Nigerian Journal of Parasitology
ISSN 1117 4145 Volume 43[2] September, 2022

Effect of Coccidial infection on growth of Broilers raised on different Litter Materials in a deep Litter System

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Abstract
The present study was carried out on broiler chickens to evaluate the effects of coccidial infection on the growth rate of broilers raised on different litter materials. Sixty-day-old broiler chicks, each weighing an average of 33.3 g, were randomly divided into four treatments of deep litter materials: sawdust, maize cob, groundnut husk and fallen leaves. Average weight was recorded, and faecal samples were collected weekly for eight weeks and analysed using the floatation technique. About 34% of the weekly faecal samples collected were infected with Coccidia. There was no significant difference in the intensity (Geometric Mean Intensity, GMI) of coccidial Oocyst in the different litter materials ($p>0.05$; Fcal=0.62;d.f=3/28). The growth parameters tested in the experiment were body weight and body weight gain. Broilers on sawdust and maize cob gained more body weight with over 25% growth rate. Significant differences in growth were observed between the different litters; sawdust and maize cub; sawdust and groundnut husk; and sawdust and fallen leaves ($p<0.05$). The result of the variance analysis showed that coccidial infection does not affect the growth rate of the broilers at ($p>0.05$), and this was irrespective of the litter they were raised on. It can therefore be stated that maize cob, groundnut husk and fallen leaves could be used as an alternate litter to the commonly used sawdust which may reduce the high demand for sawdust and subsequently fall in price.

Keywords: Broiler, Coccidia, Litter, Growth rate.

Introduction

Avian Coccidiosis is a parasitic enteric disease in poultry with the potential to inflict considerable economic loss on farm profitability [1, 2]. The disease is widespread and spreads from one animal to another [1] by contact with infected faeces or ingestion of infected tissue. Diarrhoea, which may become bloody in severe cases, is the primary symptom, which leads to dehydration, and sometimes mortality [3]. Infection with coccidiosis may also cause susceptibility to other diseases such as necrotic enteritis [3]; and can damage the epithelial cells of the intestinal tissue, resulting in inflammation and haemorrhage [4]. Most animals infected with Coccidia are asymptomatic, but young or immunocompromised animals may suffer severe symptoms and even death. Hence, Chickens are

The foregoing study on pages 364-368 was submitted in May 2022.
https://dx.doi.org/10.4314/njpar.v43i2.19

susceptible to at least 11 species of Coccidia of which only seven are valid species of chicken coccidia: *Eimeria acervulina, E. brunetti, E. maxima, E. mitis, E. necatrix, E. praecox*, and *E. tenella* [5] each species developing in a particular location within the chick digestive tract. The most common species are *Eimeria tenella*, which causes the caecal or bloody type of coccidiosis, *E. necatrix*, which causes bloody intestinal coccidiosis, and *E. acervulina* and *E. maxima*, which causes chronic intestinal coccidiosis. These seven species are specific to chickens and cannot infect other types of fowls or birds or mammals [6].

Coccidiosis presents itself in many strains and reproduces rapidly in poultry houses, making eradication difficult. They are distributed worldwide in poultry, game birds reared in captivity, and wild birds [7]. Coccidiosis is encountered wherever chickens are reared, and this disease has generated an immense burden on the poultry industry. The poultry industry raises approximately 40 billion chickens annually and coccidiosis is the most common and frequently reported disease of poultry worldwide [8, 9].

Litter materials are an integral part of keeping broilers healthy and they provide a soft surface to absorb the broiler's excess moisture from the drinkers and faecal droppings; thus, it insulates chickens from the cooling effects of the ground and provides a protective cushion between the birds and the floor [10]. An effective bedding material must be absorbent, lightweight, inexpensive, and non-toxic and the ideal material will have high moisture absorption and release qualities to minimize litter caking Pagthinathan, [11]. However, in many countries of the world, sawdust is the most common litter material used in commercial broiler production [11] but because of high demand and low supplies, farmers were encouraged to search for alternative litter materials which will be readily available. This study aims to identify new litter beddings; and know the relationship between coccidial Oocyst infection and its effect on the growth rate of the broilers between the different litter materials. These relationships will, to some extent, guide farmers on the choices of litter beddings.

