Journal of Arid Agriculture

J. Arid Agric. 2024, Vol. 25 (3): 129 - 134

0189-7551

EFFECT OF AQUEOUS EXTRACT OF WATERMELON PULP ON THE MORPHOMETRIC CHARACTERISTICS OF RABBIT (*Oryctolagus cuniculus)* REPRODUCTIVE TRACT

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ABSTRACT: The effect of aqueous extract of watermelon pulp on the morphometric characteristics of 40 matured mixed breeds of rabbit about 1200-1400g (comprising of 20 bucks, 20 does) reproductive tract was investigated. Watermelon pulp extract was at zinclusion levels of 0, 5, 10, 15 and 20 g per 80-ml of water. The rabbits were randomly allocated to five treatments comprising of four replicates per treatment at two rabbits per replicate making eight rabbits per treatment in a completely randomized design. Feeds were given *ad-libitum* for twelve weeks and water was provided daily for 20 hours while for the remaining hours of the day (4 hours), they were deprived of water so that they can take of the treatment dosage. At the end of the experiment, 4 rabbits (2 bucks and 2 does) were randomly selected from each treatment. The animals were sacrificed and eviscerated for reproductive organ weight determination. Data obtained were subjected to the analysis of variance (ANOVA) following completely randomized. design. Duncan's Multiple Range Test, Duncan (1955) was used to determine the significant differences ($p<0.05$) among treatments means. The experimental results showed that the inclusion level of aqueous extract of watermelon pulp at 5 g per 80-ml of water produced the best performance in terms of reproductive organ weight and length for both the rabbit bucks and does. From the results obtained it is observed that inclusion of aqueous extract of watermelon pulp at 5 g per 80-ml water will lead to increased productivity in rabbit breeding programmes, however higher levels may result in decrease performance and should not be encouraged.

Keywords: Aqueous Extract, Watermelon Pulp, Morphometric Characteristics, Rabbit, Reproductive Tract

INTRODUCTION

In Nigeria, rabbit (*Oryctolagus cuniculus)* production has been observed to be one of the livestock enterprise with the greatest opportunity and potential for expansion. They are source of white meat which is low in fat and cholesterol. The rabbit provides valuable wool (fur), skins, manure, toys and novelties and can be used for patients (Olaide, 2022).

Inefficiency in reproduction is the major constraint to the efficient production of rabbits in the tropics (Gbadamosi and Egbunike, 1999). The libido, sperm production efficiency and sperm quality tend to remain constant all through an animals' reproductive life, although could be markedly changed by environment, stage of production, drugs, chemicals, health status as well as by nutrition (Togun and Egbunike, 2006). Lakabi *et al*. (2016) reported that the study of the sexual development in rabbit requires the knowledge of growth profiles and tissue maturation or parts of the reproductive system associated with the potential capacity for sperm production. The fundamental understanding of an animals' reproductive organ morphometry provides helpful information for the assessment of its potential fertility and breeding ability (Ogbuewu, 2008). The size of the testes serves as a valuable indication of the present and future sperm production and the breeding potential of male animals (Perry and Petterson, 2001). The Watermelon fruit (*Citrullus lanatus*) is popular in most parts of the world, well known for its attractive look and high water content. It often contains about 92% water and 6% sugar by weight, and it is a valuable source of vitamin C as with various fruits. According to Rhodes and Zhang (1999), watermelon serves greatly as a natural lycopene source, a carotenoid which is of major advantage due to its potential health benefits and antioxidant capacity. Presently, there are limited research work carried out on effect of aqueous extract of watermelon pulp on the reproductive tract morphometry on animals. This works is therefore aimed at examining the effect of aqueous extract of watermelon pulp on the morphometric characteristics of rabbit reproductive tract. The work is aimed at bringing about an alternative to the commercially available sources of vitamins, this will help to reduce

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Journal of Arid Agriculture. 2024, Vol. 25 (3): 129 - 134

the cost production and to eliminate harmful effects of synthetic chemicals in commercially available sources of vitamins and anti-stress.

MATERIALS AND METHODS

Experimental Site

The experiment was conducted at the Teaching and Research Farm and Animal Production Laboratory of the Department of Animal Production, Federal University of Technology, Gidan Kwano Campus, Minna. Minna is geographically located in the Southern Guinea Savanna Zone of North central Nigeria, between Latitude 9° 37' North and Longitude 6° 33' East. The mean monthly minimum and maximum temperatures of 22°C and 36.5°C respectively. The mean annual rainfall ranges from 1300mm and an annual relative humidity of 65% (Federal University of Technology Minna, Student handbook, 2018).

