Crude protein	8.13
Ether extract	1.96
Nitrogen free extract	44.26
Neutral detergent fibre	63.63
Acid detergent fibre	36.22

The neutral detergent fibre (NDF) value was observed to be 63.63%. This shows that the grass has a high composition of hemicellulose that can digest rapidly when consumed (9). This is an indication that MWR hay can be fed to rabbits and ruminants, and have high fibre digestibility.
The acid detergent fibre (ADF) value was observed as 36.22%. This implies that the cellulose content of the grass is less thereby making it more digestible. The ADF value is used as a marker for slowly digestible fibre structure and the less the composition, the more the value of the grass been highly digestible (9).

CONCLUSION AND APPLICATION

Based on the present findings, MWR hay has high DM (93.47%) and organic matter (91.37%). Crude protein (8.13%) was within ranges in relation to crude protein values of grasses in Nigeria, while NDF (63.63%) was within acceptable value for high fibre digestibility. In conclusion, the values of nutrient contents observed for MWR hay in this study shows that it has an acceptable range that can be used for feeding ruminant and non-ruminant animals and consequently, its use is hereby recommended.

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Pasture and Range Management: PRM002

EFFECT OF DIFFERENT RATE OF POULTRY MANURE ON THE GROWTH AND YIELD OF COLUMBUS GRASS (*Sorghum almum*) IN DUTSE, JIGAWA STATE

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ABSTRACT

The study was conducted to determine the effects of different rate of poultry manure on the growth and yield of Sorghum almum. The experiment was conducted at Teaching and Research Farm, Faculty of Agriculture, Federal University Dutse, Jigawa State, Nigeria. Located between latitude 11.00^{oN} to 13.00^{oN} and longitude 8.00^{oE} to 10.15^{oE} The experiment was laid out in a Completely Randomized Design (CRD) with three replications and four different levels of poultry manure as (0.25 kg/m^2, 0.5 kg/m^2, 1.0 kg/m^2 and 1.5 kg/m^2) and control. Data collected on growth parameters including number of tillers, plant height, number of leaves, and leaf length. Proximate analysis was carried out to determine; dry mater, crude protein crude fiber ether extract and ash. The results indicated that poultry manure significantly affect growth of S. almum ($P < 0.05$). However, S. almum that received treatment T3 (1.0 kg/m^2) of poultry manure produced significantly ($P < 0.05$) higher biomass compared to other treatments. In terms of proximate composition, S. almum did well with the poultry manure rate of 1.0 kg/m^2 (equivalent to 10 t/ha) and 0.5 kg/m^2 (equivalent to 5.0 t/ha) as shown by T3 and T2 respectively. It was concluded that, Columbus grass (Sorghum almum) in T3 produced sufficient biomass (plant height, number of tillers number of leaves and leaf length) with the poultry manure rate of 1.0 kg/m^2 bed (equivalent to 10 t/ha) as shown T3.

Keywords: Sorghum almum, Plant height, Poultry, Manure and Growth

DESCRIPTION OF PROBLEMS

Animals experience deficit or drop in the quantity and quality of feeds as a result of dry season in the torrid zone of tropics, in order to reduce these problems, development of grass or legumes with high grass fodder production should be encourage especially in the developing countries, like Nigeria whereby there is little or no effort in production of fodder grasses particularly the study area Jigawa state. In order to solve the shortage of feed and increase livestock productivity, it is necessary to introduce and cultivate high-quality forages with high yielding ability and adaptability to the biotic and abiotic environmental stresses (6). Columbus grass is a fast-growing and high-yielding species that will weaken within 3 years. It is usually grown in pure stands but also thrives when mixed with other grasses such as *Megathyrsus maximus*,*Cenchrus ciliaris*or *Chloris gayana* in Australia. It makes a good quality, though coarse, hay and silage, provided it is cut at mature stage and the weather is not too wet (2)

MATERIAL AND METHOD

Experimental area: The experiment was conducted at Teaching and Research Farm, Faculty of Agriculture, Federal University Dutse, Jigawa state, Nigeria. Located between latitude 11.00^{oN} to 13.00^{oN}and longitudes 8.00^{oE} to 10.15^{oE} high temperatures are normally recorded between the month of April and September the daily minimum and maximum temperature are 15^{o}c and 35^{o}c. Rain season last from May to September with average rainfall of between 600mm to 1000mm (3).

Experimental Materials: The experimental materials includes: Seed of Columbus grass, Poultry manure, weighting scale, hoe, tape and watering can. Seed of Columbus grass (*Sorghum almum*) was purchased at National Animal Production Research Institute (NAPRI) Zaria

Experimental layout: The site was cleared manually, debris and all other unwanted materials was removed, and the field was prepared by ploughing and harrowing to provide a clean seed bed and to enhance early seed germination. The total experimental field was 8m by 8m which was divided in to 15 plots each plot was 1m by 1m.

Experimental design: The experiment consist of poultry manure as a factor with four different levels (0.25 kg/m^2, 0.5 kg/m^2, 1.0 kg/ m^2 and 1.5 kg/ m^2) and control (no application), treatments was applied to each of the experimental plot a week before planting. The experiment was laid in a Completely Randomized Design (CRD) with three replications. The treatments are shown below;

T_1 0.25 kg/m^2 bed (equivalent to 2.5 t/ha) T_2 0.5 kg/m^2 bed (equivalent to 5.0 t/ha)
T_3 1.0 kg/m^2 bed (equivalent to 10 t/ha) T_4 1.5 kg/m^2 bed (equivalent to 15 t/ha)
T5 control (no application).

CULTURAL PRACTICE

Land Preparation: Land was cleared and tilled using simple tools like hoe and cutlass. The site was manually cleared and all debris were parked after which fifteen (15) beds of dimensions 1m by 1m was made with 0.5m between the beds as guard and 1m between the replication as a path way.

Sowing: The Columbus grass (*Sorghum almum*) seeds was sown by direct seeding in line which consisted of plant spacing's (intra and inter spacing's) was 20 cm by 20 cm.

Irrigation: Irrigation was done to maintain the field in moist soil condition but not flooded condition. Supplemental irrigation was done during the hot weather.

Weeding management: Weed control was done through manual method; hoe weeding and hand weeding was practiced. The expected weeds were: *Cassia tora, Amaranthus spinosus* and *Cynodon dactylon*.

Data collection: Four plants were selected randomly in each treatment plot for data collections at 5th and 9th week. The data that was collected was: plant heights, number of tillers per plants, number of leaves per plant, length of leaves per plant, and were measured as follows;

Plant height: The height is the length of the plant from base to the tip of the plant, four plants was randomly selected and measured from the base of the plant to the tip of the tallest leaf, the height of each plant was recorded in centimeters, and the mean values of four randomly selected plants for each plot was determined.

Number of tillers per plant: The number tillers per plant of four randomly selected plants was counted from each plot to calculate the mean of tillers number per plant.

Number of leaves per plant: The number of leaves per plant was counted from the sample of four randomly selected plants from the plot and the mean value of number of leaves per plant was determined.

Length of leaf per plant: The length of leaf per plant of the four randomly selected plants was measured from the node of the stem to the tip of the leaf.

Statistical analysis: Data were analysed using the General Linear Model procedures of the Systems Analytical Statistics package (8), package and differences between means were separated using Fisher's Least Significant (FLS) at ($P<0.05$).

RESULTS AND DISCUSSION

The result presented in table 1 show the values of the parameters recorded at week 5. There was a significant difference across all the treatments. Plant height, number of leaves, leaf length, and number of tillers were all higher inT3, but, T5 (control) had the lowest value in plant height, number of tillers and leaf length, whereas T4 lowest value in term of number of leaves. This may be due to variable rate of poultry manure applied while poultry manure was not applied in T5 (control).

Plant height: A significant difference was observed in the effect of different rate of poultry manure on the plant growth of Columbus grass in the plant height in the 5weeks after planting. The greatest mean plant

height was T3 which was 62.33cm, while the least value was T5 which was 47.67cm during the period of the study. An increase in plant height was observed over the period. This agreed with the result of (1) who reported a significant increase in plant height of pepper with difference level of poultry manure. (4) who reported a significant effect on plant height with effects of fertilizers and rates of application on growth and yields of Rhodes grass (*Chloris gayana*).

Number of tillers: There were notable differences in the effect of different rate of poultry manure on the number of tillers generated by the Columbus grass in the 5weeks after planting. The highest mean number of tiller growth was recorded from treatment T4 which was 4.33, while the least was 3.00 which was obtained from treatments T2 and T5. These findings agree with that of (5) who observed that tiller number of guinea grass (*P. maximum)* were generally increased with incremental application of nitrogen fertilizer.

Number of leaves: A significant difference was observed in the effect of different rate of poultry manure on the plant growth of Columbus grass in the number of leaves generated in the 5weeks after planting. The highest mean number of leaves was recorded in T3 which was 5.33, while the least value was in T4 which was 3.67 during the period of the study. An increase in the number of leaves was observed over the period. This result confirmed what was reported by (7) that reported a significance difference in the increase in the number of leaves in the Effect of row spacing and level of fertilizer on performance of Columbus grass (*Sorghum almun* Parodi)

Leaf length: There were notable differences in the effect of different rate of poultry manure on the plant growth in term of leaf length after 5weeks of planting. The highest mean leaf length was observed in T3 which was recorded as 33.33cm, while the least value was in T5 (control) which was 28.67cm during the period of the study. An increase in the leaf length was observed over the period of the research which shows a significant difference. This result is in contrary with the research by (7) which reported that there was no significant difference in the increase in the number of leaves when the Effect of row spacing and level of fertilizer on performance of Columbus grass (*Sorghum almun* Parodi) were assessed.

Table 1. Effect of different rate of poultry manure on the growth of irrigated Columbus Grass (*Sorghum almum)*

Treatment	Plant Height (cm)	Number of Tillers	Number of Leaves	Leaf Length (cm)
T1	57.67^{c}	3.33^{bc}	5.00^{a}	30.00^{cd}
T2	60.33^{ab}	3.00^{c}	4.67^{ab}	30.67^{bc}
T3	62.33^{a}	3.67^{b}	5.33^{a}	33.33^{a}
T4	59.67^{bc}	4.33^{a}	3.67^{c}	32.33^{ab}
T5	47.67^{d}	3.00^{c}	4.00^{bc}	28.67^{d}

$^{a, b, c, d}$ Means with different superscripts along columns differ significantly at ($P < 0.05$).

Table 2. Effect of different rate of poultry manure on the growth of irrigated Columbus Grass (*Sorghum almum)* at Dutse in 9 weeks

Treatment	Plant Height (cm)	Number of Tillers	Number of Leaves	Leaf Length (cm)
T1	81.30^{d}	6.33^{b}	7.00^{ab}	39.67^{c}
T2	84.50^{c}	6.67^{b}	7.33^{ab}	41.33^{b}
T3	92.83^{a}	8.00^{a}	8.33^{a}	44.00^{a}
T4	89.70^{b}	7.33^{ab}	6.67^{b}	41.67^{b}
T5	59.30^{e}	6.33^{ab}	6.67^{b}	38.33^{d}

t. $^{a, b, c, d}$ Means with different superscripts along columns differ significantly at ($P < 0.05$).

The result presented in Table 2 showed the values of the parameters recorded at week 9. There was a significant difference across all the parameters. Plant height, number of tillers, number of leaves and leaf length are all higher in treatment T3, while the least value was T5 (control) in terms of plant height and leaf length; this could be because there was no any poultry manure applied. But in terms of number of tillers T1

and T5 was the least value and in terms of number of leaves T4 and T5 was the lowest value and this could be due to the low rate of poultry manure applied in T1, high rate of poultry manure applied in T4 and no poultry manure applied in T5 (control).

Plant height: A significant difference was observed in the effect of different rate of poultry manure on the plant growth of Columbus grass in plant height in the 9 weeks after planting. The highest mean plant height was T3 which was 92.83cm, while the least value was T5 which was 59.30cm during the period of the study. An increase in plant height was observed over the period. This agreed with the result of Ogedegbe *et al*,. (4) who reported a significant effect on plant height with effects of fertilizers and rates of application on growth and yields of Rhodes grass (*Chloris gayana*).

Number of tillers: A significant difference in the effect of different rate of poultry manure on the number of tillers generated by the Columbus grass in the 9 weeks after planting was observed. The highest mean number of tiller growth was recorded from treatment T3 which was 8.00, while the least was 6.33 which was observed in treatment T1 and T5 These findings is in line with that of (5) who observed that tiller number of guinea grass (*P. maximum)* were generally increased with incremental application of nitrogen fertilizer.

Number of leaves: A significant difference was observed in the effect of different rate of poultry manure on the plant growth of Columbus grass in the number of leaves generated in the 9 weeks after planting. The highest mean number of leaves was recorded at T3 which was 8.33, while the least value was recorded on T4 and T5 which was 6.67 during the period of the study. A significant increase in the number of leaves was observed over the period. This result confirmed what was reported by (7) who reported a significance difference in the increase in the number of leaves in the Effect of row spacing and level of fertilizer on performance of Columbus grass (*Sorghum almun* Parodi).

Leaf length: There were Significant differences in the effect of different rate of poultry manure on the plant growth in term of leaf length in the 9 weeks after planting. The highest mean leaf length was T3 which was 44.00cm, with least value at T5 (control) which was 38.33cm during the period of the study. This result is contrary to the research by (7) which reported that there was no significance difference in the increase in the number of leaves in the Effect of row spacing and level of fertilizer on performance of Columbus grass (*Sorghum almun* Parodi).

CONCLUSION

Based on the results obtained from the experiment, it can be concluded that Columbus grass (*Sorghum almum*) produced sufficient biomass (plant height, number of tillers number of leaves and leaf length) with the poultry manure rate of 1.0 kg/m^2 bed (equivalent to 10 t/ha).

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Pasture and Range Management: PRM003

GROWTH MEDIA EFFECTS ON YIELD OF MAIZE FODDER UNDER LOW-COST GREENHOUSE HYDROPONICS IN WEST COAST REGION OF THE GAMBIA

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ABSTRACT

There is an urgent need to increase protein intake among people in the Sub-Saharan Africa which include meat as well as milk production and especially in the Gambia, Ruminant animals such as Cattle, Sheep and Goats remained the most valued animals in this line, and to feed these animals effectively required quality fodder production which prompted this type of study. A study on Growth Media Effects on Yield of Maize Fodder under Low-Cost Greenhouse Hydroponics in West Coast Region of the Gambia in a 3-cycles from July to September, 2023. Three (3) treatments of nutrient solutions: T_1 = control (tap water), T_2 = 10% diluted cow manure and T_3 = 10% diluted chicken manure, with 4 replicates each in a randomized complete block design (RBCD) was used. Proximate and mineral analyses of the cow and poultry manure was determined. The data were analyzed using analysis of variance (one-way ANOVA). The experiment was conducted in three cycles of three harvest ages. Each cycle was terminated after 12 days from seeding. The parameters determined (weight, water use, nutrient use and their efficiency) were carried out at the days 4, 8 and 12, respectively. At the 4th day, there was no significant difference among the treatments for the weight, water use and nutrient use efficiency. However, at day 8th, in cycle one, poultry manure (PM) showed higher significant value of 5.92 cm as well as 4.91 kg in yield of maize fodder produced. At day 12th, cycle two, poultry manure (PM) also recorded significant higher values of 11.09 cm and 4.96 kg of height and weight respectively. Water and nutrient use (WNU) were significantly higher on poultry manure (PM) with 2.02 m^3/tray, while tap water (TW) has the lowest value of 1.52 m^3/tray at day 8th. At 12th day. The poultry manure recorded high yield in height and in plant weight.

Keywords: maize fodder, poultry manure, cow manure, hydroponics

INTRODUCTION

Green fodder is an essential component of livestock production, productivity and reproductive performance. Therefore, for sustainable dairy farming, quality green fodder should be fed regularly to the dairy animal [1]. Conventional method of fodder production is facing many constraints like scarcity of land, water, good quality seeds, higher labour cost, and more investment on fertilizers and longer growth period etc. [2] reported that 1.5-2 litres of water is necessary for germination of 1 kg grain in hydroponic system as against 73 litres of water consumption for 1 kg green fodder under conventional barley production. Hydroponics is now emerging as an alternative technology to grow fodder for farm animals [3 and 4]. Hydroponic is a method of growing plants without soil. It is a well-known technique for high fodder yield, year-round production and least water consumption. This technology may be especially important in the regions where forage production is limited [5]. Development of this planting system has enabled the production of fresh forage round the year from oats, barley, wheat and other grains [6]. Hydroponics is produced in greenhouses under controlled environment within a short period [7]. Therefore, the aim of this research was to grow hydroponic fodder using different locally available and most suitable cereal maize under low cost screen house production system and to produce green fodder

to feed some ruminant animals in The Gambia.

MATERIALS AND METHODS

Study Site

The study was carried out at the teaching and research center, my farm Gambia status, Nemakunku located one off the road on the Kombo coastal, Main highway, Kombo Central West Coast Region Brikama.

Treatments and Experimental Design

Three (3) treatments of nutrient solutions/growth media: T_1 = Tap water (control), T_2 = 10% Diluted cow manure, T_3 = 10% Diluted poultry manure, Completely Randomized Design (CRD) because it was a greenhouse experiments without little or no environmental variation. with 4 replications.

Preparation of Manure Solution, planting of maize seed, total water use and water use efficiency

To make the liquid manure, the poultry and cow manures were put in separate sacks made from porous cloths that will act as a strainer to separate the solid from the liquid. Immersed in 20 Liter capacity drum filled with water (The quantity of the manure fill 1/3 of the 50 kg plastic size, the manure is allowed to remain in the water for a period of 7 days to ferment and allow nutrients to dissolve. The mixture of water and the manure, diluted ten times and to look the color of weak. Maize seeds were soaked in water for 60 hrs to break the seed dormancy, after which each half cut 5 litter gallons was used to plant.. Holes were drilled in the half-cut 5 litter gallons to drain excess water. Soon after germination, seeds were spread in plastic trays. The total quantity of water added and drained out of trays throughout the experimental period were recorded per tray daily. The representative green fodder sub-sample (300 g) taken from each tray was separated into the dead/yellow (if any) and green fodder. Each unit was weighed, recorded, and packaged separately in labeled appropriate envelopes. The summation of the two sub-units amounted to the total biomass yield per tray/treatment (Dung et al, 2010).

Statistical Analysis

Data were statistically analyzed using analysis of variance (ANOVA) according to the statistical package MSTAT-C. Least Significant Difference ($p \leq 0.05$) was used to compare means among treatments.

RESULTS AND DISCUSSION

Paired t test value of the proximate analysis of cattle manure and poultry manure

The result of the characterization of dry cattle manure and chicken manure used for the experiment. The organic matter in cow manure was significantly higher than the poultry manure with values of 82.5% and 70.0%, respectively. The potassium (K) content of the two organic manures showed no significant difference. The phosphorous (P) values in poultry and cattle manure showed no significance difference. This findings was in agreement with the reports of Adeoye *et al*. [1]. Cow manure (CM) had a pH of 7.4 while poultry manure (PM) revealed a pH of 7.5, which shows that more of the nutrients from the cow and poultry manure would be soluble and readily available if used for maize fodder in hydroponics. This agrees with the findings of Olojugba and Chinedu [11] that minerals such as Nitrogen (N), Phosphorus (P), Potassium (K), Sulphur (S), Calcium (Ca) and Magnesium (Mg) are readily available to plants at pH ranges of 6.5 to 7.5.

Plant height measured in cm

At day 12th, cycle two, poultry manure (PM) also recorded significant higher values of 11.09 cm and 4.96 kg of height

TABLE: 1. Plant height measured in cm

TRT	1st Cycle			2nd Cycle			3rd Cycle		
	Day 4	Day 8	Day 12	Day 4	Day 8	Day 12	Day 4	Day 8	Day 12
TW	0.46^{b}	2.71^{c}	5.54^{c}	0.56^{b}	2.73^{c}	6.00^{c}	0.50^{b}	2.74^{c}	6.10^{c}
CM	0.64^{b}	3.85^{b}	7.54^{b}	0.65^{b}	3.90^{b}	7.57^{b}	0.65^{b}	3.90^{b}	7.55^{b}
PM	1.00^{a}	5.92^{a}	11.09^{a}	1.10^{a}	6.00^{a}	11.23^{a}	1.20^{a}	5.90^{a}	11.12^{a}

Means on the same column followed by the same letter are not significantly different at $P < 0.05$.
TRT= Treatment, TW = Tap Water, CM = Cow Manure and PW = Poultry Manure

Yields of hydroponic maize fodder

Table 2 shows the yield of maize fodder from the three growth/nutrient media (Tap water= TW, Cow manure= CM and Poultry manure = PW) at the 4th, 8th and 12th days of harvests. There was significant differences ($p<0.05$) in the yield of maize fodder across the different sources of nutrient media used in this study. At 4th day, poultry manure (PM) was significantly higher than both cow manure and tap water while there was no significance between tap water manure and cow manure with the value ranges from 3.82 kg, 3.9 kg and 4.23 kg for Tap water, cow manure and poultry manure, respectively. Amongst the organic fertilizers, poultry manure is highly preferred due to its high organic matter content, concentration of plant macro and micronutrients in available from easy to uptake by the plant as well as its availability. Chicken manure if applied with sufficient quantity could be covered the plant nutrient requirements {Dung *et al.,* [4], Olojugba and Chinedu, [11].

Table 2: Yield (kg/tray) of maize fodder

TRT	Cycle of fodder harvest								
	1st cycle (days)			2nd cycle (days)			3rd cycle (days)		
	4	8	12	4	8	12	4	8	12
TW	3.82^{b}	4.02^{c}	4.11^{b}	3.86^{b}	4.05^{c}	4.22^{b}	3.85^{b}	4.06^{b}	4.12^{b}
CM	3.90^{b}	4.43^{b}	4.57^{a}	3.94^{b}	4.47^{b}	4.48^{a}	3.91^{b}	4.44^{a}	4.25^{a}
PM	4.23^{a}	4.93^{a}	4.96^{a}	4.97^{a}	4.91^{a}	4.98^{a}	3.93^{a}	4.80^{a}	4.99^{a}

^{abc}= Means on the same column followed by the same letter are not significantly different ($p<0.05$). TRT= Treatment, TW = Tap Water, CM = Cow Manure and PW = Poultry Manure

Water and Nutrient Solution Use Efficiency (Kg/M^{3})

Water and nutrient use efficiency (WNUE) shows no significance difference among the nutrient/growth media. However, the water and nutrient use efficiency increased as days in the cycle increased due to higher yield and higher water and nutrient use. At the 8th day, the values of WNUE were 2.44, 2.56 and 2.65 for PM, CM and PM, respectively. At the 12th day, the WNUE was significantly different across the treatments, with a higher values recorded in TW (7.90) and lower for PM (3.43). The efficient use of water and manure solutions from the cow and poultry at the day 8th and 12th days as observed in the yield of maize fodder (Tables 1, 2 and 3) showed that the solution contained manure enhanced higher and yield of maize fodder as supported by Naik *et al*., [7], they submitted that The comparative evaluation of hydroponic maize produced by using tap water or nutrient solution revealed that sprouts grown with nutrient solution had higher crude protein and ash contents than those grown with tap water.

Table 3: Water and Apparent Nutrient Solution Use Efficiency Kg/M^3

TRT	1st Cycle			2nd Cycle			3rd Cycle		
	Day 4	Day 8	Day 12	Day 4	Day 8	Day 12	Day 4	Day 8	Day 12
TW	1.39^a	2.65^a	7.90^a	1.47^a	2.31^a	6.81^a	1.42^a	2.86^a	5.02^a
CM	1.39^a	2.56^a	4.57^b	1.45^a	2.21^a	3.83^b	1.39^a	2.38^b	2.94^b
PM	1.38^a	2.44^b	3.43^c	1.38^b	2.11^a	3.02^c	1.37^a	2.39^b	3.02^c

Means on the same column followed by the same letter are not significantly different at $P < 0.05$. TRT= Treatment, TW = Tap Water, CM = Cow Manure and PW = Poultry Manure

CONCLUSION AND APPLICATION

Hydroponic fodder production uses solution (water or nutrient solution). It was observed that the yield of maize fodder increased with the use of poultry and cow manure solution, respectively, than tap water. Relatively, poultry nutrient solution uses less water to produce fodder and the length of the maize fodder also increased with the used of poultry nutrient solution. Use of cow manure increased the yield of maize fodder than the use of tap water.

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Pasture and Range Management: PRM004

EFFECT OF POULTRY MANURE ON FORAGE YIELD AND NUTRIENT UPTAKE OF *Megathyrsus maximum*

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ABSTRACT

The present study sort to evaluate the effect of poultry manure at varying levels on yield and nutrient uptake in grasses. The trial was laid down in a completely randomized design (CRD), and the treatment were poultry manure applied at varying levels (0, 15, 30 and 45-ton ha^{-1}), which was replicated three times. Plot size was 3x3m making a total of 12 plots. At 4 and 6 weeks, plants where harvested for relevant assessments. Result revealed that poultry manure had a significant ($P<0.05$) influence on morphological characteristics, dry matter yield and nutrient composition of guinea grass, with the highest application rate of 45-ton ha^{-1} producing the highest yield within a short time frame. The study recommends application rate of 30t/ha for optimum yield and cost efficiency.

Keywords: Age, Forage Quality, Forage Yield, Guinea Grass, Poultry Manure.

DESCRIPTION OF PROBLEM

Nutrient exhaustion has been traced to be caused by a decline in soil organic matter in most cases [1]. However, recent studies have suggested the use of organic manure for soil improvement irrespective the deficit [2, 3]. *Megathyrsus maximum* formally known as *Panicum maximum* and commonly known as guinea grass exist as a large bunch grass that is native to Africa. The specie has been observed to be abundantly available within the southern part of Nigeria, and as such it exists as a native weed that suppresses the growth of other natural species. In order to get a large quantity of *Megathysus maximum* to be used in feeding animals, the plant has to advance in age, and given this sequence, it will also affect the quality of the forage material [4]. Although according to [5], studies on the nutritive value of forages has been focused on acceptability and digestibility since the 1960s, and factors limiting nutritive value of forage especially grasses were highlighted to be high cell wall content which result to low digestibility and resistance to passage from the rumen, which in turn reduces voluntary intake. Similarly, high protein breakdown in the rumen results in low protein absorption, causing a high protein-energy ratio of the feed, resulting in reduced nitrogen use efficiency and increased nitrogen emission, causing environmental damage [6, 7, and 8]. The study aimed at assessing the impact of poultry manure application and age on performance and quality of guinea grass.

MATERIALS AND METHODS

The study was conducted at the Animal Science Teaching and Research farm behind works Department, off Emeka off road in Nnamdi Azikiwe University, Awka, Anambra Nigeria. The area is located on longitude 7008131.911E and latitude 6015110.111N (Chike, 2015). The experiment was laid down in a completely randomized design (CRD). Treatment combinations were, applied to guinea grass with varying level of poultry manure at 0, 15, 30 and 45-ton ha- ¹ respectively making 4 treatments and 3 replicates with a total of 12 plots. Land was ploughed and harrowed once before planting. Each plot was (3x3) meters in size with a walking space of 0.5m between plots. Both Poultry manure and planting materials (tillers) were sourced

from the faculty poultry farm and fodder bank respectively. Planting was done by vegetative propagation, two weeks after broadcasting poultry manure based on varying levels, and materials planted at a distance of 0.5×0.5m. At four and six weeks after planting, morphological characteristics such as plant height, no. of tillers and number of leaves where recorded afterwards, materials were cut for dry matter assessment and proximate analysis at 6 weeks after planting.

The data collected were subjected to analysis of variance, using General Linear Model of [S. A. S, 2005] and treatment means were separated using Duncan multiple range test [Duncan,1955].

RESULT AND DISCUSSION

From the study, it was observed that poultry manure had a significant influence on morphological characteristic. Table 1 revealed that plant height, number of tillers and number of leaves were significantly different across board at 4WAS although we saw these increase to be at par for all plots where poultry manure were applied save for number of tillers which was relatively at par at 15t/ha application with zero manure application (0t/ha). Similarly, as the plant advanced in age, at 6WAS, only plant height was significantly influenced with result revealing that manure rates at 15, 30 and 45t/ha were also at par but differ significantly with non manured plot.

Refer to the figures in the below table, the influence in morphological characteristics could invariable be tied to the impact of poultry manure on the plant which has improved plant growth metrics. And although following recent studies by [3, 10], stating that organic manure had no significant influence on morphological characteristics of signal grass, the disparity could probably be tied to the grass specie. More so, the effect observed could be as a result of the decomposing of poultry manure, given application was done two weeks before planting was done. The result also disagrees with [10] who stated that six weeks is a short time to assess the impact of organic manure on morphological performance of grass. While findings could be valid, it will be best to keep an open mind as the below result states the opposite despite propagated vegetatively. The result was in agreement with the report of [9] that cattle manure significantly improved guinea grass performance following the numerical variation.

Table 1: Effect of varying levels of poultry manure on morphological characteristics of guinea grass

Poultry Manure (t/ha)	Plant Height (cm)		No. of Tillers		No. of Leaves	
	4WAS	6WAS	4WAS	6WAS	4WAS	6WAS
0	49.8^{b}	83.88^{b}	2.65^{b}	10.68	4.89^{b}	23.09
15	72.65^{a}	183.25^{a}	6.238^{b}	12.8	24.85^{a}	39.39
30	113.53^{a}	219.12^{a}	13.73^{a}	16.17	24.85^{a}	39.54
45	115.38^{a}	220.76^{a}	10.38^{a}	12.07	12.07^{a}	31.73
SEM	30.54	33.04	2.7	2.9	9.93	11.23
P-value	0.237	0.245	0.313	0.421	0.422	0.542
LOS	*	*	*	*	*	*

abc Means with different superscripts along the column differed significantly (P<0.05), WAS = Week After Sowing SEM = Standard error of means. LOS= Level of significance

Table 2 shows the effect of varying levels of poultry manure application on dry matter yield. Dry matter yield was significantly ($p<0.05$) influenced by poultry manure with 45t/ha recording the highest and 0t/ha recording the lowest with 6.02 and 1.1ton ha^{-1} yield respectively at 4weeks after sowing. Also, a similar trend was observed at 6weeks after planting with 45t/ha manure application significantly ($p<0.05$) influenced with time compared to 0t/ha recording the least at 1.65 tons yield ha^{-1}.

Following the above trend, the progressive increase in dry matter yield observed with time, could be tied to the influence of poultry manure, given the increase in yield directly associating with higher application rates. Furthermore, given this study support that there was an increase in morphological characteristics which was influenced by poultry manure application, it also correlates. This result was in agreement with (3,9) which in a study with cattle manure stated that organic manure increase grass yield. However, the result shows that at 4WAS plot with application rate of 15t/ha was similar to the zero applied field (0t/ha) but at 6WAS, it was a different narrative, this could be due to the rate of application, as 15t/ha could be a relatively small amount to influence yield thereby requiring time to release more nutrient for plant utilization.

Table 2: Effect of varying levels of poultry manure on dry matter yield of guinea grass

Poultry Manure	Dry Matter Yield t/ha	
	4WAS	6WAS
0tha/ha	1.10^{c}	1.65^{c}
15t/ha	1.65^{c}	6.05^{b}
30t/ha	3.30^{b}	6.05^{b}
45t/ha	6.05^{a}	11.00^{a}
SEM	0.62	1.28
P. Value	0.08	0.12

abc Means with different superscripts along the column differed significantly (P<0.05), WAS = Week After Sowing SEM = Standard error of means. LOS= Level of significance

Table 3 the result shows the proximate composition of guinea grass in response to varying level of poultry manure application. Variables like Nitrogen and ash were not significantly influenced by the poultry manure across all levels however, we saw that poultry manure application had a significant influence on crude protein of guinea grass with the highest rates 45 and 30 t/ha similarly recording higher crude protein at (22.68% and 21.06%) compare the unfertilized (0t/ha) field which recorded 15.81% respectively. Similarly, crude fiber was significantly lower in field with highest application rates (45 and 30t/ha) compared to the unfertilized (0t/ha) field and the field with 15t/ha application.

Nitrogen and Ash were not significantly influenced by poultry manure at six weeks' harvest probably due to the short time frame of production. Although a substantial increment of crude protein observed could be tied to the influence of manure which influenced the release of nitrogen into the soil which resulted to the significant difference. This result agrees with the study of [10] which clearly states that poultry manure improves crude protein in grasses.

Table 3: Effect of varying levels of poultry manure on proximate composition of guinea grass

Poultry Manure	NUTRIENT UPTAKE			
	Nitrogen	CRUDE PROTEIN	CRUDE FIBRE	ASH
0t/ha	2.53	15.81^{b}	40.36^{a}	10.62
15t/ha	2.57	16.06^{b}	40.16^{a}	10.20
30t/ha	3.37	21.06^{a}	38.32^{b}	10.27
45t/ha	3.31	22.68^{a}	37.28^{b}	10.71
SEM	0.26	1.63	0.38	0.35
P. Value	0.15	0.91	0.86	0.89

abc Means with different superscripts along the column differed significantly (P<0.05), SEM = Standard error of means. LOS= Level of significance

CONCLUSION

The study concludes that, poultry manure had significant influence on both morphological characteristics, dry matter yield and proximate composition of guinea grass at 6WAS harvest period across board. However, following the similarities in result and cost efficiency, it is recommended to use poultry manure at 30t/ha to ensure optimum yield and save cost.

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Pasture and Range Management: PRM005

CLASSIFICATION AND NUTRITIONAL EVALUATION OF DOMINANT HERBACEOUS FORAGES IN RANGELAND OF FEDERAL UNIVERSITY DUTSE

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ABSTRACT

The research was conducted to classify and evaluate the nutritional value of dominant forage species in Federal University Dutse (FUD) rangeland area. The total rangeland area was divided into four quarters, where one hectare of land was randomly sampled from each quarter. Each hectare was considered as a sample plot while a sample point of 4 m × 4 m (16 m^2) within each hectare was marked and replicated 4 times, given 16 sample points. Quadrant method was employed to sample the herbaceous forages. A total of eleven different forage species belonging to five different families were identified, namely; Poaceae, Fabaceae, Rubiaceae, Orobanchaceae, Asteraceae. The forages were identified and classified based on their scientific, English and local names, forage type and family. Five forages namely; *Pennisetum pedicillatum, Digitaria sanguinalis, Striga hermonthica, Setaria pumila, Spermacoce ocymoides* were considered dominant and nutritional compositions were determined through proximate analysis. The result showed that all the proximate compositions were significantly different ($p<0.05$). *Seteria pumila* had the highest CP (8.80%), EE (15%) and ASH (14%), *Striga hermonthica* has high DM (95.60%) and NFE (66.58%), and *Spermacoce ocymoides* has high CF (47.5%). It can be concluded that, these forage plants at the FUD rangeland can meet the nutritional requirements of ruminant livestock.

Keywords: Classification, Evaluation, Forages, Nutritive value, Rangeland

INTRODUCTION

Rangelands are the largest and most diverse land sources of forage for livestock compared to other fodder crop lands which are costly (Ismail *et al*., 2014). Rangelands takes approximately 54% of the global terrestrial surface and support more than 200 million households and 50% of the world's livestock (ILRI, 2021). Oliver (2017) reported that, rangeland sustain 35% of global biodiversity hotspots, and also, offer a home for 28% of all endangered species.

The population of livestock continuously increase, with this there is threat to their production due to feed scarcity, and there needs to be adequate feed for their production, where there is inadequate livestock grazing area and reduction of palatable plant species. In northern Nigeria, crop farmers have been involved in alteration of rangeland area for crop cultivation, leaving few areas for livestock grazing, while the grazing area are poorly managed. However, livestock lack good availability of grazing area during wet and dry seasons, thus pastoralist migrating along with their animals from one place to another searching for grazing land end up entering cropping land which in return causes crisis between the crop farmers and pastoralist (Aduma *et. al.,* 2018).

The natural feed sources for livestock are declining due to the conversion of grazing lands into cultivated lands and increased grazing intensity (Tadesse and Solomon, 2014). However, inadequate feed supply, reduction in available grazing area, poor condition of the grasslands that might contribute to the low nutritional content of the native forage, and shortage of feeds and forages especially in the dry season were among the major constraints hindering livestock production (Habtamu *et al.,* 2013).

Natural grazing lands, dominated by herbaceous plant species, are major sources of feed for grazing animals (Melak *et al.,* 2019). However, improper rangeland monitoring, assessment and management may also result in severe deterioration in the nutritive values of herbaceous plants, reduced biodiversity, and gradual replacement of local grasses by undesirable species (Haftay, 2017).

Monitoring and specie richness in rangeland plants is considered as an appropriate medium for evaluating the current management status and therefore, it can be used to plan against the desired ecosystems (Haftay, 2017). Also, Information on rangelands can be used for the management and rehabilitation of degraded rangelands (Muhammad *et al.,* 2024).

MATERIALS AND METHODS

The Study was conducted in Federal University Dutse (FUD) Rangeland, Dutse, Jigawa State. Which is located close to the FUD teaching and research farm. The mean annual rainfall is about 615mm per annum and it also has minimum and maximum temperature of about 26.0°C and 39.0°C. The total case study of the rangeland area covers 10.7 hectares (latitude 11° 42'31.87188N and longitude 9°2321.462E) and the average altitude is 431.90 above sea level (GPS, 2023).

Identification and classification of forage plant composition
The total rangeland area (10.7 hectares) was divided into four quarters, where one hectare of land was randomly sampled from each quarter. Each hectare was considered as a sample plot while a sample point of 4 m × 4 m (16 m^2) within each hectare was marked and replicated 4 times, given 16 sample points. Forage species within each were identified and classified based on their scientific, English and local names, forage type and family.

Collection and preparation of the dominant forage sample
Samples were collected from the identified dominant herbaceous species using quadrant method. The samples were sorted and sun dried on an open field and thereafter, the dried samples were dried in oven at 60°C for 24 hours (Kassahun *et al.*, 2016). The dried sample was ground and mixed thoroughly, then sieved through 1mm sieve and thereafter, immediately stored for chemical analysis in the laboratory.

Chemical analysis of the dominant forage samples
The prepared dominant forage samples were subjected to proximate analysis. The dry matter (DM), crude protein (CP), crude fiber (CF), ether extract (EE), and ash (ASH) were determined according to the methods of AOAC (2013). Nitrogen free extract (NFE) was determined on dry matter basis; %NFE = 100 - (%crude protein + %crude fiber + %ether extract + %ash).

Statistical Analysis
The data generated were subjected to analysis of variance (ANOVA) using the GLM procedure of GENSTAT (2014), where significant differences between the means were detected and separated using Tukey test, Differences between the means were considered at a 5% probability level ($p<0.05$).

RESULTS AND DISCUSSIONS

Classification of the herbaceous forages identified in the study area
Eleven (11) herbaceous forages were identified and classified based on scientific, English and local names, forage type and family. Among these eleven herbaceous species, five (5) were identified to be dominant in the rangeland area of the University (Table 1). The dominant herbaceous species were analysed for proximate composition (Table 2).

Table 1. Dominant herbaceous forages in the rangeland area

Scientific name	English name	Local name	Forage type	Family
Digitaria sanguinalis	Crab grass	Harkiya	Grass	Poceae
Pennisetum pedicillatum	Kyasuwa grass	Kyasuwa	Grass	Poceae
Setaria pumila	Yellow fox tail	Kamsuwa	Grass	Poceae
Spermacoce ocymoides	False button weed	Gogamasi	Forb	Rubiaceae
Striga hermonthica,	Giant witch weed	Makasha	Forb	Orobanchae

Table 2. Proximate composition (%) of the dominant herbaceous forages in the rangeland

Scientific name	DM	CP	CF	EE	ASH	NFE
Digitaria sanguinalis	94.90	7.90^{a}	31.8^{c}	10^{b}	9^{b}	36.20^{c}
Pennisetum pedicillatum	95.30	6.13^{b}	33.6^{b}	5.0^{c}	4^{c}	46.57^{b}
Setaria pumila	94.80	8.80^{a}	29.1^{d}	15^{a}	14^{a}	27.90^{d}
Spermacoce ocymoides	94.70	5.30^{b}	47.5^{a}	16^{a}	8^{b}	17.90^{e}
Striga hermenthica	95.60	5.60^{b}	9.20^{e}	10.7^{b}	3.5^{c}	66.58^{a}
P-Value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Means in the same column with different superscripts (^{a,b,c,d,e}) are significantly different ($p<0.05$). DM: Dry matter, CP: Crude protein, CF: Crude fibre, EE: Ether extract, NFE: Nitrogen free extract.

DISCUSSIONS

Eleven (11) herbaceous forages were identified, among which five (5) of them were considered dominant leading to the nutritional evaluation of the five shown in Table 2, The result showed that all the proximate components were significantly different ($p<0.05$). The dry matter (DM) contents of the forages vary from 95.60% in *Striga hermonthica* and 94.70% in *Spermacoce ocymoides.* The DM content was in line with the range of 87.96% to 96.10% reported by Muhammad *et al.* (2024) and slightly higher than 88.30% to 91.74% reported by Khan *et al.* (2020). Njidda *et al.* (2010) also reported a range of 95.20% to 97.00% on some semi-arid forages of Northeastern Nigeria. The dry matter yield falls within the range of 500 and 1200kg/ha reported by Aduku, (2004) in the Sudan savannah zone. Moreover, it is important to note that forage dry matter yield varies with rainfall and soil conditions (Aduku, 2004). Crude protein (CP) contents ranges from 8.80% in *Setaria pumila* to 5.30% in *Spermacoce ocymoides*. This result can be compared with the values of 5.44% reported by Awad and El-Hadi (2010) during the early dry season of the semi-arid rangeland of Sudan. It was also slightly lower than the 8.20% and 8.81% reported by Suleiman *et al.* (2020) and Muhammad *et al.* (2024) respectively. The CP content of the forages was also slightly lower than the 8% CP which is the lower threshold that will warrant giving supplements to livestock (Aduku, 2004). Crude fibre (CF) in these findings ranged from 9.20% in *Striga hermonthica* to 47.5% in *Spermacoce ocymoides*. This agrees with the report of Norton (1995) that tropical legumes and grasses have a CF content of above 28%. Ether extract (EE) ranged from 5% in *Pennisetum pedicillatum* to 16% in *Spermacoce ocymoides* . This finding is higher than many researches (Njidda, 2010; Khan *et al.,* 2020; Suleiman *et al.,* 2020; Muhammad *et al.,* 2024). Ash (ASH) ranges from 14% in *Seteria pumila* and 4% in *Pennisetum pedicillatum*. This finding agrees with Muhammad *et al.* (2024). Nitrogen free extract (NFE) ranged from 66.58% to 17.90% in *Striga hermonthica* and *Spermacoce ocymoides* respectively, which can also be compared with the report of Muhammad *et al.* (2024).

CONCLUSION

This research has indicated that the herbaceous forages at the Federal University Dutse rangeland can meet the nutritional requirements of ruminant livestock..

It can be recommended that further studies should be conducted to come up with more detail information on the rangeland on the other nutritional components. The study also recommends that, adequate care and management of rangelands is very important for the production of highly nutritive forages for livestock.

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Pasture and Range Management: PRM006

EFFECTS OF DOUM PALM AND CANE SUGAR MOLASSES ON PHYSICAL AND CHEMICAL QUALITIES OF ENSILED NAPIER GRASS IN A SEMI-ARID ENVIRONMENT OF NIGERIA

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ABSTRACT

The field experiment was conducted to determine the effects of doom palm and cane sugar molasses on physical and chemical qualities of ensiled Napier grass. A total of fifteen (15) polyehene bags were used for the silage making. The bags were allocated to treatments at five bags per treatment and each bag serves as replicate. T1 as control (ensiled Napier grass without molasses), T2 (ensiled Napier grass with cane sugar molasses) and T3 (ensiled Napier grass with doum palm molasses). Both molasses (doum palm and cane sugar) was diluted with at one liter per four liters of water while the poultry litter was diluted at fifteen-kilogram (15kg) per thirty (30) litres of water which was used at 5% for both types of molasses (doum palm and cane sugar) were diluted while the poultry litter at 15% inclusion level. The Napier grass was harvested and chopped into 2-3 inches and the molasses and the poultry litter was sprinkled on the ensiled material and compressed into polythene bags and allowed to stand for 21 days. Exactly at 21 days, the polythene bags were opened and physical parameters such as pH, odour, texture, colour and temperature were recorded. A sample was equally collected from each treatment for proximate analysis. The result obtained revealed that the physical qualities of doum palm treated ensiled Napier grass is comparable with that of cane sugar molasses treated ensiled Napier grass and superior to control treatment. The result further reveals that the CP and NFE (9.54% and 47.54%) of doum palm molasses treated Napier grass were better than cane sugar molasses (8.92% and 46.42%) and control (8.57% and 43.07%). However, the CP values were above the minimum maintenance requirement of 7.5% CP for ruminants. In conclusion, the inclusion of doum palm molasses improved the physical characteristics and chemical composition of the ensiled Napier grass and can replace cane sugar molasses as additive in ensiled Napier grass.

Keywords: Doum palm, Molasses, Napier grass and Ensiled

INTRODUCTION

Feed resources for ruminant livestock production in the developing countries such as Nigeria normally are natural grass or forage crops, natural pastures and natural feeding has increased rapidly due to its high yielding properties, relatively high energy content, palatability and easy incorporation in total ration (TMR) or total mixed block (TMB) (1,2). The concept of adding a doom palm molasses is to improve the soluble carbohydrate content of the Napier grass to provide optimum energy requirement of both the animal and rumen microbes for better microbial digestion in rumen and when fed to ruminant livestock improve performance such as meat and milk production (3). Napier grass (*Pennisetum purpureum*) can yield more crude protein to meet above maintenance requirement. This grass requires lower inputs and easier to establish than corn and can be a good alternative, especially in production situations that require consistent nutrition on a daily basis. It is for this reason that two silage additives will be tested to find out the effectiveness of preserving the quality of Napier Grass and its effects on growth of sheep (2).Molasses is one of the feed additives that enhance utilization of unpalatable crop residues and also serves as a good source of soluble carbohydrate. Nowadays, due to competition between the livestock farmers and brewery industry it has now become unaffordable to livestock farmers. Hence, there is a need for developing cane sugar molasses substitute (3,4).

The main objective of this study is to produce doom palm treated Napier grass silage that can replace the popular cane sugar molasses Napier grass silage. The specific objectives are to:

i. Produce doum palm and cane sugar-based Napier grass silages
ii. Determine the physical characteristics of doum palm and cane sugar molasses treated Napier grass silage
iii. Assess the proximate composition and pH of the silage produced

MATERIALS AND METHOD

Experimental Site

The Livestock Unit of the Department of farming system research, Lake Chad Research Institute, Maiduguri, Borno State, Nigeria, was the location of the experiment. The semi-arid region lies in West Africa's Sahel zone, which is renowned for its extreme weather and seasonal variations. The area is characterized by a lengthy dry season that lasts from October to May, and a brief wet season that typically lasts from June to September. The warmest months of the year are March, April, and May while the temperature drops significantly during the harmattan months, which takes place between October and February. Extreme temperatures of 43°C and 20°C have been seen in June. August has a relative humidity of roughly 45%, while the drier months of December and January have a relative humidity of roughly 5% (5).

Experimental Design

The experiment consists of three (3) treatments laid out in a Completely Randomized Design (CRD) and each treatment allotted with 5 bags serves as replicate making fifteen (15) bags.

Doum palm molasses and poultry litter preparation

The doum palm molasses was prepared by 1kg doum palm pulp covered in a 3 litter water and put to boiling for 30 minutes and allowed to cool for about an two hours sieving with sieve size of about 50u and 150 x 100mm size was used. The sieved doom palm molasses was reboiled to attained similar viscosity with cane sugar molasses while sugarcane molasses was obtained from Numan Savana sugar industry, Adamawa state which served as control.

Poultry dropping was source from Maiduguri poultry production unit (PPU). The litter was properly sundried, ground and sieved to remove the bedding material from the poultry litter. Poultry litter was dissolved in water at the rate of 15kg per 30 liters of water.

Silage Making

Napier grass was cut at the Lake Chad Research Institute Maiduguri, pasture farm. Doum palm was sourced from Baga market, Maiduguri, Borno state, Nigeria. The Napier grass was wilted for 24 hours and chopped to 3 – 5 cm. The chopped Napier grass and doom palm molasses were mixed at the rates of 1 liter per 5 liters of water while the molasses of same dilution rate to come up with three treatments plus control (Table 1), compressed and poured into polythene bags and allowed to stand for 21 days. At 21 days ensiling, the polythene bags were opened and physical parameters such as pH, temperature, texture, odour and appearance were observed as described by (6). Table 1 displays the proportions in percentage terms.

Table 1. Gross composition of Napier grass silage

Composition	T1	T2	T3
Napier grass (%)	85	80	80
Poultry litter (%)	15	15	15
Cane sugar molasses (%)	-	5	-
Doom palm molasses (%)	-	-	5

T1-Control, T2-Cane sugar treated ensiled Napier grass and T3-Doum palm molasses ensiled Napier grass

Analytical technique

The data obtained from the field were subjected to simple statistical tools such as mean, average and percentage

RESULTS AND DISCUSSION

Physical characteristics of the silages

The physical characteristics of Napier grass silage is presented in Table 1. There was a difference in odour, temperature and pH among the treatments. Silage from T_2 and T_3 had the same olive green appearance and was characterized with a very pleasant odour and firm texture. The green olive appearance and firm texture of the silage observed in T_2 and T_3 is an indication of good quality silage which could be attributed to application of doum palm and cane sugar molasses as a source of soluble carbohydrate. Temperature observed across the treatments in this study was within the ranged (26.1 to 29.1°c). Temperature of silage above 30°c could be result to silage with dark appearance as a result of caramelization of soluble carbohydrates in the ensiled material. The pH values ranged (3.40 to 5.20) are within the recommended pH value of (3.50 to 5.50) for good quality silage (3). The physical characteristics of Napier grass silage observed in this study agreed with the physical characteristics of different varieties of Napier grass silage reported by (7). The physical quality of Napier grass silage observed in this work agrees with the result reported by (3) on quality of ensiled forage.