Materials and Methods

Designing the Experiment

The experiment was conducted in October and November, which is the transition period between summer (wet season) and winter (dry season) in Nigeria. A total of 60-day-old commercial (super live) broilers derived from the same flock of breeders, and having an average weight of 33.3 g each, were randomly and equally distributed into four compartments. Each compartment houses a different litter material, which are the commonly used sawdust (SD), maize cob (MC), groundnut husk (GH) and fallen leaves (FL). The maize cob was chopped by a chopping machine and the leaves were allowed to dry at room temperature. The litter materials were used at a depth of 5cm. Adequate spacing was made available and other managerial conditions were similar throughout the study period. The broiler house was lighted for 23 hours a day and the temperature was not below 30^{o}C. The birds were fed on broiler starter and finisher for the first four weeks and last four weeks, respectively.

Data Collection

Starting at one week after placement, at least 5g of faeces were picked from the litters and collected into a specimen bottle on a weekly routine (for 8 weeks), from the four compartments. Litter Samples were taken early in the morning between 6:00 – 8:00 am along a roughly W-shaped path, starting and finishing in the corners of one of the long sides of the house. They were immediately taken to the laboratory within a period of 30mins to 1hr for laboratory investigation.

Parasitological Examination

The floatation technique was used with approximately 3g of faeces measured using a digital weighing scale in a container with a 50ml floatation medium. It was stirred thoroughly with a fork. The resulting faecal suspension was poured through a double layer of cheesecloth into another container. The faecal suspension was then poured into a test tube and filled, leaving a convex meniscus at the top of the tube. A cover slip was carefully placed on top of the test tube and allowed to stand for 20 minutes after which the coverslip was carefully lifted and immediately placed on the microscope slide and viewed under 10x and 40x objectives, respectively.

Data Analysis

The data obtained were analysed statistically for a significant difference in disease prevalence and intensity of coccidial infections among chickens raised on different litter. Test statistics used include analysis of correlated samples to check for significant differences in weight between different

litters. Variance analysis was adopted to confirm whether coccidial infection affected the growth rate of the broilers within 8 weeks of the experiment.

Results and Discussion

Prevalence and Intensity of Coccidial Oocyst of Broilers Raised on Different Litter Materials

The weekly prevalence (%) and intensity (Oocyst per gram of faeces, OPGF) of coccidial Oocyst detected in broiler faeces reared on sawdust, maize cob, groundnut husk, and fallen leaves in a deep litter rearing system has been presented on Table 1. The geometric mean intensity (GMI) is used to measure the intensity of the Oocyst shed per one gram of faeces. From the table, the GMI of sawdust and maize cob compartments increased steadily and then suddenly drops in week 5 with 18.59 and 8.89 OPGF respectively; and also, week 6 of maize cob with 8.89 OPGF. There was a sudden increase afterwards for the remaining weeks. The highest GMI was, however, observed in the sawdust and maize cob compartments with 42.42 and 43.84 OPGF, respectively. Though, chicks in the groundnut husk and fallen leaves compartments generally recorded a lower GMI as compared to the other groups. This indicates that both the litter materials of groundnut husk and fallen leaves harboured less Oocyst as compared to sawdust and maize cob. There was, however, no significant difference in the intensity of coccidial Oocyst (GMI) within the different litter materials (p>0.05; Fcal=0.62;d.f=3/28).