Experimental Materials and Sample Preparation

Animals

A total number of 40 mixed breeds of rabbits (weighing 1200 to 1400 g) at 4 months old of age was used for the experiment. The rabbits comprised of 20 bucks and 20 does. The experimental animal was sourced from Funtua Local Government Area of Katsina State, Nigeria. They were allowed 2 weeks' pre-experimental period to ensure that the animals are acclimatized with the new environment. Anti-stress vitalites was administered via clean drinking water to the animals on arrival. The rabbits were also dewormed using Piperazine (liquid) and were given doses of Ivomec medication against ecto-and endo-parasites.

Sample Preparation

The watermelon fruits were purchased locally from Minna central market, Niger state. The fruit was cut into two halves and the pulp was cut out of the rind and the seeds were removed. The pulp was further cut into the following 5 g, 10 g, 15 g, and 20 g respectively. Each of the quantity were blended separately using an electronic blender. Each of the blended sample was mixed with 80 ml of water and allocated to the various treatments.

Experimental Design, Treatment and Procedures

The Rabbits were kept under intensive management system for twelve weeks in completely randomized design. The animals were randomly allocated to five treatments comprising of four replicates per treatment at two rabbits per replicate making eight rabbits per treatment. Adequate care was taken when placing the animals into groups so as to help balance the groups such that there will be no significant differences existing between the animals on the basis of weight and age. Treatment 1 was tagged $AEWPOL_0$ (Aqueous Extract of Watermelon Pulp) Control with 0 g / 80-ml water aqueous extract of watermelon pulp inclusion level. Treatment 2, 3, 4 and 5 contained aqueous extract of watermelon pulp at 5, 10, 15 and 20 g / 80-ml water inclusion levels, respectively. They were tagged $AEWPOL_5$, $AEWPOL_{10,}$ $AEWPOL_{15}$, and $AEWPOL_{20}$ respectively, as shown in Table 2.

All necessary management requirements were strictly followed. Feed was given to the animals' *ad-libitum.* The Rabbits were provided water daily for 20 (10am- 6am) hours, while for the remaining hours of the day (6am-10am), the animals were deprived of water so that it can take the treatment dosage.

Data Collection

Proximate Composition Analysis of Watermelon Pulp

Fresh samples of the watermelon pulp were taken to the laboratory of the Department of Animal Production, Federal University of Technology Minna for analysis of its proximate composition.

Reproductive Tract Morphometric Measurement

At the end of the 12^{th} week of study, the weight of the animals was taken. Four (4) rabbits per treatment was taken for analysis comprising of two males and two females each. Immediately after slaughter, the testicular morphometric characteristics of the buck rabbit was measured. The testes were removed immediately. Two

samples each of the testis was taken from each treatment group. The female reproductive tract immediately after slaughter was also taken, trimmed of the adhering connective fats and tissues.

Table 1: Gross composition of the experimental diet

Ingredients	Concentrate supplement (%)
Maize	42.20
Maize Offal	26.00
Rice Offal	11.00
Soya bean	4.00
Fish meal	1.00
Groundnut cake	12.00
Limestone	1.00
Bone meal	2.00
Salt	0.20
Premix	0.30
Methionine	0.20
Lysine	0.10
Total	**100**
Calculated Analysis	
Crude Protein	16
Crude Fibre	9
Metabolizable Energy (kcal/kg)	2643.958

Table 2: Aqueous Extract of Watermelon pulp (AEWPOL) inclusion levels

Treatments	Inclusion level
$AEWPOL_0$ (Control)	0 g / 80-ml Water
$AEWPOL_5$	5 g / 80-ml Water
$AEWPOL_{10}$	10 g / 80-ml Water
$AEWPOL_{15}$	15 g / 80-ml Water
$AEWPOL_{20}$	20 g / 80-ml Water

Male Reproductive Tract Morphometry

Scrotal Morphometry of Buck Rabbit

The scrotal circumference was measured with the use of a tape rule, passed round the broad parts of the scrotum.

Testicular and Epididymal Morphometry

Each of the individual testes weights was measured after it had been trimmed-off of the attached epididymis. Archimedes Principle of water displacement was used in the estimation of the volume of each testis. The weight of the epididymis was recorded after removal from each testis. The Testes density was calculated using the formula:

$$\text{Testes Density} = \frac{\text{Weight of testes (g)}}{\text{Volume of testes (m/l3)}}$$

Female Rabbit Reproductive Tract Morphometry

Immediately after slaughter, each animal was dissected. The entire reproductive tract was removed, then trimmed of the adhering connective tissues and free fats. The entire tract weight was measured, then the ovaries were removed with care from the ovarian bursa at the end of its infundibulum. The oviducts were removed just after the removal of the infundibulum. The two-uterine horns were then taken from the end of the two cervixes to the rosette projection of the utero-tubal junction. Morphometric measurement was carried out with highly sensitive digital balance whereas linear measurement was taken with well calibrated measuring tape.