Table 2. Physical characteristics of the Napier silages

Characteristics	T1	T2	T3
Appearance	Yellowish	Olive green	Olive green
Odour	Pleasant (sour)	Very pleasant (Fruity sour)	Very pleasant (Fruity sour)
Texture	Firm	Firm	Firm
Temperature	29.1°c	26.1°c	27°c
pH	5.20	3.40	3.77

T1-Control, T2-Cane sugar treated ensiled Napier grass and T3-Doum palm molasses ensiled Napier grass

Proximate composition of Napier grass silage

The proximate composition of Napier grass silage is presented in Table 1. The result shows that Dry matter content of all the treatments were high, indicating better storage of nutrients in the feeds (8). The results also reveals that doom palm Napier grass molasses silage with the higher (9.54%) crude protein value while cane sugar molasses Napier grass silage had the similar (8.92%) crude protein with control constituted (8.57%) crude protein above maintenance requirement of ruminant animals. The crude protein values obtained in this study were above the critical level of 7.5% requirement for minimum performance of ruminants (9), thus doom palm molasses Napier grass silage could be served as a good supplement to augment the available nutrient. The result further indicates that doom palm molasses had the highest (47.54%) while control had the least NFE. This could be attributed to the addition of doom palm in the silage making. The crude value for doom palm molasses-based silage recorded in this study is higher that the crude protein value reported by (10) for Napier grass silage was 8.55% crude protein. The crude protein obtained in this work was also lower than the crude protein reported by (2) for Napier grass silage.

Table 3. Proximate composition Napier grass silage

Treatments	DM	MC	CF	CP	EE	ASH	NFE	ADF	NDF
T2	94.20	5.80	22.00	8.57	2.00	2.58	43.07	11.00	19.00
T1	94.60	5.40	24.00	8.92	2.00	5.50	46.42	9.50	20.00
T3	94.60	5.40	21.03	9.54	1.00	6.00	47.54	8.00	31.20

T1-Control, T2-Cane sugar treated ensiled Napier grass and T3-Doom palm molasses ensiled Napier grass

CONCLUSION

In conclusion, inclusion of doum palm molasses improved the physical characteristics and chemical composition of the ensiled Napier grass. Therefore, doum palm molasses can successfully replace cane sugar molasses as source of soluble carbohydrate.

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Pasture and Range Management: PRM007

COMPARATIVE EFFECT OF ORGANIC FERTILIZER TREATMENTS ON THE NUTRITIVE VALUE AND IN-VITRO DIGESTIBILITY OF CONGO GRASS (Brachiaria ruziziensis) HAY

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ABSTRACT

Organic fertilizers treatments were applied to *Brachiaria ruziziensisis* to evaluate their effect on the nutritive value and in-vitro digestibility of the hay in a completely randomized design. The four fertilizer treatments were T1 (no fertilizer), T2 (Natsoil), T3 (Wonder fertilizer), and T4 (poultry manure). Congo grass was harvested at bloom stage, packed and air-dried as hay and stored for chemical analysis and in-vitro digestibility. The results showed that crude protein, ether extract and carbohydrate fraction were significantly higher ($p<0.05$) in T3 than other fertilizer treatments. Furthermore, the T3 (4.36), T4 (4.28) and T2 (4.16) fertilizers were significantly higher ($p<0.05$) in metabolizable energy than T1 (3.80) while the cellulose content was significantly highest ($p<0.05$) in T2 (21.75) followed by T1 (21.65), T3 (21.19) and T4 (21.02). The fertilizers T3, T4 and T2 had significantly higher ($p<0.05$) contents of propionate, butyrate and lactate compared to T1. The total volatile acid was significantly highest ($p<0.05$) in T3 (152.50) followed by T4 (145.00), T2 (142.80) and the least T1 (123.40). Fertilizer T3 had significantly highest ($p<0.05$) gas produced at 9, 12, 21 and 24 as well as NH_3-H gas and IVDMD than other fertilizer treatments. Conspicuously, the OMD was significantly higher ($p<0.05$) in T3 (60.87), T4 (60.06) and T2 (60.11) than T1 (56.06). It could be concluded that though Congo grass treated with fertilizers had increased crude protein, metabolizable energy, volatile fatty acid as well as in-vitro gas production and digestibility. However, the T3 fertilizer treatment was outstanding.

Key words: Organic fertilizer, nutritive value, in-vitro digestibility, Congo grass, hay

DESCRIPTION OF PROBLEM

The availability of green forage is seasonal, mostly in rainy season, when plant growth is high [1]. *Brachiaria ruziziensis* or Congo grass is a forage crop that is grown throughout the humid tropics with fast growth at the beginning of the wet season due to strong seedling vigour, ease of establishment, and the ability to suppress weeds[2]. *Brachiaria ruziziensis* is a tropical grass that has remarkable qualities that favour improved ruminant production[3]. *Brachiaria ruziziensis* has remarkable traits like excellent acceptance, a good response to fertilization, high fodder quality and nutritional content [3], quick establishment, strong growth at the start of the wet season, ability to work well in a consortium with legumes, dense flowering, and abundant seed yield [4]. Congo grass (*Brachiaria ruziziensis*) is important in many parts of the world as it gives a high yield and is economically attractive [5]. However, low soil fertility and unfavourable soil physical properties are some of the major flaws of its production in Nigeria [6]. Fertilizers play a critical role in enhancing crop productivity and maintaining soil fertility [7] hence this study.Objectives of the study are to determine the effect of organic fertilizer treatments on the nutritive value of Congo grass and to evaluate the effect of organic fertilizers on the in-vitro digestibility of *Brachiaria ruziziensis*

MATERIALS AND METHODS

Experimental Site

The research was carried out at the Teaching and Research farm of the Osun State University College of Agriculture located in Ejigbo, Osun State in the Southwest of Nigeria.

Experimental layout, design, and treatments

Congo grass experimental field of 900m^2 was divided into four experimental main plots with each measured 225m^2 in a completely randomized design. Each plot was further divided into four sub-plots with each representing a replicate. There were four fertilizer treatments comprising of The fertilizer treatment; No fertilizer (T1), Natsoil was applied (3.18% N) at the rate of 250kg per hectare (T2), Wonder fertilizer was applied (3.40% N) at the rate of 250kg per hectare (T3) while poultry manure with 2.09% nitrogen was applied at 5 tons per hectare (T4).

Preparation of hay

The harvested grass was gathered using a rake, packed, and air-dried until proper moisture level (85%) was achieved. The hay was then packed in the sacks and stored at a room temperature for a month before the samples were taken for analysis.

Chemical analysis

The proximate content of hay samples was determined using the procedure of [8] while fibre fractions were analyzed using [9] method.

Volatile fatty acids determination

Following 24-hour incubation, the decanted supernatant was centrifuged and preserved with 25% metaphosphoric acid and total volatile fatty acids (VFAs). The amounts of propionate, acetate, and butyrate were calculated following the protocol outlined by [10].

In-Vitro gas production and dry matter Digestibility

The silage samples were analyzed for in-vitro DM digestibility according to the method of [11]. Rumen contents were squeezed through four layer of cheese cloth kept in water bath at 39^{O}C until incubation takes place. Representative samples of the mixtures (2.5g DM) were taken in a separate bottle having 0.05 litres rumen liquor 0.2 litres buffer solution (Buffer solution: KCl 0.57 g/L, MgSO4. 7H2O 0.12 g/L, NaCl 0.47 g/L, CaCl2 0.04 g/L, Na2HPO4.12H2O 9.30 g/L, NaHCO3 9.80 g/L, Cysteine 0.25 g/L [12], [11]. The bottles were kept in water bath at 39OC. The samples were run for in-vitro dry matter digestibility at 6, 9, 12, 15, 18, 21 and 24 hours of incubation.

Data analysis

The data collected were subjected to one way analysis of variance procedure of the General Linear Model [13]. Significant means were separated using the Duncan New Multiple Range Test.

RESULTS AND DISCUSSION

The results showed that treatment effects showed no significant difference in the dry matter, crude fibre, ash, NDF, ADF, ADL and hemicellulose across the fertilizer treatments (Table 1). However, the crude protein, ether extract and carbohydrate fractions were significantly higher ($p<0.05$) in T3 than other fertilizer treatments. Furthermore, the T3 (4.36), T4 (4.28) and T2 (4.16) fertilizers were significantly higher ($p<0.05$) in metabolizable energy than T1 (3.80) while the cellulose content was significantly highest ($p<0.05$) in T2 (21.75) followed by T1 (21.65), T3 (21.19) and T4 (21.02). The CP values of the present study compared with 7.35% reported by [14] for *Andropogon gayanus* hay. The CP values recorded for all treatments in this study were above 7% recommended for small ruminants [15]. The differences observed in this study could be due to available soil nutrients provided by organic fertilizers [16]. The ME obtained in the present study was lower than those reported by [17]. [18] reported that cellulose content of *Panicum maximum* was influenced by fertilizer types as also evident in this study.

Table 1 Chemical Composition and fibre fractions of *Brachiaria ruziziensis* hay

Parameters (%)	T1	T2	T3	T4	SEM
Dry matter	92.66	92.82	92.76	92.85	0.06
Crude protein	7.54^{b}	7.70^{b}	8.52^{a}	7.90^{b}	0.09
Crude fibre	27.88	27.57	26.12	26.67	0.51
Ash	8.25	9.95	10.02	9.87	0.24
Ether extract	2.62^{b}	2.62^{b}	3.07^{a}	2.77^{b}	0.06
Carbohydrate fraction	51.02^{b}	52.00^{ab}	55.10^{a}	52.82^{ab}	0.62
Metabolizable energy	3.80^{b}	4.16^{a}	4.36^{a}	4.28^{a}	0.06
Neutral detergent fibre	67.50	65.87	65.57	65.87	0.25
Acid detergent fibre	33.32	33.27	32.21	32.42	0.25
Acid detergent lignin	11.67	11.52	11.02	11.40	0.18
Hemicellulose	34.23	32.55	33.36	33.45	0.20
Cellulose	21.65^{ab}	21.75^{a}	21.19^{c}	21.02^{c}	0.13

a, b, c: Means in the same row with different superscripts are significantly different ($p<0.05$)
T1 = Control T2= Natsoil fertilizer T3= Wonder fertilizer T4= Poultry manure

Treatment effect showed no significant difference among the means of gas produced at 3, 6, 15, 18 hours as well as TVG, methane, CO_2 and SCFA across the fertilizer treatments (Table 3). Notwithstanding, fertilizer T3 had significantly highest ($p<0.05$) gas produced at 9, 12, 21 and 24 as well as NH_3-H gas and IVDMD than other fertilizer treatments. Conspicuously, the OMD was significantly higher ($p<0.05$) in T3 (60.87), T4 (60.06) and T2 (60.11) than T1 (56.06). The results obtained in the present study after 24 hours of incubation were in agreement with those reported by [19]. It is widely established that feedstuffs which have higher gas production and IVDMD possess tendency to produce more CH_4 production during incubation [20]. The values of DMD obtained in this study were comparable with (56.0%) reported by [14] for *Andropogon gayanus* hay and [21] for *Brachiaria brizantha* (56.9%).

Table 2 Gas production and digestibility of *Brachiaria ruziziensis* hay

Hours of incubation	T1	T2	T3	T4	SEM
3	1.00	1.37	1.75	1.50	0.15
6	2.00	2.70	3.23	2.87	0.27
9	2.75^{b}	4.00^{ab}	5.20^{a}	4.50^{ab}	0.40
12	2.75^{b}	4.00^{ab}	5.20^{a}	4.50^{ab}	0.40
15	4.75	5.50	7.62	6.50	0.45
18	6.37	6.87	8.50	8.00	0.35
21	7.65^{d}	9.37^{c}	10.12^{a}	9.75^{b}	0.36
24	7.95^{d}	10.57^{c}	12.00^{a}	11.42^{b}	0.50
Total volume of gas (ml)	7.95	10.57	12.00	11.42	0.50
Methane (ml)	2.26	2.81	3.60	3.25	0.27
CO_2 (ml)	5.69	7.76	8.40	8.17	0.50
NH_3-N	11.00^{c}	12.80^{b}	15.60^{a}	12.75^{bc}	0.01
Organic matter digestibility (%)	53.66^{b}	60.00^{a}	60.87^{a}	60.06^{a}	0.93
In-vitro dry matter digestibility (%)	56.06^{c}	56.06^{c}	60.11^{a}	58.92^{b}	0.44
Short chain fatty acid (µmol)	0.13	0.19	0.22	0.21	0.00

a,b,c: Means in the same row with different superscripts are significantly different ($p<0.05$) T1 = Control T2= Natsoil Fertilizer T3= Wonder Fertilizer T4= Poultry Manure

CONCLUSION AND APPLICATION

It could be concluded that though Congo grass treated with fertilizers had increased crude protein, metabolizable energy as well as in-vitro gas production and digestibility. However, the T3 fertilizer treatment was outstanding.

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Pasture and Range Management: PRM008

EFFECT OF INTERCROPPING *Sorghum almum* WITH *Centrosema pascuorum* ON GROWTH PARAMETERS AND FORAGE YIELD UNDER FLOODED IRRIGATION IN GASHUA, YOBE STATE.

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ABSTRACT

This study was carried out to assess the effect of intercropping *Sorghum almum* with *Centrosema pascuorum* on growth parameters and forage yield under flooded irrigation at Teaching and Research Farm, Department of Animal Science, Faculty of Agriculture, Federal University, Gashua. The experiment was carried out using a Randomised Complete Block Design, consisting of six treatments: T1= as sole sorghum, T2=sole Legume, sorghum with Centro in inter-row arrangements as; 1:1 (T3), 1:2 (T4), 2:1 (T5) and 3:1 (T6). The growth parameters were significantly ($p< 0.05$) affected by intercropping pattern. The highest plant height (145.17cm) and leaf area index (4.9) were recorded in T1, and the best tillers number (16.94) was observed in T5 (2:1).Fresh and dry matter yields were significantly ($P>0.05$) affected by intercropping pattern. The highest fresh forage yield of *S. almum* (8.64 t/ha) obtained in *Sorghum almum* intercropped with *C. pascourum* in 1:2 inter-row ratio (T_4) was significantly ($P>0.05$) higher than (7.17 t/ha) and (7.25 t/ha) for T_5 and T_6respectively. The dry matter yield of *S. almum* was significantly ($P<0.05$) higher in intercropped plots than in sole S. *almum* treatment (T_1). The highest dry matter yield of 6.48 t/ha was obtained in T_4, with the least recorded in T_5 (5.02 t/ha). The best total land equivalent ratio (TLER) was observed in the intercropped treatments. The value of one (1) recorded was against both sole *S. almum* (T_1) and sole C. *pascourums* (T_2) plots were significantly ($P<0.05$) lower than 2.67, 3.12, 2.50 and 2.41 for T_3, T_4, T_5 and T_6, respectively. This study revealed that *S. almum* can be intercropped with *C. pascuorum* for better forage yield than the sole crop. Therefore intercropping *S. almum* with *C. pascuorum* in inter-row arrangement is recommended for livestock farmers in Nigeria.

Keywords*:* Flooded, Forage, Intercropping, Irrigation Yield.

INTRODUCTION

Livestock production plays a significant role in the economic and social activities of Nigerians. Pasture is an important resource for livestock production. Its establishment and improvement have been recommended for better performance of ruminant animals for enhancing the production of milk, meat hide and skin and other livestock such as rabbit, pig etc. for their products (meat, fur, pork and lard) (1). In most tropical countries of the world, most of the livestock (80-90 %) depend on available grasses during the wet season, scarcity and the low quality of these feeds have made it mandatory to produce and conserve quality forages against dry season and periods of drought (2). Intercropping legumes into grass pastures has proven to be a viable means to mitigate the decline in the quantity and quality of grass forages (3). Intercropping is an alternative way for smallholder farmers to improve the yield and nutrient quality of the native grasses. It has been reported that intercropping grasses with legumes increased yield, improved growth, enhanced palatability and nutrient quality feeds for animals (4). Recently, intercropping has been considered an effective strategy to increase the resilience of the farming system to climate change hazards (5; 6). Generally,

cereal–legume intercropping systems are receiving increased attention in both developing and developed countries to attain sustainability in grain and forage production (7) while avoiding the degradation associated with the extensive use of non-renewable resources (8).The report of (9) showed that its yield can be enhanced when intercropped with legumes. *Centrosema pascuorum* is a legume species of high potential as a fodder crop because of its high biomass production compared to other forage legumes. Like other nitrogen (N) fixing legumes, *Centrosema pascuorum* (Centurion) is a soil improver and in association with grass in mixtures is beneficial to grass yields making nitrogen (N) fertilizer not necessary (10). There is a paucity of information on *Sorghum almum* and *Centrosema pascuorum* intercropping. This study aims to determine the effect of intercropping *Sorghum almum* with *Centrosema pascuorum* on growth parameters and forage yield under flooded irrigation in Gashua, Yobe State.

MATERIALS AND METHODS

Description of the Experimental Site

The experiment was carried out during the dry season in 2021, at the teaching and research farm of the Department of Animal Science, Federal University Gashua, Yobe State. The vegetation characteristic of the area is Sahel Savannah. It consists of an open Thorny Savanna with short trees and grasses. Gashua is located between Longitude 10° 02' and 11°, 11°E and Latitude 12° 48' and 12°88'N. The maximum and minimum air temperatures 40ºC and 26.5ºC respectively were recorded for April to May during the rainy days which were slightly similar to the previous records. The total annual rainfall of 600 mm with an average of 209.18 mm was recorded in 2021. Total number of rain days in Gashua was 61 days for 2021. A mean relative humidity of 73.33% and mean sunshine of 7 hours was observed (11).

Soil Sampling and its Analysis

Composite soil samples were collected from the experimental site with the aid of a Soil auger at 4 corners and the centre of the plots to depths of 0-30cm. The soil sample was then analysed for physical and chemical properties at the Department of Soil Science, Faculty, Ahmadu Bello University, Zaria.

Experimental Layout, Treatments, Design and Management

The field was ploughed by a tractor, and leveled manually with hand hoes before sowing to provide an appropriate and well-established bed for seed germination. The experiment was laid out in a Randomised Complete Block Design (RCBD), which consists of six treatments: T_1= sole *S. almum*, T_2=sole *C. pascuorum* and T_3 – T_6 = *S. almum* with *C. pascuorum* in an inter-row arrangement as; 1:1, 1:2, 2:1 and 3:1ratio, respectively, and replicated three times. Seeds of the two species were drilled in rows with 50cm inter-row spacing at the rate of 20kg/ha. The fertilizer (N P K 15-15-15) was applied during land preparation. All plots were hand-weeded twice at 3 and 6 weeks after sowing. Also, irrigation was carried out at three days intervals from the onset to the end of the experiment.

Data Collection and Chemical Analysis

Three (3) plants from the two middle rows were randomly sampled per plot and tagged for the measurements of various agronomic parameters (Plant height, branch number, leaf number and tiller number) using the standard procedure as reported by (12). Forage yield was determined by harvesting the fresh forage, within each sub-plot within 0.5 m^2 quadrat at a height of 15cm above the ground level at 9 weeks after sowing using a hand sickle. The harvested fresh wet forage materials were weighed and a known weight of sub-samples (200-250 grams) was oven-dried at 65^0C for 48 hours and reweighed to estimate dry matter yield (DWss) at the animal science laboratory, Faculty of Agriculture, Federal University Gashua. Dry matter yield (t/ha) was calculated using the formula below as reported by (13) as stated below:

Forage dry matter yield (kg DM/ha) = Fresh weight (kg) x Oven-dried weight (DM %) × 20,000.
There are 20,000 quadrats (0.5m^2) per hectare.

Data Analysis

The results obtained were subjected to Analysis of Variance (ANOVA) using the General Linear Model procedure (proc. GLM) of SAS (14). Significant (P<0.05) differences among treatment means were compared using the Duncan Multiple Range Test (15) of the SAS package.

RESULTS AND DISCUSSION

The effect of intercropping on the growth components of *Sorghum almum* is presented in Table 1. The plant height of 145.19 cm for *S. almum* observed in treatment 4 (T4, 1:2 *S. almum-C. pascourum*) was significantly (P<0.05) higher than sole *Sorghum almum* with a plant height of 109.33 cm. The number of tillers per plant, plant density and leaf area index were also significantly (P<0.05) affected by the intercropping pattern with control having the lowest values. The lowest values recorded in the sole *S. almum* plots for several tillers per plant, plant density and leaf area index were 14.77, 36.74 and 1.42, respectively. The least values recorded in the sole *S. almum* plots for the number of tillers per plant, plant density and leaf area index could be due to the absence of nitrogen fixation of *C. pascuorum* by rhizobia relative to intercropped plots which was benefited by the *S. almum*. This was in agreement with the report of (16; 17) who noted an increase in plant heights of maize: *Tephrosia bracteolate, Brachiaria ruziziensis*: *C. pascuorum* when intercropped than sole cropping.

Table 1: Effect of Intercropping and Plant Species on Growth Parameters

Treatments	Parameters				
	Plant Height (cm)	Number of Leaves	Tillers Number	Plant Density	LAI
T_1	99.42^{b}	14.77^{c}	11.44^{b}	42.42^{a}	4.90^{a}
T_2	109.37^{b}	28.11^{a}	18.22^{ab}	34.74^{b}	0.42^{b}
T_3	110.35^{b}	18.71^{bc}	11.99^{ab}	65.33^{b}	5.46^{a}
T_4	149.17^{a}	19.53^{bc}	14.25^{ab}	69.44^{a}	3.90^{a}
T_5	99.94^{b}	19.36^{bc}	16.94^{a}	66.25^{a}	3.31^{a}
T_6	111.46^{b}	19.86^{b}	12.11^{ab}	72.08^{a}	3.68^{a}
SEM	7.53*	1.32*	1.41*	10.25*	1.16*
Species (S)					
S1	144.18^{a}	19.81	14.30	73.38^{a}	6.12^{a}
S2	77.10^{b}	19.77	12.45	42.25^{b}	1.47^{b}
SEM	13.08*	2.29^{NS}	2.14^{NS}	17.70*	2.02*

^{abc} means with different superscripts within rows differed significantly (P<0.05), * = significant at 5% level of significant, NS = not significant, SEM= standard error of mean, T_1 = sole sorghum almum, T_2 = sole Centrosema pascourum, T_3 = 1:1 *Sorghum almum – Centrosema pascuorum*,T_4 = 1:2 = *sorghum almum – Centrosema pascuorum*, T_5 = 2:1 *Sorghum almum – Centrosema pascuorum*, T_6 = 2:2 *sorghum almum – Centrosema pascuorum* ratios, LER = land equivalent ratio, $_s$ = sorghum almum, $_c$ =Centrosema pascuorum

The forage yield of *S. almum* Intercropped with *C. pascuorums* is presented in Table 2. The yield data obtained in this study are all within the range (5.4 - 19.4 DM t/ha).The findings revealed that *S. almum – C. pascourum* intercropping in a 2:1 row proportion resulted in the highest fresh(8.64 t/ha) and dry biomass (6.48 t/ha) than other spatial arrangements. The best total land equivalent ratio (TLER) was observed in the intercropped treatments. The value of one (1) recorded was against both sole *S. almum* (T_1) and sole *C. pascourums* (T_2) plots were significantly (P<0.05) lower than 2.67, 3.12, 2.50 and 2.41 for T_3, T_4, T_5 and T_6, respectively. This agrees with the report of (18; 19) who also reported that when mash (*Vigna mungo* L.) and tephrosia (*Tephrosia bracteolata*) were intercropped with maize, intercropping resulted in a significantly higher LER. Similarly, when maize and cowpea were sown in mixtures of 100:100, 75:25, 50:50, and 25:75, LER for the intercropping systems was higher than 1 indicating an intercropping advantage compared to monoculture crops (20**).**It was also reported when maize (*Zea mays* L.) was planted in alternate rows with cowpea (*Vigna unguiculata* L.), comparatively had better agronomic growth of component crops led to the highest fresh and dry biomass owing to a greater number of plants per unit land area (21).

Table 2: Effect of Intercropping and Plant Species on Forage Yields and Land Equivalent Ratio

Treatments	Parameters				
	Fresh Forage Yield (t/ha)	Dry matter yield (t/ha)	LER_S	LER_C	TLER
T_1	8.00^{ab}	5.68^{b}	1.00^{b}	1.00^{b}	1.00^{b}
T_2	3.99^{d}	2.68^{c}	1.00^{b}	1.00^{b}	1.00^{b}
T_3	7.38a^{b}	5.39^{b}	1.53^{ab}	1.32^{ab}	2.67^{a}
T_4	8.64^{a}	6.48^{a}	1.54^{a}	1.56^{a}	3.12^{a}
T_5	7.17^{c}	5.02^{b}	1.24^{ab}	1.26^{ab}	2.50^{a}
T_6	7.25^{bc}	5.08^{b}	1.25^{ab}	1.24^{ab}	2.49^{a}
SEM	0.39*	0.28*	0.15*	0.14*	0.23*
Species (S)					
S1	10.04^{a}	7.23^{a}	1.29	1.29	2.36
S2	4.55^{b}	3.25^{b}	1.30	1.27	2.57
SEM	0.68*	0.49*	0.26^{NS}	0.24^{NS}	0.40^{NS}

^{abc} means with different superscripts within rows differed significantly (P<0.05), * = significant at 5% level of significant, NS = not significant, SEM= standard error of mean, T_1 = sole sorghum almum, T_2 = sole Centrosema pascourum, T_3 = 1:1 *Sorghum almum – Centrosema pascuorum*,T_4 = 1:2 = *sorghum almum – Centrosema pascuorum*, T_5 = 2:1 *Sorghum almum – Centrosema pascuorum*, T_6 = 2:2 *sorghum almum – Centrosema pascuorum* ratios, LER = land equivalent ratio, $_s$ = sorghum almum, $_c$ =Centrosema pascuorum

CONCLUSIONS

It was concluded that all intercropping plots gave higher leaf area index, plant density, forage yield and land equivalent ratio than the sole treatment. However, intercropping *S. almum* and *C. pascuorum* at a 1:2 mixture recorded the highest fresh and dry matter yield and land equivalent ratio. The species S_1 (*S. almum*) produces the best leaf area index, plant density, forage yield and land-land equivalent ratio under flooded irrigation in Gashua. Farmers should CULTIVATE *Sorghum almum* with legumes under flooded irrigation for better forage during the dry season in Gashua, Yobe State. Future research should be conducted to explore different intercropping systems/patterns in Gashua.

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Pasture and Range Management: PRM009

ASSESSMENT OF PLANT SPECIES DIVERSITY IN A NATURAL VEGETATION DURING DRY SEASON IN MANDO, KADUNA NORTHERN GUINEA SAVANNA ZONE OF NIGERIA.

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ABSTRACT

A study was conducted to determine agronomic features and specie richness of forages on a rangeland during the dry season in Mando, Kaduna. A rangeland area of 100m by 100m dimension was mapped out during the mid-dry season of 2023/2024. Ten (10) quadrants of 0.25cm^2 were randomly distributed in the sampled area to determine specie richness and percentage frequency. Results revealed that, *Chamaecrista rotundifolia* recorded the highest frequency (60%) followed by *Rhynchospora fascicularis* (50%), *Bothriochloa ischaemum* (40%) and *Tridax procumbens* (20%) in the rangeland. Majority of the identified plant species recorded the least frequencies of (10%) each. Grasses were dominant (60%) among the forage type. Majority (86%) of the identified plant species were perennial while 14% consisting of rabbit weed and sea barley exhibit biennial and annual life cycle, respectively. It was concluded that, the rangeland will sustain ruminant production as the specie richness and presence of dormant perennial grasses indicates characteristics of a good pasture.

Keywords: Forage, Quadrant, Rangeland and Specie

INTRODUCTION

Rangelands are defined as large areas of land which support native plants growing in association with each other and suitable mainly for grazing purposes (1). In Northern Nigeria, livestock are mainly reared under the nomadic pastoral system of grazing over large expanses of rangelands. Under this production system, livestock rely on natural pastures with little or no supplementation for their nourishment year-round. Extensive areas of Nigeria's grazing lands are composed of indigenous forage species with their various botanical characteristics (2). Despite the significant contribution of rangeland to the socio-economic lives of the inhabitants of developing countries, the resource is often abused and neglected in terms of planned utilization, development and management for sustainability (3).

Changes in the composition of plant species in savanna ecosystems have a significant influence on the sustainability of livestock production (4). Studies on plant diversity provide information on rangelands that can be used for the management and/or rehabilitation of degraded rangelands (5). Specie richness and agronomic features of range plant species is considered as an appropriate index for evaluating the current management status and hence, it can be used for the future planning of the desired ecosystems (6). Therefore, the broad objective of this study was to undertake an inventory assessment of rangeland plant species at a rangeland in College of Agriculture and Animal Science, Mando, Kaduna State, Nigeria.

MATERIAL AND METHODS

The study was conducted at rangeland area of College of Agriculture and Animal Science, Division of Agricultural Colleges, Ahmadu Bello University, Mando Road, Kaduna located on latitudes (10^0 and 20^0N) and longitudes (7^0 and 45^0E) in the Northern Guinea Savanna of Nigeria (7). The relative humidity during the dry season is about 15-20% (8). A rangeland area of 100m length by 100m width was marked out during the early mid dry season of 2023/2024 and was used for the study. To know about the species occurring in the rangeland, ten quadrants of 0.25cm^2 was randomly distributed in the sampled area. All the species

occurring in each quadrant was noted and their numerical count was carried out.

The plant species were identified by their common names. Those species that were difficult to identify in the field, samples were collected, pressed and later taken to the herbarium of the College where they were later identified by matching with the herbarium specimens or the use of plant identification software (plant identifier version 1.1.3) using an android mobile phone. The identified forages were then grouped into grasses, legumes, browses and other variables for agronomic feature occurrence. Names of species, number of individual species and specie richness in each unit were recorded and percentage frequency were calculated using the following formula recommended by (9).

$$\% \text{ Frequency (F)} = \frac{\text{Number of units in which the species occurred} \times 100}{\text{Total number of unit studied}}$$

RESULTS AND DISCUSSION

Chamaecrista rotundifolia was found to have the highest frequency (60%) followed by *Rhynchospora fascicularis* (50%), *Bothriochloa ischaemum* (40%) and *Tridax procumbens* 20%) in the rangeland. Majority of the identified plant species recorded the least frequencies of 10 % each. Grasses were dominant (60%) among the forage type. Majority (86%) of the identified plant species were perennial while 14% consist of rabbit weed and sea barley exhibit biennial and annual life cycle, respectively. In the present trial, greater species richness occurred for perennial plants. This could be attributed to the survival of the species during the dry season. Moreover, the range of forage species found in the rangeland is a characteristic of a good pasture as reported by Ekwe *et al.* (10). This could be a reason why the neighboring Fulani herdsmen are usually found on the College rangeland.

Table 1: Species richness and frequency of plant species on the rangeland area.

S/N	Botanical name	Number of Quadrants										F (%)
		1	2	3	4	5	6	7	8	9	10	
1.	*Lantana montevidensis*			X								10
2.	*Chamaecrista rotundifolia*			X	X		X	X			X	60
3.	*Rhynchospora fascicularis*			X	X		X	X			X	50
4.	*Ruellia nudiflora*			X								10
5.	*Bothriochloa ischaemum*		X		X			X			X	40
6.	*Andropogon schirensis*									X		10
7.	*Tridax procumbens*					X				X		20
8.	*Azadirachta indica*									X		10
9.	*Ammophila brevigulata*								X			10
10.	*Hypericum prolificum*											10
11.	*Alyscarpus vaginalis*											10
12.	*Erythrina lanceolata*	X										10
13.	*Hordeum murinum*	X										10
14.	*Andropogon gayanus*					X						10
15.	*Themada triandra*						X					10

X= specie richness, F = frequency

Table 2: Agronomic features occurrence in terms of forage type and life cycle on the rangeland.

Parameters	No (plant/0.25m^2)	Percentage (%)
Forage Type		
Grasses	9	60.0
Forbs	3	20.0
Shrubs	3	20.0
Total	15	100.00
Life Cycle		
Annual	1	6.7
Biennial	1	6.7
Perennial	13	86.6
Total	15	100.0

CONCLUSION

It was concluded that, the rangeland will sustain ruminant production as the specie richness and presence of dormant perennial grasses indicates characteristics of a good pasture.

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Ruminant Nutrition and Management: RMN001

DEGRADATION OF MAIZE STOVER DIET FORTIFIED WITH COWPEA GRAINS IN THE RUMEN OF YANKASA SHEEP

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ABSTRACT

Effect of fortification of maize stover (MS) with cowpea grain at 0, 10, 20, 30 and 40% on rumen degradation were evaluated using the nylon bag technique at the Teaching and Research Farm, Bayero University, Kano. Treatments were incubated for 0, 12, 24, 36, 48 and 72hrs using three matured fistulated Yankasa sheep. Levels of cowpea grain inclusion in the treatments had significant effect ($p<0.05$) on degradability of dry matter, with the 40% supplementation promoting higher degradability as from 24 to 48hrs. Extended period of incubation significantly influenced ($p<0.001$) MS in-sacco dry matter degradability in the following decreasing order of time 72, 48, 36, 24 and 12hrs. Longer incubation period also resulted in lower ether extracts, crude protein, crude fibre and ash content ($p>0.05$) of the feedstuffs evaluated. It was therefore concluded, that greater degradation of maize stover could be achieved by inclusion of 40% cowpea grain in the supplementation of Yankasa sheep. It is thus recommended that higher levels of cowpea grain inclusion should be assessed to attain maximum potential and the economic implications.

Keywords: Maize Stover, Cowpea Grain, Yankasa Ram, Rumen Degradation.

DESCRIPTION OF PROBLEM

Livestock contribute substantially to the world's human high biological value protein supply, especially in locations where human population is on the increase (1). However, for these animals to play a leading role in food supplies, their nutrient requirements will have to be given adequate attention (2).

Degradability tends to be relatively low in ruminants raised on crop residues such rice straws, degradability tends to be relatively low because of the high lingo-cellulose and low N content, providing insufficient nutrients for maintenance rations (3). However, increasing the protein content of diets fed to ruminants optimizes degradation of basal and or supplementary diets and may result in increased utilization of soluble nutrients with improved animal performance (3).

The potential of diets to meet the requirements of the animals for amino acids, glucogenic precursors and long chain fatty acid depends on the pattern of fermentation and on dietary proteins, lipids and starch which escape fermentation and are digested in the intestines (3).
Balancing rations for ruminants requires knowledge of the proportion of feed protein that escapes ruminal degradation (4). The extent to which the protein in a supplement escapes the rumen is partly a function of its rate of degradation in the rumen (5). The objectives of the research are to determine the effect of grain legume on the rate of *in vivo* rumen degradation in Yankasa rams, fed maize stover diets.

MATERIALS AND METHODS

Animals and Experimental Design

The experiment was conducted at the Bayero University Teaching and Research Farm. Bayero University, Kano**.** Five Yankasa sheep with an average weight of 20kg were purchased from local market around Kano

metropolis. The sheep were quarantined, ear-tagged and adapted following standard procedures. The animals were given 300g concentrate mixture (200g Cotton Seed Cake, 100g Maize bran) per animal as supplements at 8.00 hours, and groundnut haulms as roughage daily. Water and salt-lick blocks were offered *ad libitum*. At the end of the adaptation period, three of the animals were fitted with rumen cannulae having 40mm internal diameter. The fistulated animals were used to evaluate the rate of degradation of feeds formulated with graded levels of cowpea grain. The method of incubation in the rumen of the sheep was as described (6), (7) and (3)

Rumen Degradation Trial

Maize stover comprising of leaves and stem, fortified with graded levels of cowpea grains were incubated (in triplicates) to determine their rates of rumen degradation. The proportions of stover to cowpea grains were (100:0, 90:10, 80:20, 70:30, and 60:40) in degradation time of 0, 12, 24, 36, 48 and 72 hours. Before the incubation, the treatment components were milled separately to pass through a 2.5mm sieve.

Six nylon bags with a size 6.5 x 14 cm and made of nylon mesh were incubated for 0, 12, 24, 36, 48 and 72 hours and weighed. 5g of each treatment was weighed into the six nylon bags. The nylon bags and their contents that were not incubated, (0-hour incubation) were washed to determine the water-soluble fraction (a) in each treatment. Then 5 nylon bags containing 5g each of the same treatment were attached to the string using rubber rings. The samples were then introduced serially into the rumen through the cannula. The bags were inserted during the morning feeding time (8.00 hours). The sample (bag) for 72 hours' incubation goes in first, followed by the ones for 48 hours, 36 hours, 24 hours and the one for 12 hours goes in last. After each incubation time, nylon bag containing the sample for that time was removed and thoroughly washed under a running tap at the farm. The bags were thoroughly washed until the water coming out of the bag was clear (8; 3).

Chemical Analysis: One set of bags for each sample was also prepared and washed immediately to determine the readily soluble or extractable fraction (a). Following washing, all bags were dried at 60°C for 48 h. The proportion of DM degraded after each time interval, for each sample was calculated for each bag. The residuals from three bags of each sample for a sheep, after each incubation time, were bulked and analyzed for proximate composition according to standard procedure (9). The degradation characteristics of the ration was described using the exponential equation by (10):

$P = a + b (1 - e^{-ct})$

Where a, b and c are constants

a = intercept or immediate soluble fraction; b = insoluble but potentially degradable material at time t; c = rate of degradation per hour; e = natural logarithm; t = time lag and P = potential of degradation at time t

Statistical Analysis: All data were analysed using Microsoft Excel, (11) and were subjected to analysis of variance using the Statistical Analysis System (12). The Difference between treatments were considered significant at 5% probability ($p<0.05$).

RESULTS AND DISCUSSION

The proximate composition of maize stover fortified with varying levels of cowpea grain is presented in Table 1. Values obtained showed that there were significant differences ($p<0.05$) in the DM with the 0% level of cowpea inclusion having the least DM degradation and the highest degradation was in the 40% cowpea inclusion level. The EE composition decreased from 2.03% in the treatment without cowpea grain to 2.64% in the 40% cowpea included treatment, with no significant differences. There were significant differences in the composition of CP in the treatments with the treatment containing 0% cowpea inclusion rate having the lowest CP content of 6.70% and the highest CP content of 14.08% found in the treatment containing 40% cowpea grain.

The CF content of the samples decreased significantly from 46.53% for 0% cowpea inclusion rate to 39.38% in ration with 40% cowpea with significant ($p<0.05$) differences. The ash content of the samples were

significantly different ($p<0.05$), with 0% cowpea inclusion rate having the highest ash content while 40% cowpea inclusion rate had the least. The CP and EE contents increased with increased level of cowpea while the DM, CF and Ash decreased with the increase in cowpea inclusion.

Table 1: Proximate Composition of Maize Stover with Graded Inclusion Levels of Cowpea Grain

Proximate Composition (%)	Cowpea grain inclusion levels (%)					SEM	Significance
	0	10	20	30	40		
Dry matter	67.00[a]	66.66[b]	59.00[c]	55.67	45.00[d]	4.06	*
Ether extract	2.03	2.16	2.27	2.46	2.64	1.54	NS
Crude protein	6.70[e]	8.28[d]	9.16[c]	12.15[b]	14.08[a]	1.34	*
Crude fibre	46.53[a]	44.86[b]	43.07[c]	42.41[c]	39.38[d]	1.21	*
Ash	6.93[a]	6.20[b]	6.05[b]	4.87[c]	4.37[d]	0.47	*

Means along same row with different letters superscript differed significantly ($p<0.05$)
S.E.M.: standard error of the mean.
NS: Not significant; *: $p<0.05$.

Rate of Degradation of Experimental Diets

Addition of cowpea grains to Maize stover improved DM degradation from 12 hours of incubation, with the effect being more noticeable at 72hours of incubation. Soluble fraction (a) increased with higher inclusion of cowpea grain in both stover evaluated. Similarly, the insoluble but potentially degradable fraction at time t (b) increased with cowpea grain incorporation. The summation of the soluble fraction and the insoluble but potentially degradable fraction (a+b) also increased as level of cowpea grain in the evaluated stover increased. The rate of degradation (c) in maize decreased from 0 level of inclusion to 30% cowpea grain inclusion and increased afterwards.

Table 2: *In Situ* DM Degradation(hrs) of Maize Stover with Varying Cowpea Grain Inclusion, Obtained by Fitting Data of DM Degradation Over 72hrs Incubation to the Equation
$P = a+b\ (1-e^{-ct})$

***Levels(%)**	**DM Degradation (Hours)**					**A**	**b**	**a+b**	**c**
	12	24	36	48	72				
0	14	22	34	36	48	10	48	58	0.020
10	18	28	36	40	48	14	48	62	0.013
20	22	34	42	44	52	18	52	70	0.005
30	28	38	42	48	56	20	56	76	0.001
40	40	46	54	58	62	36	62	98	0.008
Mean	10.13	33.60	41.60	45.20	53.20	19.60	53.20	72.80	0.009
SEM	4.534	4.118	3.487	3.774	2.653	4.445	2.653	7.031	0.0033

* **Cowpea grains inclusion levels**
Means along same row with different letters superscript differed significantly ($p<0.05$)
DM: Dry Matter
S.E.M.: standard error of the mean.

CONCLUSION AND APPLICATIONS

1. Diets of maize stover supplemented with successive increments of cowpea grains resulted in enhanced degradation of total DM.

2. Greater DM degradation of maize stover can be achieved by inclusion of 40% cowpea grain as supplement to Yankasa sheep, since it gave the highest DM degradation and lowest nutritional values in the residues after incubation.

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Ruminant Nutrition and Management: RMN002

EFFECTS OF GRADED LEVELS OF CASSAVA PEELS (*Manihot esculentum* Cranz) SUPPLEMENTATION ON OFFALS AND ORGAN WEIGHT OF GOATS FED A BASAL DIET OF *Gmelina arborea* LEAVES

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ABSTRACT

The study was conducted to investigate the effects of graded levels of cassava peels supplementation on offal and organs weight of goats fed a basal diets of *Gmiliena arborea* leaves. Sixteen (16) goats with body weight of 18.25 – 19.00 kg were used for the study. The goats were weighed and divided into four (4) groups. Each group of four (4) goats were randomly assigned to one of the 4 treatment in a completely randomized design (CRD). Fresh *Gmelina arborea* leaves was fed as basal diet *ad libitum*, while cassava peels were fed as supplement at the levels of 0, 100, 150 and 200 g/head/day for T1 (control) T2,T3 and T4, respectively. Clean drinking water and mineral salt lick were provided *ad libitum* for twelve (12) weeks. Offal and organs weight indicated that there were significant ($p<0.05$) differences between the treatments except head, skin and omasum which did not differ significantly ($p>0.05$) among the treatments.T3 and T4 recorded the highest fasting weight, slaughter weight and dressed weight 32.49 – 34.63, 31.10 – 33.34 and 14.34- 14.40 (kg) respectively, while T1 (control) recorded the highest dressing percentage (46.42 %) and T4 recorded the least (42.24 %).In conclusion the result of the study showed that cassava peels fed at 200 g /head/day in the diet of goats do not affects offal and organs weight in goats.

Key words: goats, Offal weight, Cassava peels, Gmelina arborea, supplementation**.**

DESCRIPTION OF PROBLEM

The current high in price of conventional feedstuffs seems to warrant intensified efforts to find sustainable alternatives to the major feed inputs (maize or soybeans) that would support performance without compromising health of animals. The production of animal feeds that would meet the nutritional requirement of ruminants' animals is a great challenge because of the high cost of protein and energy feed ingredients. This situation has resulted in search for alternative feed ingredients to reduced production cost without compromising animal performance (1). Cassava peels (5-15 % of tuber weight), an important by-product of cassava, when processed could be used to replace corn or wheat in animal production (2). Cassava peels degrade rapidly in the rumen and has a high potential as energy feed (3), cassava peels is also used as livestock feed and regularly fed to sheep and goats in Africa. Majority of the smallholder sheep and goat farmers in southwest Nigeria regularly feed cassava peels as an energy supplement to grass and hay (3). The study was designed to determine the effects of graded levels of cassava peels on offal and organ characteristic of goats fed a basal diet of *Gmelina arborea* leaves.

MATERIALS AND METHODS

Study location

The study was conducted at the Livestock Teaching and Research Farm of the Department of Animal Health and Production Technology, Federal polytechnic Bali, Taraba State. Bali covers a total land area of about 5,500 KM and extends between latitude 80 and 351 0011 North of the equator and 100 461 0011 East of the Greenwich meridian (4). It lies within the guinea savannah zone. The climatic condition is characterized by dry and rainy season. Rainfall varies from 1000 mm – 1500 mm/annum, and the temperature ranges from 30 to 38^0 C depending on the season.

Experimental Animals and their Management

Prior to the commencement of the experiment the pens were thoroughly swept, washed and disinfected to eliminate any disease-causing organism. The goats were purchased from Graba Chede cattle market in Bali Local Government Area, of Taraba State. The goats were balanced for weight and divided into four (4) groups and each group of four (4) goats was randomly assigned to one of the treatments in a completely randomized design (CRD). The goats were vaccinated against PPR and pasteurellosis and treated against internal and external parasite with ivemectin injection based on individual body weight. The goats were fed for adaptation period of fourteen (14) days to enable them adjust to the diets and confinement before data collection. The study lasted for a period of 12 weeks (84 days).

Sample collection

At the end of the study, three experimental (3) goats were randomly selected from each treatment for offal and organ analysis based on average weight of the group. The goats were weighed and then starved overnight for 12 hours. The goats fasting weight were recorded in the morning before slaughter. The goats were slaughtered by transversely cutting the trachea, oesophagus, large carotid arteries and jugular vein to ensure maximum bleeding (5). Carcass characteristics were determined by measuring the live weight of the representative goat before slaughtering. The slaughtered animals were dressed and cut into component parts. The dressed carcass is the part of the goat left after the removal of the head, feet, skin, kidney and visceral organs. The weight of the dressed carcass were expressed as percentage of live weight to obtain the dressing percentage (5).

$$\text{Dressing percentage} = \frac{\text{Carcass Weight (kg)}}{\text{Live Weight (kg)}} \times 100$$

RESULT AND DISCUSSION

The result of offal's and organs weights is presented in Table 2. There were significant ($p<0.05$) differences in all the parameters measured except head, skin and omasum which did not differ significantly ($p>0.05$) between the treatment groups. Treatment 1 (control) recorded the heaviest weight of testis and lungs compared to T2, T3 and T4 diets. The weight of liver and spleen were heavier in T2, T3 and T4 than T1 (control) that recorded the least (1.86 and 1.44 %, respectively). T1 and T2 recorded the heavier weight of rumen than T3 and T4 with similar values. T1 (control), T2 (100 g CPM) and T3 (150 g CPM) had the heavier weight ($P<0.05$) of reticulum compared to T4 (200 g CPM). The weight of kidney were heavier ($P<0.05$) in T4 (200 g CPM) but did not differ ($P>0.05$) significantly from T1 (0 g CPM). However T1 (control) is similar to the other treatments groups.

The weight of head, skin and legs in the study were not affected by the level of treatments. (6) Reported that the weight of most non-carcass component (offal) depend more on weight at slaughter than on the level of treatment or chemical composition of the diets. (7) .Reported that components with a high proportion of bone and low metabolic activity (head and legs) showed little variation when animals were subjected to different levels of feeding. The weight of abdominal fat express as percentage of the slaughtered weight were 0.43, 1.33, 1.16, and 1.92 % for T1, T2, T3, and T4 diets, respectively. There were significant ($P<0.05$) differences of diets on fat deposition in thane abdominal region. Bucks fed T2, T3 and T4 diets recorded heavier abdominal fat compared to T1 diets however, values obtained for bucks on T2, T3 and T4 diets are within the range of 1.2-2.6 and 0.72-2.6 % reported by (8) and (9), respectively for West African dwarf goats.

The result of the organ weights in the study revealed that weight of liver, heart and spleen increased as the level of cassava peels increases in the diets. This agreed with the report of (10) who stated that weight of non-carcass component's, organs and viscera were heavier for animals fed ad libitum, compared with the animals fed at 25 and 50 % cassava peels. He further observed that the high dry matter intake could be responsible for further development of the stomach and liver to digest and metabolize greater amount of feed

and nutrient in animals with high feed availability. The range of values, 1.86-2.78, 1.78-2.90, 1.44- 1.192, 1.31-2.26 and 0.65 – 2.23 %, for liver, heart, spleen, kidney and lungs, respectively were higher than 2.15 – 2.23, 0.57 – 0.76, 0.17 – 0.20, 0.77 – 1.22 and 1.58 – 1.81 % for liver, heart, spleen, kidney, and lungs, respectively reported by (11) in West African dwarf goats fed *Panicum maximum* supplemented concentrate Bambara nut meal. Furthermore the difference in the organ weights might be attributed to the diets, levels of anti-nutritional factors and also individual animals' differences.