Growth Performance of Poultry Raised on Different Deep Litter Materials

The average body weight and body weight gain of broiler chickens reared on sawdust, maize cob, groundnut husk and fallen leaves were 550.09±47.50, 481.90±15.00, 481.67±42.90, 408.13±11.24g for body weight and 195.84±28.44, 195.93±30.92, 183.34±31.88, 183.34±129.36 for weight gain, respectively (see Table 2). However, chicks in the sawdust and maize cob compartments gained more body weight with a 28.00% growth rate and those in the groundnut husk and fallen leaves compartments gained 26.20% each. Significant differences in growth were, however, observed between the commonly used sawdust and other litter materials; sawdust and maize cob; sawdust and groundnut husk; and sawdust and fallen leaves with (p<0.05; Fcal=3.00; df=8), (p<0.05; Fcal=3.00;

Table 1: Weekly Prevalence and Intensity of Coccidian Oocyst of Broilers Raised on Different Litter Materials for 8 weeks.

Litter		Sawdust		Maize cob		Groundnut husk		Fallen leaves	
Week	No. examined per litter compartment	No. +ve (%)	GMI (OPGF)	No. +ve (%)	GMI (OPGF)	No. +ve (%)	GMI (OPGF)	No. +ve (%)	GMI (OPGF)
1	10	1 (10.00)	5.99	3 (30.00)	2.71	1 (10.00)	2.99	3 (30.00)	3.11
2	10	1 (10.00)	10.00	3 (30.00)	14.56	3 (30.00)	15.87	1 (10.00)	14.99
3	10	3 (30.00)	10.00	4 (40.00)	29.23	3 (30.00)	11.44	3 (30.00)	7.93
4	10	5 (50.00)	33.93	5 (50.00)	43.84	3 (30.00)	15.87	2 (20.00)	10.00
5	10	4 (40.00)	18.59	4 (40.00)	19.68	6 (60.00)	23.65	3 (30.00)	23.36
6	10	4 (40.00)	42.42	4 (40.00)	8.89	1 (10.00)	29.99	4 (40.00)	27.38
7	10	2 (20.00)	41.83	4 (40.00)	32.78	4 (40.00)	27.54	3 (30.00)	34.34
8	10	6 (60.00)	41.27	6 (60.00)	21.54	6 (60.00)	24.55	4 (40.00)	19.98

Keys

GMI: Geometric Mean Intensity (OPGF)

No.+ve: Number of positive samples

Table 2: Body Weight and Weight Gain of Poultry Raised on Different Litter Materials for 8 Weeks

Litters	Average body weight, g Mean±S.E	Body weight gain, g Mean±S.E
Sawdust	550.09±47.50	195.84±28.44
Maize cob	481.90±15.00	195.93±30.92
Groundnut husk	481.67±42.90	183.34±31.88
Fallen leaves	408.13±11.24	183.34±129.36

Table 3:Relationship between Mean Weight Gain of Poultry and Intensity of Infection with Coccian Oocyst on Broilers Raised on Different Litter Materials

Week	Sawdust			Maize cob			Groundnut husk			Fallen leaves		
	Mean body weight (g)	Mean weight gain (g)	GMI	Mean body weight (g)	Mean weight gain (g)	GMI	Mean body weight (g)	Mean weight gain (g)	GMI	Mean body weight (g)	Mean weight gain (g)	GMI
0	33.30	33.30	0.00	33.30	33.30	0.00	33.30	33.00	0.00	33.30	33.30	0.00
1	220.00	186.70	5.99	200.00	166.70	2.71	200.00	166.70	2.99	200.00	166.70	3.11
2	420.50	200.50	10.00	408.30	208.30	14.56	450.00	250.00	15.87	425.00	225.00	14.99
3	891.60	471.10	10.00	866.60	458.30	29.23	950.00	500.00	11.44	900.00	475.00	7.93
4	1460.00	568.40	33.93	1260.00	393.40	43.84	1360.00	410.00	15.87	1460.00	560.00	10.00
5	1600.00	140.00	18.59	1330.00	70.00	19.68	1430.00	70.00	23.65	1530.00	70.00	23.36
6	1730.00	130.00	42.42	1830.00	500.00	8.89	1930.00	500.00	29.99	1800.00	270.00	27.38
7	2060.00	330.00	41.83	2130.00	300.00	32.78	2030.00	100.00	27.54	1960.00	160.00	34.34
8	2200.00	140.00	41.27	2260.00	100.00	21.54	2160.00	130.00	24.55	2000.00	40.00	19.98
Growth rate (%)	33.35			35.41			34.64			33.35		