Journal of Arid Agriculture. 2024, Vol. 25 (3): 129 - 134

Statistical Analysis

Data obtained were subjected to the analysis of variance (ANOVA) following completely randomized. design. Duncan's Multiple Range Test, Duncan (1955) was used to determine the significant differences ($p<0.05$) among treatments means. The whole data collected were statistically analyzed with the use of SAS statistical package (2000).

RESULTS AND DISCUSSION

Testicular, Epididymal and Scrotal Morphometry

The morphometric characteristics of bucks drenched orally with varying levels of aqueous extract of watermelon pulp are contained in Table 3. The result shows that the weight of testes, epididymis and scrotal circumference was significantly ($p<0.05$) influenced with 5 g level of inclusion of WMP having the best result.

The reduction of some of the testicular parameters observed in this present study with the introduction of watermelon pulp extract at levels above 5 g per 80-ml water is a pointer that watermelon pulp extract does not promote testicular growth at levels of inclusion above 5 g per 80-ml of water. Testicular size serves as valuable predictor of the present and future spermatozoa production potential of an animal (Morris *et al*., 1979; Perry and Petterson, 2001; Gupta and Mohanty, 2003; Togun and Egbunike, 2006). Testes that are larger (without any abnormality) have been reported to produce more spermatozoa than those that are smaller (Oyeyemi *et al*., 2002; Galmessa *et al*., 2003; Britto *et al.,* 2004; Oyeyemi and Okediran, 2007).

The increase in epididymis weight at 5 g per 80-ml water inclusion level is a pointer that the bucks' ability for the storage of spermatozoa may be positively influenced by the increase. The smaller epididymis weights of the bucks on other treatments including the control in this study suggest that fewer spermatozoa is being stored on it. Scrotal circumference had been reported to be positively correlated with sperm volume, mass motility, sperm concentration, and testosterone and negatively correlated with dead sperm cells, total spermatozoa and primary abnormality in male goat (Daramola *et al.,* 2007).

Table 3: Testicular morphometric values of buck rabbits drenched with varying levels of aqueous extract of watermelon pulp.

	Inclusion levels of aqueous extract of watermelon pulp WMP g / 80-ml Water						
Parameters	**T1 (0 g)**	**T2 (5 g)**	**T3 (10 g)**	**T4 (15 g)**	**T5 (20)**	**SEM**	**Remark**
Testes weight (g) - Right	1.74^{bc}	1.81^{a}	1.78^{ab}	1.70^{c}	1.71^{c}	0.014	*
Testes weight (g) - Left	1.79^{b}	1.89^{a}	1.87^{a}	1.73^{c}	1.76^{bc}	0.020	*
Paired testes weight (g)	3.53^{b}	3.69^{a}	3.65^{a}	3.43^{c}	3.49^{bc}	0.034	*
Epididymis weight (g) - Right	0.85^{b}	0.92^{a}	0.86^{b}	0.80^{d}	0.82^{c}	0.014	*
Epididymis weight (g) - Left	0.92^{c}	0.98^{b}	1.03^{a}	0.83^{d}	0.88^{c}	0.024	*
Paired weight of epididymis (g)	1.77^{b}	1.90^{a}	1.89^{a}	1.63^{d}	1.70^{c}	0.036	*
Testis volume (ml) - Right	1.80^{bc}	1.91^{a}	1.81^{b}	1.72^{c}	1.77^{bc}	0.022	*
Testis volume (ml) - Left	1.86^{bc}	1.97^{a}	1.93^{ab}	1.76^{d}	1.80^{cd}	0.027	*
Paired testes volume (ml)	3.66^{bc}	3.87^{a}	3.74^{ab}	3.48^{c}	3.57^{bc}	0.048	*
Epidydimal volume - Right	1.06^{b}	1.14^{a}	1.11^{ab}	0.96^{c}	1.00^{c}	0.023	*
Epidydimal volume - Left	1.10^{b}	1.17^{a}	1.20^{a}	0.99^{d}	1.04^{c}	0.026	*
Paired epidydimal volume (ml)	2.16^{b}	2.30^{a}	2.31^{a}	1.95^{c}	2.04^{c}	0.048	*
Mean testes density (g/ml^3)	0.97	0.96	0.98	0.99	0.98	0.004	NS
Mean Scrotal circumference (cm)	0.53^{b}	0.61^{a}	0.56^{ab}	0.47^{c}	0.52^{bc}	0.017	*