Table 1. Offal and Organ weight of Goats Fed *Gmelina arborea* Leaves and Graded Levels of Cassava Peels Express as Percentage of Slaughter Weight

	Levels of cassava peels				
Parameters	T1 (0 g)	T2 (100 g)	T3 (150 g)	T4 (200 g)	SEM
Fasting weight (Kg)	24.90^{b}	26.45^{b}	32.49^{a}	34.63^{a}	1.07*
Slaughter weight (Kg)	23.92^{b}	25.26^{b}	31.10^{a}	33.34^{a}	1.21*
Dressed weight (kg)	11.57^{b}	12.02^{b}	14.34^{a}	14.40^{a}	0.67*
Dressed percentage	46.42^{a}	45.44^{a}	44.14^{ab}	42.24^{b}	1.15*
Head	5.11	5.23	5.66	5.44	0.28^{NS}
Skin	5.16	5.14	5.36	5.44	O.41^{NS}
Legs	1.04^{b}	1.90^{a}	1.09^{b}	1.02^{b}	0.29*
Abdominal fat	0.43^{c}	1.33^{b}	1.16^{b}	1.92^{a}	0.15*
Liver	1.86^{b}	2.44^{a}	2.63^{a}	2.78^{a}	0.11*
Heart	1.78^{b}	2.01^{b}	2.22^{ab}	2.90^{a}	0.25*
Spleen	1.44^{b}	1.84^{a}	1.89^{a}	1.92^{a}	0.06*
Kidney	1.70^{ab}	1.31^{b}	1.33^{b}	2.26^{a}	0.21*
Small intestine	3.32^{a}	1.82^{b}	1.83^{b}	2.36^{a}	0.54*
Large intestine	1.09^{c}	1.88^{b}	2.52^{a}	1.22^{c}	0.09*
Rumen	3.81^{a}	2.00^{a}	2.19^{a}	1.70^{b}	0.22*
Reticulum	3.61^{a}	3.54^{a}	2.94^{a}	0.62^{b}	0.24*
Omasum	1.12	0.81	1.11	1.14	0.21^{NS}
Lungs	2.23^{a}	1.11^{b}	0.82^{b}	0.65^{b}	0.33*
Abomasum	2.76^{a}	1.99^{ab}	1.39^{b}	1.95^{ab}	0.28*
Testis	1.23^{a}	0.82^{b}	0.59^{c}	0.56^{c}	0.06*

SEM= Standard Error of Mean, NS= Not Significant, *= Significant, a,b,c = Mean on the same row with different superscript differ significantly (P<0.05).

CONCLUSION AND APPLICATION

Based on the offal and organ weight obtained in this study, goats fed 200 g/head/day supplementation of cassava peels in their diet hard better performance than goats in other treatment. The feed hard no detrimental effects on offal and organ weight of the experimental goats. This information will assist farmers and researchers in the area in addressing the problem of feeding goats during the dry season.

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Ruminant Nutrition and Management: RMN003

NUTRIENTS DIGESTIBILITY BY YANKASA RAMS FED BASAL *Digitaria smutsii* HAY SUPPLEMENTED WITH DIFFERENT PROTEIN SOURCES

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ABSTRACT

The study was conducted to evaluate the performance of Yankasa rams fed basal Digitaria smutsii hay supplemented with different protein sources. Sixteen (16) growing Yankasa rams with average live weight of 24.40±0.01kg were allotted to four (4) dietary treatments as diet without supplementation, diet supplemented with cotton seed cake, groundnut haulms, cowpea husk designated as T1 (control), T2, T3, and T4, respectively. Digestibility trial was designated in a completely randomized design (CRD), replicated (4) times. Nutrient digestibility showed that there were significant ($P<0.05$) differences in all the parameters evaluated. Conclusively, an inclusion level of 30% GNH was the best digestible compared to other diets. Thus, it is recommended that D. smutsii could be fed as basal diet to Yankasa rams supplemented with up to 30% GNH,

Keywords: Digestibility, Yankasa ram, Protein sources Suplementation and *Digitaria smutsii*

DESCRIPTION OF PROBLEMS

One of the major problems facing ruminant livestock production in Nigeria is nutrition (5). Another factor limiting the productivity of small ruminants in developing countries are nutrition, feed scarcity and over dependence on low digestible feeds which during the dry season cannot meet even the maintenance requirement of these animals (12). Grasses which are the most abundant basal feed for ruminant, most of the time dry up and become dominant (7). Majority of ruminants in tropical Africa are raised on natural pasture which decline rapidly in quality and quantity during the dry season and such changes in nutritional status result in very in-regular growth and development,

MATERIALS AND METHODS

Experimental area

The experiment was conducted at the Aliko Dangote University of Science and Technology Teaching and Research Farm, Gaya ($11^{0}51^{1}$ N; $9^{0}20^{1}$E; altitude 430m above sea level) in the semi-arid Kano, Nigeria. The area is characterized by a defined wet season which normally begins in May and ends in October. The mean annual rainfall is about 800mm, while temperature ranges between 20^{0}C in December to 43^{0}C in May (8).

Acquisition of Experimental Materials

Digitaria smutsii hay was obtained from the National Animal Production Research Institute (NAPRI) Shika, Zaria. Other feed ingredients in the diets includes ground nut haulms (GNH), cotton seed cake (CSC), cowpea husk (CH), rice milling residues (RMR), wheat bran (WB), sorghum chaff (SC) and salt were purchased from Wudil market. The experimental animals (Yankasa rams) were also purchased from the International Livestock market in Wudil, Kano State.

Experimental diets

The experimental animals were offered *Digitaria smutsii* hay *ad libitum* in the morning. They were later supplemented with the experimental supplements at 1.5% BW in the evening daily (Ibrahim *et al.*, 2018). The experimental study lasted for ten (10) weeks.

The treatments were as follows:

T_1 = Diet without supplementation (Control)

T_2= Diet Supplemented with 30% CSC

T_3= Diet supplemented with 30% GNH

T_4=Diet Supplemented with30% CPH

Other feed ingredients include wheat bran (WB), rice milling residues (RMR), sorghum chaff (SC) and salt.

Experimental Animals and their Management

Sixteen (16) growing Yankasa rams with an average live weight of 24.40 ± 0.1kg were quarantined for two weeks and ear tagged for easily identification. Prior to commencement of the study, the animals were given prophylactic treatments. They were dewormed with albendazole (2.5%) against endo-parasite, then. Injection Ivermectin was given at 0.1/10 kg body weight subcutaneously for ecto-parasites. Oxytetracycline 20% (LA) was given at 1ml/10kg body weight as broad spectrum antibiotic against bacterial infection (9). Experimental animals was fed with basal diet in the morning and supplemented with three protein sources in the afternoon around 2-4:00 pm. Fresh water was provided to experimental animals *ad libitum*.

Experimental Design and Treatments

The experimental animals were balanced by weight and allotted to four (4) treatments in a completely randomized design (CRD), replicated four (4) times. The treatments were T_1 (*D. smutsii* with RMR + WB and SC) as control, T_1 (*D. smutsii* supplemented with WB + RMR + SC + CSC), T_2 (*D. smutsii* + WB + RMR + SC + GNH and T_3 (*D. smutsii* + WB + RMR + CPH) T_4.

Nutrient intake and digestibility

Digestibility study was conducted at the end of feeding trial using three (3) animals per treatment which were randomly selected. The digestibility study lasted for three weeks (one week for the adaptation of harness bag and two weeks for sample collection). Fecal collection bags were used to collect the fecal sample and were fitted on the first day of adaptation.

Data collection

During the collection period, daily feed intake and total fecal output from each animal was recorded. After thorough mixing, 5% of the faeces were transferred into plastic containers for dry matter determination.

Chemical Analysis of the experimental diets

Basal Digitaria smutsii hay samples and other ingredients diets were taken to laboratory for chemical analysis .for {dry matter (DM), crude protein (CP), crude fibre (CF), ether extracts (EE), ash and nitrogen free extract (NFE)} were determined by procedures of (14). While for Fibre fractions, (ADF, NDF and (ADL) were determined using the procedure of (14)

Statistical Analysis

The data obtained were analyzed using the General Linear Model (GLM) of SAS (10) and significant differences in the treatment means were separated using Duncan Test (4) at 5% level of probability.

RESULTS

Nutrients digestibility (%) by Yankasa Rams fed basal *Digitaria smutsii* hay supplemented with different protein sources.

The results of nutrients digestibility by Yankasa rams fed basal *Digitaria smutsii* hay supplemented with three different protein sources was presented in Table1. The (DMD) was significantly ($P<0.05$) higher in T_4 (77.00%) and lower in T_1 (69.09%). In terms of crude protein digestibility (CPD) treatment 2, 3 and 4

were .similar (P<0.05) but higher than T_1 significantly (P<0.05), Treatment 3 was significantly (P>0.05) higher in terms of crude fiber digestibility (CFD), followed by T_4 and lower in T_1 and T_2 which were similar (P>0.05). The ether extract digestibility (EED) value was significantly (P>0.05) higher in T_2, followed by T_3 and T_4 and lower in T_1 significantly (P<0.05) .Ash digestibility (AshD) was significantly (P>0.05) higher in T_4 and lower in T_3. Treatment 4 was significantly (P>0.05) higher in terms of Nitrogen free extract digestibility (NFED), followed by T_3 and lower in T_1 and T_2. Nutrient detergent fiber digestibility (NDFD) was significantly (P>0.05) higher in T_3, other treatments were similar. Acid detergent fiber digestibility (ADFD) acid detergent lignin digestibility (ADLD) was significantly (P>0.05) higher in T_3 (77'10) and lower in T_2 (71'62) significantly (P<0.05). Cellulose digestibility (CELLD) was significantly (P>0.05) higher in T_3 and other treatments differ significantly (P>0.05). Hemicellulose digestibility (HEMD) was significantly (P>0.05) higher in T_4 (79.58) and lower in T_3 (72.52).

Table 2. Nutrients digestibility (g/day) by Yankasa Rams fed basal *Digitaria smutsii* hay supplemented with different protein sources.

	Treatments				
Parameters	**T_1 (0%)**	**T_2 (30%CSC)**	**T_3 (30%GNH)**	**T_4 (30%CPH)**	**SEM**
DMD	69.09^{d}	72.59^{b}	70.38^{c}	77.00^{a}	0.27
CPD	81.01^{b}	83.19^{a}	83.56^{a}	82.97^{a}	0.29
CFD	70.48^{c}	70.39^{c}	76.72^{a}	73.97^{b}	0.29
EED	82.04^{c}	80.55^{a}	86.07^{b}	84.35^{b}	0.25
AShD	74.27^{b}	77.05^{b}	73.26^{c}	74.34^{a}	0.28
NFED	85.95b^{c}	83.90^{c}	88.03^{b}	90.23^{a}	0.65
NDFD	84.25^{b}	83.99^{b}	86.83^{a}	85.99^{b}	0.33
ADFD	81.71^{c}	81.32^{c}	89.51^{a}	85.99^{b}	0.27
ADLD	77.10^{b}	71.62^{c}	76.98^{a}	76.22^{b}	0.37
CELLD	68.78^{d}	70.15^{c}	76.41^{a}	73.28^{b}	0.42
HEMD	74.35^{c}	77.50^{b}	72.52^{d}	79.58^{a}	0.30

^{ab} means within the same row with different superscript differs significantly (P<0.05). SEM= Standard means, DMD = Dry matter digestibility, CPD = Crude protein digestibility, EED = Ether extract digestibility, AshD = Ash digestibility, NFED = Nitrogen free extract digestibility, NDFD = Nitrogen detergent fibre digestibility, ADFD = Acid detergent fibre digestibility, ADLD = Acid detergent lignin, CELLD = Cellulose digestibility, HEMD = Hemicellulose digestibility

DISCUSSION

Nutrients digestibility (%) by Yankasa Rams fed basal *Digitaria smutsii* hay supplemented with different protein sources.

The dry matter digestibility (DMD) of the present study was similar with 67% reported by (1) for growing WAD sheep fed for ensiled maize stover and concentrate suplement. The dry matter digestibility (DMD), crude protein digestibility (CPD), nitrogen free extract digestibility (NFED) and ash digestibility (AshD) values obtained were higher than 69.81%, 78.21%, 59.14% and 72.36% respectively, reported by (3) for Yankasa rams fed cowpea haulms and groundnut haulms as protein supplements. The crude protein digestibility (CFD) and ether extract digestibility (EED) values obtained were higher in T3 than 84.25% and 94.20% reported by (3). The variation could be attributed to the varieties of cotton seed cake, ground nut haulms and cowpea husk used in the experiments. Experimental factors such as soil characteristics and rainfall amounts as well as crop management practices like fertilizer application, stage of maturity at harvest as stressed by Savadogo *et al.* (11). The variation in percentage digestibility of dry matter (DM), crude protein (CP) and acid detergent fiber (ADF) across the treatments in this study showed significant increase in dry matter observed which coincided with the report of (6) who reported increase in dry matter digestibility (DMD with legume supplementation. All feeds nutrients were higher in digestibility of diets of animals fed on the supplemented ground nut haulms, cotton seed cake and cowpea husk relative to those on *Digitaria smutsii* hay (control). Feeds with higher nutrient digestibility as in ground nut haulms improve the intake

and performance of sheep (13). Arkinson *et al.* (2) reported that feeding frequency has a positive impact on DM and CP digestibility.

CONCLUSION

In inclusion level of 30% GNH was the best digestible compared to other diets. Thus, it is recommended that D. smutsii could be fed as basal diet to Yankasa rams supplemented with up to 30% GNH,

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Ruminant Nutrition and Management: RMN004

NUTRIENT DIGESTIBILITY OF GROWING YANKASA RAMS FED MASAKWA AND SAMSORG-17 STOVER SORGHUMS VARIETIS AND CONCENTRATE DIETS

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ABSTRACT

An experiment was conducted to evaluate nutrient digestibility of growing Yankasa rams fed Masakwa, SAMSORG-17 and concentrates. Twelve (12) growing Yankasa rams (17.0±0.2 kg) were used and each serve as a replicate. Four (4) dietary treatments with three (3) replicates in a completely randomized design (CRD), which were T_1 = Masakwa crushe + concentrate daily, T_2 = SAMSORG-17 crushed + concentrate daily, T_3 = Masakwa chopped + concentrate daily and T_4 = SAMSORG-17 chopped + concentrate. Molasses was added to the stover daily at 5%. There were no significant ($P>0.05$) differences for all the digestibility parameters considered except for NDF which had significantly ($P<0.05$) higher nutrients digestibility values for rams fed SAMSORG-17 crush compared to the other treatment groups. Feeding Sorghums stover and concentrate to growing Yankasa rams at 2 and 1% body weight improves their nutrient digestibility.

Keywords: Digestibility, Sorghums stover, and rams,

INTRODUCTION

Sorghum (*Sorghum bicolor L. Moench*) is the fifth most important cereal crop in the world and second to maize in Africa [1]. It is widely grown in the subtropics, tropics and Africa continent. Of all Sorghum cultivars available for cultivation by farmers, "Masakwa" the dry Season - Sorghum has occupied an important position for some time in the region [2]. This cereal crop grows very well on Vertisol (30 – 60% clay), heavy and light alluviums, red, gray, yellow loams and sandy soil [3]. SAMSORG-16 and SAMSORG-17 are grain sorghum varieties with released names SSV2 (FBL) and KSV3 (SK.5912), respectively [4]. They are potential forage crops that are adapted to Northern and Southern Guinea Savanna zones of Nigeria. Several works had shown that young animals raised on forages alone had lower daily gains, dressing percentage and carcass quality than those supplemented with concentrate [5, 6, 7 and 8]. Concentrate feeds promote rapid growth of sheep and cattle [9], Feed additives are important components used in improving nutritional quality of feed which is influenced not only by nutrient content but also by other aspects such as hygiene, digestibility, palatability and pH stabilization [10]. Molasses is a by-product of the sugar industry and reduces the dustiness of feeds with fine particles [11]. Molasses is used to enhance the quality of pelleted feed and reduces the dustiness of feeds with fine particles [12]. However, it has been observed that the main constraint of traditional storage of crop residues was the gradual loss of their nutrients, their level of digestibility, and their digestion potential [13]. Digestion is the one of the problem face by animals because is basic that lead to output of animals product when the digestion is excellent there is nutrient utilization by the animals. However this study was aimed to evaluate the apparent nutrient digestibility of concentrate and stover of two sorghum varieties under different processing method (chopped and crushed) fortified with 5% molasses inclusion.

MATERIALS AND METHOD

Study area

The experiment was conducted at the sheep unit of the Teaching and Research Farm, Department of Animal Science Faculty of Agriculture, Ahmadu Bello University, Zaria Kaduna State, Nigeria. Zaria is located between two latitude of 11^0 14' 14''N and two longitude 7^0 38' 65''E at an altitude of 610m above sea level (Ovimap, 2016), within the Northern Guinea Savannah Zone of Nigeria.

Source of experimental animals and their management

Twelve Yankasa rams of average weight of 18±0.5kg were used for the experiment and were sourced from Getso Monday Market, Gwarzo Local Government, Kano State. Feeding troughs and drinkers were thoroughly washed and disinfected before the arrival of the animals. The animals were dewormed with Albendazole oral suspension at 1 ml per kg live weight and 0.1ml/10kg body weight of Ivermectin was used to treat against endo and ectoparasites during the adjustment period of 10 days.

Feeds, Feeding Management, Data Collection and analysis

Masakwa and SAMSORG-17 sorghums stover were harvested at 12 weeks after grown in Feeds and Nutrition Research Program of National Animal Production Research Institute, Shika, Zaria. After being harvested, each variety was divided into two Masakwa; half were chopped and other half were crushed and the same applied to SAMSOR-17. The cutlass was used for chopping while a machine for crusher was used for crushing. Stover was sundried with adequate turning. There was uniform inclusion of 5% molasses in both stovers before giving to the animals. The rams were balanced for their weight before being randomly allocated to dietary treatments arranged in a Complete Randomized Design (CRD). Three rams were assigned per treatment for the crushed and chopped sorghums stover prepared from both Masakwa and SAMSORG-17. The animals were fed experimental diets (sorghum stover) in their individual crate at 2% of their body weight. A concentrate diet was formulated and fed to animals at 1% of their body weight and fed to animals before offering stover. The experimental animals were taken to the metabolic crate individually and the animals were allowed to get accustomed to the crate for a period of 10 days.

Faecal output was weighed and 10% of each day's collection was sub sampled and oven dried at 60°C for dry matter determination which was bulked and stored until ready for laboratory analysis and dry matter (DM), Ash, crude fibre (CF), crude protein (CP), nitrogen free extract (NFE), acid detergent fibre (ADF) and neutral detergent fibre (NDF) according to AOAC (2005). The samples were collected for 7 days.
The digestion coefficient was calculated using formula

$$\text{The percentage digestibility} = \% \frac{\text{Nutrient in feed} - \%\text{Nutrient in faeces}}{\%\text{Nutrient in faeces}} \times 100$$

faecal samples was analyzed for dry matter (DM), Ash, crude fibre (CF), crude protein (CP), nitrogen free extract (NFE), acid detergent fibre (ADF) and neutral detergent fibre (NDF) according to AOAC (2005).

Table 1: Chemical Composition of Experimental Diets Fed to Growing Yankasa rams

		Masakwa		SAMSORG-17	
Parameters %	**Concentrate**	**Chopped**	**Crushed**	**Chopped**	**Crushed**
Dry Matter	88.88	90.06	90.51	91.03	91.24
Crude Protein	11.88	11.02	11.14	11.29	11.38
Crude Fiber	10.80	30.89	30.89	30.73	30.81
Ether Extract	4.12	0.46	0.49	0.47	0.48
Ash	5.21	6.77	6.72	6.70	6.59
NFE	68.33	50.79	50.70	50.72	50.80
ADF	33.14	28.44	28.44	28.68	28.75
NDF	60.79	64.78	65.13	65.64	65.66

NFE = Nitrogen Free Extract, ADF = Acid Detergent Fiber, NDF = Neutral Detergent Fiber

Data collection

Daily faecal output was weighed and 10% of each day's collection was sub sampled and oven dried at 60°C for dry matter determination which was bulked and stored until ready for laboratory analysis. Data collected was statistically analyzed using the General Linear Model Procedure (SAS, 2002). Differences in means were separated using Duncan Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

The apparent nutrient digestibility of growing Yankasa rams fed two sorghums variety (Masakwa and SAMSORG-17) and concentrate fortified with molasses is shown in table 2. It was observed that all the parameters were statistically (P>0.05) the same with the exceptional of NDF, which had significantly (P<0.05) higher digestibility values for rams fed SAMSORG-17 crushed compared with those fed Maskwa crushed. However, the values were statistically similar with those fed both in Masakwa chopped and SAMSORG-17 chopped. The report is not in line with that [15] who fed sorghum hay and silage with concentrate supplementation and obtained significant difference in DM, CP and NDF. The results are also not in line with [14] who fed Digitataria smutsii hay, sweet sorghum silage and SAMSORG-17 hay in combinations with concentrate diet to Red Sokoto bucks. From studies is revealed that Chopped Masakwa + Concentrate treatment resulted in a higher NDF value (63.99%) compared to the Crushed treatment (42.20%), suggesting that the physical form of the feed (chopped vs. crushed) can influence the fiber content. Crushed SAMSORG17 + Concentrate, the treatment showed a much higher NDF value (74.23%) than the Chopped treatment (57.05%). This is contrary to the trend observed with the Masakwa variety.

Table 2: Apparent Nutrient Digestibility of Growing Yankasa Rams Fed Stover of Two Sorghum Varieties and Concentrate Fortified with Molasses

	Masakwa + Concentrate		SAMSORG17+Concentrate		
Parameters %	**Chopped**	**Crushed**	**Chopped**	**Crushed**	**SEM**
Dry matter	77.61	67.13	73.95	74.61	4.34
CP	26.94	24.19	21.24	20.17	2.37
EE	69.18	65.33	64.19	63.07	2.32
Ash	44.52	52.28	41.18	33.44	5.79
NFE	52.16	58.16	58.95	61.66	3.45
ADF	31.72	30.59	29.51	30.92	0.82
NDF	63.99^{ab}	42.20^{b}	57.05^{ab}	74.23^{a}	6.53
CF	49.89	45.72	45.99	45.72	2.32

^{abc} Means with the same superscript along the rows are not significantly different at 5%. SEM = Standard Error Mean, CP = Crude Protein, CF = Crude Fibre, EE = Eater Extract, NFE = Nitrogen Free Extract, ADF = Acid Detergent Fibre, NDF = Nitrogen Detergent Fibre,

CONCLUSION

From the study it was concluded that there was no significant differences in apparent nutrient digestibility coefficient of feeding growing Yankasa rams with either chopped or crushed Masakwa and SAMSORG-17 sorghums stover. Though in NDF apparent nutrient digestibility, which represents the cell wall components (hemicellulose, cellulose, and lignin) of the feed, varied significantly depending on the treatment and sorghum variety. The study suggests that both the type of sorghum variety and the physical processing of the stover (chopped vs. crushed) significantly affect the NDF content in the diet of Yankasa rams. This could have implications for the digestibility coefficient and overall nutritional value of the feed.

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Ruminant Nutrition and Management: RMN005

PREFERENCE COEFFICIENT OF WEST AFRICA DWARF GOATS FED TREATED RICE HUSK AS REPLACEMENT FOR WHEAT BRAN.

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ABSTRACT

The study was conducted to evaluate the coefficient of preference of treated rice husk as a replacement for wheat bran on the performance of West African Dwarf (WAD)goats. Nine (9) WAD goats of about 45 weeks old with average weight of +– 8.6 kg were fed the test-formulated feed. The diets were weighed and randomly placed in feeding troughs of 30 cm in diameter in a 20 m x 20 m size pen. In triplicates, 1 kg each of the formulated feed with treated rice husk was placed in strategic locations in plastic feeding troughs. The feeding of the WAD goats lasted 14 days with 7 days' adjustment and 7 days' data collection periods. The goats were allowed to feed for two hours between 08:00 to 10:00 am daily. The positioning of the feed was changed daily to avoid the animals sticking to the same feed in the particular position. The feed preferred was assessed from the coefficient of preference (CoP) value, calculated from the ratio between the intakes for the individual feed, divided by the average intake of the forages. Consumption was measured by deduction of remnants from the amount of feed served. Therefore, feed was inferred to be relatively acceptable provided the CoP was greater than unity (1). Chemical composition of the diets differed (T1,0% rice husk < T2,25% rice husk < T3,50% rice husk < T4,75% rice husk < T5,100% rice husk). The study revealed that diets T1,0% RH and T3,25% RH were more preferred as their CoP was observed to be above unity compared to others, which were less preferred with their CoP below unity. This calls for further studies to ascertain nutrient utilization in treated rice husk to replace wheat bran in WAD goat diet using other means of evaluation studies.

Keywords: Acceptability, Rice husk, Coefficient, Preference, West African Dwarf goat

INTRODUCTION

The West African Dwarf Goat (WADG) is a widely reared breed in West Africa, particularly by small-scale farmers, due to its adaptability to harsh environmental conditions and its potential for meat production (1). In order to maximize productivity and improve carcass characteristics, it is crucial to ensure optimal nutritional intake for these goats. Wheat bran, a byproduct of wheat flour milling, is commonly used as a feed ingredient for ruminant animals. It is known to offer high energy content and fiber, which contribute to animal growth and development (7). However, the availability and affordability of wheat bran may vary depending on geographic location and market fluctuations. As a result, alternative feed sources need to be explored to address potential challenges and limitations associated with traditional feed resources. Rice husk, on the other hand, is a byproduct of the rice milling industry and is often considered an agricultural waste. However, it contains a significant amount of nutrients, including carbohydrates, fiber, and minerals. Utilizing rice husk as an alternative feed source could have the potential to alleviate pressure on traditional feed resources and provide a cost-effective solution for goat nutrition (5). In order to fully understand the impact of utilizing rice husk as a replacement for wheat bran in the diet of West African Dwarf Goats, it is important to evaluate the coefficient of preference for this feed option. The coefficient of preference refers to the measure of how much an animal prefers or selects a particular feed option over others. It takes into account factors such as taste, smell, texture, and nutritional value. By studying the coefficient of preference for West African Dwarf Goats fed treated rice husk as a replacement for wheat bran, this research aims to provide

insights into the acceptability and palatability of this alternative feed source. Additionally, this research seeks to understand the potential effects of this dietary replacement on the carcass characteristics of the goats. The findings from this research could contribute to the development of sustainable and cost-effective feeding strategies for West African Dwarf goat production. This, in turn, has the potential to enhance profitability and sustainability in small-scale farming systems. Furthermore, this research may recommend the utilization of agricultural byproducts, like rice husk, thereby reducing waste and improving resource efficiency.

MATERIALS AND METHODS

Experimental site

This research work was carried out at the Small Ruminant Unit, Teaching and Research Farm, Faculty of Agriculture, Kwara State University, Malete, Moro Local Government, Nigeria.

Experimental material and collection

Rice husk was collected from a rice milling industry. Dried cassava peels and soybean cheese waste were obtained at Shao and Malete, Moro Local Government Area, Kwara State.

Improvement of rice husk

Three litres of water were introduced into a cooking pot and allowed to boil after which 500 g rice husk was weighed, introduced into the boiling water and allowed to boil for 150 minutes with continuous stirring to obtain a homogenous mixture. The cooked rice husk was strained to remove excess water and dried to 35% dry matter. After which the rice husk was packed inside an air-tight polythene bag, and it was allowed to ferment for 20 days after which it was dried, packed, and weighed to formulate experimental diets (Table 1).

Management of experimental animals

The study was conducted using nine (9) WAD goats with an average weight of $^{+}_{-}$ 8.6 kg. The animals were purchased from the local goat rearers at Oro and Alapa areas of Kwara State. Prior to commencement of the experiment, the pens were swept, washed and disinfected using Moriguard. The goats were treated against external parasites using pour-on and dewormed with the aid of active ingredient. The animals were also treated with oxytetracycline HCl (a broad spectrum antibiotics) and vaccinated against Peste des Petits ruminants (PPR).

Acceptability study

Nine (9) West African dwarf goats of average weight of $^{+}_{-}$ 9 kg were used to evaluate the free-choice intake of formulated feed with treated rice husk to replace wheat bran mixed with cassava peels, palm kernel cake and enriched with soybean cheese waste. In triplicates, 1 kg each of the formulated feed with treated rice husk was placed in strategic locations in plastic feeding troughs. The feeding of the WAD goats to determine relative preference and acceptability lasted 14 days with 7 days' adjustment and 7 days' data collection periods. The goats were allowed to feed for two hours between 08:00 to 10:00 am daily. The positioning of the feed was changed daily to avoid the animals sticking to the same feed in the particular position. The feed preferred was assessed from the coefficient of preference (CoP) value, calculated from the ratio between the intakes for the individual feed, divided by the average intake of the forages (6). Consumption was measured by deduction of remnants from the amount of feed served. Therefore, feed was inferred to be relatively acceptable provided the CoP was greater than unity one (1).

Chemical composition of the experimental diet

Dried Samples were analyzed for crude protein, crude fibre, ether extract, and ash, according to the methods described by AOAC, (2012). 200 g were taken from each of the treatment sample and oven-dried to a constant weight at 65° C. The dried samples were milled through a 1mm sieve and crude protein was determined with micro kjeldhal distillation apparatus. Neutral detergent fibre, (NDF) acid detergent fibre (ADF), and acid detergent lignin (ADL) were determined according to the (13) method. Hemicellulose was

calculated as the differences between NDF and ADF while Cellulose was calculated as the differences between ADF and ADL.

Statistical Analysis

Data collected for all determined parameters were subjected to Analysis of Variance (ANOVA) and differences between treatment means were separated by least significance difference using General Linear Model procedure of Statistical Analysis System (DSAASTAT, 2011).

RESULTS AND DISCUSSION

The chemical composition of the experimental diets suggests that treated rice husk can be used to replace wheat bran up to 50%RH replacement as a crude protein and carbohydrate (CHO) source for ruminants especially during the dry season. The crude protein, crude fibre, crude fat, ash and CHO values obtained for the experimental diets used in this study were similar to the values reported by (7). The crude fibre content of the experimental diets in the study was lower than the value (34.85%) reported by (12). The contrast could be as a result of the treated rice husk inclusion in the diets. However, the crude fibre fraction values of ADF, NDF and ADL for all the experimental diets were lower than the values 62.29% NDF, 47.83% ADF and 20.25% ADL reported by (11). According to (12), ADF is used to produce energy content of feed which goes with the T5 (100%RH) having the highest ADF with higher energy content also. ADL is the lignin cellulose fraction of ADF (10) hence, diet in T1(0%RH) was seen to have the lower values of lignin and cellulose (6.13%). The lowest value (0.22%) for hemicellulose was recorded in T5 (100%RH) while T1 0%RH had the highest hemicellulose which indicates that energy sources were present.

Table 1: Chemical composition (%) of the experimental diets.

Trt	DM	CP	CFAT	CF	ASH	CHO	NDF	ADF	ADL	HMC	CELL
T1	96.15^{c}	12.23^{b}	3.55^{c}	11.62^{e}	10.03^{e}	58.81^{a}	39.62^{e}	20.18^{e}	14.05^{e}	19.44	6.13
T2	97.31^{a}	13.04^{a}	3.59^{b}	15.81^{d}	13.18^{d}	51.69^{b}	39.67^{d}	29.08^{d}	19.03^{d}	10.59	10.05
T3	96.13^{c}	9.12^{d}	2.88^{d}	20.55^{b}	14.86^{c}	48.69^{c}	43.76^{b}	34.38^{c}	21.93^{c}	9.38	12.45
T4	97.20^{b}	11.47^{c}	3.92^{a}	20.94^{a}	15.26^{b}	45.61^{e}	44.12^{a}	42.25^{b}	29.55^{a}	1.87	12.7
T5	97.31^{a}	7.59^{e}	2.42^{e}	19.50^{c}	17.15^{a}	50.64^{c}	42.12^{c}	42.34^{a}	27.95^{b}	0.22	14.39
S.E.M	1.52	5.77	4.47	5.38	1.55	4.94	5.37	5.38	5.28	0.01	5.38
P-value	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Trt= Treatment; WB=Wheat Bran, RH-Rice Husk, DM= Dry matter, CP= Crude protein, CFAT=Crude Fat, CF=Crude fibre, CHO= Carbohydrate, NDF= Neutral detergent fibre, ADF= Acid detergent fibre, ADL= Acid detergent lignin, HMC= Hemicellulose, CELL= Cellulose, T1 (RH0%), T2 (RH25%), T3 (RH50%), T4 (RH75%), T5 (RH100%).

Another method of evaluating the nutritive values of a feed for ruminant is through acceptability studies. Diets T1(0% RH) and T3(25%RH) were more preferred as their CoP was observed to be above unity compared to others in which were less preferred with their CoP below unity. As the days were progressing, the animals were accustomed to the feed as the intakes were observed to increase progressively. T1 (0%RH) and T2 (25%RH) were more accepted with their CoP above unity and this could be due to their CP content, sweet smell, palatability and texture of the feed at higher inclusion of wheat bran. (4) and (6) reported that factors that might affect acceptability include the physical structure of the feed, chemical composition, smell, taste, harshness and presence of anti-nutritional factors. The reasons for more preferred diets in T1 (0%RH, 1.82) and T3 (1.84) in the first day were attributed to the report of (3) which states that when feed is newly introduced to animals they may completely reject or consume less quantity feed.

Table 2: Intake (kg) and coefficient of preference of the experimental diets fed WAD goats.

Days	T1(0	%RH)	T2(25	%RH)	T3(50	%RH)	T4(75	%RH)	T5(100	%RH)	SEM	P-value
	F1	CoP	F1	CoP	FI	CoP	FI	CoP	FI	CoP		
1	0.38	1.82^{a}	0.41	0.66^{a}	0.47	1.84^{a}	0.09	0.51^{b}	0.03	0.13^{c}	0.31	0.0079
2	0.41	2.31^{a}	0.22	1.22^{b}	0.14	0.80^{c}	0.09	0.50^{c}	0.04	0.17^{e}	0.15	<0.01
3	0.47	2.42^{a}	0.22	1.15^{b}	0.16	0.80^{c}	0.04	0.23^{e}	0.08	0.41^{d}	0.10	<0.01
4	0.45	2.15^{a}	0.26	1.25^{b}	0.20	0.95^{c}	0.08	0.36^{d}	0.06	0.28^{d}	8.22	<0.01
5	0.26	2.05^{a}	0.23	1.35^{b}	0.14	0.83^{c}	0.06	0.38^{d}	0.06	0.28^{d}	9.45	<0.01
6	0.49	2.21^{a}	0.27	1.23^{b}	0.17	0.77^{c}	0.09	0.40^{d}	0.06	0.28^{e}	7.63	<0.01
7	0.49	2.29^{a}	0.31	1.44^{b}	0.15	0.69^{c}	0.09	0.39^{d}	0.04	0.18^{d}	7.68	<0.01

FI = Feed intake (kg), CoP = Coefficient of preference, RH=Rice husk, ^{abcde}=Means with the same letters with the column are not significantly different (p>0.05). T1=0%Rice husk, T2=25%Rice husk, T3=50%Rice husk, T4=75%Rice husk, T5=100%Rice husk.

CONCLUSION

West African Dwarf (WAD) goats vary in their preference and acceptability for treated rice husk. The pattern of preference gives a clue of the ultimate nutrients utilization in treated rice husk and the level of productivity. The preference rankings, based on acceptability or preference showed that diet T1, 0%RH and T2, 25%RH was most preferred by the WAD goats amongst the treatment diets due to their palatability and high protein content.

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Ruminant Nutrition and Management: RMN006

EFFECTS OF ADDITION OF SUGAR ADDITVES AND VARYING FERMENTATION DAYS ON SILAGE pH AND ORGANOLEPTIC CHARACTERISTICS OF RICE MILLING WASTE

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ABSTRACT

The effects of sugar additives (molasses and pineapple peels) and fermentation days on ensiled rice milling waste were studied. Rice milling waste with molasses or pineapple peel mixture was ensiled in three treatments: T_1 (Control), T_2 (rice milling waste 80% + 20% molasses) and T_3 (rice milling waste 60% + 40% pineapple peel). The experiment was laid in a completely randomized design (CRD) with three (3) replications per treatments. All the replicates were ensiled in an open-mouthed kilner jar (cope Bs 910-8, 100ml) for 20 fermentation days in the laboratory. Samples per treatment were taken at different fermentation days; 0, 5, 10, 15, and 20 for pH analysis and analysis of organoleptic characteristics. The results shows that pH value of the results significantly increases ($p<0.05$) in all treatments across the fermentation days. Similarly, the color and aroma in T2 and T3 were the best compared to the control T1 across the fermentation days. The overall findings of the study suggested that addition of 40% pineapple peel in rice milling waste silage for 15-20 fermentation days could improve ruminant's animal production in the tropics.

Keywords: Rice milling waste; Molasses; pineapple peel; silage and fermentation days.

DESCRIPTION OF PROBLEM

High cost of feed and feed ingredients, especially the conventional energy and protein feed ingredients are among the major factor influencing intensive animal production in Nigeria (1). Meanwhile, rice milling waste is presently considered as waste, which when disposed, constitutes environmental hazards. Rice milling waste generally are not offered to animals as feed, the major challenges are however, its high level of fiber (33.18% CF), low protein (5.25% CP) and energy (3.66 kcal/g) (2), (3). Studies have shown that the nutritional value of rice milling waste can be significantly improved by processing/treatment techniques such as mechanical treatment and ensiling with additives, especially sugar additives, which have proven to improve the palatability and quality of forages and crop residues that are of low quality (4), (5). The objectives of the study were to determine the effect sugar additives and fermentation days on pH and organoleptic characteristics (color and aroma) most suitable for feeding ruminants animals in the tropics.

MATERIALS AND METHODS

Study Area

The study was conducted at Department of Animal Science Laboratory; Federal University Dutse, Jigawa State of latitude: 11.0 °N to 13.0 °N and longitude: 8.0 °E to 10.1 °E. (6).

Experimental Design

The experiment was laid out in a Completely Randomized Design (RCD) consisting three (3) treatments namely: T1 (rice milling waste without additive) serving as control; T2 (rice milling waste 80% and molasses 20%) and T3 (rice milling waste 60% and pineapple peel 40%) each in triplicate. Data on each replicate was taken 5 times on 5 days interval from day 0 up to day 20.

Preparation of Rice Milling waste for Ensiling

Rice milling waste was collected from Majestik Dairy farm Birnin-kudu Jigawa state. Each of the treatments were ensiled in *in vitro* silos and filled to the brim in three replicates. The silos were kept at a temperature (28 – 30ºC) for 20 days' incubation period in the laboratory.

Statistical Analyses

The data generated from the effects of additives and fermentation days on pH and temperature of rice milling waste silage were analyzed statistically using graph pack prism version 8.0.2 and means was separated using turkey's multiple comparable test.

Determination of pH and Organoleptic Characteristics

Based on days' interval during the fermentation, the silos were opened, observed, scored for color and scored for aroma on a subjective score of 1-4 as described in below; then, pH and temperature of the ensiled materials were determined using a combined digital pH/temperature meter model: PHS-25.

Table I: Description of color and aroma used as good silage indicator

Score	Color	Aroma
1	Yellowish green	Putrid or rancid
2	Pale yellow	Pleasant
3	Light brown	Sweet
4	Dark or Deep brown	Very sweet

Source: (7)

RESULTS AND DISCUSSION

Silage Color and Aroma

As shown in **table II** the color of the treatments across the fermentation days shows light brown in T1 and T3 because of the nature of the rice milling waste used (dried form) and deep brown in T2 basically because of the dark color of molasses. The aroma (sweet and very sweet) got in T3 and T2 respectively were in-line with the findings of (8) and (9).

Silage pH indicates the level of acidity and alkalinity of the resultant silage, it also indicates the palatability of silage as it indicates the level of lactic acid. The pH of T2 and T3 shows significant difference ($p<0.001$) across the fermentation days, indicating values within the recommended range of pH in silages 3.5-4.5 (10). The pH obtained in this study agrees with the findings of (4) for rice straw ensiled with molasses and contrary to findings of (11) for urea treated rice milling waste.

CONCLUSION

There is a strong relationship between silage additives and fermentation days. This study shows that ensiling rice milling waste with pineapple peel for 15-20 days yields qualitative silage as it leads to the production of moderate silage aroma and more stable pH.

Table II: Effect of fermentation days on color and aroma in rice willing waste and sugar additives.

Treatments	Fermentation days		
		Color	Aroma
T1 (Control 100% RMW)	0	3	2
	5	3	2
	10	3	2
	15	3	2
	20	3	2
T2 (RMW 80% + molasses 20%)	0	4	4
	5	4	4
	10	4	3
	15	4	3
	20	4	3
T3 (RMW 60% + pineapple peel 40%)	0	3	2
	5	3	2
	10	3	3
	15	3	3
	20	3	3

Table III: Effects of additives and fermentation days on pH and temperature of rice milling waste silage.

		Treatments			*P*-values		
Parameters	F-days	T1	T2	T3	Trt	FD	Trt*FD
pH	0	3.23±0.03	4.30±0.00	4.00±0.00	<0.0001	<0.0001	<0.0001
	5	3.67±0.12	4.63±0.03	4.34±0.05			
	10	3.70±0.60	5.09±0.01	4.52±0.01			
	15	4.00±0.60	4.72±0.01	4.55±0.04			
	20	3.9±0.56	5.14±0.01	4.23±0.01			

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BLOOD CHARACTERISTICS OF RED SOKOTO GOATS FEEDLOTTED ON CROP RESIDUES DURING DRY SEASON

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ABSTRACT

Fifteen Red Sokoto bucks were assigned to five treatments diets consisting of a combination of cowpea husks, cowpea haulms and sorghum stover with cowpea husk inclusion levels at 0, 25, 50, 75 and 100% to replace cowpea haulms at 100, 75, 50, 25 and 0% respectively designated as T1, T2, T3, T4 and T5 to evaluate the blood characteristics of feed-lotted Red Sokoto goats on selected crop residues. Ten goats were randomly selected and blood samples withdrawn from each of them to analyse for haematological and serum biochemical composition. Data obtained were subjected to analysis of variance (ANOVA). Results showed that apart from basophils, eosinophils, MCHC and the MCH, all the other haematological parameters were significantly ($P<0.05$) influenced by the dietary treatments. Total protein, blood glucose and blood urea as well as blood sodium and zinc were significantly ($P < 0.05$) influenced by the dietary treatments. Values achieved for haematological, serum biochemical and blood mineral parameters were within normal range for healthy Red Sokoto goats, implying that the test diets did not induce any adverse effect on the health of the goats

Keywords: Red Sokoto goats, crop residues, haematology, serum biochemistry.

DESCRIPTION OF PROBLEM

Crop residues are important feed resources, and increased ruminant production can be accomplished through improved utilization of the crop residues (1). Large tons of crop residues are generated yearly which, together with by-products could result in environmental burden or pollution if not recycled or consumed by livestock. According to (2) efforts are being geared towards harnessing crop residues or by-products into animal feed. Crop residues such as sorghum stover, cowpea haulms and cowpea husk are vital feedstuffs for ruminants (3). Cowpea haulms (4) and cowpea husks (5) are well accepted by goats and could serve as an efficient fattening ration and dry-season feed for ruminants, especially in the Sahel regions of West Africa (6). The objective of this study is, therefore, to determine the blood characteristics of Red Sokoto goats feedlotted on crop residues composed of sorghum stover, cowpea haulms and cowpea husks.

MATERIAL AND METHODS

Location of Study Area

The research was carried out in the Livestock Teaching and Research Farm, Federal Polytechnic, Bali B ward, Bali Local Government Area (LGA) of Taraba state, Nigeria. Bali covers a total land area of about 5,500km and extends between latitude 8^{O} and 35 '00'' North of the equator and 10^{O} 46' 00'' East of the Greenwich Meridian (7).

Experimental Animal and Diets

Fifteen weaned Red Sokoto goats of about five (5) months of age were sourced from the goat unit of the teaching and research farm, used to carry out the experiment. Crop residues such as sorghum stover, cowpea haulms and cowpea husks were sourced from Gazabu grain market in Bali B, Bali L.G.A, crushed and used to compound the treatment diets. Five diets were formulated using cowpea haulms and cowpea husks as test ingredients in graded levels of 0, 25, 50, 75 and 100% designated as T1, T2, T3, T4 and T5. Each goat represented a replicate giving a total of 3 goats per treatment.

Table 1: Composition of treatment diets (%) fed RSG during dry season.

Ingredients	T1	T2	T3	T4	T5
Sorghum stover	50.00	50.00	50.00	50.00	50.00
Cowpea husk	0 .00	11.75	23.50	35.25	47.00
Cowpea haulms	47.00	35.25	23.50	11.75	0.00
Bone ash	2.00	2.00	2.00	2.00	2.00
Common salt	1.00	1.00	1.00	1.00	1.00
Total	100.00	100.00	100.00	100.00	100.00
Calculated (%)					
Crude protein	10.00	9.30	9.00	8.10	7.40
Crude fibre	29.20	29.92	30.59	31.32	32.00
Ether extract	10.26	10.12	9.65	9.72	9.47
Ash	8.00	7.65	7.40	7.00	6.69
ME (Kcal/kg)	5481	5295	5108	4971	4734

Data collection

Blood samples were collected from ten randomly selected goats from each treatment into labelled anti-coagulant *Ethylene Diamine Tetra Acetic Acid* (EDTA) treated tubes to analyse for haematological parameters (8) and (9) respectively. A set of EDTA-free blood sample tubes were used to collect blood for serum biochemical analysis as described by (10).

Experimental Design and statistical analysis

All data collected during this study were subjected to analysis of variance (ANOVA) appropriate for a Completely Randomized Design (11) using (12), statistical software version 16.

RESULTS AND DISCUSSION

Table 2: Haematological Profile of RSG Feedlotted on crop residues during dry season

Parameters	**T1**	**T2**	**T3**	**T4**	**T5**	**SEM**
Haemoglobin (g/gl)	12.45^{a}	9.77^{c}	12.30^{a}	11.20^{b}	11.35^{b}	0.78
PVC (%)	32.75^{a}	28.18^{b}	33.33^{a}	29.88^{a} ^{b}	28.63^{b}	1.83
RBC ($\times 10^{6}$/ul)	12.60^{a}	10.36^{b}	12.42^{a}	10.88^{b}	11.56^{ab}	0.48
WBC ($\times 10^{6}$/ul)	5.37	5.93	5.67	5.26	5.55	0.40
MCH (Pg)	32.10	32.30	32.23	32.40	32.23	0.02
MCV (fl)	6.31^{c}	8.20^{c}	8.42^{a}	7.15^{b}	7.45^{b}	1.90
Neutrophil (%)	30.67	31.37	31.07	29.97	30.21	1.38
Basophil (%)	0.01	0.00	0.00	0.02	0.03	0.11
Eosinophil (%)	2.33	2.39	3.01	2.67	2.42	0.30
Monocytes (%)	3.15	2.92	1.30	1.38	2.04	0.24
Lymphocytes (%)	69.71^{a}	53.47^{b}	53.68^{b}	61.22^{a} ^{b}	61.82^{ab}	2.46

a-c means on the same row with different superscript differ significantly (P<0.05). SEM= Standard error of the means

Values of haemoglobin and PCV in this study are in harmony with the normal ranges reported for goats by (13). The RBC results indicated that goats on the T_1, T_3 and T_4 diets were significantly (P<0.05) influenced by the treatment diets. RBC results are with the normal range of 9-13.5 million/c.mm for goats reported by (14) and up to 13.90 million/c.mm (15). WBC counts (5.26-5.93) are within the normal range of 6.8-20.1 thousand/c.mm (14) and 5.14thousand/c. mm (15) in goats. In the serum biochemical parameters investigated, the total protein, blood glucose and blood urea were significantly (P<0.05) influenced by the dietary treatments, as well as the blood sodium and zinc. Most haematological, serum biochemical and blood

mineral values recorded were within normal range for healthy goats (13; 14; 15) except for neutrophils (29.97-31.37%) which were far below the normal range of neutrophil of 50-70% (13) and 47-82% (14) for goats although higher than the 24.67-26.00% range recorded by (16) when he fed fermented baobab leaves to RSGs. The normal range of values recorded for almost all the parameters measured implies that the test diets did not induce any adverse effect on the health of goats.

Table 3: Serum Biochemical and blood mineral Parameter of RSG fed crop residue during dry season

Parameters	T1	T2	T3	T4	T5	SEM
Total Protein (g/l)	63.36[a]	60.72[ab]	55.43[c]	62.14[b]	62.25[b]	0.21
Albumin (g/l)	42.11	42.03	39.76	41.21	42.41	0.13
Glucose (mg/dl)	60.02	60.32	59.88	60.12	59.97	1.42
Cholesterol (mg/dl)	108.87	111.33	106.37	112.41	107.25	1.65
BUN (mmol/l)	19.61	21.20	21.23	21.32	20.74	0.14
AST (IU/L)	126.27	124.40	126.07	122.42	123.97	3.43
ATL (IU/L)	46.27	47.10	46.86	49.27	48.54	0.92
Iron (mg/dl)	1.18	1.12	1.09	1.14	1.16	0.03
Calcium (mg/dl)	1.62	1.65	1.62	1.69	1.66	0.01
Sodium (mmol/l)	96.01[a]	96.42[a]	96.33[a]	96.33[a]	94.20[b]	0.01
Zinc (mg/dl)	0.68[a]	0.61[b]	0.60[b]	61.22[ab]	0.66[a]	0.01

CONCLUSION AND RECOMMENDATION

Proportional inclusion of cowpea husks in combination with cowpea haulms did not have any adverse effect on the blood constituents of the animals, thus, a good feedstuffs combination in goat fattening. It is recommended that percentage inclusion of cowpea haulms and cowpea husks should be 50:50 to ensure better health efficiency in a goat fattening program.

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Ruminant Nutrition and Management: RMN008

HAEMATOLOGICAL ANALYSIS OF SOKOTO RED BUCK FED DIFFERENT MULTI-NUTRIENT BLOCKS (MNB) AS SUPPLEMENT TO SORGHUM HUSK IN SEMI-ARID ZONE OF NIGERIA

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ABSTRACT

The study was conducted to determine the influence of multi nutrient blocks (MNB) as supplement to sorghum husk in the semi-arid region of Nigeria. From result of proximate and in sacco degradability properties, four multi nutrient blocks (MNB) were selected and subjected to in vivo trial. The animals were divided into four (4) treatment groups. The study lasted for 60 days. The results of pack cell volume (PCV) showed that there were no significant difference (P>0.05) between the treatment means. The pack cell volume ranged from 25.67 (T5) to 28.00 % (T1). Similarly, there were no significant (P>0.05) differences in haemoglobin value among the treatment. The result of white blood cells showed that there was significance difference among the treatment (P<0.05) among the treatment. The highest value of WBC was recorded in T3 ($8.53X10^3/mm^3$) while the lowest value was recorded T2 ($6.23X10^3/mm^3$).