df=8), ($p<0.05$; Fcal=3.00; df=8). However, this was not consistent with the findings of Pagthinathan *et al*. [11] 2019, which observed no significant difference in growth performance between the litters used. Similarly, the result of a previous study by [12] also showed a statistically non-significant difference in life weight on chicks reared on different litter materials.

Relationship between Mean Weight Gain of Poultry and Intensity of Infection with Coccidial Oocyst on Broilers Raised on Different Litter Materials

There was a consistent increase in mean weight gain for all the poultry in the different litter compartments from weeks 1 to 4. However, a sharp decline in poultry weight gained was observed in week 5 for all the compartments. At the same time, there was a drastic drop of the GMI in week 5 of sawdust, and weeks 5 and 6 of maize cob; though, a sharp increase of the GMI was noticed in groundnut husk and fallen leaves in week 5.

The highest mean weight gain recorded for each treatment was 568.40g and 560.00g in week 4 of sawdust and fallen leaves compartments, respectively; 500.00g in week 6 of maize cob and weeks 3 and 6 of groundnut husk. On the other hand, the highest GMI recorded for the different treatments was 42.42 OPGF in week 6 of sawdust, 43.84 OPGF in week 4 of a maize cob, and 29.99 OPGF in week 6 of groundnut husk and 34.34 OPGF in week 7 of fallen leaves.

The result of the variance analysis shows that for sawdust, maize cob, groundnut husk and fallen leaves compartments, the coccidial infection does not affect the growth rate of the broilers at ($p> 0.05$). This has been reflected in a previous study by [13] which observed Litter type had no significant influence on body weight.

Mortality

The mortality rate of the chicks was low with only six chicks (10.00%) lost for the entire 8 weeks of the study. The death of poultry first occurred in week 2 of the maize cob compartment with single mortality. Afterwards, there was no mortality recorded in weeks 3, 4, 5 and 6 for all the compartments. However, in week 7, two (2) mortality occurred in fallen leaves only, then in week 8, three chicks were lost from groundnut husk (2 chicks) and sawdust (1 chick). Results from the post-mortem procedure revealed the mortality was not as a result of Eimeria infection.

Conclusion

From the results of the analysis, it was concluded that infection with Coccidia (Eimeria) does not significantly affect the rate at which the broilers grow, and this is also irrespective of the litter they were reared on (sawdust, maize cob groundnut husk or fallen leaves). In other words, data from this study has revealed no significant difference observed between the spread of coccidial infection and the type of litter used. It can therefore be stated that maize cob, groundnut husk and fallen leaves could be used as an alternate litter to the commonly used sawdust which may reduce its high demand and subsequently fall in price.

Acknowledgements

This work acknowledged the Late Dr Ejima I. A. A., for his scholarly contribution to the work. Special appreciation to Mrs Amina D. Usman, Mr Samuel Kolo and Dr Abbas all of Niger State Veterinary

Hospital, for their immense contribution throughout this work. Also, to Mr Zakari Jibrin for the moral support.

Authors' Contributions
UYH Conceptualization, Data curation; EAA Formal analysis and Supervision; IH Investigation and Methodology; AAY Review and editing

Declaration of Interest
The authors agree that there is no conflict of interest

Funding Source
None

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Citation
Usman-Yamman, H., Ejima, I. A. A., Idris, H. and Adamu, A. Y. (2022). Effect of Coccidial infection on growth of Broilers raised on different Litter Materials in a deep Litter System. *Nigerian Journal of Parasitology* 43(2) 364-368

https://dx.doi.org/10.4314/njpar.v43i2.19

Nigerian Journal of Parasitology
ISSN 1117 4145 Volume 43[2] September, 2022