$^{a\,b\,c\,d}$ Means within a row having different superscripts differs significantly ($p<0.05$);
WMP – Watermelon Pulp; NS – no significance; * - significance present; SEM - Standard Error of Mean

Female Reproductive Tract Morphometry

The data on morphometric characteristics of those administered varying levels of aqueous extract of watermelon pulp are shown in Table 4. The weights of the tracts were between 1.98 g and 2.34 g. The weight of the entire tract appeared to decline beyond 5g WMP inclusion level. The weight of the ovary recorded in this study is in line

with 0.075g as documented by Osuagwu (2004), although lower than 0.23 g reported by Bitto *et al*. (2007). The 7.80 - 8.50 cm recorded for length of vagina was lower than 10cm reported by Frandson (1981). The weight of vagina, oviduct, and length of cervix, length of uterine horns was comparable to that reported in control group of weaner rabbits fed varying levels of paw- paw leaf meal (Bitto *et al*., 2007).

The results of this study indicate that levels of 5 g per 80-ml water inclusion of watermelon pulp extract may enhance the development of the female reproductive tracts of rabbit does while the smaller values of the morphometric parameters measured on other treatments including the control, suggest a decline of the development of the female reproductive tracts. It is difficult to ascertain if such disparity is as a result of differences among individual animals or due to vitamin concentration which may bring about such abnormalities (as the vitamin concentrations of the pulp was not evaluated). It is however hoped that an analysis of the vitamin concentration in watermelon pulp will help in providing a better understanding of the safe levels of inclusion in the drinking water of male and female rabbits.

Table 4: The effect of graded levels of aqueous extract of watermelon pulp on female rabbit reproductive tract morphometry

	Inclusion levels of aqueous extract of watermelon pulp WMP g / 80-ml Water						
Parameters	T1 (0 g)	T2 (5 g)	T3 (10 g)	T4 (15 g)	T5 (20)	SEM	Remark
Weight of reproductive tract (g)	2.12^{bc}	2.34^{a}	2.17^{ab}	2.25^{ab}	1.98^{c}	0.043	*
Weight of ovary (g) - left	0.05^{b}	0.09^{a}	0.06^{b}	0.08^{ab}	0.05^{b}	0.006	*
Weight of ovary (g) - right	0.05^{bc}	0.08^{a}	0.05^{bc}	0.08^{ab}	0.04^{c}	0.006	*
Weight of paired ovary (g)	0.10^{b}	0.17^{a}	0.11^{b}	0.15^{a}	0.09^{b}	0.011	*
Weight of uterine horn (g) - left	0.04	0.05	0.04	0.04	0.04	0.003	NS
Weight of uterine horn (g) - right	0.04	0.04	0.04	0.05	0.04	0.003	NS
Weight of paired uterine horn (g)	0.08	0.09	0.08	0.09	0.07	0.003	NS
Weight of oviduct (g) - left	0.87^{a}	0.89^{a}	0.88^{a}	0.88^{a}	0.83^{b}	0.008	*
Weight of oviduct (g) - right	0.48^{a}	0.52^{a}	0.49^{a}	0.50^{a}	0.43^{b}	0.011	*
Weight of paired oviduct (g)	1.35^{a}	1.41^{a}	1.37^{a}	1.38^{a}	1.25^{b}	0.019	*
Weight of cervix (g)	0.06^{bc}	0.08^{a}	0.06^{bc}	0.07^{ab}	0.05^{c}	0.004	*
Weight of vagina (g)	0.55^{ab}	0.60^{a}	0.56^{ab}	0.57^{a}	0.52^{b}	0.009	*
Length of cervix (cm)	0.70^{b}	0.80^{a}	0.70^{b}	0.80^{a}	0.60^{c}	0.025	*
Length of vagina (cm)	8.20^{c}	8.40^{b}	8.20^{c}	8.50^{a}	7.80^{d}	0.080	*
Length of uterine horn (cm)	7.95^{ab}	8.20^{ab}	7.90^{ab}	8.50^{a}	7.65^{b}	0.119	*

$^{a\,b\,c\,d}$ Means within a row having different superscripts differs significantly ($p<0.05$);
WMP – Watermelon Pulp; NS – no significance; * - significance present; SEM - Standard Error of Mean

CONCLUSION

The experimental result has shown that watermelon pulp aqueous extract can be administered to a growing rabbit up to 5 g per 80-ml of water, since it supports the development of the rabbit reproductive organ without any harmful effect. Watermelon fruits are often less expensive and easily obtainable, also since the quantity required for effective result is minimal (5 grams), therefore its utilization would go a long way in improving Nigerian protein shortage.

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