Key words: Multi Nutrient Blocks (MNB), Sorghum husk, pack cell volume (PCV), haemoglobin and White Blood Cell.

DESCRIPTION OF PROBLEM

Feed availability has been the major factor affecting ruminant livestock production during the dry season. Poor quality roughages such as crop residues and dry grasses are the available feed resources for feeding ruminants during the dry season. These feed resources are characterized by low intake and digestibility which result in poor animal performances. Supplementation with conventional protein base feed to ameliorate the problem is not within the reach of the small holder farmers. The use of agro- industrial by-products by livestock farmers especially in Nigeria is restricted to few, wealthy individuals because of high cost (1)

Browse plants have been used as supplements to a wide range of forages and agricultural by-products.(2) stated that they have been incorporated into concentrates as substitute for more expensive processed protein source such as groundnut cake, cotton seed cake, palm kernel cake etc. Studies by (3) and (4) showed that *Ziziphus Mauritania* and *Faidherbia albida* have high crude protein (CP) content and could be used as supplement for feeding ruminants.

Multi- nutrient blocks are licks that contain various nutrients such as energy, protein, mineral, vitamins and other nutrients mixed together from various feed ingredients that are used as livestock feeds (5). Feeding of the blocks is convenient and inexpensive method of providing array of nutrients required by both the rumen microbes and animals, which may be deficient in the normal diet (6) sorghum stover. Feed availability has been the major factor affecting ruminant livestock production during the dry season. Poor quality roughages such as crop residues and dry grasses are the available feed resources for feeding ruminants during the dry season. These feed resources are characterized by low intake and digestibility which result in poor animal performances. Supplementation with conventional protein base feed to ameliorate the problem is not within the reach of the small holder farmers. The use of agro- industrial by-products by livestock farmers especially in Nigeria is restricted to few, wealthy individuals because of high cost (1)

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MATERIALS AND METHODS

Study Area
The study was carried out at the Livestock Teaching and Research Farm of the Department of Animal Science, University of Maiduguri.

Animals And Experimental Design
Twenty (20) Sokoto red buck with average weight of 21.75 kg were used for the feeding trial. Feeding trial was carried out using multi- nutrient blocks (MNB) as a supplement to millet stover. The four multi-nutrient blocks (MNB) were selected based on proximate composition and *in sacco* digestibility. Multi- nutrient blocks (MNB) that are high in crude protein (CP) content and dry matter degradability were selected as supplement. Each group of four animals with four replicates were randomly assigned to one of the five (5) treatments in a completely randomized design. The experiment lasted for 56 days.

Feed Ingredients And Preparation
The feed ingredients used for the study are millet bran, rice bran and wheat bran as energy sources. While *Faidherbia albida* pod and *Ziziphus spinachristi* fruit as protein sources, and locust bean pulp used as binder and also for energy source for multi nutrient blocks.

Mixing Of Feed Ingredients
The feed ingredients were mixed manually in a 200 L drum cut to a height of 50 cm. Batches of 15 kg (ingredients) were mixed in various ratio in order to get a homogeneous mixture as recommended by (7).

Multi Nutrient Block Formulation
The blocks were formulated using *Faidherbia albida* pods and *Ziziphus spinachristi* fruits as protein sources while Maize bran, Rice bran and Wheat bran as energy sources, Locust bean pulp was used as a binder and also serve as energy source. All ingredients were used in various proportion and cold method of production was used (6).

Feeding And Management
Prior to the commencement of the study, the animals were given prophylactic treatment consisting of intra-muscular injection of oxytetracycline (LA: 1ml/10kg body weight, multi vitamin and ivormetin 1m/50kg). The basal diet (millet stover) were chopped into 2-3 cm length in order to avoid wasting and selection. Basal diet and water were provided *ad- libitum,* while the supplement was provided to all the treatment except T1 (control).

Chemical Analyses

The blood samples were collected from the animals through the puncturing of the jugular vein with syringe at the end of the experiment. Five mill (5 ml) samples obtained from each treatment, preserved in EDTA bottle and analyze for haematological parameters

Statistical Analysis

All data collected were subjected to analysis of variance (ANOVA) using completely Randomized Design (CRD) Significant differences between means were compared using the least Significant Difference (LSD).

TABLE 1: Percentage Composition (%) Of The Multi- Nutrient Block (MNB)

	Percentage (%) of Feed Ingredients Used in the Formulation of the Multi-Nutrient Blocks (MNB)
T1 =	55% MB + 5% LBP + 40% FA
T2=	55% MB + 5% LBP + 40% ZM
T3=	55% WB + 5% LBP + 40% FA
T4=	55% WB + 5% LBP + 40% ZM
T5=	55% RB + 5% LBP +40% FA
T6=	55% RB + 5% LBP + 40% ZM
T7=	55% MB + 5% LBP + 20% FA + 20 % ZM
T8=	55% WB+ 5% LBP + 20% FA + 20% ZM
T9=	55% RB + 5% LBP + 20% FA+ 20% ZM

Abbreviation: MB=Maize bran, FA=*Faidherbia albida*, LBP= Locust bean pulp, ZM=*Ziziphus spinachristi*, RB= Rice bran and WB= Wheat bran

RESULTS AND DISCUSSION

The results of haematological study of sokoto red buck different multi nutrient blocks (MNB) as supplement to sorghum husk based diet are presented in Table 2. There were significant ($P < 0.05$) differences in white blood cell. The highest value was recorded in T3 (8.53×10^3 / mm^3) while the lowest recorded in T2 ($6.23 \times 10^3/mm^3$). The value obtained fall within the normal range of 4- 12×10^3 mm^3 reported by (8), but higher than 2-3 x $10mm^3$ reported by (9).Higher white blood cells (WBC) in T3 is an indicator of immune response to infection or toxic substance in the organism and lower white blood cell (WBC) count is an indication of pathogenic infection or presence of antigens in the organism (10). While the pack cell volume (PCV), haemoglobin (Hb), red blood cell (RBC), means corpuscular volume (MCV), means corpuscular haemoglobin (MCH) and means corpuscular haemoglobin concentration ((MCHC) were not significant ($P > 0.05$) different among the treatment groups. The highest value obtained in each parameters were, 27.00 % (T3), 9.30 g/di (T1), 12.47 10^6m^3 (T3), 27.24 fentolitres (T2), 9.06 pictograms (T2) and 33.35 % (T2) respectively. All the values fall within the normal range as reported by (8). (11) Stated that blood is an important index of physiological, pathological and nutritional status in the organism and the blood variable most consistently affected by dietary influence as Red blood cell (RBC) and Pack cell volume (PCV). The values of MCV, MCH and MCHC in the present study are very important in the diagnosis of anemia and also serve as useful index of the capacity of the bone marrow to produce red blood cell as reported by (12).

CONCLUSION AND APPLICATION

The results of the present study revealed that there was no adverse effect on the health of the animals fed the formulated multi nutrient blocks (MNB) and all the values were within the normal range. The process of making multi nutrient blocks is simple and does not required sophisticated equipment and can be made by used of wide variety of by products which are available locally.

RECOMMENDATION

It is recommended that the use of multi nutrient blocks to feed sokoto red buck has no detrimental effect.

TABLE 2: Haematological Indices Of Sokoto Red Buck Fed Different Multi Nutrient Blocks (MNB) And Sorghum Husk Based Diet

	Treatments						
Parameters	T1	T_2	T_3	T_4	T_5	SEM	Standard** Values
PCV (%)	28.00	27.67	27.00	25.67	25.00	1.36^{NS}	24-45
Hb (g/dl)	9.30	9.20	8.93	8.50	8.30	0.46^{NS}	8-16
WBC ($X10^3/mm^3$)	6.50^{c}	6.23^{c}	8.53^{a}	6.77^{c}	7.67^{ab}	0.35*	4-12
RBC $X10^6/mm^3$)	11.33	10.33	12.47	10.67	11.53	1.04^{NS}	9-15
MCV (fentolitres)	25.28	27.24	21.69	24.43	22.25	0.54^{NS}	23-48
MCH (pictograms)	8.39	9.06	7.18	8.09	7.38	0.84^{NS}	8-12
MCHC, (%)	33.21	33.35	33.09	33.12	33.19	0.06^{NS}	31-38

a,b,c,. = Means in the same row bearing different superscript differ significantly (P> 0.05) *= Means significantly (P<0.05) different NS = Not significantly (P> 0.05) different SEM = Standard error of means PCV =Pack cell volume HB = Haemoglobin WBC = White blood cell RBC = Red blood cell MCH = Means corpuscular volume MCH = Means corpuscular haemoglobin MCHC =Means corpuscular haemoglobin concentration RAR = Research Animal Resource **=Source (RAR, 2009).

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Ruminant Nutrition and Management: RMN009

IMPACT OF MOISTURE LEVELS ON NUTRITIONAL COMPOSITION OF ENSILED NAPIER GRASS (*Pennisetum purpureum)* AUGMENTED WITH POULTRY LITTER

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ABSTRACT

The study was conducted to assess the influence of moisture levels on the nutritive value of ensiled Napier grass enhanced with poultry litter as an additive. Combinations of Napier grass and poultry litter (PL) were ensiled at different moisture levels to achieve four (4) treatments: treatment I (200mls), II (250mls), III (300mls), and IV (350mls) of water in triplicates. The samples were ensiled for three weeks (21 days). The experiment was laid out in a completely randomized design with four replications. Data obtained were analyzed using Analysis of Variance with Duncan's New Multiple Range Test used to separate significant means at 5% level. The physical properties of the prepared silages showed that all the silages were adequately fermented and had color ranging from yellowish brown to dark brown. Treatment III which has high moisture contents is slimy indicating spoilage due to molds activities. Treatment I had high pH compared to other treatment, however there is no significant difference in term of the temperature recorded. The results for the proximate analysis of the prepared silages showed significant ($P<0.05$) differences among the treatment means in all the parameters evaluated except DM. The DM values ranged from 90.44% in treatment II to 93.52% in treatment IV. The Crude Protein (12.86%), Crude Fibre (26.02%) and ash (5.56%) mean values were significantly ($P<0.05$) higher in treatment III whereas treatment II had significantly ($P<0.05$) higher Ether Extracts and Neutral detergent fibre values. In conclusion Treatment IV has highest CP content (13.18), lowers pH, acid detergent and Neutral detergent fiber respectively (30.02% and 63.33%) as such was recommended as the best quality silage which would increase feed intake and growth performance of ruminant animals.

Keywords: Napier grass, Poultry litter, Ensiling

INTRODUCTION

Napier grass (*Pennisetum purpureum)* known as elephant grass is one of the most important tropical forage crops. It is widely used in cut and carry feeding systems and is of growing importance in other agricultural systems [1]. Napier grass possesses many desirable characteristics, including high yield per unit area, tolerance to intermittent drought and high water use efficiency, making it forage of choice [2]. It has the ability to withstand repeated cutting and will rapidly regenerate, producing palatable leafy shoots [3]. Consequently, enhancing the knowledge-based use and conservation of the available Napier grass resources promises to substantially benefit livestock value chains [4]. Napier grass is the most important fodder crop for livestock farmers in Nigeria [5]. Its high productivity makes it particularly suited to feed cattle, goats and sheep [6]. Various physical, chemical and biological treatments have been used to improve the utilization of Napier grass; the most prominent among which are chemical treatments through the use of sodium hydroxide, which is expensive to the rural farmers and hazardous [7]. The researches into the use of by-products like poultry litter at various levels of dietary inclusion have been shown to improve digestibility of poor-quality feeds [8]. There is much availability of poultry litter in Northern Nigeria.

Poultry litter is organic manure enriched with major plant nutrients like N, P, K and trace elements like Zn, Cu, Ash, etc. The composition and quality of a poultry litter varies with the types of poultry, types of litter used, diet and dietary supplements, and collection and storage of the litter [9]. Before the litter may be utilized as feed, any foreign objects like as plastic, feathers, glass etc. must be removed. Poultry litter with ash content more than 28% is not safe to be used as feed, so low ash content must be maintained. Poultry

litter as an additive for ensiling Napier grass can be beneficial in enhancing the fermentation process and improving the nutritional quality of the silage [10]. Therefore, the purpose of this study was to ascertain how Moisture levels affected the nutritional content of ensiled Napier grass (*Pennisetum Purpureum)* supplemented with chicken litter.

MATERIALS AND METHODS

Study Site

The study was conducted at the Animal Science Laboratory of Federal University Dutsin-ma Katsina, Katsina State (Latitude 12º 27'N and Longitude 7º 29' E and on Altitude 605 m above sea level) (10). The mean annual temperature is between 29-31ºC [11].

Experimental materials

Napier grass was obtained from the Department of Agronomy Orchard. Fresh poultry droppings were obtained from caged layers at Professor Lawal Abdu Saulawa Livestock Teaching and Research Farm, Federal University Dutsin-ma Katsina. The poultry droppings were sun-dried for 5-6 hours daily for four (4) days to ensure pathogenic microbial safety. The dried poultry droppings were pounded using pestle and mortar.

Experimental Design

The experiment was divided into four (4) treatment groups and laid down in a Completely Randomized Design with four (4) replications. Water was used in the four different proportions for 21 days namely: first group has only Napier grass with 200ml of water as the Control, the second group, Napier grass with poultry litter and 250ml of water while the third group consists of Napier grass, poultry litter and 300ml of water and the fourth group consists of Napier grass, poultry litter and 350ml of water. The quantity of the poultry litter used was 250g across all the treatments. The quantity of the grass used was 700g in each of the treatments.

Ensiling Procedures

The ensiling procedure followed the protocol of Ogunlolu *et al.* (12) in which Napier grass used for silage was chopped into 2-3cm length using forage chopper to make compaction easy. Twelve (12) bottles of (2L) was used as laboratory silos. The dried Napier grass and poultry litter was then milled separately through 8mm mesh in a hammer mill. The Napier grass used for the silages was then mixed with the poultry litter in the ratio of 70:30. Water (moisture) was used in four different proportions of 200ml, 250ml, 300ml and 350ml in treatment 1, 2, 3 and 4 respectively. The samples were ensiled for 21 days, with masking tape used to seal the bottles after filling with weighed materials and compressed. At the expiration of ensiling period, the silos were opened and the top most 5cm material was scooped off to avoid contamination with partially ensiled materials. The samples were taken using forceps from each ensiled bottle for physical observations. Data obtained were collected from temperature and pH of the ensiled materials using multi-purpose pH meter (Model: Hi9813-6) as described by AOAC [13]. The samples were analyzed for Dry Matter (DM), Crude Protein (CP), Acid Detergent Fibre (ADF), Neutral Detergent Fibre (NDF) and Ash contents as described by AOAC [13]. Samples were appraised for color, texture, and smell. The colors for the silage were obtained using a color chart. Description of color and aroma which was use as indices of Silage quality.

Statistical Analysis

The data collected were analyzed using Analysis of Variance (ANOVA) using SAS [14] version 9.1; where there are significant differences; means were separated using Least Significant Difference (LSD) at 5% level of probability.

RESULT AND DISCUSSION

The results obtained for the physical properties of the prepared silages (Table 1) showed that all the silages were adequately fermented and had colours ranging from yellowish brown to dark brown. The results

obtained for colour (Table 1) was close to the original starting colour of the materials used in the silage. The aroma of the silages was sweet, pleasant and rancid which are all indicative of good quality silage. All the compounded silages were firm in texture due probably to the low moisture contents. Treatment III which has high moisture contents is slimy indicating spoilage.

Table 1: Physical characteristics of ensiled Napier grass

	Treatments			
Parameters	**I**	**II**	**III**	**IV**
Colour	Yellowish brown	Dark brown	Brownish colour	Dark brown
Aroma	Moisture grass odour	Chocking smell	Chocking smell	Chocking smell
Texture	Firm	Firm	Slimmy	Firm
Others	-	-	Presence of moulds	-

The result for pH and temperature of ensiled Napier grass (Table 2) indicated significant difference ($P<0.05$) among the treatments with treatment I having the highest pH value of 6.42 while treatment II has the lower pH value of 4.53. However, there is no significant difference in terms of temperature recorded for all the treatments.

The results for the chemical composition of prepared silage presented in Table III. The dry matter values ranged from 90.44% (in treatment II) to 93.52% (in treatment IV). The composition of crude protein contents of the prepared silage ranges from 10.32% (TI) to 13.18% (T IV). The treatment III had crude fiber value of 26.02% compared to the control (13.52%). The ash content of the prepared silage ranges between 4.45% (TI) and 7.88%(IV). The result indicated that treatment I, II and III had the same ash values. There is significant difference in the values of NDF and ADF with treatments. However, the amount of NDF among the treatments ranges between 63.33% (TIV) to 77.56% (TI). The acid detergent fiber in the diets ranged between 30.02% (TIV) to 56.02% (TI). The NDF and ADF decrease with increase in varying moisture and poultry dropping.

Table II: pH and Temperature values of the prepared silages

	Treatments			
Parameters	**I**	**II**	**III**	**IV**
pH	6.42	4.53	4.96	4.59
Temperature	29.3	29.7	29.6	29.7

Table III: Proximate composition of ensiled Napier grass

	Treatments				
Parameters	**I**	**II**	**III**	**IV**	**SEM**
DM	92.05^{b}	90.44^{c}	92.37^{b}	93.52^{a}	0.06
ASH	4.45^{c}	4.95^{c}	5.56^{b}	7.88^{a}	0.01
EE	14.43^{a}	6.61^{d}	10.45^{c}	11.62^{b}	0.18
CF	17.12^{b}	17.86^{b}	26.02^{a}	13.52^{c}	0.01
CP	10.32^{c}	12.82^{b}	12.86^{b}	13.18^{a}	0.07
NDF	77.56^{a}	72.97^{b}	73.18^{b}	63.33^{c}	0.01
ADF	56.02^{a}	47.84^{b}	42.39^{c}	30.02^{d}	0.01

N.B: Value(s) with the same superscripts across a row are NOT significantly different at P=0.05

DISCUSSION

The ensiled napier grass had different physical properties such as color, aroma and texture from the control indicating that all the silages were adequately fermented. This is in conformity with the work of Oduguwa *et al*. [15] who reported similar observation from an experiment with ensiled cassava foliage. It is important to note that the ensiling technique has been utilized to process and improve the palatability of several ingredient as stressed by Dan Abba *et al*. [16]. The color of the ensiled treatments varies slightly from that

of the control. This is in agreement with the work of Muhammad *et al*. [17]. Treatment III which has a slimy texture indicating spoilage due to mould growth, the presence of fungus is caused by the presence of spoilage microbial activity during fermentation process. This finding was in conformity with the work of Wattiaux [18] who reported high moisture level to favour growth of moulds on silages.

The high pH values were attributed to the high protein content in these silages. This was in conformity with the work of Musa *et al*. [19]. Furthermore, a decrease in pH was due to the varying moisture levels and fermentation period. Maximum pH was found in treatment I. However, the pH for treatment II, III and IV which is recommended for ensiling is consistent with the work of Kung' u *et al*. [20] who reported that ensiling typically falls within the range of 3.5 to 4.5. According to Huang and Tian [21] achieving low pH is one of the critical determinants for final silage fermentation quality. The temperature recorded in this research is similar to the work of Musa *et al*. [19] who stated that the optimal temperature for ensiling is around 25-30°C (77-86°F), as this range promotes the fermentation process while reducing the risk of spoilage, when the respiration process is prolonged the silo temperature increases, which results in damage to the silage color [22] of prepared silage.

The nutritional composition of the prepared silages provides a clear picture of the nutrients available in each of the treatments. The value of the DM contents of the prepared silages is in agreement with the previous finding of McDonald [22]. The Crude Fibre and Crude Protein values were higher in treatment II and treatment IV while lowest in treatment I, whereas treatment I had higher Ether Extracts values. The NDF appears to differ in each treatment. The addition of poultry dropping improves fermentation and affect the ADF [23].

CONCLUSION

In conclusion, based on the results of the physical characteristics and proximate composition, all the silages can be considered to be well fermented due to moisture levels enhanced fermentation, however, Ensiling Napier grass with poultry droppings under varying moisture levels at 350ml would increase Crude Protein content, lowers pH, NDF and ADF, enhance palatability of feed and improve feed intake and growth performance of livestock animals, make feed available during dry season and alleviate feed scarcity.

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EFFECT OF GRADED LEVELS OF CASSAVA LEAF MEAL ON GROWTH PERFORMANCE AND BLOOD PARAMETERS OF WEST AFRICAN DWARF BUCKS

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ABSTRACT

Cassava tuber (*Manihot esculentum*) is a staple food in Nigeria, but the leaves are often left unused. The leaves have been reported to be high in protein and minerals and its use in the feed of animal is therefore of interest to farmers. This experiment is therefore designed to study the effects of graded levels of cassava leaf meal (CLM) supplementation (0g, 5g, 10g, 15g and 20g per 100kg) on growth performance and blood parameters of West African Dwarf bucks. Fifteen (15) WAD bucks between the ages of 8 and 12 months were used for this study. The animals were randomly allotted to five (5) groups of three (3) animals per group to receive 0g, 5g, 10g, 15g and 20g per kg of supplementary cassava leaf meal respectively. The duration of the experiment was 9 weeks during which data on growth performance such as feed intake, weight gain, and nutrient digestibility were collected. Blood was collected forthnightly for haematology and serum biochemical evaluation. Results obtained showed that the final weight gain, total weight gain, and average daily weight gain were significantly ($p>0.05$) affected by the treatments. The average daily feed intake, initial weight and feed conversion ratio were not significantly ($p<0.05$) affected by the treatments. The WAD bucks fed 20g of supplemented CLM recorded the highest (11.56kg) final weight, average daily weight gain (39.76g), total weight gain (2.23kg) and feed conversion ratio of 10.83. The nutrient digestibility showed that the CLM had significant effect ($p<0.05$) on the faecal dry matter, moisture content, crude protein, ether extract, crude fibre, nitrogen free extract, neutral detergent fibre and acid detergent fibre. The inclusion of CLM on blood parameters, heamatoloy showed that it has significant effect ($p<0.05$) with highest values on haemoglobin (11.81g/dl) , packed cell volume (37.94%,) red blood cell (11.35 $x10^6$ ml), white blood cell (14.55l), mean corpuscular haemoglobin (10.96pg), mean cell volume (35.55%) and mean corpuscular haemoglobin concentration (40.77%). Also in serium biochemistry, It had no significant ($p>0.05$) effect on globulin, creatinine and bilirubin content in all the treatment and the highest value (12.02mg/dl) of urea was recorded in 15g CLM. The highest values of total protein (11.1100g/l), glucose (45.5200mg/dL), AST (36.1200iu/I), ALT (28.8500iu/L) were obtained in WAD bucks fed 20g of supplemented CLM. The study therefore concluded that CLM can be supplemented with concentrate for improved growth performance and blood parameters.

Keywords: Cassava, bucks, performance, digestibility, blood

INTRODUCTION

Livestock production is a very important segment of agriculture. It is referred to as one or more domesticated animals raised in agricultural settings to produce commodities such as food, fibre and labour. Apart from providing food, it serves as a source of employment and income generation to rural farm families. Livestock may be raised for subsistence or for profit (9).

Goat is a small ruminant animal of great importance to man. The animal is produced basically for meat, milk and fibre, but could also be used in the generation of organic manure. In developing and developed countries, goats fulfil important economic and social functions due to the position as a source of investment and animal protein for the teeming population (13). The products are however in short supply due to seasonal fluctuation in feed quality and quantity, thus making feeding an important constraint to improved goat production.

Cassava (*Manihot esculenta Crantz*) is a root crop grown throughout the tropics by more than 800 million people (20). It can grow with minimal inputs under marginal soil conditions and in regions prone to drought. Though mainly cultivated for its starchy roots nutrient-dense cassava leaves are also consumed as vegetables in many regions of Africa (35). Cassava leaf or its by-products (5, 14, 15 and 12) has been used as feeds for sheep and goats. Results on the chemical profile of cassava leaf meal revealed high protein content of 16.6% to 39.9% (17, 12), high mineral content and also a major source of vitamin B1, B2 and C and carotenes (1). High amino acid profile and metabolizable energy value (1,590 kcal/kg to 1,800 kcal/kg) (32, 16) have been report. Cassava leaves (*Manihot esculenta*) are a good source of protein, energy, fiber, minerals, and vitamins and they also contain secondary metabolites such as tannins, cyanogenic glycosides, and phytates, which can influence nutrient digestibility and animal performance (23).

Cassava leaves is an agro-wastes that are mostly fibrous materials which are been considered valueless as they are discarded as waste and they have no economic value and which actually may constitute an environmental nuisance when is not properly disposed of (22) earlier noted that a potential alternative feed ingredient must not be a staple item that is directly eaten by man to avoid scarcity. Among such interest in this research is the cassava leaves, which are hitherto not eaten by man but can be used as feeds supplement for ruminant animals (West African Dwarf Bucks).

The aim of this study was to determine the effect of graded levels of cassava leaf meal supplementation on growth performance and blood parameters of West African Dwarf Bucks.

MATERIALS AND METHODS

Sourcing and Management of the WAD Bucks

The experiment was carried out at the Small Ruminant Unit, Teaching and Research Farm, University of Ilorin, situated in the north central area of Nigeria at latitudes 8°30 and 8°50N and longitudes 4°20 and 4°35E of the equator in Ilorin south local government area of Kwara State, Nigeria. A total number of Fifteen (15) West African Dwarf Bucks between the ages of eight to twelve months (8-12 months) were purchased at Ipata market, Ilorin East local government area of Kwara State, Nigeria. The bucks were quarantined for two weeks, the pen was disinfected using Morigad disinfectant before the arrival of the animal. Ivermectin injection was administered at the rate of 0.5ml per 10kg body weight against external and internal parasites. The feeding routine was two times daily (morning and evening), and the feeding troughs and drinkers were washed thoroughly to prevent disease transmission.

Experimental Design

Five experimental diets were formulated containing dried cassava leaf meal (CLM) at 0gCLM/kg concentrates (A) control, 5g CLM/100 kg concentrate(B), 10g CLM/100 kg concentrate(C), 15g CLM/100 kg concentrate(D) and 20g CLM/100 kg concentrate(E) inclusions. Each level of dried cassava leaf meal serves as a treatment. 15 West African Dwarf Bucks (WAD) 8-12 months were allotted to each of the 5 experimental diets with each treatment having 3 WAD Bucks as a replicate for the first 56 days of the feeding trial before being transferred into individual metabolism cages that allowed for separate collection of faeces during the last seven days after a seven day period of adjustment to the cage conditions. The total faeces collected daily by each goat which were harvested from polythene sheet fastened underneath each metabolism cage were voided and weighed. A 10% sample of the faeces was oven dried at 65^{o}C for three consecutive days and kept in a refrigerator (-5^{o}C) for chemical analysis.

Blood sample (10ml) was collected fortnightly by jugular vein-puncture from 2 randomly selected bucks into plane (5ml) and Ethylene diamine tetracetic acid coated bottles for serum biochemical parameters analysis and haematology indices respectively. The collected blood samples were taken to the laboratory to be appropriately analyzed. The blood parameters determined from the haematological studies include Red Blood Count (RBC), White Blood Count (WBC), Packed Cell Volume (PCV), Neutrophils, Eosinophils, Basophils, Lymphocytes, Monocytes, Haemoglobin, and Platelets. The serum biochemical indices parameter

were Total Protein, Albumin, Globulin, Bilirubin, Glucose, Alanine Transaminase ALT, Alkaline Phosphatase ALP, Aspartate Aminotransferase AST, Glucose and Creatinine.

Statistical Analysis

All data collected were subjected to analysis of variance (ANOVA) of a completely randomized design (CRD) model procedure of Statistical Analysis Software (33), using a co-variate analysis. Significant differences between means were separated using Tukey Studentized Test at 5% level of significance.

RESULT

Table 1: Feed Composition of Experimental Diets

INGREDIENTS	Diet A(0g/kg)	Diet B(5g/kg)	Diet C(10g/kg)	Diet D(15g/kg)	Diet E(20g/kg)
BDG	50.00	50.00	50.00	50.00	50.00
PKC	20.00	20.00	20.00	20.00	20.00
WHEAT	16.50	16.50	16.50	16.50	16.50
COMBRAN	8.00	8.00	8.00	8.00	8.00
OYSTER SHELL	4.75	4.75	4.75	4.75	4.75
SALT	0.50	0.50	0.50	0.50	0.50
VITAMINS	0.25	0.25	0.25	0.25	0.25
CRUDE PROTEIN	17.88	15.05	14.98	14.99	13.09
DRY MATTER	92.72	92.88	93.69	93.99	91.60
CRUDE FAT	4.62	6.11	6.09	5.73	5.57
CRUDE FIBRE	22.12	21.82	20.80	21.56	22.16
Ash	17.48	14.5	17.22	16.43	13.98
NFE	30.66	35.41	34.65	36.25	36.83

Palm karnel cake (PKC), Brewery dried grain (BDG), Nitrogen Free Extract (NFE)

The effect of graded level of cassava leaf meal supplementation on the growth performance of West African Dwarf bucks is shown in Table 2. The supplementation of cassava leaf meal (CLM) fed at graded levels to West Africa dwarf (WAD) goats had significant effect ($p < 0.05$) on final weight with the highest value of 11.56kg at 20g/kg and lowest value of 9.63kg at 0g/kg, total weight gain recorded highest value at 20g/kg which was lower at 0g/kg and average weight gain. The graded level cassava leaf meal on average daily feed intake (ADFI), initial weight (IW) and the feed conversion ratio (FCR) of the goats had no significant effect ($p > 0.05$). The highest final weight (11.56kg), average daily weight gain (39.76g) and total weight gain (2.23kg) with the feed conversion ratio of 10.83 was recorded in bucks fed 20g of CLM

Table 3 shows the effect of graded levels of cassava leaf meal on nutrient digestibility of West African dwarf bucks. Graded inclusion levels showed that CLM had significant effect ($P < 0.05$) on the faecal dry matter content (DM), moisture content (MC), crude protein (CP), ether extract (EE), crude fibre (CF), nitrogen free extract (NFE), neutral detergent fibre (NDF) and acid detergent fibre (ADF) and had no significant effect ($p>0.05$) on Total ash (T.ASH)

Goats fed 0g/kg graded level of cassava leaf meal (A) had highest value (86.84) for the DM and NDF (0.78) digestibility while the lowest value (84.29) was obtained in the diet containing 15g/100 kg graded level of cassava leaf meal (D) and diet containing 10g/100 kg graded level of cassava leaf meal (C) respectively. Consequentially, D had the highest moisture compared to other treatments. Diets containing 5g/kg graded level of cassava leaf meal (B) had the highest value in terms of CP and CF compared to other diets. Also, diet E had the highest EE (3.64), NFE (44.31) and ADF (3.04) compared to other diets.

Table 2: Effect of graded level of cassava leaf meal on growth performance of West Africa Dwarf (WAD) bucks

PARAMETERS	A (0g/kg)	B (5g/kg)	C (10g/kg)	D (15g/kg)	E (20g/kg)	±SEM	P value
Initial weight(kg)	7.67	9.00	8.67	9.33	9.33	0.25	0.0046
Final weight(kg)	9.63^{b}	11.12^{a}	10.76^{ab}	11.22^{a}	11.56^{a}	0.28	0.0060
ADFI(kg/animal)	0.38	0.43	0.44	0.40	0.43	0.02	0.1232
TWG(kg/animal)	1.96^{ab}	2.12^{ab}	2.09^{ab}	1.89^{b}	2.23^{a}	0.07	0.0475
ADWG(g)	35.00^{ab}	37.86^{ab}	37.26^{ab}	33.81^{b}	39.76^{a}	1.25	0.0476
FCR	10.85	11.35	11.81	11.84	10.83	0.27	0.0561

a, b, c, d, e Means with difference superscript along the same row for each parameter are significant different($p<0.05$); SEM, Standard error of mean; IW, initial weight; FW, final weight; WG, weight gain; ADFI, Average daily Feed intake; TWG, Total weight gain; ADWG, Average daily weight gain FCR; feed conversion ratio; A, 0g of cassava leaf meal per 100kg commercial feed; B, 5g of cassava leaf meal per 100kg commercial feed; C, 10g of cassava per 100kg commercial feed; D, 15g of cassava leaf meal per 100kg commercial feed; E, 20g of cassava leaf meal per 100kg commercial feed.

Table 3: Effect of graded levels of cassava leaf meal on nutrient digestibility of West Africa dwarf bucks

	A (0g/kg)	**B (5g/kg)**	**C (10g/kg)**	**D (15g/kg)**	**E (20g/kg)**	**±SEM**	**P-Value**
DM	86.84^{a}	86.00^{ab}	85.40^{ab}	84.29^{b}	85.85^{ab}	0.43	0.0218
MC	13.16^{b}	14.00^{ab}	14.60^{ab}	15.71^{a}	14.15^{ab}	0.432	0.0218
CP	8.30^{b}	8.53^{a}	8.11^{c}	7.21^{e}	7.65^{d}	0.01	<.0001
EE	3.60^{a}	3.40^{bc}	3.38^{c}	3.48^{b}	3.64^{a}	0.02	<.0001
CF	23.14^{b}	24.30^{a}	24.10^{a}	22.60^{c}	23.00^{b}	0.05	<.0001
T. ASH	9.18	9.30	10.02	9.00	8.25	0.50	0.2304
NFE	42.62^{ab}	40.47^{ab}	39.79^{b}	42.00^{ab}	44.31^{a}	0.84	0.0231
NDF	0.78^{a}	0.57^{ab}	0.52^{b}	0.58^{ab}	0.62^{ab}	0.05	0.0302
ADF	2.12^{a}	2.32^{b}	1.99^{b}	2.91^{a}	3.04^{a}	0.01	<0001

a, b, c, d, e Means with difference superscript along the same row for each parameter are significant different($p<0.05$); SEM, Standard error of mean ;A , 0g of cassava leaf meal per 100kg commercial feed; B, 5g of cassava leaf meal per 100kg commercial feed; C, 10g of cassava per 100kg commercial feed; D, 15g of cassava leaf meal per 100kg commercial feed; E, 20g of cassava leaf meal per 100kg commercial feed

Table 4 shows the effects of graded level of cassava leaf meal on haematological parameters of WAD bucks. The inclusion of cassava leaf meal significantly ($p<0.05$) influence the haematological parameters of WAD bucks across all the treatment means. Haemoglobin parameter values significantly ($p<0.05$) increased from diet A to B. PCV values was significantly influenced ($p<0.05$) by the inclusion of cassava leaf meal with diet E recording the highest value of 37.94% while diet B recorded the lowest value of 25.88%. There was a significant drop at C with E having the highest value of 11.35% for RBC values. The values of WBC differed significantly ($p<0.05$) with C recording the highest value ($14.55x10^{6}$/ml) compared to other treatment groups. The values of MCH was significantly different ($p<0.05$) with diet A (9.36) the lowest and C (10.96) having the highest value. The values of MCV was influenced significantly ($p<0.05$) with diet B having the lowest value for MCV recorded at 25.57% and A having the highest value. MCHC values were significantly increased ($p<0.05$) in A (40.77%) and a significant drop in E (31.13%).

Table 5 shows the serum biochemical parameters (total protein, albumin, globulin, glucose, ALP, ALT, AST, creatinine, bilirubin, urea, calcium, potassium and sodium contents) of the experimental WAD bucks fed varying levels of cassava leaf meal. The inclusion of cassava leaf meal influenced all the serum biochemical parameters measured significantly ($p<0.05$) across all treatments except in globulin, creatinine and bilirubin. Total protein increases with increase in the level of inclusion of cassava leaf meal, with A being the significantly lowest ($p<0.05$) with 7.50 and E being the highest. The values obtained for albumin

were significantly ($p<0.05$) differed across the treatment levels with A having the lowest value of 3.00. Glucose was significantly highest ($p<0.05$) at D (45.5200) and E (45.5200) and lowest at B (42.2800). ALP values ranged from 85.20 (A) to 96.78 (D). ALT was significantly highest ($p<0.05$) at E and lowest ($p<0.05$) at A. Urea showed significant increase ($p<0.05$) from A to D and a drop in E. Sodium and Potassium show a similar trend, the two parameters were significantly highest ($p<0.05$) at C and lowest ($p<0.05$) at A. Calcium was significantly highest at B (4.2300) and lowest ($p<0.05$) at B (2.0000).

Table 4: Effects of graded level of cassava leaf meal on Haematological parameters of West African dwarf bucks

Parameters	**Treatments**						
	A	**B**	**C**	**D**	**E**	**±SEM**	**P value**
HG (g/dl)	9.45d	10.55c	10.82cb	11.37ab	11.81a	0.17	<.0001
PCV (%)	34.84a	25.88b	32.30a	34.42a	37.94a	1.28	0.0007
RBC (x 10^6/ml)	10.10c	10.12c	9.87c	10.73b	11.35a	0.08	<.0001
WBC (x 10^6/ml)	13.50b	13.75ab	14.55a	13.65ab	14.00ab	0.21	0.0339
MCH (pg)	9.36d	10.42bc	10.96a	10.60b	10.40c	0.04	<.0001
MCV (%)	34.50a	25.57b	32.38a	32.07a	33.43a	1.30	0.0054
MCHC (%)	28.99b	40.77a	33.51b	33.03b	31.13b	1.51	0.0028

a, b, c, d Means with difference superscript along the same row for each parameter are significant different($p<0.05$); HG, haemoglobin; PCV, pack cell volume; RBC, red blood cell; WBC, white blood cell; MCH, mean corpuscular haemoglobin; MCV, mean cell volume; MCHC, mean corpuscular haemoglobin concentration; SEM, standard error of mean. A, 0g of cassava leaf meal per 100kg commercial feed; B, 5g of cassava leaf meal per 100kg commercial feed; C, 10g of cassava per 100kg commercial feed; D, 15g of cassava leaf meal per 100kg commercial feed; E, 20g of cassava leaf meal per 100% commercial feed

DISCUSSION

The feed composition result from this study was lower in terms of dry matter content with the value recorded by (37) fed varied levels of poultry manure in whole cassava plant based concentrate diet to goats but was higher compared to the study of (26) who fed formulated concentrate and palm kernel cake supplementation to growing WAD goats. The crude protein content was relatively higher than the recommended (8%) (26) crude protein in diets of WAD goats. The crude fibre content was relatively higher compared to (26) but had similar ether extract value when compared together. The ash content was relatively higher with lesser NFE in comparison with the recorded by (26).

In the present study, all the bucks fed experimental diets gained weight, which implies that the experimental diets coupled with the concentrate supplement, was able to provide sufficient nitrogen, which ensured optimal microbial growth in the rumen. Bucks fed CLM at 20g was the most superior in terms of performance characteristics as it recorded the highest values for most of the performance indicators taken such as weight gain, total and average weight gain. The result of the study in terms of daily weight gain does not correlate the research of (26) who fed ensiled *Pennisetum purpureum* and formulated concentrates with PKC to WAD bucks. It also does not correlate with the result of (30) who compared the use of commercial feed and soy waste as supplements to goats fed *Pennisetum purpureum*. The results did not also correlate with the research of (37) who fed varied levels of poultry manure in whole cassava plant based concentrate to WAD bucks. The result of this experiment on total weight gain is similar to the result of (19) who fed broiler litter to replace cottonseed cake at different levels to WAD goats compared to this study (1.89-2.23) and also it is completely different to the result of (38) who fed *Brachiaria ruziziensis* hay fertilized with varying levels of goat manure to KalaWAD bucks (crossed Kalahari red and WAD goats).

Table 5: Effects of graded levels of cassava leaf meal on serum biochemical parameters of West African dwarf bucks

	Treatments						
Parameters	**A**	**B**	**C**	**D**	**E**	**±SEM**	**P value**
Total protein (g/l)	7.5000e	9.4800d	9.7700c	10.3400b	11.1100a	0.0229	<.0001
Albumin (g/l)	3.0000d	3.8600a	3.5700c	3.6200bc	3.7100b	0.0229	<.0001
Globulin (g/l)	0.3500	0.3400	0.3400	0.3200	0.3600	0.0214	0.7920
Glucose (mg/dL)	45.0000b	42.2750d	44.7000c	45.5200a	45.5200a	0.0229	<.0001
AST (iu/l)	34.5000c	33.2800e	34.3750d	34.9900b	36.1200a	0.0193	<.0001
ALT (iu/l)	26.5000d	26.8600c	28.4400b	28.8100a	28.8500a	0.0203	<.0001
ALP (iu/l)	85.2000e	93.1650c	92.9500d	96.7800a	96.6000b	0.0229	<.0001
Creatinine (umol/l)	0.3000	0.3100	0.3400	0.3400	0.3300	0.0156	0.6540
Bilirubin (mg/dl)	0.0500	0.0600	0.0500	0.0600	0.0600	0.0229	0.9930
Urea (mg/dl)	9.0000e	10.1000d	10.2400c	12.0200a	11.4500b	0.0209	<.0001
Calcium (mmol/l)	2.0000e	4.2300a	2.8800d	3.6500b	3.2000c	0.0246	<.0001
Potassium (mmol/l)	3.0000e	4.8200b	4.9600a	4.3400c	3.6400d	0.0178	<.0001
Sodium (mmol/l)	125.0000e	132.1700b	133.4200a	128.4000d	129.1100c	0.0205	<.0001

a, b, c, d, e Means with difference superscript along the same row for each parameter are significant different($p<0.05$); SEM, Standard error of mean; A , 0g of cassava leaf meal per 100kg commercial feed; B, 5g of cassava leaf meal per 100kg commercial feed; C, 10g of cassava per 100kg commercial feed; D, 15g of cassava leaf meal per 100kg commercial feed; E, 20g of cassava leaf meal per 100kg commercial feed.
AST: Aspertate amino transferase
ALT: Alanine amino transferase
ALP: Alkaline Phosphate

The digestibility of nutrient was relatively high across the treatments which could be as a result of the available nitrogen present in the diets that enhance the activities of microorganisms in the rumen of the goat. Digestion in the rumen is dependent on the activities of microorganisms that require energy, nitrogen, minerals and a suitable medium to enable the microbes perform well (31). The dry matter digestibility was different across all levels which is different from the work of (38) who worked with Kal-WAD breed of goat. The variation in dry matter utilization is caused as a result of variation in genetic make-up, diet composition, feeding frequency, stress and weather. These factors can also lead to the variation in the moisture content digestibility. The crude protein digestibility varied ($p < 0.05$) with increasing supplementation of cassava leaf meals which did not agree with the (21) who worked with sheep. The variation in crude protein utilization can be as a result of differences in gut microbiome or minor genetic variation. Increased CLM levels (5-15%) might have initially diluted the overall dietary fat content, leading to a slight decrease in ether extract digestibility. However, subsequent rise at 20% could indicate lipid profiles in CLM in higher inclusion level (18). Also, CLM may contain anti-nutritional factors such as tannins and saponins that can interfere with lipid digestion and absorption at higher inclusion level. The specific type of fibre within CLM can influence digestibility. Fibres such as hemicellulose are present in CLM. Rumen pH and fermentation can also be influenced by CLM. Moderate CLM inclusion might create favourable condition for fibre-degrading bacteria which enhances crude fibre digestibility. Excessive fibre levels could lower rumen pH which in turn reduces fibre degradation and digestibility. The observed variation in NFE across diets with different CLM levels indicates a significant influence on nutrient

digestibility. This aligns with research from (3) and (8), who reported decreased digestibility of protein and energy with increasing CLM inclusion in other livestock species. Factors such as rumen microbiome composition and gut health can cause variation in nutrient digestibility. The observed decrease in NDF with increasing CLM content signifies an impact on fibre digestibility in WAD goats. This aligns with previous studies, such as (2) who reported reduced NDF content in *Moringa oleifera* leaf meal-supplemented diets, leading to improved digestibility. The reduction in NDF digestibility could be as a result of fibre composition, gut microbial activity, digestive system adaptation or a slight difference in the genetic make-up of the animals.

Haematology indices

The haematological studies revealed that the Packed Cell Volume (PCV) values obtained was higher than the range of 21% and 35% which was reported in the study of (7) but falls within the range of 22% to 38% as reported by (27) who fed cassava leaves-based concentrates to West African Dwarf goats. It was also observed that there was a significant increase in Packed Cell Volume (PCV) when compared to the control group. According to (11), environmental temperature plays a crucial role in influencing PCV values. It is reported that higher temperatures can lead to an increase in PCV. The Haemoglobin (Hb) range of 9.45g/dl and 11.81g/dl was obtained in this study which lies within the physiological range of 7-15g/dl and 8-16g/dl for clinically healthy West African Dwarf goats reported by (7 and 28). Observed values indicated that dietary treatment did not result in deficiency of minerals such as iron and magnesium for the synthesis of haemoglobin that would have comprised the capability of the red cell to transport oxygen. The result of the Red Blood Cell (RBC) obtained from the study fell above 7 – 10.00 x 10^{12}/l reported by (27) for WAD goats. However, the result obtained from this study falls within the range stated by (7) in his study that RBC falls between 9.2 – 13.5 x 106/ml. The study indicated that supplementing cassava foliage and cassava peel did not have adverse effects on ruminants that are apparently healthy. This gives credence to higher values of RBC obtained at the end of the experiment. When compared to the study of (7), the result for WBC for this study falls within the range of values stated in this research. However, all result recorded falls above the range of values when compared to the study of Muhammad et al. (2021). The mean corpuscular haemoglobin concentration (MCHC) were within the range of (7) apart of that of Treatment B (40.77) which might be an indication of a condition known as hyperchromic anaemia. Hyperchromic anaemia is characterized by higher than normal MCHC levels, which means that the haemoglobin in the red blood cells is more concentrated than usual. Hereditary conditions or certain diseases can result in the production of spherocytes, which are smaller and denser red blood cells which can also lead to elevated MCHC levels.

Serum biochemical parameters serve as valuable indicators for assessing the physiological status and overall health of animals, particularly in evaluating liver function. In this study, we observed certain trends in the serum biochemical parameters that shed light on the health and physiological condition of the goats fed cassava leaf meal.

The Serum albumin levels ranged from 3.00 to 3.86 g/dl, falling within the reported range for West African Dwarf (WAD) goat bucks despite exceeding those reported by (24) and (28). Elevated serum albumin levels can indicate dehydration or impairments in liver, kidney and digestive system functions, as highlighted by (33). Conversely, low albumin levels may suggest poor blood clotting ability. Alkaline phosphatase (ALP) levels in this study ranged from 85.20 to 96.78 U/L, surpassing the range reported by (10). These values suggest a diet rich in high-quality protein, as noted by (4). The total protein in this study (7.50 – 11.11) is not within the range stated by (7) (6.3 – 8.5). The reason for this is as a result of higher temperature which leads to higher dehydration. Higher dehydration can also leads to blood thickening and inevitably, false elevation of the total protein in the goat. When glucose is lower than the normal range, it is known as hypoglycaemia and called hyperglycaemia occurs when it is higher than the normal range (36). The glucose content in the blood (42.275 – 45.52 mg/dL) falls below the normal range (50.04 – 74.88 mg/dL). This may probably have been due to persistent hypoglycaemia since according to (29), catabolic activity is increased for gluconeogenesis thus resulting in high serum urea levels. AST, ALT and ALP were all significant across all diets. Their uses are primarily for the clinical diagnosis of liver diseases (Burke *et al.,* 2003). The result varies compared to the result of (25) who worked on the effect of crude leaf extract of *V. amygdalina* on stress modulating effect of captive grass cutter. The urea, calcium, potassium and sodium all showed

significant effects in the study and were all within the range as stated by (7). The electrolytes are known to regulate osmotic pressure, maintain membrane potentials and acid base balance and transmission of nerve impulses (25). Sodium and Potassium deficiency affect the tubes of kidney which results in its inability to concentrate the urine (6).

These findings collectively provide valuable insights into the health and physiological status of the goats in this study, highlighting the potential impact of dietary interventions on their biochemical profiles.

CONCLUSION AND APPLICATION

The findings from the study demonstrate that cassava leaf meal used as supplement can be tolerated by WAD goats at different levels when incorporated with conventional feeds for the feeding of the goat. All the animals consumed adequate feed dry matter, gained in body weight, haematology indices and serum biochemistry showed no sign of intoxication. Cassava leaf meal could therefore be added safely to conventional feeds to feed goats. Inclusion level of cassava leaf meal at 20g level in conventional feeds promoted feed intake and body weight gain in the goats at levels comparable to those of the other groups.
It is been recommended that cassava leaf meal should be added at 20g to conventional supplementary diets and fed to WAD goats as it will not have any adverse effect on their health. It is also recommended for further studies to be carried out on the use of CLM at higher levels to supplement the feed of the WAD buck to enhanced growth and reduction of feed cost in WAD goats. It was recommended that 20g of CLM can be supplemented with 100 kg of concentrate without adverse effect on the growth performance and blood parameters of WAD bucks.

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UTILIZATION OF CITRUS AND OTHER FRUIT RESIDUES AS FEED FOR DAIRY CATTLE USING IN-VITRO GAS PRODUCTION TECHNIQUE

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ABSTRACT

This study investigates the effects of citrus and various fruit residues on the feeding efficiency of dairy cattle using the in-vitro gas production technique. Data were analyzed using descriptive statistics and ANOVA at α0.05. The results showed that Y, extent of production; ABS, absolute rate of production; and EGB, effective gas production were significantly different ($p<0.05$). The released gas 'a' ranged from -7.51 in coconut to 3.90 in pineapple pulp. There were no significant ($p >0.05$) difference in the content of the fruit ranged between 37.4 in water melon and 523.0 in pawpaw residences. The rate of constant 'C' varied from 0.022 in pineapple peel to 0.105 in coconuts. These findings suggest that citrus and fruit residues can be effectively incorporated into dairy cattle diets to enhance feeding efficiency and optimize nutrient utilization. Further research is warranted to explore their practical applications and economic feasibility in commercial dairy operations.

KEYWORDS: Rumen fermentation, Dairy cattle, Fruit residues, Gas production, Livestock

DESCRIPTION OF PROBLEM

In dry season livestock are fed mainly on agro-industrial by product containing a large proportion of lingo-cellulosic feeds like cereal strews, stover, sugarcane by productions, watermelon by- products similar other. These feeds are poor in protein, energy, minerals and vitamins. Addition of foliage from tree, leave or supplementation with seeds meals or even urea can improve the utilization of low-quality roughage's mainly through the supply of nitrogen to rumen microbes. Recent advances in ration balancing include manipulation of feed to increase the quantity and quality of protein and energy delivered to the small intestine. Selection of fibrous feeds on the bases high efficiency of microbial protein synthesis in the rumen along with along high dry matter digestibility and development of feeding strategies as well as high microbial protein synthesis in the rumen will lead to higher supply of protein post.(4) established the depressive effect of rice tropical fruits on methanogenesis in faunated and defaunated rumen fluid, being favor of both animal and the environment by the reduction of methane emission .This would boost the productivity of livestock, thereby secure the hope of feeding million of humans.The prediction of organic matter, metabolizable energy and short chain fatty acids, utilization of alternative source of feeding such as fruit residues on dairy cattle is the concern of this study through the use of *in-vitro* rumen fermentation.

MATERIALS AND METHODS

Experimental site and location: The laboratory experiment was carried out in the department of animal science, University of Ibadan.

In vitro Gas Production Technique: This was carried our as described by (5) and it is count of gas production over a 24 hours incubation period. The amount of gas released when the feed is incubated in vitro with rumen fluid is closely related to the digestibility of the feed.

Calculation: The average volume of gas produce form the blank was subtracted from the volume of gas produced from each sample which gave the net gas produced (GP) for each sample. Graph was plotted against the incubation time. From the graph, the degradation characteristics were estimated as defined by Orskov and McDonald, 1979 equation
$(Y = a+b\ (1 - e^{-et}))$.
Where Y = degradability at time; a = intercept (or initial gas produced); b = potentially degradable fraction; c = rate of degradation of b; t = incubation time

Preparation of the buffer solution and rumen liquor: The buffer solution preparation was the MC Dougall's buffer which consisted of sodium bicarbonate ($NaHC0_3$), sodium phosphate, (Na_2HP0_4), Magnesium sulphate($MgS0_4.7H_20$) and calcium chloride ($CaCl_2.\ 2H_20$).The buffer solution was freshly prepared and stored in a dark bottle. The reagent was dissolved in distilled water. The calcium chloride was added only after the other reagents are completely in solution prior to use, and the volume was warmed at 39^0C, and reduced with a steam of CO_2. During the warming and reducing step, Urea was added to the MC Dougall's at the rate of 1.0gn /liter. The rumen liquor – buffer solution was mixed in a ration of 1:4 for this incubation. 120ml of rumen liquor was also mixed with 48ml of buffer solution using a plastic syringes containing the substrates and placed in a water bath at 38-39ºC an hour before the incubation started. The incubation lasted 24 hours and the accumulating gas recorded was read every 3 hours interval by measuring the space formed between the top of the piston and the liquid in the syringe. Data obtained from the in vitro gas production was subjected to ANOVA (6) and the level of significance of the means was tested using Duncan Multiple Range Test.

RESULTS AND DISCUSSION

Table 1 shows *In vitro* gas production characteristics of some fruit and citrus residues**.** Initial gas produced 'a' ranged from -7.51 in coconut to 3.90 in pineapple pulp, while the values are statistically similar ($p>0.05$). Also, there were no significant ($p>0.05$) differences in the insoluble content of the rumen fluid "b" which ranged between 37.4 g/100g in water melon and 523.0 g/100g in pawpaw residences. Gas production constant 'c' varied from 0.022/hour in pineapple peel to 0.105/hour in coconut. Although there were no significant differences ($p < 0.05$) differences among the reported values. Sweet orange was significantly lesser than grape ($p<0.05$) in their extent of gas production "y", but other fruit peels has higher values which were insignificantly different ($p>0.05$). The absolute rate of gas (abs) production was the highest in coconut 6.29/hour was apparently higher in abs but similar to other apart from banana and pineapple peel. The values for the potential gas production (PGP) varied from 35.5ml/200g DM in watermelon to 389.91ml/200g DM in pineapple peels. There were no significant differences in the PGP among the residues. Effective gas production (EGP) is also in found in Table 1. The values range between 21.91ml/200g DM in banana and 48.40ml/200g DM in pineapple peel. This suggests that fruit normally has the capacity to break down appropriately so that volatile fatty acids can be released, providing ruminants with energy. The production of methane by an animal feed is undoubtedly a loss of energy for the animal (2) and a factor in the ozone layer's depletion. Certain feedstuffs promote methanogenesis; consequently, methane synthesis should be inhibited by specific manipulations.

CONCLUSION AND APPLICATION

The findings indicated significant nutrient variability among citrus fruit residues. While many of these residues fall short of meeting the minimum crude protein requirements for ruminant animals, they exhibited relative gas production. Despite some methane production, the levels were comparatively modest.

Table 1: In vitro gas production characteristics of some fruit and citrus residues

	Parameters measured						
Fruit residues	a (ml/200g DM)	b (g/100g)	c (per hour)	y (g/100g)	abs (per hour)	PGP (ml/200g DM)	EGP (ml/200g DM)
Coconut	-7.51	326.3	0.105	29.11^{ab}	6.29^{a}	318.8	39.16^{ab}
Banana	2.11	240.1	0.038	15.65^{b}	1.55^{b}	242.2	21.91^{b}
Pineapple pulp	-0.19	115.4	0.026	29.08^{ab}	2.67^{ab}	115.2	48.40^{ab}
Pineapple peel	3.90	385.2	0.022	18.88^{ab}	1.30^{b}	389.1	33.35^{ab}
Water melon	-0.90	37.4	0.080	20.92^{ab}	3.06^{ab}	35.5	25.30^{ab}
Pawpaw	3.04	523.0	0.029	27.94^{ab}	2.49^{ab}	526.1	41.61^{ab}
Citrus residues							
Sweet orange	0.19	72.5	0.070	38.21^{a}	5.08^{ab}	72.7	47.55^{ab}
Grape	0.90	318.0	0.064	38.72^{a}	5.22^{ab}	319.9	49.08^{ab}
Lime	4.54	74.7	0.029	24.83^{ab}	1.89^{ab}	79.2	37.50^{ab}
Tangerine	0.39	375.0	0.027	33.60^{ab}	3.32^{ab}	375.4	51.40^{a}
SEM	2.23	131.38	0.01	3.71	0.83	133.04	3.69

Mean values of different superscripts (a,b) along the columns are significantly different at ($p<0.05$)
a = soluble, b = insoluble, c = rate of production, y = extent of production, abs = absolute rate of production, PGP = potential gas production, EGB = effective gas production

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ANTI-NUTRITIONAL FACTOR AND AMINO ACID PROFILE OF RAW AND DIFFERENTLY PROCESSED KARANJ (*Pongamia pinnata)* SEED MEAL

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ABSTRACT

An experiment was conducted to assess the nutritional composition and anti-nutritional factors of differently processed Karanj (*Pongamia pinnata)* Seed Meal. The seeds were obtained from karanj tree and were divided into five (5) batches; raw, soaked in tap water for 24 hours at room temperature in a plastic container, boiled for 60 minutes, and fourth seeds were toasted on open frying pan. The raw and processed seeds were used for the determination of Anti-nutritional Factor (phytate, tannin, trypsin inhibitors) and Amino Acid Profile. The results revealed that the raw seed cake has the highest concentration of trypsin inhibitor (233.10 mg/100 g), phytates (152.10 mg/100 g), tannins (113.23 mg/100 g), and (42.90 mg/100 g). The different processing methods used in this study were observed to be effective in reducing the level of anti-nutritional factors in karanj seed cake (KSC). The toasted method however, recorded the highest reduction of 37.05, 52.76, 76.68 and 61.21 % for tannins, phytates, trypsin inhibitor, and karanjin, respectively followed by KSC boiled for 60 minutes with corresponding reduction levels of 33.37, 28.91, 40.59, and 16.50 %, respectively. Soaking method reduced the anti-nutritional factor of karanji seed meal.

Keywords: Anti-nutritional factor, amino acid, Proximate composition, Karanj **(***Pongamia pinnata),*

DESCRIPTION OF PROBLEM

The major problem of Poultry Production globally is the high cost and scarcity of feed due to famine and drought and feed accounts for 70-85% of total production cost [7, 1]). [18] reported that the major cause of the high price of cereal and legume crops which are major sources of energy and plant protein is due to the competition between man and animals for the available feed. Over the years researchers have channeled their resources in searching for a solution to this problem, the use of non-conventional feedstuffs on livestock is the solution to the prevailing issue. The non-convection feedstuff for poultry production must be available, cheap, easy for cultivation, less important to humans as feed, and must be rich in essential nutrients like high protein with less fiber [13,3].

Pongamia pinnata popularly known as karanj, belongs to the family *Leguminosae*, and is a medium-sized glabrous tree capable of growing under a wide range of agro-climatic conditions. It is planted in the humid tropical lowlands around the world and it is also available in Nigeria as an ornamental plant [4].

At the time of this study, limited information is available on the proximate composition, anti-nutritional factor, and amino acid profile of raw and differently processed Karanj (*pongamia pinnata)* seed meal, therefore the present study will fill an important research gap.

MATERIALS AND METHODS

Sample Collection

The samples (seeds) were collected from the *pongamia* plant (karanj) tree which found within the university of Maiduguri environment The seeds were divided into five (5) batches. The first batch was left raw, the second batch was soaked in tap water for 24 hours at room temperature in a plastic container. The third was boiled for 60 minutes, and fourth seeds were toasted on open frying pan containing sand; it was stirred continuously until the seeds were crispy and acquired a characteristic aroma of roasted beans.

Anti-nutritional factors determination

Phytate determination: Two grams (2 g) of each sample was weighed into a 250 ml conical flask and 100 ml of 2% hydrochloric acid was added to soak each sample in the conical flask for 3 hours. This was filtered through a double layer of hardened filter paper; 50 ml of each filtrate was placed in a 0.50 ml conical flask and 107 ml of distilled water was added in each case to give proper acidity. Some quantities (10 ml) of 0.3% Ammonium Thiocyanate (NH_4SCN) solution was added to each solution. This was titrated with the standard iron (III) chloride solution which contained 0.00195 g Iron per ml. The end point was slightly brownish-yellow which persisted for 5 minutes. The % phytic acid was calculated using the formula:

$$\% \text{ Phytic Acid} = \frac{\text{Titre value} \times 0.00195 \times 1.19 \times 100 \times 3.55}{\text{Wt. of sample}}$$

Tannin determination: The tannin content of the seeds was determined using the Folin-Dennis spectrophotometric method described [10]. Two grams of the powdered sample was mixed with 50 ml of distilled water and shaken for 30 minutes in the shaker. The filtrate (5 ml) was measured into a 50 ml volume flask and diluted with 3 ml of distilled water. Similarly, 5 ml of standard tannic acid solution and 5 ml of distilled water were added separately. Folin-Dennis reagent (1 ml) was added to each of the flasks followed by 2.5 ml of saturated sodium carbonate solution.

The content of each flask was made up to mark and incubated for 90 minutes at room temperature. The absorbance of the developed colour was measured at 760 nm wave-length with the reagent blank at zero. The process was repeated two more times to get an average. The tannin content was calculated as shown below:

$$\% \text{ Tannin} = 100/W \times AU/AS \times C/100 \times VF/VA \times D$$

Where, W = Weight of sample analyzed AU = absorbance of the test sample AS = absorbance of the standard solution C = concentration of standard in mg/ml VA = volume of filtrates analyzed D = dilution factor where applicable

Determination of trypsin inhibitors

The determination of trypsin inhibitors was carried out according to the procedure outlined [6]. This involves weighing 0.2 g of the samples into a screw cap centrifuge tube. A measured quantity (1 ml) of 0.1M phosphate buffer was added and the contents were shaken at room temperature for one hour on a UDY shaker. The suspension obtained was centrifuged at 5000 rpm for 5 minutes and filtered through the Whatman No. 42 filter paper. The volume of each was adjusted to 2 ml phosphate buffer. The test tubes were placed in a water bath, maintained at 37^0C. Six milliliters of 5% TCA solution was added at one of the tubes to serve as a blank. Casein solution (2 ml) was added to all the tubes, which were previously kept at 37^0C. These were incubated for 20 minutes. The reaction was stopped after 20 minutes by adding 6 ml of trichloro acetic acid (TCA) reagent to the experimental tubes and the tubes were shaken. The reaction was allowed to proceed for one hour at room temperature. The mixture was filtered through the Whatman No. 42 filter paper. The absorbance of filtrate from the sample and trypsin standard solutions was read at 280 nm.

Determination of Amino Acid Profile

The amino acid profile in the samples of KSC was determined using the method described [15]. The known sample was dried to constant weight, defatted, hydrolyzed, evaporated in a rotary evaporator, and loaded into the Technicon Sequential Multi-Sample amino acid Analyzer (TSM).

RESULTS AND DISCUSSION

Anti-Nutritional Factors in Karanj (*Pongamia pinnata*) **Seed Cake**

The levels of the anti-nutritional factors of raw and processed karanj seed cake are presented in Table 2. The results revealed that the raw seed cake has the highest concentration of trypsin inhibitor (233.10 mg/100 g), phytates (152.10 mg/100 g), tannins (113.23 mg/100 g), and karanjin (42.90 mg/100 g). The different processing methods used in this study were observed to be effective in reducing the level of anti-nutritional factors in karanj seed cake (KSC). The toasted method however, recorded the highest reduction of 37.05, 52.76, 76.68 and 61.21 % for tannins, phytates, trypsin inhibitor, and karanjin, respectively followed by KSC boiled for 60 minutes with corresponding reduction levels of 33.37, 28.91, 40.59, and 16.50 %, respectively. However, the lowest reduction level for tannins was observed in the karanj seed soaked for 24 hours. It was also observed that the toasting of the sample can eliminate higher levels of anti-nutritional factors than the other processing methods. Toasting eliminated up to 61.26 % of the karanjin in karanj seeds. Soaking the sample for 24 hours reduced the tannin level up to 5.29 % the findings is also in conformity with the findings of [2],[8];[5]; [15] have all reported that toasting decreased the tannin content of feeds. Among all the processing methods employed, the toasting of the sample showed a better or higher reduction of the anti-nutritional factors compared to the other methods. Therefore, toasted karanj seed (TKS) was selected as the best for the elimination of anti-nutritional factors in the KSC. The finding is similar to the one reported by [12] who concluded that toasting seeds had beneficial effects as a method of processing.

Table 2: Anti-nutritional Factors in Karanji (*Pongamia pinnata*) Seed (mg/100 g)

Sample	Raw	Soaked for 24 hr	Boiled for 60 Min	Toasted
Tannins (mg/100 g)	113.23	107.24	75.45	30.52
% Tannin reduction	-	5.29	33.37	73.05
Phytate (mg/100 g)	152.10	117.42	108.13	43.12
% Phytate reduction	-	22.80	28.91	52.76
Trypsin inhibitor (mg/100 g)	233.10	194.82	138.48	76.68
% Trypsin inhibitor reduction	-	16.42	40.59	67.10
Karanjin (mg/100 g)	42.90	39.15	35.82	16.62
% Karanjin reduction	-	8.74	16.50	61.26

Amino Acid Profile of Karanj (*Pongamia pinnata*) Seed Cake

The amino acid profile of karanj seed cake is presented in Table 3. The results revealed that the seed have fair amounts of amino acids which compared favourably with other unconventional feed resources. The methionine and lysine contents of the soaked karanj seed cakes (SKSC) (2.13 and 4.74 % respectively), being the major limiting amino acids, seem to compare favorably with that of soya bean (1.40 and 6.40 %). The amino acid profile of SKSC was observed to be higher compared to other processed KSC. This finding is consistent with the report [11] who explained that fermented feed possesses higher concentrations of small-sized peptides and available amino acids.

The results showed that processing methods such as boiling reduced the amino acid contents of the cake (Table 3). The values of essential amino acids obtained in this study were similar to those reported by [16] for both raw and processed KSC. It has been observed that leucine is higher in KSC than soya bean cake (SBM), while methionine content is lower in KSC than SBM. However, KSC is rich in isoleucine and

phenylalanine. KSC could, therefore, be utilized as a partial substitute of costly vegetable protein sources like SBM. KSC contains around 20 – 28 % protein having well-balanced amino acids [17].

Table 3: Amino Acid Profile of Karanj (*Pongamia pinnata*) Seed Cake (%)

Amino acid	Raw	Soaked 24 hr.	Boiled 60 Min.	Toasted
Lysine	2.13	3.64	2.37	2.55
Methionine	0.71	2.23	0.72	0.78
Threonine	2.81	4.34	2.87	3.02
Isoleucine	2.43	1.13	1.01	1.32
Leucine	7.32	10.01	7.34	9.24
Phenylalanine	2.33	9.12	2.43	8.17
Valine	2.54	5.04	2.55	4.23
Tryptophan	2.44	4.98	2.46	3.12
Histidine	1.42	2.08	1.43	1.99
Arginine	3.02	4.32	3.42	4.13
Serine	2.32	3.92	2.37	3.72
Cysteine	0.20	0.42	0.23	0.40
Tyrosine	2.92	2.97	2.01	2.33
Alanine	2.21	3.01	2.12	2.43
Aspartic Acid	6.20	10.22	6.25	9.23
Glutamic Acid	6.32	10.23	8.43	8.03
Glycine	2.08	4.16	2.43	3.01
Proline	2.31	3.43	2.03	3.03

Soaked 24 h. = Soaked for 24 hoursnKSC = Karanj seed cake boiled for 60 minutes* Source: [17]

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DRY SEASON DIETARY SUPPLEMENTATION OF VITAMIN A (RETINOL) AND ITS IMPACT ON GROWTH PERFORMANCE OF PREGNANT WEST AFRICAN DWARF EWES

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ABSTRACT

This study investigated the impact of dietary Vitamin A (Retinol) supplementation on growth performance of pregnant West African Dwarf ewes during the dry season. Eighteen mature ewes (14-16 kg) were randomly assigned to three treatment groups, with six replicates each. The treatments consisted of a control group (basal diet without Vitamin A), a group supplemented with 140,000 IU Vitamin A/kg, and a group supplemented with 280,000 IU Vitamin A/kg in a Completely Randomized Design. Data was collected on growth performance and was analysed using One Way Analysis of Variance while Tukey's test was used to separate significantly different means. The results showed that Vitamin A supplementation had no significant effect ($p>0.05$) on growth performance parameters. It may have helped maintain the ewes' nutritional status during pregnancy, as revealed by the lack of weight loss and numerical increase in weight gain, lowest feed conversion ratio, increased dry matter particularly at the highest supplementation level (280,000 IU). The study found that while Vitamin A supplementation did not notably affect the growth performance of pregnant West African Dwarf ewes, it could be included in their diet by farmers at a concentration of 280,000 IU/kg. This inclusion improved feed efficiency, increased dry matter intake and reduced overall feed intake in pregnant West African Dwarf ewes. These findings suggest enhanced nutrient utilization and digestive health, indicating that Vitamin A may have supported the ewes' metabolic needs during this critical period.

Keywords: dry season, Vitamin A, growth performance, West African dwarf ewes

DESCRIPTION OF PROBLEM

Small ruminants, such as sheep and goats, are a vital part of Nigeria's agricultural sector (1). Their small size and high reproductive efficiency make them an attractive option for farmers (2). However, the quality of pasturelands in tropical regions is often poor, particularly during the dry season (3). This can lead to malnutrition, which negatively impacts reproductive success and overall health (4). Growth performance is a critical aspect of sheep production, and it is influenced by various factors, including nutrition (5). Minerals and vitamins play a crucial role in growth performance, as they are essential for various physiological processes, including bone development, immune function, and energy metabolism (6).

Vitamins, in particular, are essential for growth performance, and Vitamin A is one of the most critical vitamins, it is an essential nutrient, plays a critical role in growth, development, and reproduction (7,8). It plays a central role in gene expression, cell differentiation, and immune function, and its deficiency can lead to impaired growth performance, poor physical condition, increased morbidity, reproductive issues and mortality (9). Supplementation with vitamin A has been shown to improve growth performance, reproductive success, and overall health in sheep (10).

In pregnant ewes, Vitamin A deficiency can also lead to poor reproductive performance, low birth weight, and weak lambs (8). Therefore, ensuring adequate Vitamin A nutrition is essential for optimal growth performance and reproductive success in sheep. This study investigated the effects of dietary supplementation with vitamin A (retinol) on the growth performance of pregnant West African Dwarf Ewes during the dry season, aiming to provide insights into the importance of vitamin A supplementation for optimal growth and reproductive performance in this breed.

MATERIALS AND METHODS

Experimental site

The experiment was conducted at the Small Ruminant Unit of the Directorate of University Farms (DUFARMS), located at 7° 10' N latitude, 3° 2' E longitude and 76 mm above sea level in the rain forest vegetation zone of South-Western Nigeria. The region experiences a humid climate with an average annual rainfall of 1037 mm, mean temperature of 34.7^{0}C and humidity at 83% (Google Earth, 2020).

Experimental animals and management

Eighteen (18) matured ewes, weighing between 14kg to 16kg, were used for this experiment. Prior to their arrival, the pens were thoroughly cleaned, fumigated and disinfected with phenol disinfectant. The pens were equipped with feeding and drinking troughs and individualized housing made of corrugated iron sheet with raised floors. The ewes were acclimatized for four weeks, dung which they were fed a basal diet of guinea grass for the first week, followed by a gradual introduction of concentrate diet in the second week. To synchronize ovulation, the ewes were administered Synchromate (FSH) at the end of the acclimatization period. Rams were introduced 12 hours after hormone administration and successful mating was ensued though close monitoring. Pregnancy was detected and confirmed using the no-return-date method and ultrasound scanning at two months gestation. The experimental diet (Table 1) consisted of a basal diet of *M. maximus* and a supplemented concentrate diet fed at 4% body weight while the basal diet was fed ad libitum. The experiment lasted for 150 days.

Table 1: Proximate Composition (%) of experimental diet

Feed Ingredient	Kg
Corn Bran	15
Rice Bran	30
Cassava Peel	20
Palm Kernel Cake	15
Wheat Offal	17
Salt	1
Bone Meal	2
Total (%)	100
Crude Protein (%)	12.50
Metabolizable Energy (MJ/Kg DM)	11.55

Experimental Design

Eighteen (18) matured ewes were apportioned to three (3) treatment groups at random consisting of six (6) replicates.
Treatment 1 (Control) = Basal feed and concentrate fed without Vitamin A
Treatment 2 = Diet supplemented with 140,000IU vit A per Kg
Treatment 3 = Diet supplemented with 280,000IU vit A per Kg

Data collection

Growth performance of WAD Ewes

Body weight (BW) data was generated at the start of the trial and weekly by weighing individual animals. During the first, second, and third phases of gestation, feed intake (FI) was measured every day and used to compute the feed conversion ratio (FCR) and average weekly gain (AWG).

Average feed intake (g) = $\frac{\text{Feed intake – Leftover feed}}{\text{Number of ewes per treatment}}$

Average weekly weight gain (g) = $\frac{Final\ weight - Initial\ weight}{Number\ of\ Ewes\ per\ Treatment}$

Feed conversion ratio (FCR) = $\frac{Total\ feed\ intake}{Total\ body\ weight\ gain\ (g)}$

Statistical Analysis

We conducted a One-Way Analysis of Variance (ANOVA) using SPSS (version 2000) to analyze all data collected throughout the experimental period. This analysis utilized a completely randomized design. To determine significant differences between treatment means, Duncan's multiple range tests were employed at a significance level of $p<0.05$.

RESULTS AND DISCUSSION

Table 2 presents the effect of vitamin A dietary supplementation throughout the dry season on the growth performance of West African dwarf ewes in pregnancy. The supplemented levels of vitamin A did not significantly ($p>0.05$) alter any of the growth performance assessed metrics. Apart from the feed conversion ratio (FCR), which was greater in 280,000IU vitamin A inclusion levels than in 140,000IU, the observed parameters in 140,000IU Vitamin A inclusion levels were, however, higher than those provided at 280,000IU. The similar weight gain observed among the treatment justify the feed and/or supplement would rather compensate for other physiological performance instead of growth. Vitamin A is an important nutrient for ruminants, its deficiency impacts reproduction and with low vitamin A, it can lead to reabsorption or abortion of foetus (11). The non-significant results in the ewes' growth performance indices aligns with the results of (12) study who observed similar effect when vitamin was fed to a black yearling steer. The study by (13), which found no variations in the feed intake of cattle fed diets containing varied amounts of vitamin A, is corroborated by the feed intake recorded in this present study, which was not significantly impacted by the inclusion level of vitamin A. Similar metabolic weight gain observed across the treatments was also in accordance with the findings of (14) indicating no changes in the metabolic weight of west African dwarf pregnant ewes fed vitamin A. The reason for the non- significant results obtained in the growth parameters of the pregnant ewes can be adduced to the fact that retinol can be converted to retinoic acid which can be utilized for most essential functions of vitamin A such as maintaining healthy reproduction, supporting bone health and maintaining the body defense rather than growth (15). However, contrary to the present study is the study by (16) who reported an enhanced weight gain in cows fed diet containing Vitamin A during late gestation.

Table 2: Dry season dietary supplementation of vitamin A on the growth performance of pregnant West African Dwarf ewes

Parameters	**Vitamin A inclusion levels**			
	0IU	**140,000IU**	**280,000IU**	**SEM**
Initial weight (kg)	15.95	15.17	14.85	0.48
Final weight (kg)	18.45	17.67	18.18	0.61
Weight gain (g)	417.00	417.00	555.00	362.89
Weight gain (g/day)	3.72	3.72	5.00	3.24
Metabolic weight (g/day$W^{0.75}$)	92.28	92.28	114.35	1.17
Feed intake (g/day)	271.38	256.25	267.06	8.28
Dry matter intake (g DM/day^{-1})	241.53	228.06	273.68	9.10
Feed conversion ratio	0.65	0.61	0.48	67.47

SEM= standard error of mean

CONCLUSION AND APPLICATION

1. While Vitamin A supplementation did not significantly affect the growth performance of pregnant West African dwarf ewes, it could be incorporated into their diet by farmers at a concentration of 280,000 IU/kg.
2. It improved feed efficiency, increased dry matter intake, and reduced feed intake in pregnant West African Dwarf Ewes, suggesting enhanced nutrient utilization and digestive health.
3. Vitamin A may have played a role in supporting the ewes' metabolic demands during this critical period.

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ASSESSMENT OF FRUIT AND VEGETABLE WASTE POTENTIAL ON RUMINANT FEED USING *IN VITRO* GAS PRODUCTION TECHNIQUE

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ABSTRACT

In this study, vegetable and fruit wastes were collected from various markets, including cabbage, okra, jute mallow, Lagos spinach, zobo leaf, mango, cucumber, watermelon, pineapple, and pawpaw wastes. Their nutrient contents were analyzed using proximate and *in vitro* gas production methods. The results showed significant variations ($p < 0.05$) in chemical composition and *in vitro* gas production. Crude protein (CP) ranged from 3.06% in mango waste to 20.50% in Lagos spinach and cucumber wastes. Neutral detergent fiber (NDF) varied from 56.45% in zobo leaf waste to 69.38% in watermelon waste, while acid detergent fiber (ADF) ranged from 23.40% in zobo leaf waste to 55.35% in watermelon waste. Watermelon waste had the highest ash content (20.22%). Pawpaw waste had the highest CH4 (21.50), ME (8.82), and DMD (54.80), while jute mallow had the highest OMD (59.57). Lagos spinach had the lowest CH_4 (6.50), SCFA (0.45), and ME (6.15). Incorporating these wastes into ruminant diets could address feed shortages, improve animal performance, and reduce methane emissions.

Key words: Vegetable wastes, Fruit wastes, Proximate analysis, *In vitro* gas production, Ruminant diets

DESCRIPTION OF PROBLEM

The demand for animal products has surged in the last decade and is expected to grow further with the increasing human population (FAO, 2012). In sub-Saharan Africa, recurring animal feed shortages, climate change, and biodiversity loss necessitate exploring alternative feed sources for livestock. Meat and milk demand is rising in developing countries, where feed deficits are prominent (1). To address this, alternative feed resources for ruminants should be continuously investigated to reduce competition with human food, improve animal performance, and enhance food security (2,3).A major constraint in sub-Saharan Africa is the year-round availability of ruminant feed (4). Non-conventional feed resources, such as fruit and vegetable wastes, could supplement ruminant diets. Vegetable wastes include leftovers from human consumption, transport damage, and visually unappealing items. The production of fresh vegetables increased by 40 million tons between 2003 and 2013, ensuring the availability of vegetable wastes as animal feed (5). This study assesses the nutritive value of vegetable and fruit wastes from Ibadan and Epe markets as ruminant feed and evaluates their chemical composition and *in vitro* digestibility. The objective is to develop a livestock system base on fruits and vegetables waste.

MATERIALS AND METHODS

Experimental Site:
The experiment was carried out in Yaba College of Technology, Epe Campus, Lagos state, Nigeria. The study area was located within Latitude $3^0$58'E and Longitude 6^0'47^0 N, (Google Earth 2022).

Sample Collection:
Vegetable and fruit wastes collected from Ibadan and Epe markets included cabbage, okra, jute mallow, Lagos spinach, zobo leaf, mango, cucumber, watermelon, pineapple, and pawpaw wastes.

Determination of chemical composition:

Dry matter (DM), organic matter (OM), crude protein (CP) was determined according to (6), and neutral detergent fibre (NDF) was determined according to. (7)

Determination of *In vitro* gas production:
Samples were incubated in-vitro with rumen fluid in glass syringes following (8). Rumen liquor was collected from a ruminant via suction before morning feeding. About 200mg of milled samples were placed into 100ml calibrated syringes in duplicate. The syringes were pre-warmed at 39°C for an hour before adding 30ml of buffered rumen fluid. All syringes were incubated in a water bath at 39°C. After 24 hours, gas volume (GV) was measured. Organic matter digestibility (OMD %) and metabolisable energy (ME, MJ/Kg, DM) were calculated using Menke and Steingas's equations.

OMD = 14.88 + 0.889*GV + 0.45*CP + 0.65*XA
ME = 2.20 + 0.136*GV + 0.057*CP + 0.0029*CF
SCF = 0.0239*GV – 0.601

GV is 24-hour net gas production (ml/200mg DM), CP, CA, and CF are crude protein, crude ash, and crude fiber (% DM). Gas production characteristics were estimated using (9) equation Y = a + b (1 - e^(-ct)).

Statistical Analysis:
Data collected were subjected to one-way analysis of variance (ANOVA), and significant differences among means were compared using the Duncan Multiple Range Test (SAS, 2002) package.

RESULTS AND DISCUSSION

Table 1 shows the chemical composition of selected vegetable and fruit wastes, revealing significant variations ($p < 0.05$). Crude protein (CP) ranged from 3.06% in mango waste to 20.50% in Lagos spinach and cucumber waste, with some values between 12% and 20%, aligning with (5). Some samples had CP below the 7% minimum for tropical ruminants (10, 11).

Neutral detergent fiber (NDF) ranged from 56.45% in Z. leaf waste to 69.38% in watermelon waste, while acid detergent fiber (ADF) ranged from 23.40% in Z. leaf waste to 55.35% in watermelon waste. Watermelon waste had the highest ash content (20.22%), with values ranging from 3.80% to 20.22%.
Ether extract, or crude fat, ranged from 2.20% in okra wastes to 5.70% in pineapple wastes, lower than the values reported for cabbage and jute mallow (12). Ether extract includes lipids, chlorophyll, and fat-soluble vitamins (13). Crude fiber values ranged from 16.35% to 36.45%, promoting fullness and aiding in waste elimination and cholesterol reduction (12).

Nitrogen-free extract content, representing highly digestible carbohydrates, ranged from 27.39% to 65.41%, aligning with(5). Feedstuff composition is influenced by growth stage, maturity, species, drying method, environment, and soil type (14), which may explain the variations among the waste products studied (15).

Table 2 shows significant differences ($p<0.05$) in the *in vitro* fermentation parameters of selected vegetable and fruit wastes. Pawpaw waste had the highest CH_4 (21.50), ME (8.82), and DMD (54.80), while jute mallow had the highest OMD (59.57). Lagos spinach had the lowest CH_4 (6.50), SCFA (0.45), and ME (6.15), likely due to lower gas production in the first 24 hours of incubation. The bioavailability of nutrient like carbohydrates and protein can significantly affect ME while efficiency of microbial fermentation in the rumen affects SCFA.

CONCLUSION AND APPLICATION

Overall, the study provides valuable insights into the nutritive value of vegetable and fruit wastes and their environmental implications in ruminant feeding.

Table 1: Chemical composition (g/100g DM) of some selected vegetable and fruit wastes.

SAMPLES	CP	CF	EE	ASH	NFE	ADF	NDF	ADL	CEL	HEM	PDMI
J.Mallow waste	19.32^{b}	26.15^{b}	3.25^{f}	4.40^{i}	45.41^{a}	29.70^{g}	57.60^{g}	14.20^{f}	15.50^{g}	27.90^{b}	2.08^{b}
Z.leaf waste	3.98^{h}	17.95^{g}	3.50^{e}	5.65^{h}	65.41^{a}	23.40^{h}	56.45^{h}	11.55^{g}	11.85^{h}	33.05^{b}	2.12^{a}
Okra waste	4.87^{g}	36.45^{a}	2.20^{h}	7.57^{f}	46.04^{d}	41.80^{e}	59.45^{f}	18.50^{c}	23.30^{f}	17.65^{e}	2.02^{c}
L.spinach waste	20.50^{a}	23.85^{c}	2.65^{g}	15.65^{c}	37.39^{f}	38.65^{f}	60.40^{e}	15.65^{e}	23.00^{f}	21.75^{c}	1.98^{d}
Cabbage waste	12.28^{d}	19.80^{e}	2.40^{h}	12.46^{d}	53.60^{d}	38.70^{f}	57.90^{g}	14.30^{f}	24.40^{e}	19.20^{d}	2.07^{b}
Pineapple waste	8.41^{f}	17.95^{g}	5.70^{a}	3.80^{j}	65.53^{b}	53.40^{b}	67.95^{b}	19.25^{b}	34.15^{bc}	14.55^{g}	1.76^{g}
Pawpaw waste	8.77^{c}	19.30^{f}	4.65^{c}	8.85^{e}	43.32^{c}	52.30^{c}	66.70^{c}	18.60^{c}	33.70^{c}	14.40^{g}	1.79^{f}
Cucumber waste	20.50^{a}	16.35^{h}	5.20^{b}	6.80^{g}	55.56^{d}	49.40^{d}	65.80^{d}	17.90^{d}	35.10^{d}	16.40^{f}	1.83^{e}
Mango waste	3.06^{i}	19.75^{e}	3.70^{e}	18.62^{b}	56.21^{b}	53.55^{b}	67.80^{b}	19.15^{b}	34.40^{b}	14.25^{g}	1.76^{g}
Watermelon waste	13.20^{c}	21.30^{d}	4.40^{d}	20.22^{a}	39.73^{e}	55.35^{a}	69.38^{a}	20.25^{a}	35.10^{a}	14.03^{g}	1.73^{h}
SEM	0.02	0.06	0.05	0.05	0.30	0.12	0.08	0.07	0.11	0.16	0.02

$^{a, I,}$ means along the same row with different superscript are significantly varied (P<0.05), CP = crude protein, CF= crude fiber, EE = ether extract, NFE= nitrogen free extract, ADF= acid detergent fiber, NDF= neutral detergent fiber, ADL= acid detergent lignin, CELL= cellulose, HCELL= hemicellulose, PDM= Potential dry mater intake,SEM= Standard error of mean

Table 2: *In vitro* fermentation parameters of some selected vegetable and fruit wastes.

SAMPLES	CH_4	SCFA (µm)	ME (MJ/Kg DM)	OMD (%)	TVG	DMD
J.mallow waste	16.50^{b}	0.88^{ab}	8.74^{a}	59.57^{a}	182.83^{a}	38.60^{d}
Z.leaf waste	20.00^{a}	0.98^{a}	8.47^{a}	56.63^{a}	54.00^{a}	53.40^{a}
Okra waste	14.50^{b}	0.78^{b}	7.31^{b}	49.16^{bc}	45.00^{a}	47.80^{c}
L.spinach waste	6.50^{d}	0.45^{c}	6.15^{c}	44.37^{c}	30.00^{a}	35.53^{e}
Cabbage waste	16.50^{b}	0.94^{a}	8.68^{a}	59.10^{a}	185.33^{a}	50.80^{b}
Pineapple waste	20.50^{a}	0.94^{a}	8.46^{a}	56.76^{a}	52.00^{a}	48.50^{c}
Pawpaw waste	21.50^{a}	0.99^{a}	8.82^{a}	59.48^{a}	54.50^{a}	54.80^{a}
Cucumber waste	11.00^{c}	0.50^{c}	6.29^{c}	42.49^{d}	31.00^{a}	33.00^{f}
Mango waste	16.50^{b}	0.81^{b}	7.34^{b}	49.94^{b}	46.00^{a}	47.60^{c}
Watermelon waste	8.50^{d}	0.55^{c}	6.35^{c}	44.46^{cd}	34.50^{a}	36.20^{e}
SEM	0.50	0.02	0.14	0.93	34.15	0.33

$^{a-i}$ means along the same row with different superscript are significantly varied (P<0.05), SEM= Standard error of mean

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QUALITATIVE ASSESSMENT OF SOME SELECTED AGRICULTURAL WASTES AND CROP RESIDUES USING *IN-VITRO* GAS PRODUCTION METHOD

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ABSTRACT

In this study, vegetable and fruit wastes were collected from various markets, including cabbage, okra, jute mallow, Lagos spinach, zobo leaf, mango, cucumber, water melon, pineapple, and pawpaw wastes. Their nutrient contents were analyzed using proximate and *in vitro* gas production methods. The results showed significant variations ($p < 0.05$) in chemical composition and *in vitro* gas production. Crude protein (CP) ranged from 3.06% in mango waste to 20.50% in Lagos spinach and cucumber wastes. Neutral detergent fiber (NDF) varied from 56.45% in zobo leaf waste to 69.38% in watermelon waste, while acid detergent fiber (ADF) ranged from 23.40% in zobo leaf waste to 55.35% in watermelon waste. Watermelon waste had the highest ash content (20.22%). Pawpaw waste had the highest CH4 (21.50), ME (8.82), and DMD (54.80), while jute mallow had the highest OMD (59.57). Lagos spinach had the lowest CH_4 (6.50), SCFA (0.45), and ME (6.15). Incorporating these wastes into ruminant diets could address feed shortages, improve animal performance, and reduce methane emissions.

Key words: Vegetable wastes, Fruit wastes, proximate analysis, *In vitro* gas production, Ruminant diets

DESCRIPTION OF PROBLEM

The Nigerian ruminant industries are faced with the problems of meeting the nutritional requirement of the animals because the available grains and food crops are in high demands and the feasible options are the use of unconventional feedstuffs. However, agricultural waste and crop residues can be a valuable resource for various applications, including feed for livestock and bio-energy production if their nutrient content is evaluated for proximate composition and gas production, which can provide insights into their digestibility and fermentation characteristics. (1). Furthermore, (2), reported that the determination of intake and digestibility of feedstuffs in *in vivo* is time consuming, laborious, expensive, requires large quantities of feed evaluation. The *in-vitro* method of feed evaluation is less expensive and less time consuming compared with *in vivo* methods (3). It allows researchers to compare different feedstuffs, determine their suitability for animal nutrition, and optimize their utilization in various livestock production systems (4). This evaluation provides valuable information for optimizing the utilization of these materials in animal nutrition, bio-energy production, and other applications (5).

MATERIALS AND METHODS

Experimental Site:
The experiment was carried out in Yaba College of Technology, Epe Campus, Lagos state, Nigeria. The study area was located within Latitude $3^0$58'E and Longitude 6^0'47^0 N, (Google Earth 2022).

Sample Collection:
Vegetable and fruit wastes collected from Ibadan and Epe markets included cabbage, okra, jute mallow, Lagos spinach, zobo leaf, mango, cucumber, water melon, pineapple, and pawpaw wastes.

Determination of chemical composition:
Dry matter (DM), organic matter (OM), crude protein (CP) was determined according to (6), and neutral detergent fibre (NDF) was determined according to. (6)

Determination of *In vitro* gas production:
Samples were incubated in-vitro with rumen fluid in glass syringes following (7). Rumen liquor was collected from a ruminant via suction before morning feeding. About 200mg of milled samples were placed into 100ml calibrated syringes in duplicate. The syringes were pre-warmed at 39°C for an hour before adding 30ml of buffered rumen fluid. All syringes were incubated in a water bath at 39°C. After 24 hours, gas volume (GV) was measured. Organic matter digestibility (OMD %) and metabolizable energy (ME, MJ/Kg, DM) were calculated using Menke and Steingas's equations. OMD = 14.88 + 0.889*GV + 0.45*CP + 0.65*XA ME = 2.20 + 0.136*GV + 0.057*CP + 0.0029*CF;SCFA = 0.0239*GV – 0.601. GV is 24-hour net gas production (ml/200mg DM), CP, CA, and CF are crude protein, crude ash, and crude fiber (% DM). Gas production characteristics were estimated using (8) equation Y = a + b (1 - e^(-ct)).

Statistical Analysis:
Data collected were subjected to one-way analysis of variance (ANOVA), and significant differences among means were compared using the Duncan Multiple Range Test (SAS, 2002) package.

RESULTS AND DISCUSSION

Table 1 shows the chemical composition of some selected agricultural wastes and crop residues which varied significantly ($p<0.05$). Crude protein (%) ranged from 2.72 (Potato peels) to 9.14 (Groundnut haulms), while crude fiber (%) ranged from10.85 (Maize cob) to 28.40 (Sorghum husk). Ash content varied between 3.10% and 9.14% for Groundnut haulms and Maize husk respectively.

Table 1: Chemical composition (g/100g DM) of some selected agricultural wastes and crop residues.

SAMPLES	CP	CF	EE	ASH	NFE	ADF	NDF	ADL	CELL	HCELL
Potatopeels	2.72^{i}	18.65^{e}	1.85^{b}	9.11^{a}	36.28^{g}	37.35^{d}	59.80^{e}	18.00^{c}	19.35^{e}	22.45^{g}
Sorghumhusk	3.45^{g}	28.40^{a}	1.55^{cd}	8.55^{b}	46.29^{f}	35.80^{e}	62.70^{c}	17.00^{d}	18.80^{f}	26.90^{b}
Maizehusk	3.10^{h}	17.35^{f}	1.80^{b}	3.10^{h}	68.16^{b}	38.55^{c}	63.95^{b}	20.25^{a}	18.30^{g}	25.40^{c}
MaizeStover	8.41^{b}	15.70^{g}	2.25^{a}	8.41^{c}	55.94^{c}	35.20^{f}	55.20^{g}	13.30^{g}	21.90^{b}	20.00^{h}
Groundnuthusk	7.04^{d}	28.05^{a}	1.75^{b}	7.04^{e}	46.63^{f}	39.90^{b}	57.85^{f}	14.70^{e}	25.20^{a}	17.95^{i}
Melon husk	6.12^{f}	20.45^{c}	1.40^{de}	6.12^{g}	54.63^{d}	29.60^{h}	54.15^{h}	12.65^{h}	16.96^{i}	24.55^{d}
Cowpeahusk	8.12^{c}	23.90^{b}	1.70^{bc}	8.12^{d}	20.76^{h}	30.95^{g}	55.20^{g}	13.30^{g}	17.65^{h}	24.25^{e}
Maizecob	3.18^{h}	10.85^{h}	1.25^{e}	3.18^{h}	71.13^{a}	41.50^{a}	70.10^{a}	20.30^{a}	21.20^{c}	28.60^{a}
Groundnuthaulms	9.14a	18.30^{e}	1.75^{b}	9.14^{a}	50.62^{e}	35.15^{f}	58.05^{f}	14.25^{f}	20.90^{c}	22.90^{f}
Plantainpeels	6.31^{e}	19.55^{d}	2.15^{a}	6.31^{f}	54.26^{d}	38.90^{c}	61.30^{d}	18.45^{b}	20.45^{d}	22.40^{g}
SEM	0.02	0.09	0.03	0.03	0.10	0.80	0.08	0.05	0.07	0.04

[a,i,]meansalongthesamerowwithdifferentsuperscriptaresignificantlyvaried(P<0.05),CP= crude protein, CF= crude fiber, EE = ether extract, NFE= nitrogen free extract, ADF= aciddetergent fiber, NDF= neutral detergent fiber, ADL= acid detergent lignin, CELL= cellulose,HCELL= hemicellulose,SEM=Standard errorof mean.

The higher crude protein (CP) content in Groundnut haulms agrees with results of Woyengo *et al*.(2004) (9) who observed it could be used to supplement poor quality roughages to ruminant livestock in tropical regions. However, values obtained for Sorghum husk, maize husk andmaize cob are below the minimum threshold (7.0 - 8.0 g/100g) of CP levels for animal nutrition, this indicates they must be supplemented with good protein feed additives to satisfy animal‟snutrient requirements. Nevertheless, the CP for maize cob (3.18) is similar to the value (4.19%)documented by (10). The CFvalue obtained in groundnut husk (28.05%) and cowpea husk is in agreement with (11). High NDF observed in Maize cob (70.10) will affect the feedintake of animals. According to (12), NDF content above 55% limits feedintake. According to (13), Ash content provides an estimation of its mineral content andthe values obtained in this study reveals that

the agricultural waste have high mineral content andthismay affectsensory quality(14).However,thevalues observedarebelowedthe value obtainedby (15) butinagreement with (11).Table 2 shows significant differences ($p<0.05$) in the *in vitro* fermentation parameters of some selected agricultural waste and crop residues. Groundnut haulms had the highest CH_4 (19.00), SCFA (0.85), ME (8.42), OMD (58.72), TVGE (47.50) and DMD (47.70).The bioavailability of nutrient like carbohydrates and protein can significantly affect ME while efficiency of microbial fermentation in the rumen affects SCFA. High values of OMD indicate that wastes and residues are more digestible, likely due to lower lignin and higher soluble carbohydrates compared to other residue.

CONCLUSION AND APPLICATION

Overall, the study provides valuable insights into the nutritive value of agricultural wastes and crop residues, and their environmental implications in ruminant feeding.

Table 2: *In vitro* fermentation parameters of some selected agricultural waste and crop residues

SAMPLES	CH_4	SCFA (µm)	ME (MJ/Kg DM)	OMD (%)	TVGE	DMD
Potato peels	16.50^{a}	0.73^{b}	7.38^{c}	51.36^{a}	42.50^{b}	43.80^{c}
Sorghum husk	9.50^{bc}	0.38^{e}	5.74^{fg}	38.44^{g}	28.00^{e}	39.50^{d}
Maize husk	9.50^{bc}	0.41^{de}	5.53^{g}	33.62^{h}	29.00^{de}	35.80^{e}
Maize Stover	12.00^{b}	0.43^{d}	5.92^{ef}	42.35^{e}	30.00^{d}	42.60^{c}
Groundnut husk	7.00^{c}	0.41^{de}	6.07^{e}	39.95^{f}	29.00^{de}	39.30^{d}
Melon husk	8.00^{c}	0.29^{f}	5.11^{h}	34.50^{h}	24.00^{f}	32.30^{f}
Cowpea husk	17.50^{a}	0.74^{b}	7.91^{b}	53.59^{c}	43.00^{b}	45.80^{b}
Maize cob	12.00^{b}	0.60^{c}	6.44^{d}	42.83^{e}	37.00^{c}	33.90^{f}
GroundnutHaulms	19.00^{a}	0.85^{a}	8.42^{a}	58.72^{a}	47.50^{a}	47.70^{a}
Plantain peels	18.50^{a}	0.85^{a}	8.29^{a}	55.60^{b}	47.50^{a}	46.80^{ab}
SEM	0.50	0.01	0.05	0.29	0.33	0.33

$^{a-i}$meansalongthe samerowwith different superscript aresignificantlyvaried ($P<0.05$), SEM=Standard error of mean, CH_4= Methane, SCFA= Short Chain Fatty Acids, ME= MetabolisableEnergy, OMD= Organic Matter Digestibility, TVGE= Total Volume Gas Energy, DMD= DryMatterDigestibility.

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Ruminant Nutrition and Management: RMN016

EFFECT OF AQUEOUS *Gmelina arborea* EAF EXTRACT ON THE NUTRIENT DIGESTIBILITY OF WEST AFRICAN DWARF SHEEP

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ABSTRACT

An exponential growth in the practice and use of herbal medicine in recent time cannot be overemphasized in livestock industry. Hence, a 56 day trial was conducted to investigate the effect of aqueous *Gmelina arborea* leaf extract (AGALE) on nutrient digestibility in West African Dwarf (WAD) sheep. Twenty (20) WAD sheep, with an average live weight of 16 ± 0.02kg were randomly assigned into four treatment groups consisting of 5 animals per treatment in a completely randomized design (CRD). Fresh, clean water, cassava peel, and grasses were made available *ad libitum* during acclimatization. AGALE was administered on daily basis at varying levels such that T_1 served as the control (0 mL), while T_2, T_3, and T_4 received 5, 10, and 15 mL respectively. At 35th day of the feeding trial, three WAD sheep per treatment were randomly selected and transferred into metabolic cages for daily faecal samples collection to determine nutrient digestibility. AGALE administered had significant influences ($P<0.05$) on all nutrient digestibility values observed in this study. WAD sheep administered 5mL AGALE had the highest nutrient digestibility values while the lowest values was obtained in those on 0mL AGALE. It can therefore be concluded that 5mL AGALE administration optimized nutrient digestibility values in WAD sheep, offering a viable alternative feed strategy.

Keywords: Medicine, *Gmelina arborea*, Extract, Herbs, Phytochemicals, browse plant

DESCRIPTION OF PROBLEM

The cornerstone of sustainable livestock production in Nigeria hinges on the availability, quality, and quantity of pasture resources, which undergo seasonal quantitative and qualitative variations throughout the year. To mitigate these variations, herbs and plant extracts are increasingly used as alternative growth promoters, providing a more stable and reliable feed source for livestock (1). Herbs, spices, and various plant extracts have appetizing, digestive, and antimicrobial properties (2). Natural medicinal products derived from herbs and spices have also been used as feed additives for farm animals (3). Moreover, medicinal herbs have been shown to boost feed digestibility in ruminants due to their natural secondary metabolites, which physiologically activate enzymes that speed up digestion (4; 5). Plants are considered promising sources of medicine in traditional healthcare systems. There is a renewed interest in herbal-based medicine as a source of new antibacterial drugs because they have been used by some portions of the populace for a long time and are known to be safe for humans and the environment (6). One such promising alternative is *Gmelina arborea*, a leguminous browse plant known as Gmelina, which thrives in tropical regions. *Gmelina arborea's* aqueous leaf extract (AGALE) has shown potential in enhancing nutrient utilization and improving health parameters in various animal species. Some studies suggest that *Gmelina arborea* leaves can serve as inexpensive protein supplements, boosting voluntary intake, digestibility, and overall animal performance when fed low-quality feeds. Other studies underscore *G. arborea's* potential as a high-quality feed source for ruminants due to its rich protein, mineral, and vitamin content. Additionally, research has confirmed *Gmelina arborea's* ability to enhance the digestibility of feedstuffs in ruminants. The leaves of *G. arborea* contain phytochemicals like tannins, alkaloids, saponins, oxalates, flavonoids, and steroids, which influence rumen microbial activity and alter fermentation patterns. Despite its numerous advantages, the specific effects of *G. arborea* on nutrient digestibility in West African Dwarf (WAD) sheep remain underexplored. The appropriate phytochemical dosage that could be beneficial to ruminants is crucial, as inappropriate intake has been linked to weight loss (7; 8). Properly harnessing aqueous *Gmelina arborea* leaf extract could

address the intake and digestibility challenges faced by farmers. Therefore, this study investigated the administration of AGALE in WAD sheep diets to assess its impact on nutrient digestibility.

MATERIAL AND METHODS

Experimental site and duration: The experiment was conducted at the Teaching and Research Farm, Federal College of Animal Health and Production Technology, Moor Plantation, Apata, Ibadan. The temperature and relative humidity ranges from 35 - 40°C and 76-78% respectively. The experiment lasted for eight (8) weeks,

Experimental animals, diet and design: A total number of twenty (20) West African Dwarf (WAD) Sheep aged 7 to 8 months weighing 16 ± 0.02kg were purchased from Akinyele market in Ibadan, Oyo state. Prior to the arrival of the animals, the pens were thoroughly washed and disinfected with Povidone-iodine. The WAD sheep were confined in individual pen and quarantined for a period of two (2) weeks until they were stabilized. Fresh cool clean water, cassava peel and grasses were made available *ad libitum.* During acclimatization, WAD sheep were given prophylactic treatments consisting of intramuscular injection of oxytetracycline (long acting) and vitamin B complex to ensure good body condition of the animals. After adaptation period, the 20 WAD sheep were randomly allotted into four treatment groups during which the animals were drenched AGALE at varying levels; T_1 (0mL), T_2 (5mL), T_3 (10mL) and T_4 (15mL).

Test Ingredient Preparation: *Gmelina arborea* leaves were collected from the *Gmelina arborea* trees at the College and washed thoroughly to remove any debris. The leaves were then air-dried completely, ground into a fine powder, and sieved to achieve a smooth leaf meal. This leaf meal was taken to the laboratory at the University of Ibadan for further processing. In the laboratory, the leaf meal was dissolved in 45 litres of distilled water for 24 hours, sieved using muslin cloth, and the filtrate was then filtered through Whatman's filter paper. The filtered solution was then processed using a rotary evaporator, which consisted of a pressure machine, sender flask, receiver flask, water bath, condenser, and the main unit. A quantity of the filtrate was poured into the sender flask, and the machine was activated. The bath temperature was set to 50°C to prevent denaturing the filtrate. As the process continued, vapor rose from the sender flask to the condenser. The condenser, with the aid of a water supply, condensed the vapor back into liquid form and directed it to the receiver flask. Once the *Gmelina arborea* filtrate reached a sticky consistency, it was transferred into petri dishes. The number of petri dishes used varied depending on the quantity of the extract. The AGALE was then freeze-dried to achieve a crystalline texture.

Data Collection: Daily feed intake was calculated by measuring the difference between the daily feed offered and the daily leftovers. Nutrient intake was determined by multiplying the feed intake by the nutrient content (dry matter, crude protein, crude fiber, ether extract, etc.) obtained from laboratory analysis. On the 35th day of the trial, three WAD sheep were randomly selected and transferred into metabolic cages designed for the separate collection of feces and urine. Daily fecal samples were collected, weighed, and oven-dried for chemical analysis to determine nutrient digestibility.

$$\textbf{\textit{Nutrient Digestibity}}\ \% = \frac{\textbf{\textit{Nutrient intake}} - \textbf{\textit{Nutrient Output}}}{\textbf{\textit{Nutrient intake}}} \times \mathbf{100}$$

Chemical Analysis: The proximate analysis of the experimental diet was determined according to the procedures of (9) and fibre fractions of the experimental diet were determined according to the procedure of (10)

Statistical Analysis: All data obtained were subjected to analysis of variance using statistical package; (11) and the means among the variables were separated using Duncan multiple range test of the same statistical package.

RESULTS AND DISCUSSION

Effect of Aqueous *Gmelina arborea* leaf extract on the nutrient digestibility of West African Dwarf Sheep is shown in Table 2. Aqueous *Gmelina arborea* leaf extract (AGALE) had a significant ($P<0.05$) influence on the nutrient digestibility of WAD Sheep observed in this study. Animals administered 5mL AGALE recorded the highest nutrients digestibility values followed by those administered 15mL while animals administered 10mL of AGALE recorded the least values of digestibility except Ash and ADL which decreases across the treatment groups as the level of AGALE increases.

Table 1: Chemical and Gross composition of the experimental diet

Chemical composition		Gross composition	
Parameters	%	Ingredient	%
Dry Matter	92.75	Cassava peel	50.00
Crude Protein	15.19	Soyabean	14.00
Ether Extract	2.39	Wheat offal	22.00
Ash	8.24	Palm kernel cake	11.00
Neutral Detergent Fibre	32.30	Premix	1.00
Acid Detergent Fibre	11.35	Limestone	1.00
Acid Detergent Lignin	3.88	Salt	1.00
Cellulose	7.47	Total	100.00
Hemicellulose	20.95	Calculated analysis	
Nitrogen Free Extract	59.22	Metabolizable energy (Kcal)	2274.05
		Crude Protein %	13.80
		Crude Fibre %	8.60

Phytochemical properties, including secondary metabolites found in plant extracts, have been reported by (12) to enhance animal performance, nutrient intake, and digestibility values. In this study, nutrient digestibility values were significantly influenced by AGALE administration. WAD sheep in the 5 mL AGALE group exhibited the highest nutrient digestibility values across most parameters among the treatment groups. The reduced nutrient digestibility values observed in groups receiving higher doses of AGALE could be attributed to the levels of phytochemicals in AGALE inhibiting the activities of certain microbes that enhance the degradation of ingested feeds. This finding is consistent with the observations of (13; 8), who reported similar results when Yankasa rams were fed varying proportions of *Gmelina arborea* leaf meal and when WAD goats were supplemented with different levels of *Gmelina arborea* leaves. The reduced crude fiber digestibility, including Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF), and Acid Detergent Lignin (ADL), particularly in the 10 mL and 15 mL groups, can be attributed to the inhibitory effects of phytochemicals such as tannins present in AGALE, as noted by (14). These phytochemicals likely interfere with the activity of fiber-degrading enzymes. Interestingly, the digestibility of ash remained higher in the 5 mL group compared to other groups, including the control. This pattern is consistent with the findings of (13; 8), indicating that lower doses of AGALE might enhance mineral absorption.

CONCLUSION

It can therefore be concluded that 5mL AGALE administration enhanced the activity of digestive enzymes which invariably optimized the nutrient digestibility values of WAD sheep observed in this study.
Recommendation: Future research should focus on isolating and characterizing these phytochemicals to better understand their impact on nutrient metabolism and to optimize the use of AGALE in WAD sheep diets.

Application: Administering 5 mL AGALE is recommended for improving nutrient digestibility in WAD Sheep. This dosage appears to optimize the digestibility of key nutrients without the adverse effects observed at higher dosages.

Table 2: Effect of Aqueous *Gmelina arborea* Leaf Extract on the nutrient digestibility of West African Dwarf Sheep

Parameters	T_1(0mL)	T_2(5mL)	T_3(10mL)	T_4(15mL)	SEM
Dry matter	66.13^{c}	86.50^{a}	74.60^{b}	75.92^{b}	2.35
Crude Protein	61.95^{c}	86.20^{a}	71.72^{b}	73.93^{b}	2.86
Ether Extract	45.64^{c}	82.90^{a}	62.12^{b}	76.55^{ab}	4.76
Ash	20.95^{c}	68.68^{a}	46.21^{b}	46.15^{b}	5.47
Neutral Detergent Fibre	70.75^{c}	88.94^{a}	66.87^{c}	79.56^{b}	2.69
Acid Detergent Fibre	53.75^{bc}	82.31^{a}	45.41^{c}	61.08^{b}	4.55
Acid Detergent Lignin	40.00^{c}	74.40^{a}	54.59^{ab}	53.36^{bc}	4.85
Cellulose	48.35^{c}	77.67^{a}	56.63^{bc}	65.14^{ab}	3.87
Hemicellulose	86.16^{a}	86.01^{a}	65.44^{b}	86.77^{a}	2.98
Nitrogen Free Extract	71.60^{b}	87.82^{a}	81.35^{a}	83.36^{a}	1.97

$^{a,b\ c}$ Means along the same row with different superscripts are significantly different ($P<0.05$)

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Ruminant Nutrition and Management: RMN017

EFFECTS OF DIETARY KALGO (*Piliostigma Reticulatum)* POD MEAL ON HEMATOLOGY OF GOATS FED A CONCENTRATE-BASED DIET, WITH OR WITHOUT CHARCOAL

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ABSTRACT

This research evaluated the hematology indices effects of goats fed a diet supplemented with Piliostigma reticulatum pod meal (PRPM). Nine Red Sokoto bucks (BW, 12.5kg, 5 months old) were randomly assigned to three isocaloric and isonitrogenous diets namely, a basal diet without PRPM (Control), a diet supplemented with 20% PRPM, and a diet supplemented with 20% PRPM and 0.03% charcoal in a completely randomized design. The goats were fed for 60 days, and slaughtered. The control goats had lower ($p<0.05$) packed cell volume than the goats fed other dietary treatments. Dietary treatments did not affect the concentration of hemoglobin, white blood cells, and red blood cells in goats. This result suggests that PRPM could be utilized in diets without compromising the hematological indices in goats.

Keywords: *Piliostigma reticulatum*, packed cell volume, red blood cells, and white blood cells.

DESCRIPTION OF PROBLEM

The low nutritional value of pasture and forage, especially during the dry season, and the limited availability of feed are two of the main factors limiting the production of ruminant livestock in Nigeria. [1, 2]. Thus, using all year–round novel feedstuffs present considerable merits for promoting the nutritional base to enhance the productivity of ruminant livestock [1, 3]. This is particularly relevant to the trend towards increased meat production to meet with the ever–increasing Nigerian population. Fodder trees and shrubs play a vital role in ruminant production in the tropics due to their ability to maintain their nutritive value during the dry seasons [2, 4]. *Piliostigma reticulatum* is a leguminous medium-sized tree that grows wild in the tropics [5]. In northern Nigeria, Piliostigma reticulatum is one of the most common species of *Piliostigma* [6, 7]. *Piliostigma reticulatum* is locally known as Kalgo (8). The nutritional profile and anti-nutritional factors of *Piliostigma reticulatum* pods have been documented [4, 8, 9]. However, *Piliostigma reticulatum* pod has not been extensively studied for its potential use in ruminant nutrition. Furthermore, we investigate if charcoal can mitigate the potentially harmful effects of the anti-nutritional components in the *Piliostigma reticulatum* pod. The objective of this study was to assess the impact of dietary supplementation of *Piliostigma reticulatum* pod meal on hematology indices in goats fed a concentrate-based diet.

MATERIALS AND METHODS

Experimental location, goats, and diets

The experiment was conducted at the Animal Bioresources Development Centre farm, Bayero University New site, Kano, Kano state, Nigeria. It bears a coordinate of longitude 9º 30º and 12º 30º N and latitude 9º 30º and 8º 42º E in the semi-arid zone of the semi-arid of Nigeria at an altitude of 460 m above sea level (10). The climate is characterized by a defined wet season (May to September) and a dry season (October to April). The mean annual rainfall ranges from 600 - 1000 mm [11]. Nine Red Sokoto bucks with an average mean body weight of 12±0.30 kg and about 5 months old were purchased from a local Farm in Kano, Kano state Nigeria. Before the commencement of the trial, the goats were treated against internal and external parasites by administering subcutaneous ivomec injection (0.2 ml per head). A broad-spectrum antibiotic (Ox tetracycline, L.A) was given at the rate of 0.2ml per head. The goats were randomly assigned to three

dietary treatments in a completely randomized design. Feed and water were supplied *ad libitum*. *Piliostigma reticulatum* pods were collected within the premises of Bayero University, air-dried, packed, and stored until used. The experiment lasted 60 days. The experimental diets were concentrated formulated to meet the nutrient requirement of growing goats according to the NRC requirements (12). The experimental diets included a basal diet without Piliosti*gma reticulatum* pods (T1), a basal diet with 20% *Piliostigma reticulatum* pods, (T2), and a basal diet with 20% *Piliostigma reticulatum* pods and 0.03% charcoal (T3). The chemical composition of the experimental diets was assessed following the protocol of AOAC [13] while acid detergent fibre (ADF) and neutral detergent fibre (NDF) were determined following the protocol of (14). The ingredients composition of the dietary treatments is presented in Table 1. The goats were fed twice a day at 8:00 a.m. and 4.00 p.m. The feeds were offered to the goats at 3% of body weight to allow the *ad libitum* condition.

Table 1: Ingredient composition of dietary treatments

Ingredients (%)	T_1 (%)	T_2 (%)	T_3 (%)
Maize Offal	55.00	35.00	35.00
Soya bean meal	25.50	25.50	25.47
Wheat Offal	16.00	16.00	16.00
Piliostigma reticulatum pods	-	20.00	20.00
Charcoal *	-	-	0.03
Bone meal	2.00	2.00	2.00
Salt	1.00	1.00	1.00
Vit.premix	0.50	0.50	0.50
Total	**100**	**100**	**100**

[1]T1=Control diet, T2=diet supplemented with 20% *Piliostigma reticulatum* pods. T3=diet supplemented with 20% *Piliostigma reticulatum* pods and 0.03% charcoal.

Blood collection and profiling

At the end of the last 5 days of the experimental trials, Blood samples (4 ml) were collected from each goat through jugular venipuncture into EDTA bottles and kept at - 80 ^{0}C until analysis. The blood samples were analyzed for red blood cells (RBC), packed cell volume (PCV), hemoglobin (HgB), and white blood cells (WBC) using an automatic hematology analyzer (CELL- DYN 3700 Abbott, USA).

Statistical analysis

Data obtained were subjected to an analysis of variance (ANOVA) procedure [15] suitable for a completely randomized design. Duncan multiple range test was used to compare the treatment means at $p<0.05$.

RESULTS AND DISCUSSION

The hematology parameters of goats as influenced by dietary treatments and experimental periods are presented in Table 2. Blood profiling is an effective strategy for assessing the physiological and health status of livestock [16, 17]. In this trial, the T3 goats had the highest PCV, which was significantly different from those of goats fed other dietary treatments ($p<0.05$) while, the control goats had lower PCV that was significantly different ($p<0.05$) from goats fed other dietary treatments. This observation suggests that the phytochemicals in PRPM induced better transportation of oxygen and absorbed nutrients and thus enhanced primary and secondary polycethemia [20, 21]. A similar increase in PCV was observed in Red Sokoto goats fed tannin-rich Pterocarpus erinaceus-based diets [23]. Therefore, dietary supplementation of *Piliostigma reticulatum* pods did not affect hematological parameters except PCV in goats. The concentration of WBC, RBC and HgB were not affected ($p>0.05$) by dietary treatments. The RBC, PCV, and WBC in goats increased ($p<0.05$) between dietary treatment and the sampling period on hematological indices in goats. The values of RBC, PCV, HgB, and WBC observed in our findings were within the range of reference values (HgB, 80-120 g/L; PVC, 22-38%; RBC, 5-8 $x10^{12}$/L, WBC, 4-14 $x10^9$ /L) reported for clinically healthy goats [18, 19]. The normal RBC values observed in the present study indicated that dietary *Piliostigma*

reticulatum pods did not induce hemolytic anaemia and depression of erythrogenesis [20, 22]. The lack of significant differences in the concentration of hemoglobin among the treatments indicates the absence of microcytic hypochromic anaemia, which may be caused by the deficiency and/or improper use of iron for the synthesis of HgB [18, 22]. The increase in PCV, WBC, and RBC as the experimental period progressed could be attributed to changes in the demands for metabolism occasioned by the increase in the body weight of the goats. Similar changes in hematological variables were reported in Mehsana goats due to age differences [23]. The increase in PCV over the experimental period could be due to the increase in RBC or the decrease in the circulating blood plasma [20]. The increase in RBC and HgB over the experimental period suggests the need for high oxygen demand resulting from an increase in the body weight of the goats. This observation is consistent with the findings reported in Sannen goat kids [24]. This observation further attests to the non-toxicity and perhaps the suitability *of Piliostigma reticulatum* pods in ruminant diets.

Table 2: Hematological indices in goats fed diets supplemented with *Piliostigma reticulatum* pods.

Parameter	Dietary treatments[1]				Period (days)						P value	
	T1	T2	T3	SEM	1	2	3	4	5	SEM	D	P
PCV[2] (%)	22.95^{c}	24.52^{b}	26.45^{a}	0.38	23.07^{f}	25.57^{ef}	23.97^{de}	24.56^{cd}	25.00^{bc}	0.15	<.0001	<.0001
WBC[3] ($x10^9$/L)	5.74	5.50	5.86	0.07	4.81^{g}	5.15^{fg}	5.48^{fe}	5.77^{de}	6.15^{cd}	0.12	0.201	<.0001
RBC[4] (10^{12}/L)	6.35	6.06	6.59	0.91	5.05^{c}	5.27^{bc}	5.52^{abc}	5.66^{abc}	5.79^{abc}	0.17	0.091	0.0009
HgB[5] (g/L)	94.40	91.80	92.90	5.02	84.10	85.20	86.62	88.20	91.01	3.00	0.101	0.064

T1=Control diet, T2=diet supplemented with 20% *Piliostigma reticulatum* pods. T3=diet supplemented with 20% *Piliostigma reticulatum* pods and 0.03% charcoal. [1] Dietary treatment. P= Period. [2] Packed cell volume, [3] White blood cells, [4] Red blood cells. [5] Haemoglobin

CONCLUSION

The inclusion of 20% *Piliostigma reticulatum* pods in the diet of goats did not have deleterious effect on hematology indices in goats.

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Ruminant Nutrition and Management: RMN018

REPLACEMENT VALUE OF AFRICAN LOCUST BEAN SEED MEAL (*P. biglobossa*) FOR COTTON SEED CAKE (*G. herbaceum*) IN THE DIETS OF GROWING YANKASA RAMS

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ABSTRACT

This study was conducted to evaluate the effect of replacing Cotton Seed Cake with African Locust Bean Seed meal in the diets of growing Yankasa rams. Total mixed rations containing 16% crude protein (CP) were formulated for the experiment in which Cotton seed cake (CSC) was replaced by African locust seed meal (ALBSM) at 0, 10, 20, and 30% and designated as diets 1, 2, 3 and 4 respectively. Sixteen (16) growing Yankasa rams were used for the experiment and randomly allocated to four (4) treatment groups of four (4) animals each in a completely randomized designed. Rams were fed experimental diets and water *ad libitum*. The results of the experiment revealed significant ($P<0.05$) difference in the total feed intake across the diets. Rams fed diets 1, 2 and 3 had higher intake (732.20, 636.98 and 582.17 g/day, respectively) while the least (504.16 g/day) was for those fed diet 4. Significantly ($P<0.05$) higher average daily weight gain of 126.43 g/day was recorded in animals fed diet 2 while the lower values (92.86 and 53.00 g/day, respectively) were recorded in animals fed diets 3 and 4. Similarly, better fed utilization was recorded in animals fed diet 2 (5.04) while those on diet 4 had the least (9.51). Conclusively, animals fed diet 2 (20% Cotton seed cake/ 10% African locust bean seed meal) containing Cotton Seed Cake at 20% and African Locust Bean Seed at 10% level of inclusion gave the better growth performance, feed conversion ratio and feed cost per kg gain. Therefore, this diet can be recommended for growing Yankasa sheep.

Keywords:

INTRODUCTION

The unavailability of feed in the tropics is more persistent in dry season when natural pastures mature and become highly fibrous and low in crude protein content (10). High cost of feeding has continued to remain a major impeding factor in intensive animal production. Therefore, it is imperative to exploit the use of non-conventional feedstuffs that are cheap and readily available (14). Studies have shown that non-conventional feedstuffs offer least cost of feeding in livestock production when included in the diet (12).The African locust bean tree is a leguminous plant which produces seed grain that is often cheap and readily available in northern Nigeria. It grows across Sudan and Guinea savannah ecological zones (7). The seeds, the fruit pulp, foliage and the leaves of the African locust bean are used to prepare numerous foods and drinks, and to feed livestock and poultry, hence, it is a very popular ingredient in traditional African cuisines. The fruit pulp and the seeds, once processed to remove anti-nutritional factors, can be included in livestock feed. The crude protein content of the seed on a dry matter basis ranged from 25 and 38% and has the potential to be utilized in livestock feeding (9). Their usefulness is increased by the fact that they can be harvested during the dry season when feed is scarce. Recently there has been remarkable improvement in processing legume seeds using various methods such as cooking, toasting, soaking, fermenting (3). This study therefore employed the use of toasting as a method of processing African locust bean (*Parkiabiglobosa*) seed meal to replace Cotton seed cake in the diets of growingYankasa rams with the aim of studying its effects on nutrient intake, growth performance, nutrient intake of growing rams.

MATERIALS AND METHODS

Study area

The study was conducted at Abubakar Tafawa balewa University.Bauchi state occupy the total land area of 549,260 km representing about 5.3% of Nigerian total land mass and is located between 9˚ 3´ of the equator and longitudinally, the state lies between 8˚50´ and 11˚ east of the Greenwood meridian. The annual rain fall range between 1300mm per annum in the south and 700mmper annum in the extreme north (4).

Experimental animals and their management

Before the arrival of animals, the experimental pens were cleaned, disinfected with Izal solution and labeled. Sixteen (16) growing Yankasa rams approximately 12 to 18 months old in age and with an average weight between 12 and 18 kg were used for the experiment. The animals were purchased from two markets (Mararraban Liman Katagum and Zwall) all within Bauchi state. Before the commencement of the experiment, the animals were quarantined for 2 weeks during which they were vaccinated against PPR, and treated against both internal and external parasites. They were also treated with Oxytetran long acting broad-spectrum
antibiotic. The quarantine period also serves as period for the adjustmentof the animals to confinement. Du ring the quarantine period the animals were fed chopped groundnut haulms and maize brand *ad lib* as main tenance ratio. They were also provided with good clean drinking water *ad lib*. The animals were randomly divided into four groups of four animals each. During the experiment, feeding was done every morning and evening at about 0700 and 1400hrs at approximately 10% of individual consumption.

Experimental diets and animal feeding

Five diets(16% crude protein)were formulated in such a way that cotton seed cake replaced toasted African locust bean seeds meal (ALBSM) at 0, 10, 20 and 30% levels, and designated as Treatments 1, 2, 3 and 4 r espectively. The animals were allowed 14 days period of adaptation to confinement. During the experiment, feeding was done every morning and evening at about 0800 and 1800hrs at approximately 10% of individual consumption. Animals were provided good clean drinking water *at lib* in plastic containers. The total daily allocation of the diets was adjusted on the basis of the previous day's intake. Total feed and water intake of each animal were estimated. The animals were weighed at the beginning of the experiment and weekly thereafter. The experiment lasted for 70 days. Ingredients composition of the experimental diets is shown in Table 1.

Statistical analysis

Data obtain from the experiment were subjected to Analysis of Variance (ANOVA) in a completely randomized designed using statistical package of social sciences (SPSS version 21). Where analysis of variance indicating significant difference between treatments, group means were compared using Least Significant Difference (LSD).

RESULTS AND DISCUSSION

The nutrient intake of growing Yankasa rams fed African locust bean seed meal to replace cotton seed cake in diets is presented in Table 2. There was significant (p> 0.05) on all parameters. The values of DMI differed significantly (p> 0.05) across the diets. The animals fed diet 1 recorded the higher dry matter intake (656.27g/day) followed by the animals fed 2 and 3 (574.75 and 522.15g/day), while the least value was recorded in diet 4 (452.43g/day). The DMI values (452 656.27g/day) decreased with increase in levels of ALB seed meal across the treatments.(6) rec orded a mean DMI of 884.91 g/day when growing Yankasa rams fed graded levels of baobab (A*dansonia digitata*) seed meal as replacement value for cowpea husks which was higher than the values recorded in th is study for animal fed diets1, 2, 3 and 4(740.30, 577.00, 561.90 and 439.70 g/day) respctively. The DMI v alues in this study were higher than that reported (1) for Yankasa rams fed cotton seed cake (CSC) which was partially or completely replaced by urea and / or sundried broiler litter (SDBL) (484 to 543g/day) resp ectively. The DMI (949.51 g/day) reported by (15) who fed Sorghum Stover Based Diets Containing Graded

Levels of Urea and Cotton Seed Cake was higher than reported in this study. The crude protein intake (CPI) values were significantly different across the diets. The range (73.43 to 107.56 g/day) of values reported in this study was lower than those (132.48 to 171.05 g/day) reported by (15). The CPI values were higher than 127.79 g/day reported by (2) in Growth performance and *invivo* nutrients digestibility of growing Yankasa ram lambs fed diets containing graded levels of sesame residue. The neutral detergent fibre intake (NDFI) values differed significantly (P<0.05) across the diets. Animals fed diet 1(212.24g/day), had higher NDFI followed by those fed diet 2(170g/day) and diet 3 (151.06g/day) while the least NDFI recorded in this study were the animals fed(140.71g/day). The NDFI values reported in this study were lower than the range (291.90 to 322.00 g/day) reported by(13), also than 276.00 g/day reported by (5).The acid detergent fiber intake (ADFI) values T1(136.18 g/day,) T2(114.3g/day) T3(103.18g/day) and T4 (15.79g/day) were significantly (P<0.05) different across the diets. The higher ADFI value recorded in this study falls below the range of 136.18 to 103.18g/day documented by (6). The ADFI recorded in this study falls within the range of 182.20 to 209.70 g/day reported by (13). Water intake value of 2.54 l/day recorded in this study was below the range of 1.46 to 1.60 l/day and 2.56 to 3.09 l/day that was reported by (8). The mean water intake recorded in this study falls within the range of 4.65 to 5.06 l/day reported by Sani (2018) but higher than 2.10 to 2.60 l/day reported by Oliveira *et al.* (2016) for sheep fed diets containing corn meal with dry brewer's yeast.

Growth Performance of growing Yankasa rams fed African locust bean seed meal for cotton seed cake in diets.

The results of the growth performance of growing Yankasa rams fed African locust bean seed meal for cotton seed cake in diets is presented in Table3. Average daily gain (ADG) of 126.43 which is lower than ADG of 147.14 kg report by(15). In his feeding trial to assess the nutrient intake and Growth Performance of consequent increase Yankasa Rams Fed Sorghum Stover based diets Containing Graded Levels of Urea and Cotton Seed Cake.(15) in his study Conducted on growth performance of Yankasa rams fed diet with urea, soybeans meal and poultry litter recorded lower ADW of 101 g/day. Better feed conversion ratio was observed in animal fed diets 2 (5.04) in this study. (11) reported that improved feed conversion efficiency may be due to the relatively higher nutrient composition of diets and the in body weight gain showing that diets that promote a high rate of gain will usually result in a greater efficiency than diets that do not allow rapid gain, since the rapidly gaining animals utilize less of the total feed intake for maintenance and more of it for live weight gain which was in accordance with the present study.

Table 1: Ingredients composition of experimental diets (%)

	Treatments			
Ingredients	1	2	3	4
Cotton Seed Cake	30.00	20.00	10.00	00.00
ALBSM	00.00	10.00	20.00	30.00
Maize Offal	39.74	42.24	45.04	46.04
Groundnut Haul	17.76	15.26	11.84	11.46
Wheat Offal	10.00	10.00	10.00	10.00
Bone Meal	2.00	2.00	2.00	2.00
Salt	0.50	0.50	0.50	0.50
TOTAL	**100**	**100**	**100**	**100**

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Table 2: Nutrient intake of growing Yankasa rams fed African locust bean seed meal to replace cotton seed cake in their diets.

Parameters	Treatments				
	1	2	3	4	SEM
Total feed intake (g/day)	732.20[a]	636.98[b]	582.17[c]	504.16[c]	43.77*
DMI	656.27[a]	574.75[b]	522.15[c]	452.43[d]	43.01*
OMI	536.11[a]	465.49[b]	433.38[c]	375.65[d]	33.35*
CPI	107.56[a]	94.26[b]	85.00[c]	73.43[d]	7.22*
NDFI	212.24[a]	170.36[b]	151.06[c]	140.71[d]	8.32*
ADFI	136.18[a]	114.32[b]	103.18[c]	99.04[d]	15.79*

T1-30 %CSC and 0 % ALBSM, T2- 20% and 10% ALBSM, T3- 10% CSC and 20% ALBS, T4 – 0% CSC and 30% ALBSM, DMI= dry matter intake, OMI= organic matter intake, CPI= crude protein intake, NDFI= neutral detergent fibre intake, ADFI= acid detergent fibre intake, SEM standatd error of mean.

Table 3: Growth performance of growing Yankasa rams fed African locust bean seed meal to replace Cotton seed cake.

Parameters	Treatments				
	1	2	3	4	SEM
Initial weight (kg)	15.90	13.95	14.38	13.64	0.50[NS]
Final weight(kg)	22.68[a]	22.80[a]	20.88[b]	17.35[c]	1.27*
DMI (g/day)	656.27[a]	574.75[a]	522.15[b]	552.43[c]	3.01*
Total weight gain (kg)	6.78[b]	8.85[a]	6.50[b]	3.71[c]	1.06*
Average daily gain (g)	96.86[b]	126.43[a]	92.86[b]	53.00[c]	6.47*
Feed conversion ratio	7.56[b]	5.04[a]	6.26[a]	9.51[c]	1.03*

a,b,c Means with different superscript along same row differ significantly at 0.05% SEM=standard error of means.T1-30 %CSC and 0 % ALBSM, T2- 20% and 10% ALBSM, T3- 10% CSC and 20% ALBS, T4 – 0% CSC and 30% ALBSM, DMI= Dry matter intake

CONCLUSION AND RECOMMENDATION

The inclusion of African locust bean seed meal up to 100% replace cotton seed cake in the diets of growingYankasa rams does not have any adverse effect on the productive performance of the animals however, diet 2 (10%ALBSM,20% CSC) gave the higher average daily weight gain (126.43g) and the best feed conversion ratio (5.04). Therefore, this diet may be recommended for growing Yankasa Rams

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Ruminant Nutrition and Management: RMN019

INFLUENCE OF DIETARY COPPER SUPLEMENTATION ON NUTRIENT INTAKE AND DIGESTIBILITY PARAMETERS OF WEST AFRICAN DWARF SHEEP

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ABSTRACT

Copper is an essential trace element necessary in maintaining the functioning of living organisms. The study was thus carried out to evaluate the influence of dietary copper supplementation on nutrient intake and nutrient digestibility of West African dwarf (WAD) sheep. An eighty four (84) day feeding trial was carried out using sixteen (16) WAD sheep which were randomly divided into four (4) treatments with four (4) replicates per treatment. T_1 served as control with 0 mg/kg copper glycine (Cu-G), T_2 contained 5 mg/kg Cu-G, T_3 contained 10 mg/kg while T_4 contained 15 mg/kg Cu-G into 100kg of feed respectively. The experiment followed a completely randomized design. Data was collected on feed intake and nutrient intake was determined. The results on nutrient intake revealed no significant difference ($p>0.05$) in all parameters measured except total ash intake and concentrate acid detergent lignin. Animals fed 0 mg/kg Cu-G (129.61) and 15 mg/kg Cu-G (129.46) supplementation recorded the highest total ash intake values. The result of nutrient digestibility revealed significant effect ($p<0.05$) of Cu-G supplementation in all parameters measured with animals fed 15 mg/kg Cu-G having the highest values in all of the parameters evaluated. Crude protein and acid detergent fibre digestibilities ranged from 62.19-72.50 % and 44.45-69.93 %. It can be concluded that copper glycine supplementation at 15 mg/kg in the diet of WAD sheep enhanced utilization as it positively influenced the nutrient intake and digestibility of West African Dwarf Sheep.

Keywords: Copper glycine, Nutrient intake, Nutrient digestibility, Acid Detergent Fibre, West African dwarf sheep

INTRODUCTION

Forages constitute the bulk of the feed consumed by ruminant animals. Seasonal fluctuations in the quantity and quality of forages especially, annual species often lead to considerable loss in production and in several cases, death of the animals due to malnutrition. One of the options available to ruminant farmers for sustainable production is to supplement poor quality forages with industrially processed by-products of agricultural origin and some minerals supplementation. The important role of copper (Cu) in nutrition is well documented. It is an essential component to several enzymes called cupro-enzymes. According to (1), some deficiency symptoms have been identified, however excessive amounts have also been associated with deleterious effects. In view of this, scientists have recognized the need for the inclusion of certain recommended levels of either organic or inorganic Cu salts in animal diets to improve performances. As important as mineral supplementation is, their deficiency has negative effect on livestock. In order to combat the issuance of Cu deficiency in livestock, they must be supplemented to animal diet adequately and thus, bridging the gap of competing for conventional feed stuff between man and animal.

MATERIALS AND METHODS

Experimental Site and Duration: The experiment was conducted at the Teaching and Research farm of Federal College of Animal Health and Production Technology, Moor plantation, Ibadan, Oyo-state in South-west Nigeria.

Source of Test Ingredient and Experimental Diet: The test ingredient used was Copper glycine (Cu-G), it was sourced from Alli-tech incorporation limited and was incorporated at varying levels of 0, 5, 10 and 15 mg/kg respectively with other ingredients (maize bran, corn cob, wheat offal, groundnut cake, premix (Cu free), limestone and salt) to formulate four experimental diets. Starch and molasses were introduced into the feed at ratio of 1:2 purposely to formulate 6 mm pelletized feed. Starch served as binder while molasses was used as sweetener.

Management of Experimental Animals and Design: A total number of sixteen (16) West African dwarf (WAD) sheep were purchased from Akinyele market in Ibadan, Oyo state. Prior to the arrival of the animals, the pens were thoroughly washed and disinfected with DD Force to prevent growth of micro-organisms. On arrival, the sheep were given prophylactic treatments. After adaptation period of four weeks, the animals were randomly allotted into four dietary treatments, replicated five times with one animal per replicate in a completely randomized design.

Feed intake: Feed supplied daily per animal was recorded and leftover (remnant) was weighed and recorded to compute feed intake on daily basis and this was used to determine the nutrient intake values.

Digestibility Study: The experimental animals were placed into individual metabolic cage equipped with facilities for separate collection of faeces and urine. Record of daily feed offered, feed refusals, faecal output were collected for seven (7) days, following seven days of physiological adjustment to the cage. Faeces voided was thoroughly mixed, weighed and recorded every morning while 10% of the representative samples were taken, oven dried at 65% for 3-5 days and bulked for each animal. Feed and faecal samples were analyzed for proximate composition (2) and fiber fractions (3).

Statistical Analysis: Data obtained was subjected to one-way Analysis of Variance (4) and significant means among variables were separated using Duncan Multiple Range Test of the same statistical package.

RESULTS AND DISCUSSION

Influence of Cu-G supplementation on nutrient intake of diet fed WAD sheep is presented in Table 2. The concentrate acid detergent lignin values obtained in this study decreased across the dietary treatments as Cu-G supplementation increased. Furthermore, the total ash intake of the WAD sheep varied significantly across the dietary treatments. The increment observed in total ash intake of the experimental sheep could be due to higher bioavailability of organic trace minerals (5).

Table 1: Chemical Composition of the experimental diet

Parameters	Inclusion of Cu-G				*Pennisetum*
	T_1 (0mg/kg)	T_2 (5mg/kg)	T_3 (10mg/kg)	T_4(15mg/kg)	*Purpureum*
Dry Matter	75.93	74.09	72.59	74.17	75.05
Crude Protein	12.55	12.63	12.63	11.02	13.35
Ether Extract	3.19	2.99	2.25	3.02	0.40
Ash	27.43	25.48	16.28	29.19	12.67
NFE	37.51	47.40	45.67	39.61	31.33
ADF	5.14	5.81	3.95	3.95	9.94
ADL	1.81	1.82	1.09	1.06	4.76
NDF	16.18	16.02	14.59	11.83	34.69
Hemicellulose	11.04	10.21	10.64	7.90	24.75
Cellulose	3.33	4.49	2.86	2.89	5.18

NFE: Nitrogen Free Extract, ADF: Acid Detergent Fibre, ADL: Acid Detergent Lignin,
NDF: Neutral Detergent Fibre,

Table 2: Influence of copper glycine supplementation on the Nutrient Intake of West African dwarf Sheep

	Inclusion Level of Copper Glycine (mg/kg)				
Parameters (g/d)	0	5	10	15	SEM
Dry Matter Intake					
Concentrate	399.95	314.16	346.65	366.95	24.97
Forage	157.01	194.06	203.10	176.30	9.30
Total	556.95	508.22	549.74	543.25	21.44
Crude protein intake					
Concentrate	50.21	39.67	43.77	40.44	3.13
Forage	20.96	25.91	27.11	23.54	1.24
Total	71.16	65.75	70.88	63.97	2.72
Ether Extract Intake					
Concentrate	12.78	9.41	7.80	11.07	0.89
Forage	0.62	0.77	0.81	0.70	0.04
Total	13.41	10.19	8.61	11.77	0.79
Ash Intake					
Concentrate	109.72	80.06	56.46	107.13	7.86
Forage	19.89	24.58	25.73	22.33	1.18
Total	129.61[a]	104.65[ab]	82.19[b]	129.46[a]	7.26
NDF Intake					
Concentrate	64.71	60.33	50.58	43.48	4.09
Forage	54.44	67.32	70.45	61.16	3.23
Total	119.18	117.65	121.03	104.64	3.75
NFE Intake					
Concentrate	150.02	117.50	158.34	145.35	10.48
Forage	49.19	60.80	63.63	55.23	2.91
Total	199.21	178.30	221.97	200.59	9.51
ADF Intake					
Concentrate	20.55	18.25	13.69	14.49	1.35
Forage	15.60	19.29	20.18	17.52	0.92
Total	36.16	37.54	33.87	32.01	1.21
ADL Intake					
Concentrate	7.23[a]	4.14[b]	3.77[b]	3.89[b]	0.49
Forage	7.47	9.23	9.66	8.39	0.44
Intake	14.71	13.38	13.44	12.28	0.45
Cellulose Intake					
Concentrate	13.31	14.10	9.91	10.60	0.95
Forage	8.13	10.05	10.52	9.12	0.48
Total	21.45	24.15	20.43	19.73	0.87
Hemicellulose Intake					
Concentrate	44.15	32.07	36.88	28.98	2.86
Forage	38.85	48.03	50.26	43.63	2.30
Total	83.03	80.10	87.15	72.62	2.67

[abc]means along the same row with different subscripts are significantly different ($p< 0.05$) NFE: Nitrogen Free Extract, NDF: Neutral Detergent Fibre, ADF: Acid Detergent Fibre, ADL: Acid Detergent Lignin.Cu-G: Copper glycine

Influence of Cu-G supplementation on nutrient digestibility of diet fed WAD sheep is presented in Table 3. The present study indicated that Cu-G supplementation significantly influenced DM and CP digestibility values but contradicted the result reported by (6). The increased ether extract digestibility values obtained in this study was in line with the result of (7) who reported copper supplementation increased ether extract

digestibility values. Study indicated that lignin may not be easily digestible because of potential degradability of insoluble carbohydrate transit in the gastrointestinal tract of ruminant animals (8). However the addition of copper in this study improved the recoveries of lignin from faeces thereby enhancing the acid detergent lignin. Disparity observed between these nutrient digestibility studies might be as a result of different environmental condition, genetic, dietary factors including Cu concentration in the basal diet and lastly levels and duration of Cu supplementation (9).

Table 3: Influence of Copper glycine supplementation on Nutrient Digestibility of West African Dwarf sheep

	Inclusion of Cu-G				
Parameters(%)	T_1 (0mg/kg)	T_2 (5mg/kg)	T_3 (10mg/kg)	T_4(15mg/kg)	SEM
Dry Matter	76.40^{b}	74.47^{b}	74.04^{b}	79.24^{a}	0.65
Crude Protein	62.19^{b}	66.78^{b}	65.63^{b}	72.50^{a}	1.25
Ether Extract	78.91^{ab}	75.79^{b}	71.33^{c}	80.85^{a}	1.48
Ash	66.75^{b}	62.36^{bc}	55.61^{c}	76.59^{a}	2.22
NFE	69.12^{b}	67.38^{b}	69.39^{b}	77.46^{a}	1.21
ADF	46.72^{b}	45.58^{b}	44.45^{b}	69.93^{a}	3.11
ADL	51.30^{b}	44.33^{b}	51.53^{b}	73.36^{a}	3.10
NDF	89.89^{b}	91.15^{b}	89.77^{b}	94.69^{a}	0.57
Cellulose	43.54^{b}	46.08^{b}	27.90^{c}	67.77^{a}	4.08
Hemicellulose	70.49^{b}	72.02^{b}	70.80^{b}	77.34^{a}	0.80

^{abc} means on the same row with different superscripts are significantly different ($p<0.05$)
Cu-G: Copper glycine NFE: Nitrogen Free Extract ADF: Acid Detergent Fibre
ADL: Acid Detergent Lignin NDF Neutral Detergent Fibre

CONCLUSION AND RECOMENDATION

It can be concluded that copper glycine supplementation at 15 mg/kg in the diet of WAD sheep enhanced utilization as it positively influenced the nutrient intake and digestibility.

Based on the result of this study, it could be recommended that farmers can incorporate copper glycine supplementation up to 15 mg/kg in the diet of WAD sheep for better utilization of nutrient.

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Ruminant Nutrition and Management: RMN020

INFLUENCE OF DIETARY COPPER SUPLEMENTATION ON HAEMATOLOGICAL AND SERUM BIOCHEMICAL PARAMETERS OF WEST AFRICAN DWARF SHEEP

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ABSTRACT

Copper is an important trace element needed in the formation of red blood cell and immune function in farm animals. Hence, an 84 day feeding trial was conducted to evaluate influence of copper glycine (Cu-G) supplementation on the haematological and serum biochemical parameters of West African dwarf (WAD) sheep. Sixteen (16) growing WAD sheep were randomly allotted on weight equalization into four (4) dietary treatments with each consisting of four (4) sheep per treatment, in a completely randomized design. Cu-G was incorporated at varying levels of 0, 5, 10 and 15 mg/kg to formulate four experimental diets. Data collected were subjected to one-way analysis of variance (ANOVA). Blood samples were collected from three randomly selected WAD sheep per treatment for haematological and serum biochemical analysis. Cu-G supplementation did not significantly ($p>0.05$) influence the haematological parameters. Red blood cell, packed cell volume, lymphocyte, and monocyte values ranged from 4.21-7.35 $\times 10^6$/µL, 28.50-63.50 %, 29.00-40.50 % and 0.50-1.00 % respectively. Cu-G supplementation had no influence ($p>0.05$) on the serum biochemical parameters assessed except globulin. Globulin and total protein values ranged from 3.05-3.20 g/dL and 6.95-7.25 g/dL respectively. It can be concluded that Cu-G can be supplemented up to 15 mg/kg in the diets of WAD sheep as it had no detrimental effects on their haematological and serum biochemical parameters.

Keywords: Copper glycine, Haematology, Serum biochemical, Lymphocytes, Monocytes

INTRODUCTION

Copper (Cu) is an essential trace element needed only in trace amounts by animals for iron metabolism and transportation, red blood cell formation and immune function (1). It is also needed for proper development of antibodies and white blood cell in addition to antioxidant enzyme production. Copper deficiency has been linked to a variety to clinical signs, including pale coat, poor sheep fleece quality, spontaneous fractures, poor capillary integrity, myocardial degeneration, nhypomyelinization of the spinal cord, impaired reproductive performance, decreased resistance to infectious disease, diarrhoea and generalized ill-health (2), causing severe economic losses. Copper deficiency may be primary when there is not enough copper in the soil or plants grown on soils, or when other factors preventing utilization of copper. Copper deficiency is taken to be a severe nutritional problem in tropical regions because of the low copper concentrations in animal diets or of high concentration of elements that are antagonistic towards copper such as molybdenum (Mo), sulphur (S) and iron (Fe) (3). The major target organs for copper deficiency are the blood and haematopoietic system, the cardiovascular system and connective tissues. According to (4), blood parameters have shown to be major important indices of the physiological, pathological and nutritional status of an animal and change in the constituent compounds of blood when compared to normal values could be used to interprete the metabolic state, health status of an animal as well as quality of feed. However, Copper supplementation had been reported by (5) to play a major role in iron metabolism, oxygen metabolism and insulin function. Depending on the source of the biological material, Cu content ranges from part per billion to part per million.

MATERIALS AND METHODS

Experimental Site and Duration: The experiment was conducted at the Teaching and Research farm of Federal College of Animal Health and Production Technology, Moor plantation, Ibadan, Oyo-state.
Source of Test Ingredient and Experimental Diet: The test ingredient used was Copper glycine (Cu-G), it was sourced from Alli-tech incorporation limited and was incorporated at varying levels of 0, 5, 10 and 15 mg/kg respectively with other ingredients (maize bran, corn cob, wheat offal, groundnut cake, premix (Cu free), limestone and salt) to formulate four experimental diets; T_1, T_2, T3 and T_4 respectively. Starch and molasses were introduced into the feed at ratio of 1:2 purposely to formulate 6 mm pelletized feed. Starch served as binder while molasses was used as sweetener.
Management of Experimental Animals and Design: A total number of sixteen (16) West African dwarf (WAD) sheep were purchased from Akinyele market in Ibadan, Oyo state. Prior to the arrival of the animals, the pens were thoroughly washed and disinfected with DD Force and housed intensively in well ventilated individual pen with a concrete floor. On arrival, the sheep were served glucose through their drinking water to reduce transportation stress. The animals were acclimatized for a period of 28 days in which they were maintained on *Pennisetum purpureum* (elephant grass) and concentrate supplement while fresh, cool, clean water was supplied *ad libitum*. During acclimatization, the animals were given prophylactic treatments according to standard procedures, then weighed and allotted on weight equalization basis into four dietary treatments with four animals per treatment in a completely randomized design.

Data Collection
Blood Sample Collection: Blood collection was carried out at the end (84th day) of the experiment, three (3) sheep per treatment were randomly selected and blood was collected through their jugular veins. About 5ml of the blood was collected for haematology into sterilized bottle containing ethylene diamine tetra acetic acid (EDTA) while another 5ml of blood was collected into plain sample bottles without anti-coagulant for serum separation and analysis.
Chemical Analysis: Feed offered were analyzed for proximate content (6) and fibre fractions were determined according to the procedure of (7).
Statistical Analysis: The data obtained were subjected to analysis of variance using statistical package of (8). The means among the variables were separated using Duncan multiple range test of the same statistical package.

RESULTS AND DISCUSSION

The chemical composition of the experimental diet is shown in Table 1. The DM (72.59-75.93 %) of the experimental diets obtained in this study fell below the range of 91.30-94.3% reported by (96.13-96.76%) obtained by (9). The moderately high DM of the concentrate diets in this study implied that the diets were good for the rumen function of ruminant animals as they acted as substrate for fermentative functions of the microbes. Influence of Cu-G supplementation on the haematological parameters of WAD sheep is indicated in Table 2. The result revealed no significant effect ($p>0.05$) on all the haematological parameters measured. Packed cell volume (PCV), white blood cell, neutrophil and eosinophil values obtained in this study ranged from 28.50-63.50 %, 2.57-5.51 $x10^9$/L, 58.50 70.50% and 0.00-1.50 % respectively. The values obtained for red blood cell (RBC) in this study fell within the normal range of values (4-9 x 10^6/µL) for healthy sheep as reported by (4). This revealed that WAD sheep used in this study were not susceptible to anaemia and other cardiovascular related diseases. The glucose obtained in this study corroborate the result (56.50-63.50 mg/dL) reported by (10) who fed sheep with Cu lysine supplementation.

The effect of Cu-G supplementation on serum biochemical indices of WAD sheep is presented in Table 3. There were no significant ($p>0.05$) differences across the treatment groups for all the parameters evaluated, except globulin. Globulin values obtained in this study increased across the dietary treatments as the Cu-G supplementation increased in which animals fed 15 mg/kg Cu-G supplementation recorded the highest values (3.20 mg/kg). (10) reported that the normal value of globulin for healthy sheep ranged between 3.50-5.70 g/dL. The result obtained from this study was in line with what was reported by (11). It has been reported

that low levels of globulin affect the ability of the animal to fight diseases (12) while the high globulin in the animal body can be a sign of disease in liver, kidney or intestine.

Table 1: Chemical Composition of the experimental diet

Parameters	Inclusion of Cu-G				*Pennisetum*
	T_1 (0mg/kg)	T_2 (5mg/kg)	T_3 (10mg/kg)	T_4(15mg/kg)	*Purpureum*
Dry Matter	75.93	74.09	72.59	74.17	75.05
Crude Protein	12.55	12.63	12.63	11.02	13.35
Ether Extract	3.19	2.99	2.25	3.02	0.40
Ash	27.43	25.48	16.28	29.19	12.67
NFE	37.51	47.40	45.67	39.61	31.33
ADF	5.14	5.81	3.95	3.95	9.94
ADL	1.81	1.82	1.09	1.06	4.76
NDF	16.18	16.02	14.59	11.83	34.69
Hemicellulose	11.04	10.21	10.64	7.90	24.75
Cellulose	3.33	4.49	2.86	2.89	5.18

NFE: Nitrogen Free Extract, ADF: Acid Detergent Fibre, ADL: Acid Detergent Lignin, NDF: Neutral Detergent Fibre,

Table 2: Influence of copper glycine supplementation on the Haematological parameters of West African dwarf sheep

	Inclusion Levels of Copper glycine (mg/kg)					
Parameters	Range of value	0	5	10	15	SEM
PCV (%)	27.00 – 45.00*	32.50	33.00	63.50	28.50	6.86
RBC ($x10^6$/µL)	4.00 -9.00*	5.43	6.00	7.35	4.21	0.56
WBC ($x10^9$/µL)	4.00 – 8.00*	4.05	4.93	5.51	2.57	0.51
Neutrophil (%)	27.00 – 94.00**	70.50	62.50	58.50	67.00	2.12
Lymphocyte (%)	40.00 – 70.00**	29.00	35.00	40.50	32.00	2.07
Monocyte (%)	0.00 -6.00**	0.50	1.00	0.00	0.00	0.18
Eosinophil (%)	0.00 -10.00**	0.00	1.50	1.00	1.00	0.31
Basophil (%)	0.00 -3.00**	0.00	0.00	0.00	0.00	0.31

[abc] means on the same row with different superscripts are significantly different ($p<0.05$)
SEM: Standard error mean, **PCV:** Packed cell volume**, RBC:** Red blood cell, **WBC:** White blood cell
*Latimer *et al.*(2003)
** Susan (2015)

Table 3: Effect of Copper Glycine Supplementation on Serum Biochemical Indices of West African dwarf sheep

	Inclusion Level Of Copper glycine (mg/kg)					
Parameters	Normal Range	0	5	10	15	SEM
Total protein (g/dL)	6.0-7.9[1]	7.00	7.10	6.95	7.25	0.06
Globulin (g/dL)	3.50-5.70[1]	3.10[ab]	3.05[b]	3.10[ab]	3.20[a]	0.02
Albumin (g/dL)	2.8-4.3[3]	3.90	4.05	3.85	4.05	0.26
BUN (mg/dL)	17-43[1]	26.50	34.50	31.00	37.00	1.79
Creatinine (mg/dL)	1.2-1.9[1]	1.10	1.15	1.15	1.25	0.03
Glucose (mg/dL)	50-80[1]	56.50	63.50	61.00	59.00	1.73
AST (IU/L)	60-280[1]	14.50	14.50	14.50	12.00	0.72
ALT (IU/L)	20-360[4]	21.50	21.50	20.00	17.50	0.69
ALP (IU/L)	1.4-25.7[2]	49.50	51.50	57.50	39.00	3.29

[a,b] means along the same row with different superscripts are significantly different ($p<0.05$)

BUN: Blood Urea Nitrogen, **AST:** Aspartate amino transferase, **ALT:** Alanine amino transferase, **ALP:** Alkaline phosphatase.

Conclusion: It can be concluded that Cu-G can be supplemented up to 15 mg/kg in the diet of WAD sheep as it had no detrimental effects on their haematological and serum biochemical parameters.

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Ruminant Nutrition and Management: RMN021

DIGESTIBILITY ASSESSMENT IN YANKASA RAMS FED *PENNISETUM PURPUREUM* WITH VARYING LEVELS OF CASSAVA PEELS AND FICUS LEAF MEAL.

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ABSTRACT

Fifty-six (56) days of feeding trial were conducted to determine apparent nutrient digestibility by Yankasa rams fed Pennisetum purpureum and varying levels of cassava peels with Ficus leaf meal. Nine (9) growing Yankasa rams with an average weight of 14.30kg, aged between 8 and 9 months old were randomly allocated to three dietary treatments in a completely randomized design with three rams per treatment. The diets comprised different proportions of T_1 65% cassava peel +10% Ficus leaf meal + 25% supplement, T2 60% cassava peel + 15% Ficus leaf meal + 25% supplement, and T3 55% cassava peel + 20% Ficus leaf meal + 25% supplement. The results obtained showed there was a significant ($P<0.05$) difference between all the treatment means for all parameters measured except crude fibre and ether extract which was not significantly different ($P>0.05$). The dry matter (DM), Crude protein (CP), and nitrogen-free extract (NFE) digestibility were higher ($P<0.05$) in T1 compared to T2 and T3. It is deduced that supplementation of basal grass (Pennisetum purpureum) diet with crop residue and browse fodder, particularly 65% cassava peels + 10% Ficus leaf meal + 25% supplement in treatment 1 enhances nutrient digestibility in growing Yankasa rams.

Keywords: Yankasa ram, *Pennisetum Purpureum*, Cassava peels, Ficus Leaf Meal, Digestibility

DESCRIPTION OF PROBLEM

Small ruminants play an important role in the food chain and overall livelihoods of smallholder farmers [18]. The rams are the favorite slaughter animals during Sallah festivals at which time rams command very high market prices [16]. Despite this importance, a major problem for their improved production in tropical Africa is the unavailability of good quality feed or forage throughout the year. This is the main factor responsible for lower reproductive and growth performance, especially during the dry season [13]. The dry season is characterized by the inadequacy of grazing resources because of which animals are not able to meet even their maintenance requirements and lose a substantial amount of their weight.Cassava peel is an agro-industrial by-product that continues to be available in appreciable quantity in Nigeria, but most of it is disposed of as waste, contributing to nuisance to the environment [23]. Several researchers have confirmed the suitability of cassava peel as a good source of energy in the ruminant diet, but its widespread utilization is limited due to problems related to the high content of cyanogenic glucosides, concomitant rapid rate of deterioration because of high moisture content [24], and its low crude protein content. Past efforts to address the setbacks of cassava as ruminant feed have been based on preservation methods which include soaking, boiling/cooking, fermentation, ensiling, and drying. Of all these methods, drying is the oldest and still the most important preservation method despite its dependence on suitable weather. Research efforts have focused on the use of browse species like *Gliricidia sepium, Leucaena leucocephala, Phyllanthus discoideus*[11;17], *Grewia pubescens* [3], *Danielli oliveri*[17], *Terminalia cattapa and Acalypha wilkesiana*[10], *Tephrosia spp.* (4), *Pterocarpus santalinoides* and *Enterolobium cyclocarpum* [3] as supplements to grass-based diets or crop residues in the feeding of ruminants. *Ficus thonningii* is a neglected and underutilized Indigenous browse fodder species. Farmers have appreciated its diverse merits in areas where it is used, such as acceptable nutritive content and high biomass production [12], fast growth rate,

easy propagation, drought resistance, and adaptation to diverse edaphoclimatic conditions [6]. In Nigeria, *Ficus thonningii* forms an integral part of the home garden system serving as an ornamental plant and a source of shade. Generally, the utilization of browse fodders is usually limited by high lignin content and the presence of anti-nutritional factors which may be toxic to ruminants; however, their utilization can be improved if the fresh forage is wilted or dried before feeding [8]. Thus, this study is to determine the nutrient digestibility of Yankasa ram-fed *Pennisetum purpureum* and varying levels of cassava peels with Ficus leaf meal.

MATERIALS AND METHODS

Experimental Location

The experiment was conducted at the Livestock Teaching and Research Farm. Joseph Sarwuan Tarka University, Makurdi, Benue State, Nigeria. Makurdi is located at Latitude 7°14' North and Longitude 8°24' East and lies within the Southern Guinea Savannah Region of Nigeria. It has a prevailing tropical climate with a mean annual rainfall of about 1037mm. The mean ambient temperature ranges from 28°C in December to 36°C in February, with a yearly average humidity of about 82% [20].

Experimental Animals and their management

Nine (9) growing Yankasa rams with an average weight of 14.30 kg and aged between 9 – 10 months old were used for the experiment. The rams were sourced from a small ruminant market within Azara, Awe Local Government Area of Nassarawa State. On arrival, they were given prophylactic antibiotics to fight against ecto and endo parasites while Ivomec injection was administered to control micro-organism infections. The rams were also vaccinated against *Peste des pestits* (PPR) using the PPR vaccine. The rams were quarantined in a house demarcated into individual pens with wooden floors and spaces in between to allow the passage of urine.

A completely randomized design (CRD) was adopted for the experiment in which the rams were divided into three treatment groups of three rams each after balancing weight and each group was randomly allocated to one of the three dietary treatments. The basal (elephant grass) and the experimental diets were fed to ram once daily in an equal ratio of 50:50 respectively, at the rate of 3% (dry matter basis) of their body weight. Experimental diets were offered daily (8.00 am) followed by the elephant grass on exhaustion of the diets. Fresh drinking water was also provided *ad libitum*. The feeding trial lasted for 56 days comprising of 14-day adaptation period.

Experimental diets

Elephant grass and Ficus leaves were harvested from pasture within the Teaching and Research Farm premises. The elephant grass was allowed to wilt before being chopped manually to about 6 to 7cm. While the Ficus leaves and Cassava peels were collected were air-dried and sun-dried on a flat concrete floor for 5 and 7 daysto reduce the hydrocyanic acid content present, crushed,and stored in an airtight bag for later use.

Elephant grass was fed as a basal diet for all the rams while the combination of cassava peels and Ficus leaves meal at various inclusion levels with concentrate supplement was used as the experimental diet. The composition of the concentrate supplement was as follows: Maize offal 12.00%, brewer's dry grain 8.00%, palm kernel cake 2.00%, bone meal 1.75%, and salt 1.25%. However, the three experimental diets that were formulated and designated as:

Treatment 1 = 65% cassava peel +10% Ficus leaf meal + 25% supplement
Treatment 2 = 60% cassava peel + 15% Ficus leaf meal + 25% supplement
Treatment 3 = 55% cassava peel + 20% Ficus leaf meal + 25% supplement

Digestibility studies

At theend of the 7-day feeding trial, three (3) animals were randomly selected to individual metabolic cages designed for the collection of feces. The digestibility trial lasted for 7 days with 2 days adjustment period. Harness bags were used in the fecal collection andfitted on the first day of adaptation. They received a measured quantity of feed daily and were offered water *adlibitum*. Feed refusals were collected and weighed and measured in the morning before the feeding and watering. Daily fecal sub-samples were weighed, oven-dried at 30° C, bulked together, and stored for further analysis. Apparent nutrient digestibility was determined using the formula:

$$\text{Nutrient Digestibility} = \frac{\text{Amount of feed consumed} - \text{Amount of faecal voided}}{\text{Amount of feed consumed}} \text{ X } 100$$

Chemical Analysis

The proximate composition of the diets, elephant grass as well as fecal samples were determined by the standard methods of the Association of Official Analytical Chemists [2].

Statistical analysis

Data obtained were subjected to One-way Analysis of Variance (ANOVA) using a statistical package for social sciences version 23 (SPSS, 2011), with significant means separated using Duncan's Multiple Range Test [9].

RESULTS AND DISCUSSION

Digestibility Assessment in Yankasa Rams Fed *Pennisetum Purpureum* with Varying Levels of Cassava Peels and Ficus Leaf Meal.

Digestibility assessment for the various dietary treatments is shown in Table 1. All the nutrients evaluated did not differ (P>0.05) except dry matter (DM), crude protein (CP), and nitrogen-free extract (NFE) that was influenced (P<0.05)by the treatments. Higher dry matter, crude protein, and nitrogen-free extract digestibility (%) obtained in T1 (71.79), [74.54], and [73.10]suggest that combining browse fodder with grass species promotes dry matter digestibility. The values obtained were comparable with [21] who reported a similar range of 77.47 to 81.67% for goats fed *Megathyrsus maximus* with concentrate diets containing graded *Moringa olerifera* leaf meal. However, CP digestibility in this study was lower than the value of 84.56% reported by [15] for rams fed *Panicum maximum* and *Gmelina arborea* at a ratio of 60:40, respectively. Ash digestibility (%) was highly influenced in this study, higher (P<0.05) values were recorded in rams fed on diet T1 (84.84), followed by T2 (72.65) and T3 (66.30). The generally high ash digestibility values observed in this study could be attributed to the interactions among ingredient components of the experimental diets which adversely affected microbial activity in the rumen.

Table 1: Digestibility Assessment in Yankasa Rams Fed *Pennisetum Purpureum* with Varying Levels of Cassava Peels and Ficus Leaf Meal.

Parameters (%)	Dietary treatment T1	T2	T3	SEM	P_{-value}
DM	71.79[a]	51.64[b]	53.64[b]	3.85	0.029
CP	74.54[a]	57.19[b]	58.85[b]	3.32	0.029
CF	29.91	22.42	10.49	4.64	0.248
EE	64.46	45.38	65.79	4.50	0.100
Ash	84.84[a]	72.65[b]	66.30[b]	3.07	0.010
NFE	73.10[a]	49.05[b]	58.07[ab]	4.19	0.027

[ab] means different superscripts within the same row significantly differ (P<0.05). SEM = Standard error mean, DM = Dry matter, CP = Crude protein, CF = Crude fibre, EE = Ether extract and NFE = Nitrogen free extract

CONCLUSION

The study's findings indicate that using Pennisetum purpureum as a basal diet improves dry matter and enhances nutrient digestibility in growing Yankasa rams when supplemented with 65% cassava peels, 10% Ficus leaf meal, and 25% additional supplements**.**

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Ruminant Nutrition and Management: RMN022

NUTRIENT DIGESTIBILITY AND NITROGEN BALANCE OF YANKASA RAMS FED DIETARY LEVELS OF SESAME SEED (*Sesamum indicum*) WASTE MEAL

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ABSTRACT

The study evaluated the effect of inclusion levels of Sesame Seed Waste Meal (SSWM) on nutrient digestibility and nitrogen balance of yankasa rams. Sixteen (16) intact yanks rams of 17.00±0.50 kg body weight was randomly allotted to five dietary treatments containing SSWM at 0, 10, 20 and 30% levels of inclusion in a total mixed ration with 4 replicates in a Completely Randomized Design. Data were collected and analysed using Generalized Linear Model procedure of SAS while significant differences between the treatment means were compared using Duncan Multiple Range Test. The results obtained showed that SSWM inclusion at 20% and 30% improved ($P<0.05$) dry matter and crude protein digestibility, increased nitrogen retention and nitrogen retained as a percentage of intake and resulted into lower ($P<0.05$) urinary nitrogen loss at 30% inclusion level. In conclusion, feeding yanks rams with 20% and 30% SSWM resulted into increased improved dry matter and crude protein digestibility with higher nitrogen retention and reduced nitrogen loss. It was recommended therefore that farmers can incorporate sesame seed waste meal into the diets of Yankasa rams at inclusion level of 30% to improved nutrient utilization and consequently higher growth performance.

Keywords: Digestibility, Nutrient, Residues, Yankasa Rams.

DESCRIPTION OF THE PROBLEM

Ruminant animals are important part of the global agricultural economy and they play a major role in many local economies [1]. Under nutrition, due to inadequate nutrient supply is a major constraint limiting the productivity of livestock in Nigeria. In the traditional system of production, ruminant animals mainly rely on mature grasses and crop residues, which are characterized by low to moderate digestibility, and low levels of nitrogen, protein and minerals [2]. In northern Nigeria, the most important feed resources available to livestock are native grasses and browse with crop residues increasing in importance as livestock feed [3]. The continued growth in human population have increased competition for natural resources, particularly land, in recent decades resulting in large areas of natural grasslands to be converted into arable lands and settlements. The expansion of cropping at the expense of grazing lands increases availability of crop residues, resulting in significant increase in crop and livestock integration. Sesame seed waste meal has an excellent nutrient profile. It has high protein content (30-50%), depending on the extraction method and the residual oil content with rich essential amino acids [4]. The study was therefore carried out to determine the effects of feeding different inclusion levels of Sesames Seed Waste Meals on nutrients digestibility and nitrogen balance by Yankasa rams.

MATERIALS AND METHODS

Experimental site; The experiment was conducted at the small ruminant unit of the Department of Animal Science teaching and research farm, Ahmadu Bello University, Zaria. Zaria is within the Northern Guinea savannah zone of Nigeria, Latitude 11' 14' 44 N and Longitude 7' 38' 65 E, of an altitude of 610m above sea level. The climate is relatively dry with mean annual rainfall of 700mm – 1400mm, occurring between the month of April and September [5].

Source of Experimental Material

Sesame seed waste were collected at Valency Agro Nigeria Limited Sule Gaya Road Bompai Industrial Plant Bompai, Kano state

Experimental Animal, Design and Management

Sixteen (16) healthy Yankasa Rams of 17.00±0.50 kg body weight were purchased from an open market in Kaduna State for this study. Before the commencement of the experiment, the Rams were given prophylactic treatments consisting of intramuscular application of Oxytetracycline and Vitamin B complex at the dosage of 1 ml/10 kg of body weight. Also, the animals were treated with albendazol and Ivomectin according to the manufacturer recommended dosage against endoparasites and ectoparasites. The animals were vaccinated with a single dose of Pestavax against PPR (Pest des Petits Ruminant.

Experimental Diet and Data Collection

Four (4) experimental diet were formulated to contain 0, 10, 20 and 30% inclusion of SSWM in a total mixed ration (TMR) (Table 1). Four (4) rams were randomly allotted to each experimental diet in a Completely Randomized Design (CRD). The animals were housed in individual metabolic creates for Digestivability study with total faecal and urine collection. The animals were fed with the experimental diets at 4% of their live body weight daily, 3% in the morning at 8:00am and the remaining 1% by 12noon, fresh water was given without restriction. The animals were allowed for a two-week adjustment period Daily faecal output was also collected for 7 days and weighted, sub-sampled and sundried for 48hrs for dry matter determination before the laboratory analysis. Data collected relating to digestibility and nitrogen retention were analyzed using the standard method by AOAC [6].

Table 1: Ingredient and Proximate Composition of Experimental Diet Containing different Inclusion Levels of Sesame Seed Waste Meal

Ingredient (%)	**0%**	**10%**	**20%**	**30%**
Maize bran	36.00	28.50	28.50	23.50
Cotton Seed Cake	29.00	24.00	16.50	11.50
Palm Kernel Cake	4.00	4.00	4.00	4.00
Soybean offal	2.00	2.00	2.00	2.00
Rice bran	27.00	27.00	27.00	27.00
SSWM	0.00	10.00	20.00	30.00
Bone meal	1.50	1.50	1.50	1.50
Common salt	0.50	0.50	0.50	0.50
Total	**100.00**	**100.00**	**100.00**	**100.00**
Proximate composition (%)				
Dry matter	89.74	90.84	90.19	90.99
Crude protein	16.06	16.13	15.88	16.00
Crude fibre	19.51	21.37	22.00	20.00
Ether extract	5.56	5.88	5.76	5.66
Ash	7.50	7.25	8.00	7.69
Nitrogen free extract	51.37	49.37	48.36	50.65

Data analysis

All data collected at the end of the experiment were subjected to statistical analysis using Generalized Linear Model (GLM) procedure of SAS 9.0 software. Significant differences between the treatment means were compared using Duncan Multiple Range Test.

RESULTS AND DISCUSSION

Nutrient digestibility of Yankasa Rams fed diet containing different inclusion levels of Sesame Seed Waste Meal

The nutrient digestibility of Yankasa ram fed diets containing different inclusion levels of sesame seed waste meal is shown in Table 2. The results shows that there were significant (P<0.05) differences in dry matter and crude protein digestibility coefficients while ether extract, nitrogen free extract, crude fibre, neutral detergent fibre (NDF) and acid detergent fibre (ADF) were not significantly (P>0.05) different across the dietary treatments. Dry matter digestibility coefficients were significantly (P<0.05) higher in rams fed diets containing SSWM at 20% (57.89%) and 30% (62.14) and lower in groups fed diets containing 0% (51.43%) and 10% (54.14%) SSWM. DM digestibility improves with increasing levels of SSWM, with the highest digestibility (62.14%) at the 30% inclusion level suggesting that higher SSWM inclusion enhances the overall nutrient utilization efficiency.

Similarly, crude protein digestibility was significantly (P<0.05) higher in Rams fed 30% SSWM diet (71.89%) followed by those fed 20% SSWM diet (68.40%) and lower in those fed 10% SSWM diet (65.66%) while those fed the control diet (0% SSWM) had the least CP digestibility (63.43%) and this enhanced CP digestibility at higher SSWM levels indicating improved protein utilization for growth and development. The values obtained for the dry matter digestibility (51.43 - 62.14%) were lower than the values documented by ~~Abdullah, *et al*. (2011)~~ Abdullah, who reported dry matter digestibility coefficients of 72.5 – 80.8% when sesame hull was incorporated in the diets of black goat kids, and the values of 75.64 - 76.39% reported by Adeola *et al*. [7] when lambs were fed sesame residues. This differences may be as a result of good fibre content present and other nutrient composition in the diet. However, the reported increase in dry matter digestibility coefficients with inclusion of SSWM corresponds to report of Abdullah *et al*. [8] and Adeola *et al*. [7]. This study revealed that crude protein digestibility was higher in Yankasa rams fed 20 and 30% SSWM diets compared to 0 and 10%. This is not in agreement with Adeola *et al*. [7] who reported lambs fed the control diet (0% sesame residue) had higher CP digestibility compared to those incorporated with sesame residues. This is however in agreement with Omar [9] who reported that incorporating sesame oil cake in lambs' diet improved crude protein digestibility.

Table 2: Nutrient Digestibility of Yankasa Rams fed Diet Containing different inclusion levels of Sesame Seed Waste Meal (%)

	Inclusion level of SSWM				
Parameters (%)	0	10	20	30	SEM
Dry Matter	51.43^{c}	54.14^{bc}	57.89^{ab}	62.14^{a}	2.71
Crude Protein	63.43^{d}	65.66^{c}	68.40^{b}	71.89^{a}	1.01
Ether Extract	79.66	81.71	81.85	83.93	2.30
Nitrogen Free Extract	60.71	57.62	63.95	66.89	4.96
Crude Fibre	69.48	72.74	72.54	72.62	2.90
Neutral Detergent Fibre	42.45	44.31	44.20	40.91	2.37
Acid Detergent Fibre	48.14	50.24	50.11	52.43	2.40

^{abcd}Means with the same superscripts along the rows are not significantly different (P>0.05), SEM: standard error of means.

Nitrogen Balance of Yankasa Rams fed Diet containing different inclusion levels of Sesame Seed Waste Meal

The nitrogen balance of Yankasa rams fed diets containing different inclusion levels of Sesames Seed Waste Meal (SSWM) is shown in Table 3. The results showed that urinary nitrogen, nitrogen retained and nitrogen retained as percentage of intake were significantly (P<0.05) different while nitrogen intake, faecal nitrogen, total nitrogen loss and nitrogen absorbed were not significantly (P>0.05) different. Urinary nitrogen loss was higher in rams fed 0, 10 and 20 % SSWM and lower in group fed 30% SSWM diet. Lower urinary nitrogen in rams fed 30% SSWM diet implies more efficient nitrogen utilization and reduced nitrogen waste at higher SSWM inclusion levels. Furthermore, reduced nitrogen excretion at higher levels of SSWM shows that the

diet lessens the environmental impact of livestock production and may serve as means of mitigating issues related to nitrogen runoff and pollution.

More so, nitrogen retained and nitrogen retained as percentage of intake were significantly (P<0.05) higher in Yankasa rams fed diet containing 30% SSWM and lower in other treatment groups. Nitrogen retained is highest in the 30% SSWM group (1.04 g/day) and lower in 20% (0.95 g/day), 0% (0.92 g/day) and 10% (0.92 g/day) respectively. Higher nitrogen retention at 30% SSWM inclusion suggests improved protein synthesis and retention in the body. The percentage of nitrogen retained relative to intake increases with higher SSWM levels, with highest value at 40.59% in the 30% group which was significantly higher (P<0.05) than other levels of inclusion. Increased nitrogen retention at higher SSWM levels indicates that more dietary nitrogen is being retained for growth and metabolic functions, rather than being excreted. Improved nitrogen utilization corroborates better growth efficiency reported in Yankasa rams fed 30% SSWM diet by optimizing protein usage through reduced feed costs. This improved nitrogen utilization indicates that SSWM as high-quality protein source. Diets with high-quality protein sources with balanced profile of essential amino acids has been reported to promote positive nitrogen balance by supporting protein synthesis and reducing nitrogen wastage [10].

Table 3: Nitrogen balance of Yankasa Rams fed diet containing different inclusion levels of Sesames Seed Waste Meal

	Inclusion level of SSWM (%)				
Parameters (g/day)	0	10	20	30	SEM
Nitrogen Intake	2.54	2.58	2.55	2.57	0.07
Faecal nitrogen	0.86	0.85	0.82	0.87	0.04
Urinary nitrogen	0.76[a]	0.81[a]	0.78[a]	0.66[b]	0.05
Total nitrogen loss	1.62	1.66	1.60	1.53	0.12
Nitrogen retained	0.92[b]	0.92[b]	0.95[b]	1.04[a]	0.02
Nitrogen absorbed	1.68	1.73	1.73	1.70	0.02
Nitrogen retained as % of intake	36.19[b]	35.59[b]	37.27[b]	40.59[a]	0.88

[ab]Means with the same superscripts along the rows are not significantly different (P>0.05),, SSWM= Sesame Seed Waste Meal, SEM: standard error of means.

CONCLUSION

Inclusion of Sesame Seed Waste Meal at 20 and 30% in Yankasa ram diets improves dry matter and crude protein digestibility with optimum improved nitrogen balance and reduced nitrogen loss.

Applications

Farmers should incorporate sesame seed waste meal (SSWM) into the diets of Yankasa rams at inclusion level of 30% to improve nutrient efficiency and growth performance.

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Ruminant Nutrition and Management: RMN023

EFFECT OF C*hyrsophyllum albidum* (AFRICAN STAR APPLE) BASED DIETS ON THE HAEMATOLOGY AND SERUM BIOCHEMICAL INDICES OF WEST AFRICAN DWARF GOATS

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ABSTRACT

This study evaluated the Haematological profile and serum biochemical indices of West African Dwarf (WAD) goats fed *Chrysophyllum albidum* fruit-based diets. A total of sixteen (16) WAD goats of both sexes were randomly allotted into four experimental treatments in a completely randomized design. Four experimental mash diets were compounded with inclusion of *Chrysophullum albidum* replacing wheat offal at 0, 10, 20 and 30% (T1, T2, T3 and T4 respectively) graded levels. Theses diets were fed to the goats at 2% of their body as supplement to basal diet of *Panicum maximum.* Diets containing inclusion levels of *Chrysophyllum albidum* (T2, T3 and T4) were higher in crude protein, crude fibre, ether extract and ash contents than T1 diet. However, diet T1 had highest carbohydrate fraction compared to T2, T3 and T4 diets. There was no significant difference (P>0.05) in the Packed Cell Volume, Haemoglobin count (Hb), Red blood cell (RBC) and White blood cell (WBC). Results showed that Total protein (g/dl), Albumin (g/dl), Globulin (g/dl), ALT (ul), AST (ul), ALP (ul), and Creatinine (mg/dl) were not significantly (P>0.05) affected by the experimental diets. It could be concluded that *Chrysophyllum albidum* had no negative effect on the haematological profile and serum biochemical indices of WAD goats fed up to 30% inclusion levels.

Keywords:

INTRODUCTION

Goats are natural browsers and have the unique ability to select plants when at their most nutritious state. Pasture, forbs and browse are usually the primary and most economical source of nutrients for goats, and in some cases, pasture is all these small ruminants need to meet their nutritional requirements [1]. The major constraint to ruminant livestock production in the tropics is the availability of cheap and quality feedstuffs especially in the dry season [2]. [3] observed that in the tropics, ruminants are raised mainly on grasses, which are poor in nutrients and digestibility during the dry season which leads to loss in total weight gain in dry season [4]. The seasonal changes in availability of forages had led to the search of alternative feedstuffs as supplement for ruminants especially during the dry season. These unconventional feed resources include agro-processing waste products such as African star apple (*Chrysophullum albidum*) fruits` wastes which could be processed into supplemental feeds for livestock. [5] found that *C. albidum* seed contains valuable nutrients such as crude protein, carbohydrate, crude fat, crude fibre, mineral matter in concentrations of 8.75, 83.38, 3.45, 2.42 and 2.00% respectively warranting the potentials of the seed as a good novel feedstuff in animal feed. However, the fruit seeds of *Chrysophullum albidum* contain phytochemicals or anti-nutritional factors such as saponin, cyanogenic glycoside, oxalate, phytate, tannin. These phytochemicals diminish the availability of nutrients at high concentrations [6]. The anti-nutritional factors elicit toxic biological responses with possible biochemical and physiological implications [7]. Therefore, this study was conducted to examine the haematological and serum biochemical responses of WAD goats fed diets containing graded levels of *Chrysophullum albidum* fruits.

MATERIAL AND METHODS

Experimental Site

The experiment was carried out at the Sheep and Goat Unit of the Teaching and Research Farm, Obafemi Awolowo University, Ile Ife, Osun State, Nigeria. The experiment lasted for twelve (12) weeks.

Processing of Chrysophyllum albidum

Chrysophullum albidum fruits (wastes and spoilt ones) were collected and purchased within and outside the University campus. The *Chrysophullum albidum* fruits were separated and dried for one week before they were milled and mixed with other ingredient such as rice bran, wheat offal, maize, palm kernel cakeand mineral premix.

Experimental diets

Four experimental diets were compounded with inclusion of *Chrysophullum albidum* (CA) replacing wheat offal at 0 (T1), 10 (T2), 20 (T3) and 30% (T4) graded levels. Theses diets were fed to the goats at 2% of their body as supplement to basal diet of *Panicum maximum.*

Table 1: Gross composition of the experimental diets

Ingredients (%)	T1	T2	T3	T4
Wheat offal	58.00	48.00	38.00	28.00
Chrysophullum albidum	0.00	10.00	20.00	30.00
Palm kernel cake	13.00	13.00	13.00	13.00
Rice bran	10.00	10.00	10.00	10.00
Maize	15.00	15.00	15.00	15.00
Common salt	2.00	2.00	2.00	2.00
Mineral premix	2.00	2.00	2.00	2.00

Experimental animal and management

A total of sixteen (16) West African dwarf goats were purchased in Ile Ife and Ede with an average weight of 5.25 kg. The West African goats were housed in disinfected and well-ventilated pens. They were given feed and water for Thirty-one (31) days prior to the beginning of experiments in order to adapt them to the diets of *Chrysophullum albidum*. Thereafter, animals were randomly allotted to four treatments in a completely randomized design (each treatment comprised of four (4) West African Dwarf goats).

Blood collection and analysis

At the 12th week of the experiment, two sets of blood samples were taken from the goats via jugular venipuncture using a 5 ml syringe. One ml blood sample was collected into labelled sterile bottles containing anticoagulant for determination of haematological parameters. Blood samples for serum analysis were collected into coagulant free bottles, allowed to coagulate at room temperature and centrifuged at 3000rpm for 10 minutes. The supernatant sera were then collected and stored in a freezer for subsequent biochemical analysis. The serum concentrations for creatinine, albumin and the liver enzymes such as alanine aminotransferase (ALT), aspartate aminotransferase (AST) and alkaline phosphatase (ALP) were determined using commercial laboratory kits (Randox Laboratories Ltd, U.K). The Red blood cell (RBC), white blood cell (WBC), hemoglobin concentration (Hb) and packed cell volume (PCV) were determined using the methods of [8].

Chemical Analysis

Samples of experimental diets were taken to the Poultry Meat Laboratory, Obafemi Awolowo University, Ile Ife, Osun State, Nigeria for proximate analysis according to the procedure of [9].

Statistical analysis

All data obtained from the study were subjected to one way analysis of variance (ANOVA) of [10] and significant means were separated using the Duncan's Multiple Range Test option of the same package.

RESULTS AND DISCUSSION

The proximate analysis of the experimental diets indicated that dry matter was highest in T1 than other diets (Table 2). Diets containing inclusion levels of *Chrysophyllum albidum* (T2, T3 and T4) were higher in crude protein, crude fibre, ether extract and ash contents than T1 diet. However, diet T1 had highest carbohydrate fraction compared to T2, T3 and T4 diets. [11] reported higher crude protein content of 19.80 – 21.59 % in *Chrysophyllum albidum* and a study by [12], the crude protein content of *Chrysophyllum albidum* was reported to be between 8.00 to 9.44 %. This is slightly lower than the values obtained in this study. The crude fiber content of the diets obtained in this study was higher than findings of previous studies on the same fruit species [13]. The *Chrysophyllum albidum* has been reported to contain essential fatty acids such as linoleic acid, oleic acid, and palmitic acid. The content of NFE decreased as the level of incorporation of *Chrysophyllum albidum* in the diet increased. A study conducted on the chemical composition of *Chrysophyllum albidum* reported a lower content of carbohydrates (43.9 %) than what was observed in this study [14].

Table 2: Proximate composition of the experimental diets

Parameters	T1	T2	T3	T4
Dry matter	90.09	88.82	88.80	88.94
Crude Protein	11.80	13.57	13.27	12.12
Crude Fibre	9.06	11.32	13.24	14.41
Ether Extract	2.93	4.34	3.56	6.16
Ash	4.87	6.89	8.16	8.02
NFE	71.34	63.80	61.77	60.30

There was no significant difference (P>0.05) in the Packed Cell Volume, Haemoglobin count and Red blood cell and White blood cell (Table 3). All the haematological parameters in this study were within the range; haemoglobin (7 – 15 g/dl), packed cell volume (21 – 35 %), red blood cell (9.2 - 13.5 $x10^6$/ml), white blood cell (6.8-20.1 $x10^3$/ml), lymphocyte (47 -82 %) and eosinophil (1 – 7 %) in WAD goats as reported by [15].

Table 3: Haematolodical parameters of WAD goats fed the experimental diets

Parameters	T1	T2	T3	T4	SEM
Parked Cell Volume (%)	27.50	32.50	28.75	36.75	12.98
Red Blood Cell ($x10^6$/ml)	12.71	12.87	12.92	13.66	3.25
White Blood Cell ($x10^3$/ml)	7.87	7.30	8.59	7.95	3.45
Hemoglobin (g/dl)	8.83	10.43	9.25	11.75	1.65
Lymphocyte (%)	42.75	43.50	45.25	45.25	15.02
Neutrophils (%)	52.50	51.25	48.50	49.75	15.28
Monocytes (%)	2.75	2.75	3.00	2.75	0.18
Eosinophils (%)	2.00	2.00	3.25	2.25	0.35

Results showed that Total protein (g/dl), Albumin (g/dl), Globulin (g/dl), ALT (ul), AST (ul), ALP (ul), and Creatinine (mg/dl) were not significantly (P>0.05) affected by the experimental diets (Table 4). Serum protein values obtained in this study was within the range of 6.1 - 8.4 g/dl reported by [15] for WAD goats. The values obtained were higher compared to the values 6.1 - 7.5 g/dl reported by {16] and 6.30 - 6.95 g/dl reported by [17]. The Serum Albumin range (2.80 - 2.95 g/dl) from this study was lower than the range of (3.90 - 4.55 g/dl) reported for WAD goats by [18] but similar to the range of (2.8 - 4.3 g/dl) reported by [15]. Increase in Serum Albumin above normal indicates dehydration, impairment in the function of liver, kidney and digestive system while low Albumin suggests poor clotting of blood and reduction in disease fighting ability of the animal body system which could lead to high mortality [19]. All the experimental goats in this study had globulin content which was higher compared to [17]. [17] reported a value range (1.32 - 2.86 mg/dl) for Creatinine which was higher than the value from the experiment (0.25 - 1.3 mg/dl). This explains

the effectiveness of body mass function in goats and fewer waste products in the muscle of the goats [20]. The serum alkaline phosphate (30.73 – 79.18 u/l), alanine transaminase (8.00 – 12.03 u/l) and aspartate transaminate (41. 05 – 59.00 u/l) were within a normal physiological range as reported by [21].

Table 4: Serum indices of WAD goats fed the experimental diets

Parameters	T1	T2	T3	T4	SEM
Total protein (g/dl)	7.63	7.95	7.85	7.38	4.16
Albumin (g/dl)	2.85	2.95	2.95	2.80	0.05
Globulin (g/dl)	4.78	5.00	4.90	4.58	2.13
A/G Ratio	0.06	0.06	0.06	0.63	0.02
ALT (u/l)	8.00	9.25	8.00	8.00	4.45
AST (u/l)	49.00	49.75	47.25	48.70	10.71
ALP (u/l)	75.25	72.75	73.25	75.00	22.98
Creatinine (mg/dl)	1.55	1.73	1.63	1.60	0.08

CONCLUSION

It could be concluded that *Chrysophyllum albidum* had no negative effect on the haematological profile and serum biochemical indices of WAD goats fed up to 30% inclusion levels.

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BLOOD PROFILE OF GROWING YANKASA RAMS FED AFRICAN LOCUST BEAN SEED MEAL (*P. biglobosa*) TO REPLACE COTTON SEED CAKE (*G. herbaceum*) IN THE DIETS

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ABSTRACT

This study was conducted to assess, the blood profile of growing Yankasa rams fed African Locust Bean Seed meal (*P. biglobossa*) to replace Cotton Seed Cake (*Gossypium herbaceum*) in the diets. Total mixed rations containing 16% crude protein (CP) were formulated for the experiment in which Cotton Seed cake was replaced by African locust seed meal at 0, 10, 20, and 30% and designated as diets 1, 2, 3 and 4 respectively. Sixteen (16) growing Yankasa rams were used for the experiment and randomly allocated to four (4) treatment groups of four (4) animals each in a completely randomized designed. Rams were fed experimental diets and water *ad libitum*. Data obtained were statistically analyzed using Analysis of variance and the means were separated using LSD. The results showed that Highest haemoglobin concentrations (13.15g/dl) was recorded for rams fed diet 2, followed by rams on diet 4 (11.40 g/dl) and T3 (10.90 g/dl) and least in rams fed diet1 (10.50g/dl). The packed cell volume was highest in rams on T2 (37.35%) and least in rams fed T1 (28.95%). White blood cell values were highest for rams on diets T2 (11.20 $x10^9$/l) and diet 4 (10.53 $x10^9$/l). Total protein level was highest for rams on diet T3 (78.80 g/l) followed by diet 1 (74.95 g/l) and T2 (76.30g/l) and least was recorded for rams on diet 4 (71.80g/l). Total glucose level was also highest in rams on diet 2, diet 3 and diet 4 (1.65 mmol/l) and lowest in diet 1 (1.35 mmol/l). All the parameters measured for heamatological indices and serum biochemistry were significantly ($P<0.05$) different among the treatment means. It may be concluded that African locust bean seed meal can replace Cotton seed cake at up to 30% level without any deleterious effect on blood profile of growing yankasa ram.

Keywords:

INTRODUCTION

Ruminant production in many developing countries is largely limited by unavailability and high cost of feeds (9). The use of non- conventional feed ingredient and the search for other feed resources that are not expensive is therefore necessary (5). Non-conventional feedstuffs offer the best alternative in our environment for reduction in feed cost (3). Surprisingly, energy sources (grains) had turned out to be more expensive, thereby increasing the cost of production (2). The incorporation of agro-industrial by-products into animal feeds holds tremendous potentials for alleviating the short supply and high cost of feed (2). One of these non- conventional feedstuffs considered in this study is African locust bean seed. The African locust bean tree is a leguminous plant which produces seed grain that is often cheap and readily available in northern Nigeria. It grows across Sudan and Guinea savannah ecological zones (7). The fruit pulp and the seeds, once processed to remove anti-nutritional factors, can be included in livestock feed. This study was therefore conducted to study the effect of replacing cotton seed cake with African locust bean (*Parkiabiglobosa*) seed meal with the aim of studying its effects on blood profile of growing Rams.

MATERIALS AND METHODS

Study area

The study was conducted at the Department of Animal Production Teaching and Research Farm, Abubakar Tafawa balewa University, Bauchi, Nigeria. Bauchi state occupy the total land area of 549,260 km representing about 5.3% of Nigerian total land mass and is located between 9˚ 3´ of the equator and

longitudinally, the state lies between 8˚50´ and 11˚ east of the Greenwood meridian. The annual rain fall range between 1300mm per annum in the south and 700mmper annum in the extreme north (5).

Experimental animals and their management

Before the arrival of animals, the experimental pens were cleaned, disinfected with Izal solution and labelled. Sixteen (16) growing Yankasa rams approximately 12 to 18 months old in age and with an average weight between 12 and 18 kg were used for the experiment. The animals were purchased from two markets (Mararraban Liman Katagum and Zwall) all within Bauchi state. Before the commencement of the experiment, the animals were quarantined for 2 weeks during which they were vaccinated against PPR, and treated against both internal and external parasites. They were also treated with Oxytetran long acting broad spectrum antibiotic. The quarantine period also serves as period for theadjustment of the animals to confin ement. During the quarantine period the animals were fed chopped groundnut haulms and maize brand *ad l ib* as maintenance ratio. They were also provided with good clean drinking water *ad lib*.The nimals were ra ndomly divided into four groups of four animals each. During the experiment, feeding was done every mor ning and evening at about 0700 and 1400hrs at approximately 10% of individual consumption.

Experimental Diets and Animal Feeding

Five diets (16% crude protein) were formulated in such a way that cotton seed cake replaced toasted African locust bean seeds meal (ALBSM) at 0,10,20 and 30% levels, and designated as Treatments 1,2,3 and 4 res pectively. The animals were allowed 14 days period of adaptation to confinement. During the experiment, feeding was done every morning and evening at about 0800 and 1800hrs at approximately 10% of individual consumption. Animals were provided good clean drinking water *at lib* in plastic containers. The total daily allocation of the diets was adjusted on the basis of the previous day's intake. Total feed and water intake of each animal were estimated. The animals were weighed at the beginning of the experiment and weekly thereafter. The experiment lasted for 70 days. Ingredients composition of the experimental diets is shown in Table 1.

Blood profile studies

Blood profile studies were conducted using two rams from each treatment (a total of 8) during the last week of the experiment. The rams were bled through the jugular vein and 5 ml of blood was collected from each animal from the external jugular vein following proper restraint during the 8th week of the experiment. The blood was collected in plastic tubes containing Ethylene Diaminetetra Acetate (EDTA) and tube without anticoagulant (Plain tube). The blood samples were transported to the laboratory for analysis. Packed cell volume (PCV) was determined by micro centrifugation and haemoglobin was measured through colorimetric technique of potassium cyanide (11). Blood samples without anticoagulant were centrifuged (2,500 rpm for 15 mins), serum was withdrawn and stored at -20^{0}C for biochemical analysis, which were performed by spectrophotometric methods. The examined profiles include Total Protein (TP), (TG) and Urea. The experiment was conducted in a completely randomized design **(**12), with five treatments of four animals each.

Statistical analysis

Data obtain from the experiment were subjected to Analysis of Variance (ANOVA) in a completely randomized designed using statistical package of social sciences (SPSS version 21). Where analysis of variance indicating significant difference between treatments, group means were compared using Least Significant Difference (LSD).

RESULTS AND DISCUSSION

The haemoglobin values obtained for rams were significantly ($P < 0.05$) different across the diets, but were within the standard values (9.0 – 15.0g/dl) documented for healthy sheep (12). This indicates that replacement of Cotton Seed Cake by African locust bean seed meal at up to 30% in the diets did not interfere in the oxygen carrying capacity of the ram's circulatory system, but supported it. Red blood cells values of 9.47, 11.78, 9.86 and 10.94 x109/L) were recorded among animal on diets 1, 2,3 and 4, respectively. The

animal placed on diets 1 and 3 were similar but significantly ($P < 0.05$) lower than those on diet 2 and 4. The RBC values obtained were within the recorded reference values (28-40 $x10^9$/l) as reported by (13). This could be an indication that the rams maintained on these diets had absence of anemia related diseases that could have resulted from iron deficiency. Higher values of WBC observed in animals fed diet 2 ($11.24x10^9$/l) and 4($10.53x10^9$/l) compared to those on other diets, could be attributed to the challenges from microbes infection or the presence of foreign bodies in the circulatory system of the animals. Animals with low WBC were reported to be exposed to high risk of disease infection, while those with high counts are capable of generating anti bodies in the process of phagocytosis and have high degree of resistance to diseases (4). White blood cells are usually associated with immune response capability to infection. Packed cell volume (PCV) for were significantly ($P < 0.05$) higher across the treatment diets. The PCV values of rams fed diet 2 (37.35%) and 4 (10.53%) were similar but significantly ($P < 0.05$) higher in animals fed diets 3 (30.15%) and 1(28.95%).These significant variations observed among treatment diets could probably be used to explain the realistic evaluation of the nutritional and diagnosis of health condition of these rams. However, the values obtained in this study were not adversely affecting the functions of their cells and nutritional qualities in the blood. Hence, they had low susceptibility to infections and stress. The values for Mean cell volume obtained in this study were significantly ($P < 0.05$) higher for rams fed 2 (31.80 fl)and lower for fed 4 (29.45 fl). However, all the value falls within the normal range (28-40 fl) reported for healthy by (7). The mean corpuscular haemoglobin values and mean corpuscular haemoglobin concentration values 10.50 to 11.10 pg ranged from, and 35.15 to 36.20g/L were significantly ($P < 0.05$) influenced by the experimental diets and fall within the normal range (8-12 pg) and (31-34 g/L), Fielder (2015). This further explained the better nutritional adequacy and safety of the test ingredients. (4) reported that haematological indices can be used to evaluate the immune status, efficiency of nutrient absorption and utilization in animal. Table 3 showed the serum biochemical indices of growing Yankasa rams fed experimental diets. All the values fall within the normal range for healthy rams reported by (6). Serum biochemical assay are commonly employed in monitory the status of vital organs as well as to quantify available dietary protein in ruminants. Serum total protein values for rams fed diets 2 (77.30g/dl) and 3 (78.30g/dl) were similar but significantly ($P < 0.05$) higher than rams on diets 1 (74.95/dl)and 2 (71.80/dl). The observed variability could however be linked with the different protein sources. Blood traits is a reflection of the effects in dietary treatments on the animals in terms of type, quality and amount of the feed ingested and available for the animals to meet its physiological, biochemical and metabolic necessities (9). Serum glucose was higher among rams placed on diets 2 (64.82mg/dl) and 3 (63.99mg/dl) compared with diet 1 (50.55mg/dl).

Table 1: Ingredients composition of experimental diets (%)

	Treatments			
Ingredients	1	2	3	4
Cotton Seed Cake	30.00	20.00	10.00	00.00
African locust bean seed meal	00.00	10.00	20.00	30.00
Maize Offal	39.74	42.24	45.04	46.04
Groundnut Haul	17.76	15.26	11.84	11.46
Wheat Offal	10.00	10.00	10.00	10.00
Bone Meal	2.00	2.00	2.00	2.00
Salt	0.50	0.50	0.50	0.50
TOTAL	**100**	**100**	**100**	**100**

Serum glucose is an indicator of cito metabolism in high energy diets (Coles, 1986). When glucose is lower than the normal range; is an indication of hypoglycemia, while higher levels are indication of hyper glycemia (10). Serum urea levels was significantly ($P < 0.05$) higher in diet 1 (11.07mg/dl) compared with diets 2

(8.26mg/dl) and 3 (7.99mg/dl). The higher value observed in the control diet might perhaps be ascribed to the effect of some endogenous anti-quality components which could probably reduce protein utilization owing to increase amino acid catabolism which subsequently degraded into urea (1).

Table 2: Haematological indices of growing Yankasa rams fed African locust bean seed meal to replace cotton seed cake in their diets

Parameters	T1	T2	T3	T4	SEM	SV
Haemoglobin(g/dl)	10.50^{c}	13.15^{a}	10.90^{bc}	11.40^{b}	0.30*	9-15
Packed volume cell(%)	28.95^{d}	37.35^{a}	30.15^{c}	31.70^{b}	0.73*	27-45
White blood cell($x10^{9}$/l)	9.51^{b}	11.24^{a}	7.77^{c}	10.53^{ab}	0.76*	4-12
Red blood cell($x10^{9}$/l)	9.47^{c}	11.78^{a}	9.86^{c}	10.9^{b}	0.36*	8-18
Mean cell volume (fl)	30.85^{b}	31.80^{a}	30.70^{b}	29.45^{c}	0.39*	28-40
MCH(pg)	11.10^{a}	11.10^{a}	11.00^{b}	10.50^{b}	0.11*	8-12
MCHC(g/L)	36.20^{a}	35.15^{b}	36.10^{ab}	35.75^{ab}	0.25*	31-34

a,b,c Means with different superscript along same row differ significantly at 0.05% SEM=standard error of means, SV= Standard values, MCH= Mean corpuscular haemoglobin, MCHC= Mean corpuscular haemoglobin concentration.

Source: Fielder (2015)

Table 3: Serum biochemical indices of growing Yankasa rams fed African locust bean seed meal to replace cotton seed cake in the diets.

	Treatments					
Parameters	1	2	3	4	SEM	SV
Total protein (g/L)	74.95^{b}	76.30^{b}	78.80^{a}	71.80^{c}	0.92*	60-79
Total glucose (mmol/L)	1.35^{b}	1.65^{a}	1.65^{a}	1.65^{a}	0.05*	2.78-8.44
Urea (mmol/L)	7.90^{a}	6.35^{b}	6.15^{b}	8.05^{a}	0.21*	2.80-7.10

^{a,b,c} means with different superscript along same raw differ significantly at 0.05%, SEM= standard error of the mean, SV= standard value.
Source: Fielder (2015)

CONCLUSION AND RECOMMENDATION

The inclusion of african locust bean seed meal up to 100% replace cotton seed cake in the diets of growingYankasa rams does not have any adverse effect on the blood profile. Therefore this diet may be recommended for growing Yankasa Rams.

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Ruminant Nutrition and Management: RMN025

PHYTOCHEMICAL ANALYSIS, ANTIOXIDANT AND ANTIMICROBIAL ACTIVITIES OF AQUEOUS *Gmelina arborea* LEAVES EXTRACT

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ABSTRACT

Plant species continue to be a reliable source of medications due to their low cost and minimal side effects, particularly as anti-infective agents. Therefore, the phytochemical screening, antioxidant, and antimicrobial activities of the aqueous *Gmelina arborea* leaves extract (AGALE) were evaluated. Fresh, mature *Gmelina arborea* leaves (500g) were harvested from within the College's premises. Qualitative and quantitative phytochemical screenings, antioxidant assays, and antimicrobial activities of the extract against *Escherichia coli* were determined using the disk diffusion method. Phytochemical screening revealed the presence of tannins, phenols, saponins, alkaloids, and flavonoids in AGALE. The extract demonstrated a total antioxidant activity of 33.92 ± 0.16 mg/100 mL in the Diphenylpicrylhydrazyl (DPPH) scavenging assay, 30.93 ± 0.11 mg/100 mL in the ferric reducing antioxidant potential (FRAP) assay, and 5.48 ± 0.08% in the Azino bisethylbenzo thiazoline sulfonic (ABTS) assay. The zone of inhibition observed in this study indicated that AGALE exhibited antimicrobial activity against *Escherichia coli*. AGALE demonstrated antibacterial properties, suggesting it could be a potential source of antimicrobial agents to combat pathogenic infections that are increasingly resistant to conventional antimicrobial drugs. It can be concluded that AGALE may be a useful means of strengthening the immune system of livestock because of the properties endowed in it.

Keywords: Bioactive, Herbal-based medicines, Extracts, Secondary metabolites, Phytochemicals

DESCRIPTION OF PROBLEM

Plants have long been considered promising sources of medicine within traditional healthcare systems. Recently, there has been a renewed interest in herbal-based medicines as potential new antibacterial drugs due to their longstanding use by various populations. Many researchers (1; 2) had reported that the fruits, leaves, and seeds extracts of *Gmelina arborea* contain a wealth of nutrients, minerals, and phytochemicals. These include alkaloids, steroids, carbohydrates, anthraquinone, glycosides, triterpenoids, saponins, gums, mucilages, tannins, phenolic compounds, flavonoids, and proteins. Phytochemicals are bioactive compounds that work synergistically with nutrients and dietary fiber to protect against diseases (3). As secondary metabolites, they contribute to the flavor and color of plants (4). These compounds are believed to play a significant role in disease prevention associated with diets rich in fruits, vegetables, beans, cereals, and plant-based beverages such as tea and wine. Phytochemicals can be classified based on their chemical structures into phenolic acids, flavonoids, and stilbenes/lignans. Flavonoids are further subdivided into categories such as anthocyanins, flavones, flavanones, isoflavones, and flavonols (5). Phytochemical analysis of plants is crucial for identifying non-nutritive chemicals that may impact health, with the goal of transforming these compounds into patentable drugs through suitable biological and chemical processes (6). The methods for determining these non-nutritive chemicals vary depending on the plant material and the specifics of the evaluation (7). Consequently, this study aims to investigate the phytochemicals, as well as the antioxidant and antimicrobial activities, of aqueous *Gmelina arborea* leaf extract.

MATERIALS AND METHODS

Plant collection and preparation of Aqueous *Gmelina arborea* leaf extract:
Fresh, mature *Gmelina arborea* leaves (500g) were harvested from the Botanical Garden of the Federal College of Animal Health and Production Technology, Moor Plantation, Ibadan, Oyo State, Nigeria. The leaves, which showed no signs of infection, were thoroughly washed to remove dirt and debris. They were then chopped into small pieces to increase the surface area for better extraction. To aid extraction, 150mL of water was added. The plant material was then tightly squeezed to extract the juice from the *Gmelina arborea* leaves, and the resulting extract was collected into a container. The extract was sieved to remove any particles or leaf fragments. Finally, the extract was transferred to an airtight container and stored in a cool place to prevent spoilage.

Determination of Phytochemicals screening, Antioxidants and Antimicrobial Activities
This research was conducted at Precision Food and Feed analysis Laboratory. Ajia Road, Iyana Agbala, Ejikeye, Ibadan, Oyo State. Both qualitative and quantitative phytochemical screenings were performed to identify secondary metabolites using the standard methodology described by (8). This procedure includes a series of tests to detect various classes of phytochemical compounds in plant extracts, targeting chemical constituents such as alkaloids, flavonoids, phenols, tannins, and saponins. The antioxidant activity of the extracts was evaluated through standard chemical tests, specifically the DPPH radical scavenging and reducing power assays, as outlined by (9). The antimicrobial activity of the AGALE extract was assessed using the standard Disk Diffusion Method. In this method, paper disks impregnated with antimicrobial agents were placed on a solid agar medium inoculated with the test microorganism. After incubation, the zones of inhibition around each disk were measured to determine the sensitivity of the microorganism to the antimicrobial agent.

Statistical Analysis:
All data collected were analyzed using (10). Results were replicated three times and they expressed as mean ± standard deviation.

RESULTS AND DISCUSSION

Quantitative and Qualitative Phytochemical analysis of *Gmelina arborea* leaf meal aqueous extract
Table 1 shows the quantitative and qualitative phytochemical analysis of AGALE. It was observed that tannins, phenols, flavonoids, alkaloids, and saponins were present in AGALE. Results shows that Tannins, Phenols, Flavonoids, Alkaloids and Saponins contained 103.88 ± 0.12mg/100mL, 76.25 ± 0.35mg/100mL, 117.01 ± 0.33mg/100mL, 0.33 ± 0.01% and 1.01 ± 0.02% respectively.

Table 1: Phytochemical screening of *Gmelina arborea* leaf aqueous extract

Parameters	*Gmelina arborea* Qualitative Extract	*Gmelina arborea* Quantitative Extract
Tannin (mg/100mL)	+	103.88 ± 0.12
Phenols (mg/100mL)	+	76.25 ± 0.35
Flavonoids (mg/100mL)	++	117.01 ± 0.33
Alkaloids (%)	+	0.33 ± 0.01
Saponin (%)	+	1.01 ± 0.02

Present: +, Moderately present: ++, Excessively present: +++

Antioxidant and antimicrobial activities of aqueous *Gmelina arborea* leaves extract
Indicated in Table 2 is the antioxidant and antimicrobial activities of *Gmelina arborea* extract. The antioxidant activities of AGALE analyzed were Diphenylpicrylhydrazyl (DPPH), Ferric Reducing antioxidant Potential (FRAP), Azino bisethylbenzo thiazoline sulfonic Acid (ABTS)contained 33.92 ± 0.16%, 30.93 ± 0.11MgFe^{2+}/100mL and 27.47 ± 0.11% respectively. The value obtained (5.48 ± 0.08%) as zone of inhibition in this study suggested that AGALE exhibited antimicrobial activity against *Escherichia*

coli.

Flavonoids, Tannin and Phenols were abundantly available in the aqueous *Gmelina arborea* leaf extract (AGALE) analyzed in this study and this could contribute significantly to antioxidant properties of the leaves. The result obtained in this study corroborated the findings of (11) who reported the essence of phytochemical screening and extraction. This was also in line with the findings of (12) who reported large concentration of flavonoids in the phytochemical screening of the bark, leaves, fruits and roots extract of *G. arborea.* The presence of flavonoids gives a pleasant aroma to the *G. arborea* fruit which is important in the human diet for controlling cholesterol level in the body (13). The presence of tannins in the *Gmelina arborea* may be due to the presence of polyphenolic compounds which medically are antidiarrheal and haemostatic compounds (14). Flavonoids, often referred to as nature's tender pharmaceuticals, are a diverse group of naturally occurring plant phenolic compounds. The antifungal, antiviral, antioxidant, antiallergenic, anticancer, hepatoprotective, antithrombotic, and cytotoxic activities of flavonoids have spurred significant interest in research on flavonoid-containing plants. Phenolics and flavonoids have been shown to contribute significantly to antioxidant of fruits and vegetables. Hydroxycoumarins, as typical phenolic compounds, are effective metal chelators and free radical scavengers (15).

Table 2: Antioxidant and Antimicrobial activities of *Gmelina arborea* leaves aqueous extract

Parameters	***Gmelina arborea* aqueous extract**
% DPPH Scavenged	33.92 ± 0.16
FRAP (mgFe^{2+}/100mL)	30.93 ± 0.11
ABTS %	27.47 ± 0.11
E. coli (% Inhibition (mm)	5.48 ± 0.08

DPPH: Diphenylpicrylhydrazyl, ABTS: Azino bisethylbenzo thiazoline sulfonic Acid, FRAP: Ferric Reducing antioxidant Potential**.**

This indicated the usage of phenols in the manufacture of resins, insecticides, explosives, dyes, and as raw material for the production of medicinal drugs such as aspirin. Saponins were found to be present in the aqueous *Gmelina arborea* leaf extract (AGALE) even though it makes the extract to have stimulating effect. The presence of saponins in AGALE indicated that the extract can be used as antibacterial and antimicrobial agent (16). Alkaloids detected in the extract of the leaves are compound that helps the white blood cells, dispose harmful microorganism, cell debris and improved cardiac conditions. The result obtained in this study was in accordance with the observation of (17) who reported that tannin, 1054aponin, flavonoid, alkaloids, and phenolic compound are present in AGALE*,* they also reported that AGALE had beneficial effects on blood glucose level as well as improving hyperlipidemia and other metabolic aberration. The presence of these significant metabolites suggests the use of AGALE in treating various diseases by local practitioners or herbalists.

Secondary metabolites, especially flavonoids, phenols, and tannins, have considerable pharmacological importance. The abundance of active ingredients endows the plant with exceptional pharmacological qualities, which may explain its wide range of therapeutic applications. The qualitative phytochemical screening of AGALE observed in this study aligns with the findings of (18). Plants exhibit antioxidant activity by scavenging free radicals. The abundant presence of phytochemicals in plants has been reported to significantly increase the antioxidant properties of the leaves (19). AGALE was found to possess a substantial quantity of antioxidants capable of stabilizing free radicals, which can otherwise damage internal molecules and compromise the immune system, making animals susceptible to various pathogens. The results showed that AGALE had a high antioxidant capacity, with 30.93±0.11 mgFe2+/100mL ferric reducing antioxidant potential (FRAP), 27.4 ± 0.11% ABTS, and 33.92 ± 0.16 DPPH. A higher FRAP value indicated a greater reducing capacity of the extract. The FRAP assay measures the ability of antioxidants to reduce ferric ions (Fe3+) to ferrous ions (Fe2+), suggesting a moderate level of reducing power in the AGALE. The ABTS value (27.4 ± 0.11%) obtained in this study indicates that the antioxidant capacity of AGALE, as measured by the ABTS assay, involves strong antioxidants that prevent oxidative stress and

oxidative damage to DNA, lipids, and proteins. This plays a role in preventing diseases such as cancer and cardiovascular diseases (20). This suggests that AGALE contains chemicals like flavonoids, which are well known for their antioxidant activity and can donate hydrogen to a free radical to neutralize its reactivity. Variances in antioxidant activities could be attributed to differences in chemical composition. Secondary metabolites are stored in plant leaves, and their concentration fluctuates depending on environmental exposure (21). Furthermore, the flavonoid content of AGALE and their DPPH values showed a moderate connection, suggesting that flavonoids, which are subgroups of phenolic compounds, have lower antioxidant activity than phenolic compounds, which are the primary antioxidant contributors in plants (22). Consequently, phenolic substances other than flavonoids may be responsible for the antioxidant activity of AGALE. This present study was conducted to add to the pool of knowledge of the antibacterial activity of AGALE against *E. coli.* The potency of AGALE obtained in this study revealed 5.48 ± 0.08mm zone of inhibition which was slightly lower than the values was lower than the ranged of values (8 .04 to 9.86 mm) reported by (23) who reported the antibacterial effect of *Gmelina arborea*. The variable observed could be attributed to different concentration used. The result obtained in this study was in accordance to the findings of (14) who indicated that AGALE showed higher activity on bacterial isolated than methanol and hexane extracts. It was reported by (14) that the higher concentration of the plant extracts showed higher diameters of zones of inhibition compared with the lower concentrations.

CONCLUSION AND APPLICATION

It can be concluded that AGALE contains bioactive substances such as tannins, flavonols, alkaloids, saponins, and phenols, which exhibit promising antioxidant properties and potential for new drug discoveries in the treatment of *E. coli* infections.

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Ruminant Nutrition and Management: RMN026

BLOOD PROFILE OF PREGNANT RED SOKOTO DOES FED VARYING LEVELS OF GARLIC

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ABSTRACT

A study was conducted to evaluate the effect of inclusion levels of garlic on hematological and biochemical parameters of pregnant Red Sokoto does. A total of twenty-eight (28) Red Sokoto does (RSD) weighing an average of 25 kg were used for the experiment. They were randomly assigned to four treatment diets, containing 0, 250, 500 and 750g/100kg diet levels of garlic respectively in a completely randomized design. Each of the animals were fed concentrate at 1.5% of body weight while *Digitaria smutsii* was offered at 2.5% body weight. Hematological and biochemical parameters were recorded. Results obtained indicated that (Hb and RBC) were not affected (P>0.05) by garlic inclusion levels**.** Total protein**,** albumin and creatinine were significantly affected (P<0.05) by garlic inclusion with higher value of TP (6.5g/dl) recorded in does fed diet containing 750 g garlic and the higher value for creatinine (98.5 mmol/l) was recorded in does fed diet containing 250 g garlic. The study showed that garlic can be included at levels up to 750g/100 kg for RSD without deleterious effect on blood profile.

Keywords: Red Sokoto does, hematological parameters, biochemical parameters, garlic

DESCRIPTION OF THE PROBLEM

There are about 53,885 herbs in the world (1). Numerous studies have shown the beneficial effects of herbs and spices on blood profile, feed intake, immune functions and health, rumen fermentation and productivity in small and large ruminants. Positive effects of garlic in nutrition of sheep and goats have been reported (2).

Enhancing fibrous feed digestibility and reducing nitrogen excretion by ruminants to improve immune system (most especially during pregnancy) are some of the most important goals of ruminant nutritionists. Although antibiotics achieved good performance, their potential side effects became a real public health concern globally (3). This led to the exploration of interest on the use natural materials to ameliorate some health challenges in Red Sokoto pregnant does (RSD).

MATERIALS AND METHODS

Animals and Experimental Design

The experiment was conducted at the National Animal Production Research Institute of ABU Zaria, Nigeria. A total of twenty-eight Red Sokoto does (RSD) weighing an average of 25 kg were used for the experiment. They were randomly assigned to four treatment diets, containing 0, 250, 500 and 750g/100kg diet levels of garlic respectively in a completely randomized design. Each of the animals were fed concentrate at 1.5% of body weight while *Digitaria smutsii* was offered at 2.5% body weight. Packed cell volume (PCV) and haemoglobin (Hb) concentration were determined by the microhematocrit and cyanmethaemoglobin (using filter-paper technique) methods respectively as described by (4). Erythrocyte count and total white blood cell (WBC) were determined by the haematocytometry method as described by (1). The plasma total protein was measured using biuret reaction while albumin was measured by colorimetric estimation using Sigma® diagnostic kit according to the method described by (1). Globulin was determined by difference between TP and Alb. Blood urea nitrogen was also evaluated as described by (4).

Statistical Analysis

Data generated on hematological parameters were analyzed using the General Linear Model (GLM) procedure of (5). Significant differences between treatment means were determined using Duncan's Multiple Range Test of the same software.

RESULTS AND DISCUSSION

Table 1 shows the haematological parameters of red Sokoto does fed diets containing varying levels of garlic. The PCV ranged from 23.27 for diet containing 0g/100kg garlic to 26.33% for diet containing 500g/100kg garlic. Hb and RBC values were not affected by garlic but were within the reference values.

Table 1: Haematological Parameters of Red Sokoto Does Fed Diets Containing Varying Levels of Garlic

Parameters	Inclusion levels of garlic (g/100 kg diet)				SEM	Reference Values
	0	250	500	750		
PCV%	23.27^{c}	25.00^{b}	26.33^{a}	23.30^{c}	1.30^{*}	22.0 – 38.0
Hb (g/dl)	7.50	8.00	9.67	8.45	2.35^{NS}	8.0 – 12.0
WBC ($\times 10^{9}$/l)	9.50^{b}	8.77^{bc}	11.23^{a}	8.10^{c}	1.00^{*}	4.0 – 13.0
RBC ($\times 10^{12}$/l)	7.23	8.00	8.12	8.00	0.98^{NS}	5.0 – 8.0

^{a,b}Means within the same row with different subscripts are significantly different (P<0.05) *significant at 0.05; SEM=Standard error of means; NS= not significant; PCV-packed cell volume, Hb-haemoglobn, WBC-white blood cell and RBC-red blood cell. Source of Reference values: (13)

Table 2 shows the biochemical parameters of red Sokoto does fed diets containing varying levels of garlic. The Total protein ranged from 5.50 for diet containing 0g/100kg garlic to 6.50 g/dl for diet containing 750g/100kg garlic. Globulin and Urea values were not affected by garlic but were within the normal reference values.

Table 2: Biochemical Parameters of Red Sokoto Does Fed Diets Containing Varying Levels of Garlic

Parameters	Inclusion levels of garlic (g/100 kg diet)				SEM	Reference Values
	0	250	500	750		
Total Protein (g/dl)	5.50^{b}	5.65^{b}	6.20^{a}	6.50^{a}	0.54^{*}	6.00 – 7.90
Albumin (g/dl)	2.00^{b}	2.45^{b}	3.55^{a}	3.10^{a}	0.45^{*}	2.40 – 3.00
Globulin (g/dl)	2.98	2.99	3.50	3.10	0.52^{NS}	2.70 – 4.10
Urea (mmol/l)	4.60	4.93	4.60	466	0.50^{NS}	4.50 – 9.20
Creatinine (mmol/l)	65.00^{c}	98.50^{a}	85.50^{b}	67.00^{c}	5.81^{*}	60.00 – 135.00

^{abc}Means within the same row with different subscripts are significantly different (P<0.05) *significant at 0.05; SEM=Standard error of means and NS= not significant. Source of Reference values: (13).

Haematological parameters of experimental animals are shown in Table 1. The PCV values recorded in this study were within the values reported by (6), when Red Sokoto does were evaluated for the effect of feeding diets containing varying inclusion levels of ginger. However, the values were within the range values for healthy goats. The values of PCV reported in this study were similar to the reference values of 22 to 38% for normal goats (7). This suggests that even at the highest level of garlic inclusion, the aforementioned parameter was not affected. The values for WBC being within the range for normal goats suggest that the animals possess phagocytes functions (3). WBC reported in the present study further indicates that the

animals possess protective mechanisms, providing a rapid and potent defense against infectious agents. This could be attributed to intake garlic phyto-chemicals (4).

Biochemical parameters of Red Sokoto Goats are shown in Table 2. The blood urea values obtained across the treatments were within the normal range values for healthy goats. This might be an indication that varying inclusion levels of garlic did not cause any undue elevation in the urea level of the animals as a result of amino acid imbalance. Blood urea level is also considered in ruminants to reflect the protein quality of the diet (10). The Total protein values were slightly below the normal range for healthy goats (10). The Albumin range values were slightly above the normal reference values for healthy goats. The creatinine levels were affected by garlic inclusion levels with animals fed diet containing 250 g garlic recording the higher value. However, the values were within the normal reference values reported by (8), for healthy goats which is an indication of a normal kidney function. (9), reported creatinine levels of ruminants to be increasing with increase in age of the animals. This is because creatinine as a chemical waste product in the blood increases with increase in muscles deposition. It is an indicator of normal muscle function.

CONCLUSION AND APPLICATION

It was concluded that garlic inclusion levels in diets of Red Sokoto does did not have deleterious effect on blood parameters. It can be use to improve the blood profile of small ruminants.

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Ruminant Nutrition and Management: RMN027

WATER INTAKE OF RED SOKOTO BUCKS FED VARYING LEVELS OF GARLIC

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ABSTRACT

Twenty (20) Red Sokoto bucks aged between 12-18 months and weighing between 25-30 kg were randomly allotted into four treatment groups with 0 g, 250 g, 500 g and 750 g/100 kg diet garlic inclusion levels. Water was offered at 9 liters per buck daily. Water refusal and left-over feed were recorded separately on a daily basis before feeding in the morning. Results showed that the bucks offered the highest level of the test ingredient (garlic) consumed more water than the bucks on the other treatment groups. However, there was no significant difference (P>0.05) in water consumption between all the treatments for both total and daily water intakes. Red Sokoto bucks offered higher levels of garlic (750 g/100 kg diet) required about 1.6 liters/head/day. The daily feed intake and daily weight gains were also higher in the group with 750 g/100 kg diet garlic. Therefore, 750 g/100 kg garlic in the diet of red Sokoto bucks is recommended for better performance.

Keywords: Water intake, garlic, weight gain, bucks.

DESCRIPTION OF THE PROBLEM

Water functions to give the body its shape and turgidity, it is a constituent of all living cells and it is also required for specific production need (1). The daily water requirement of livestock varies significantly among the animal species. The animal's size and growth stage will have a strong influence on daily water intake (2). Water consumption of animals depends on several factors such as activity, environmental temperature, dryness of feed, type of production, physiological activities taking place and relative humidity (3). Providing adequate amount of balanced ration to the animals is not a yardstick for its utilization if clean water is not provided in the required quantity, hence providing enough water is essential for good livestock production. Addition of garlic in the diet of livestock is expected to increase their water intake due to the nature of the garlic's aroma and other phyto-chemicals which are responsible for its pungent flavor (4).

MATERIALS AND METHIDS

Animals and Experimental Design

Feeds were compounded with inclusion levels of garlic at 0, 250, 500, and 750 g/100 kg diet. The formulation was done at the Feeds and Feeding Unit of NAPRI. Dry garlic was sourced from Samaru local market in Zaria and ground into powder using grinding machine before inclusion.

Twenty Red Sokoto bucks aged between 12-18 months and weighing between 25-30 kg were randomly allotted into four treatment groups with 0 g, 250 g, 500 g and 750 g/100 kg diet garlic inclusion levels. A completely randomized design was used with number of animals as replicates and levels of garlic as treatments. Each buck was offered nine liters of water. A calibrated bucket was used in quantifying the water. Water left over was recorded each morning and subtracted from the quantity given the previous day.

RESULTS AND DISCUSSION

The feed and water intakes of RSB fed varying levels of garlic is presented in table 3. It indicated a no significant difference (P>0.05) for both total and daily water intakes across the groups. All other parameters (feed intakes and weight gains) were significantly affected (P<0.05) by garlic inclusion levels.

Table 1: Chemical composition of the concentrate diets and *Digitaria smutsii* hay fed to Red Sokoto Bucks

	Inclusion levels of garlic (g/100 kg diet)				
Nutrients (%)	**0**	**250**	**500**	**750**	***D. smutsii***
Dry Matter	91.60	91.90	92.10	92.40	90.04
Organic Matter	81.39	81.67	81.85	82.13	87.39
Ash	10.21	10.23	10.25	10.27	2.65
Ether Extract	4.08	4.10	4.11	4.13	0.54
Crude Fiber	18.47	18.50	18.53	18.56	30.05
Crude Protein	12.10	12.10	12.10	12.20	5.36
Nitrogen Free Extract	55.14	55.07	55.01	54.84	61.40
Neutral Detergent Fiber	36.99	37.03	37.70	37.11	63.81
Acid Detergent Fiber	18.44	18.46	18.48	18.50	33.94

Table 2: Proximate composition of garlic

Constituents	**Composition (mg/100 g garlic)**
Alkaloids	4.21
Tannins	3.54
Carotenoids	0.64
Saponin	0.80
Flavonoids	5.56
Steroids	0.04
Cardenolides	0.02

Table 3: Feed and water intakes of RSB fed diets containing levels of garlic

Parameters	**Inclusion levels of garlic (g/100 kg diet)**				
	0	**250**	**500**	**750**	**SEM**
Total water intake (L)	590.20	600.90	600.64	610.88	36.01^{NS}
Daily water intake (L)	7.38	7.51	7.51	7.64	1.21^{NS}
Total feed intake (kg)	137.71^{a}	118.10^{b}	116.97^{b}	137.70^{a}	7.59*
Daily feed intake (g)	918.0^{a}	787.3^{b}	779.8^{b}	918.0^{a}	50.58*
Total weight gain (kg)	8.64^{ab}	9.21^{ab}	7.68^{b}	10.78^{a}	1.37*
Daily weight gain (g)	57.62^{a}	61.40^{ab}	51.20^{b}	71.87^{a}	9.16*

^{abc}Means within the same row with different subscripts are significantly different (P<0.05) *significant at 0.05; SEM=Standard error of means and NS= not significant.

There are several factors that influence the animal's water intake and the most important ones are feed consumption, dry matter content in the diet, dry matter intake and production status (5). The bucks offered garlic at 750 g/100 kg diet consumed more water (1.53 l/head/day) with no significant difference (P>0.05) than the bucks on the other treatments (Table 3). Also, the water consumption in this experiment is a bit lower than the values of (2.2- 3.5 l/head/day) reported by (6) where water intake of Yankasa rams was measured. This could be attributed to species and or breeds of animals, stage of growth, nutrition and environment factors at the time of the experiment (7). The higher water intake in the group fed 750 g garlic is also in line with higher feed intake (183.60 g/head/day) by the animals in that group. Water intake of livestock is directly proportional to their feed consumption. This corroborates with the findings of (5) where varying inclusion levels of ginger were fed to Yankasa rams. Garlic has a pungent flavor taste that may affect both feed and water intakes of animals.

CONCLUSION AND APPLICATION

The study concluded that incorporating garlic up to 750 g per 100 kg of diet in Red Sokoto Bucks enhances their overall performance. Additionally, the water consumption of the bucks was found to be directly proportional to their feed intake.

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Ruminant Nutrition and Management: RMN028

THE EFFECT OF YEAST SUPPLEMENTED DIETS ON THE PERFORMANCE AND BLOOD MINERAL COMPOSITION OF RED SOKOTO GOATS

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Abstract

The use of yeast as a dietary supplement in livestock nutrition has gained attention for its potential to enhance growth performance and mineral absorption. This study investigated the effect of yeast supplemented diets on the performance and blood mineral composition of intensively raised Red Sokoto (Maradi) goats. Twenty goats were randomly assigned to 4 treatment groups, consisting of 5 goats per group and the treatments consisted of a control group and 3 other treatments (0, 9, 12, 15 g inclusion of Saccharomyces cervisiae) respectively in a completely randomized design. The results showed that the supplementation of yeast in the animals' diets had significant effect ($P<0.05$) on performance and blood minerals respectively. Goats offered 15 g inclusion of yeast had the highest weight gain and the highest levels of magnesium, iron, copper and zinc (blood minerals). The study concluded that inclusion of yeast at 15 g could be adopted in goat production because it enhances nutrient absorption, significant growth performance and improved health status.

Keywords: yeast, performance, blood minerals, Red Sokoto goats

DESCRIPTION OF PROBLEM

In the tropics and subtropics, small ruminants like sheep and goats rely on native pastures, crop residues, and shrubs for feed, which are high in fiber and low in crude protein and metabolizable energy (1,2). Feeding these diets often leads to inadequate feed intake and nutrient absorption, causing weight loss (1). However, adding forage legumes or grains to these low-quality diets can enhance intake, digestion, and growth performance (3). Conversely, supplementing ruminant diets with forage legumes and grains can lead to ruminal acidosis, negatively impacting animal productivity (4). To mitigate this, commercial farmers often rely on antibiotics, but this has contributed to antibiotic resistance in animals (5). The EU has proposed banning antibiotics as growth promoters due to the risk they pose to human and animal health (6). Therefore, alternative strategies like probiotics are being explored to promote animal health and development without compromising productivity.

Probiotics, like yeast, can modulate gut microbiota, altering fermentation patterns and improving nutrient digestibility (7). Yeast, a natural growth promoter, has been extensively studied for its beneficial effects on animal health (8). Yeast can absorb oxygen in the rumen, creating a favorable environment for anaerobes (9). It also controls lactate production, reduce acidosis, and provides nutrients for bacteria (10). However, the effectiveness of yeast as a substitute for antibiotics depends on various factors, including yeast species, feed ingredients, and animal category (11).

In West Africa, the Red Sokoto (Maradi) goat is improving the lives of family farmers, stimulating local economies, and making better nutrition more accessible (12). These indigenous livestock species are well-suited to West Africa, with a wealth of genetic diversity that makes them more adaptable to a changing climate. Improving their productivity has become more imperative in other to meet the increasing demand for food on a global scale. Hence, this study seeks to investigate the effect of yeast supplemented diets on the performance and blood mineral composition of intensively raised Red Sokoto (Maradi) goats.

MATERIALS AND METHODS

Experimental Animals and management

Twenty (20) growing red Sokoto goats between 9-12 months of age was used for the experiment. The goats were purchased from Jebba in Niger State, then quarantined and acclimatized for a period of four (4) weeks in which they were assessed and treated for various conditions. The goats were administered Ivermectin and Albendazole (against internal and external parasites), Oxytetracycline L.A. (a broad-spectrum antibiotic to treat bacteria diseases), Gentamicin (against treatment of bacterial infections), and multivitamin was administered to increase the animal appetite during the quarantine period. During this period, the animals were introduced to the basal concentrate diet in order to adjust their rumen bacteria to the feed. Prior to the arrival of the goats the pen was cleaned daily and disinfected with fungicides. Throughout the experiment the pen was cleaned daily and clean water was provided every morning and evening. All the animal husbandry practices were observed to ensure proper hygiene. The experimental diet consisted of a formulated concentrate with ingredients as shown in Table 1. Goats were fed *Panicum maximum ad libitum* while the formulated concentrate served at 4% of their body weight.

Goats were grouped into four (4) groups, consisting of five goats per group. Each group was randomly allotted to the 4 experimental diets containing 0, 9, 12, and 15g of *Saccharomyces cerevisiae* per kg of feed consumed, respectively in a completely randomized design. Individual animals were weighed at the commencement of the experiment and at 7 days interval throughout the period of the experiment. Weighing was done in the morning before feeding.

Table 1: Ingredients Composition (%) for the compounded concentrate diet

Ingredients	Diet
Palm Kernel Cake	15
Cassava Peel	20
Corn bran	30
Wheat offal	17
Maize	15
Bone Meal	1
Salt	2
Total	100

Saccharomyces cerevisiae was supplemented in the diets at the rate of 0g, 9g, 12g and 15g.

Blood sample collection

Using a hypodermic needle and syringe, a sample of approximately 5 millilitres of blood was taken directly from each animal's jugular vein on the 90th day of the experiment into plain sample bottles for serum mineral analysis. Serum minerals were determined by inductively coupled plasma mass spectrometry (ICP-MS) as described by (13).

Statistical Analysis

Data generated for body weight were subjected to descriptive statistics using Python (Jupyter notebook), while data for blood minerals were subjected to one-way analysis of variance (ANOVA) using the SPSS (2006) software. Significant means were separated with the new Duncan multiple range test (Duncan 1955) contained in the same statistical package.

RESULTS AND DISCUSSION

Figure 1 presents the weight change of animals supplemented with different levels of yeast over time. From the graph, it can be inferred that goats offered diets containing 15g of yeast displayed the best performance in terms of weight gain. Supplemented groups offered 9 and 12g of yeast also had a gradual increase throughout the experiment. However, despite the increase weight gain of goats fed with the control diet (0g), it was below par all through till 8th week. Supplementing animals with 15g of Saccharomyces cerevisiae (yeast) enhanced growth performance and health and this can be attributed to the yeast's beneficial effects

on digestion and nutrient utilization (14). This study's findings align with previous research showing that yeast culture (YC) supplementation improves growth performance in cattle, without reducing dry matter intake, but body weight gain is increased, thereby resulting in improved feed efficiency (15,16,17). Additionally, YC supplementation has been shown to enhance weight gain in lambs, particularly those fed low-protein diets (18). The poor performance of animals supplemented with 9g of Saccharomyces cerevisiae may be due to slow acclimatization to the diet, highlighting the variable responses to yeast culture (YC) supplementation (15).

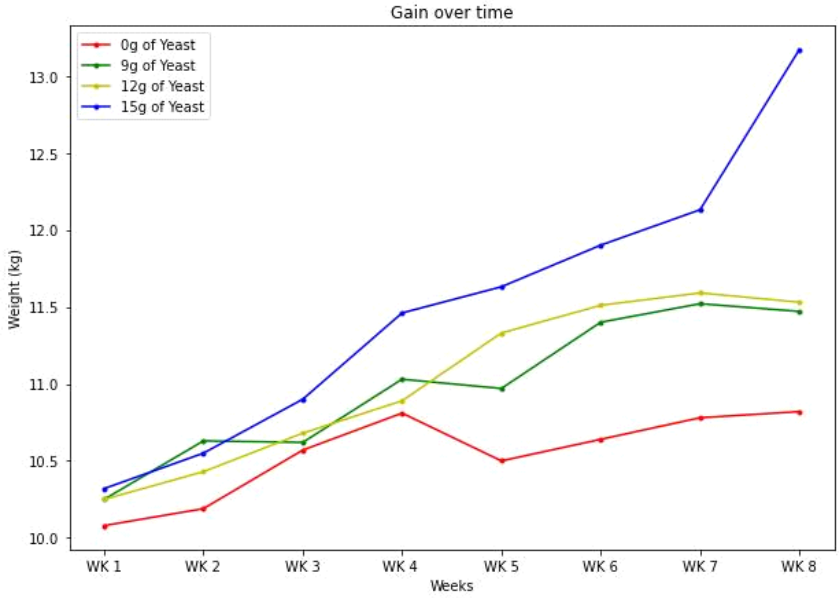

Figure 1: Influence of Yeast Supplementation on Growth Performance of Red Sokoto Goats

Table 2 presents the effect of different levels of yeast supplementation in diets on the blood minerals of Red Sokoto goats. The result shows that all parameters were significantly ($P<0.05$) affected by the supplementation of yeast except Calcium which was not significantly ($P>0.05$) affected across the treatment levels. The highest level of magnesium, iron, copper and zinc were observed in goats offered diets containing 15g of supplemented yeast. The calcium levels (8.47-10.09 mg/dl) found in this study are within the normal range for healthy goats (19,20), indicating sufficient calcium for proper bone development. The magnesium levels (1.94-2.78mg/dl) in goats were within the normal range (1.80-2.98mg/dl), indicating adequate levels for maintaining cellular toxicity, fluid balance, metabolic processes, and neural and muscular functions (21). Copper levels (90.00-138 µg/dl) were also within the normal range, suggesting adequate levels for reproductive health, as copper deficiency can lead to early embryonic death, retained placenta, and placental necrosis (22). Zinc is crucial for maintaining epithelial tissue integrity and is involved in various enzyme systems related to carbohydrate and protein metabolism, with deficiency leading to depressed gain and conversion (23). The zinc values (0.11-0.19 g/dl) in this study are slightly higher than the normal range (0.09-0.120 g/dl) reported by NRC (24), while iron is essential for hemoglobin and myoglobin synthesis, oxygen transport, and oxidative enzyme systems (25). Yeast supplementation has been shown to improve animal performance, nutrient absorption, and mineral status, while also reducing illness incidence (26). The current study found that yeast inclusion in the diet of Red Sokoto goats increased blood mineral levels, improving overall wellbeing, as minerals are essential for various physiological processes (27).

Table 2: Blood Mineral Profile of Red Sokoto Goats Fed Diets Containing Varying Levels of Yeast (*Saccharomyces Cerevisiae*)

Parameters	0g SC	9g SC	12g SC	15g SC	SEM
Magnesium	2.13^{c}	1.94^{d}	2.28^{b}	2.78^{a}	0.01
Iron	10.25^{d}	9.46^{c}	11.41^{b}	12.22^{a}	0.33
Copper	86.57^{b}	81.20^{c}	90.10^{b}	91.42^{a}	1.23
Zinc	0.14^{c}	0.11^{d}	0.17^{b}	0.19^{a}	0.00
Calcium	9.55	10.67	8.47	10.09	0.38

$^{a, b}$: means in same column with different superscript are significantly (P<0.05) different

CONCLUSION AND APPLICATION

1. Yeast supplementation in the diets of animals had significant impact on the performance and blood minerals, it could be implemented into the diet by farmers at 15 g inclusion level.
2. Supplementing animals with 15g of *Saccharomyces cerevisiae* (yeast) enhances nutrient absorption, significant growth performance and improved health status.

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Ruminant Nutrition and Management: RMN029

SHEEP RUMEN FLUID EVALUATION OF ROUGHAGES AVAILABLE IN THE DAIRY DEVELOPMENT AREAS OF OYO STATE, NIGERIA

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ABSTRACT

The study was aimed at analysing the rumen fluid of different roughages found in the Dairy Development Program (DDP) areas of Oyo State, Nigeria, in order to establish their rumen fermentation trends. Four rams, maintained in individual pens of (2×2 m^2) at a room temperature of 30°C under continuous lighting were used. Animals had free access to fresh water and a mineralized salt block to prevent any deficiency of mineral elements and vitamins. . All parameters measured were statistically different ($P<0.05$) between treatment means. Ammonia nitrogen (NH3-N) levels, reflecting the availability of protein for microbial fermentation, show significant variability. Forages such as *Pennisetum purpureum* and *Digitaria decumbens* displayed higher acetate levels (75.27 and 60.49, respectively), indicating a potential abundance of fibrous material. *Stylosanthes guianensis, Centrosema pubescens* and *Cynodon_dactylon* exhibit higher pH levels (8.61, 8.06 and 8.01 respectively), suggesting a slight alkaline influence. Contrastingly, *Centrosema pubescens* and *Tephrosia bracteolata* showed lower pH levels (12.06 and 9.62, respectively), indicating an alkaline environment. In conclusion, the rumen metabolites study revealed distinct rumen fermentation trends for various roughages, shedding light on their suitability for inclusion in diets of ruminant animals and their impact on rumen health and performance. Using roughages that have pH ranges between 5.5 and 8.0 for optimal microbial activity and fermentation are recommended.

Keywords: Volatile Fatty Acids, Rumen, Roughages, pH, Sheep

DESCRIPTION OF THE PROBLEM

Ruminant animals raised under small holder production systems, rely on crop residues and other forages of low quality which may not provide the nutrients for optimal growth and health of the animals (1). In the Dairy Development Areas of Oyo State, Nigeria, the availability and quality of roughages are crucial for sustaining the health and productivity of dairy cattle. However, the predominant use of low-quality roughages poses significant challenges to the nutritional management of these animals.

Extensive grazing in these areas exposes animals to feeds that may contain anti-nutritional factors, further compromising nutrient digestibility and leading to low milk production and poor overall performance (2). The variability in the nutritional content of available roughages, and the presence of anti-nutritional factors, necessitates a thorough evaluation of these feeds to understand their impact on rumen fermentation and animal health.

Rumen fermentation is a critical process that directly influences the efficiency of nutrient utilization and the production of volatile fatty acids, which are essential for energy metabolism in ruminants. The pH level of rumen fluid is a key indicator of rumen health, with optimal pH levels ranging from 5.5 to 7.0 (3), necessary for maintaining a stable and efficient microbial environment. Deviations from this pH range can lead to suboptimal fermentation, reduced feed efficiency, and metabolic disorders such as acidosis, which further impair animal productivity.

In the context of the Dairy Development Areas of Oyo State, there is a lack of comprehensive data on the rumen fermentation characteristics of locally available roughages. This gap in knowledge hinders the development of effective feeding strategies that can enhance the nutritional management and productivity

of dairy cattle. Therefore, this study aims to evaluate the rumen fluid of different roughages found in these areas to establish their fermentation trends and identify roughages that support optimal rumen health and productivity.

The study was aimed at analysing the rumen fluid of different roughages found in the Dairy Development Program (DDP) areas of Oyo State, Nigeria.

MATERIALS AND METHODS

Animals and Experimental Design

Four rams were used in the study that lasted four weeks, with each forage fed to one ram for 7 days. Animals were given free access to fresh water and a mineralized salt block to prevent any deficiency of mineral elements and vitamins. Each ram was fed maize bran in the morning while a forage (Table 1) was fed in the evening until the 7th day, when the forage was fed in the morning and in the evening. The liquor was then collected and sent to the laboratory for analysis.

Table 1: Forage Plants Fed to Experimental Rams

SN	Week/ Treatment	Scientific Name	Common Name	Class
1	Week1/T1	*Leucaena leucocephala*	River tamarind	Browse plant
2	Week1/T2	*Gliricidia sepium*	Agumaniye	Browse plant
3	Week1/T3	*Andropogon gayanus*	Gamba grass	Grass
4	Week1/T4	*Pennisetum purpureum*	Elephant grass	Grass
5	Week2/T1	*Panicum maximum*	Guinea grass	Grass
6	Week2/T2	*Cynodon dactylon*	Bermuda grass	Grass
7	Week2/T3	*Digitaria decumbens*	Pangola grass	Grass
8	Week2/T4	*Melinis minutiflora*	Molasses grass	Grass
9	Week3/T1	*Bracharia ruziziensis*	Bracharia grass	Grass
10	Week3/T2	*Zea mays*	Maize	Grass/Crop plant
11	Week3/T3	*Stylosanthes guianensis*	Stylo grass	Grass
12	Week3/T4	*Stylosanthes gracilis*	Pencil flower	Legume
13	Week4/T1	*Centrosema pubescens*	Butterfly pea	Legume
14	Week4/T2	*Calopogonium mucunoides*	Calopo grass	Legume
15	Week4/T3	*Tephrosia bracteolata*	Ndorba	Shrub legume
16	Week4/T4	*Manihot esculenta*	Cassava	Legume/Crop plant

Rumen liquor was collected in the morning (0 hour before feeding) and (5 hour after feeding) on the 7th day of the experiment with a suction tube. The tube was inserted from the mouth in to the rumen where 20mls of rumen liquor was withdrawn from the animals. The temperature and pH of each sample was immediately determined by using thermometer and pH meter respectively. Ten (10ml) of 0.05 sulphuric acid was poured into the bottle and taken to the laboratory for volatile fatty acid (VFA) and rumen ammonia nitrogen analysis.

Chemical Analysis

Total VFA was determined according to (4) and ammonia nitrogen concentration according to (5).

Statistical Analysis

The samples collected were subjected to analysis of variance (ANOVA). The differences were separated using least significant differences with the means±standard errors of the mean (SEM) using Statistics 18 (SPSS), and the level of significance was set at $P<0.05$.

RESULTS AND DISCUSSIONS

The rumen metabolites of available forages is shown in Table 2 below. All parameters measured were statistically different ($P<0.05$) between treatment means. Ammonia nitrogen (NH3-N) levels, reflecting the availability of protein for microbial fermentation, show significant variability. For example, *Zea mays* and *Stylosanthes gracilis* exhibit higher NH3-N levels (73.71 and 74.28 mg/100, respectively), suggesting a potentially greater availability of protein for microbial activity. In contrast, *Panicum maximum* and *Cynodon dactylon* have relatively lower NH3-N levels (58.34 and 61.73 mg/100 respectively). Forages with higher NH3-N levels may contribute more efficiently to microbial protein synthesis.

Acetate, butyrate, and propionate are key SCFAs produced during microbial fermentation in the rumen. Forages such as *Pennisetum purpureum* and *Zea mays* display higher acetate levels (65.27 and 68.21 mm/100ml, respectively), indicating a potential abundance of fibrous material. Notably, *Pennisetum purpureum* also has elevated propionate levels (60.21 mm/100ml), suggesting its potential as a carbohydrate-rich forage. Elevated acetate levels suggest a greater presence of fibrous material, while varying propionate levels indicate differences in carbohydrate composition.

pH levels are crucial indicators of rumen health, with deviations potentially impacting microbial activity. For instance, *Stylosanthes guianensis*, *Centrosema pubescens*, and *Cynodon dactylon* display higher pH levels (8.61, 8.06, and 8.01, respectively), indicating a mildly alkaline effect. This indicates that their fermentation in the rumen may create an alkaline environment, which could influence complete rumen fermentation process. Contrastingly, *Zea mays* and *Zea mays* display lower pH levels (6.02 and 6.03, respectively), indicating slight acidity. Additionally, pH variations highlight the potential influence on rumen health and microbial activity.

In a recent study by (6), the content of rumen acetate, propionate, butyrate and total volatile fatty acids (TVFAs) were significantly affected by forage-to-concentrate ratio. However, in this study, only the forages were fed and tested in the rumen. The findings in this study could be an indication that different forage types can have a substantial impact on the production of key volatile fatty acids in the rumen, which are crucial for the energy metabolism of ruminants. Furthermore, the results suggest that even without the inclusion of concentrates, variations in the type and quality of forages can alter the rumen fermentation pattern.

The ruminal Ammonia nitrogen (NH3-N) levels varied for each of the forages fed, this is in contrast with the study of (7) who found no significant difference between the ruminal NH3-N when cows were fed three different feeds. Furthermore, the findings from this study also differ from those reported by (8) who reported a range of 13.90 to 17.09 mg/dl -when lactating Holstein cows were fed different diets containing varying quantities of rumen-degradable carbohydrates. This difference could be attributed to the inclusion of sucrose in the diet as argued by (9), who reported that ruminal ammonia concentration tended to be reduced with sucrose inclusion in the diet of dairy cows.

A recent study (10) that determined the short- and long-term effects of different forage types supplemented in pre-weaning dairy calves discovered ranges for acetate (50.13 to 54.13 mM/100 mL), propionate (30.28 to 33.78 mM/100 mL), and pH (5.68 to 5.90). These values can be compared to those obtained in this study, where the range for acetate was 68.21 to 51.1 mM/100 mL, slightly different for propionate having a range of 59.25 to 40.14 mM/100 mL and pH, which ranged from 5.38 to 8.01. On the other hand, the butyrate levels in Zhang's study were 9.07, 9.06, and 10.02 mM/100 mL, while in this study, they ranged from 23.13 to 11.24 mM/100 mL. In agreement with previous studies (11; 12 and 13), we found that forages provide an increased level of rumen pH, however, our study did not agree with (14) who argued that Concentration of NH_3–N tended to decrease with increasing pH level.

Table 2: Rumen Metabolites of Available Forages Found in the Dairy Development Areas of Oyo State

Feed ingredient	NH3 – N (mg/100)	Acetate (mm/100ml)	Butyrate (mm/100ml)	Propionate (mm/100ml)	pH
Leucaena_leucocephala	63.04 cd	59.72 b	12.7 d	50.12 c	6.03 c
Gliricidia_sepium	64.19 cd	57.86 b	11.24 d	51.11 bc	6.13 c
Andropogon_gayanus	71.87 a	54.03 cd	11.24 d	49.45 c	6.08 c
Pennisetum_purpureum	64.16 cd	65.27 a	15.60 c	60.21 a	6.30 c
Panicum_maximum	58.34 ef	52.82 de	21.10 a	58.16 a	7.29 b
Cynodon_dactylon	61.73 de	52.57 de	16.28 b	59.25 a	8.01 a
Digitaria_decumbens	69.53 b	60.49 b	15.83 b	57.89 a	5.86 cd
Melinis_minutiflora	71.34 a	51.10 de	11.90 d	56.64 a	6.18 c
Bracharia ruziziensis	72.61 a	53.02 de	13.63 c	59.93 a	6.41 c
Zea mays	73.71 a	68.21 a	13.75 c	51.83 abc	6.02 c
Stylosanthes guianensis	72.29 a	52.33 de	14.79 c	40.14 d	8.61 a
Stylosanthes gracilis	74.28 a	55.77 c	19.95 a	54.85 ab	7.21 b
Centrosema pubescens	60.82 de	58.27 b	18.44 ab	50.40 c	8.06 a
Calopogonium mucunoides	66.48 c	61.03 b	23.13 a	50.17 c	5.38 cd
Tephrosia bracteolata	58.34 ef	54.57 cd	20.07 a	43.97 d	6.62 bc
Manihot esculenta	66.55 c	58.13 b	17.16 b	52.85 abc	5.92 cd
Standard Error of Means	1.38	1.60	1.09	1.43	0.23

a,b,c,d,e; means with different superscripts differed significantly (P<0.05)

CONCLUSION AND APPLICATION

The study of rumen metabolites revealed distinct rumen fermentation trends for various forage types that are found in the dairy development areas of Oyo state. Data obtained has shed light on the suitability of these forages as ingredients for inclusion in diets and their impact on rumen health and performance.

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