Evaluation of different litter materials on haematological and serum biochemical indices of intensively managed finisher broiler chickens

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Abstract

Attempts made to improve broiler production had been focused more on feed with little or no consideration on the impact of litter quality which is a major concern in chicken production not only because it affects the flock health and productivity, but also because it may act as potential reservoir and transmission vehicle for pathogens and potential pathogens. Since blood is considered as an important material for the evaluation of health status in animals, there is need therefore, to investigate the impact of different litter materials on the hematological and serum biochemistry of broiler finisher chicken. A 56-day feeding trial was conducted to evaluate the effect of different litter materials on the haematological and serum biochemical indices of intensively managed finisher broilers. Four different litter materials were used for the experiment viz wood, shaving, Groundnut hulls; coconut husks and rice hulls. Wood shavings was used as the control owing to the fact that it is the most commonly used litter in this zone. The coconut husks were manually shred to extract the fibres which was used while the other materials were used as sourced. A total of 120 broiler birds were used for the experiment, they were divided into four treatments (T₁= Wood shavings, T₂= Groundnut hulls, T₃=Coconut husks, and T₄=Rice hulls) of 30 birds each and sub divided into 10 birds per replicate. Each replicate was housed in a pen fitted with brooding facilities. Feed and water were given ad libitum for eight weeks. At the end of the experiment blood was collected from the birds, three per treatment given a total of 12 birds. They were analyzed for haematological and serum biochemical indices. Haemoglobin values compared favourably ($P>0.05$) with that of the control. PCV values of T₂ and T₃ compared favourably well with that of control but significant differences existed ($P<0.05$) between the PCV value of T₄ and the other treatments. The lymphocytes and neutrophils were not affected by the bedding materials showing that the litter conditions did not adversely affect the health and welfare of the birds. Serum protein, serum albumin and serum globulin were not affected by treatments ($P>0.05$) resulting in better protein efficiency ratio recorded in all the treatments. Serum electrolytes calcium and phosphorus levels recorded in this study shows no adverse effect on the integrity of the liver in boosting cation/anion exchange. The haematological and serum biochemical indices recorded in this study showed no notable health challenges on the birds.

Keywords: Litter materials, haematology, serum biochemistry, finisher broilers

Introduction

Quality of chicks, feed and water are all of great concern to broiler producers, but quality of litter in broiler houses is rarely given sufficient emphasis (Casey *et al.*, 2017). They further stated that in the broiler house, litter serves to absorb moisture, dilute faecal material, and provide

insulation and cushion between the birds and the floor. Poultry litter is an environmental ecosystem with a range of characteristics (Lu *et al.*, 2003; Fries *et al.*, 2005; Lovanh *et al.*, 2007). Although, litter refers to the mixture of bedding material (wood shavings, rice hulls, coconut husks, groundnut hulls, etc), faecal droppings and

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moisture, the term is used interchangeably with bedding materials (Bjedov *et al.*, 2013). These litter materials are locally available in Nigeria and are usually handled as waste. To obtain maximum broiler production potential, management of the poultry house is essential and one of the managerial practices is the proper maintenance of poultry litter (Abdul Hafeez *et al.*, 2009). According to Casey *et al.* (2017), broilers do not perform to their genetic potential in a poor environment. Litter conditions may influence poultry health and welfare (Lister, 2009), which in turn affects profits of growers and integrators. Economic losses associated with poor litter in poultry include foot and leg problems, respiratory infections, poor weight gain and feed conversion (Charles, 2005; Musa *et al.*, 2012). Dry litter helps control ammonia levels, provides a healthy flock environment, and reduces footpad burns and breast blisters. Therefore, there is need to make use of litter materials that are good moisture absorbent, less or no ability to become mouldy and have greater tendency to dry. The litter quality is a major concern in chicken production not only because it affects the flock health and productivity (Bilgili *et al.*, 2006; Bjedov *et al.*, 2013; Garces *et al.*, 2013), but it may act as potential reservoir and transmission vehicle for pathogens and potential pathogens (Gilaneh *et al.*, 2016).

Also, litter type can significantly affect the efficiency of birds' immune system and its growth (Gilaneh *et al.*, 2016). Blood is considered as an important material for the evaluation of health status in animals (Ozkan *et al.*, 2011). Blood testing is commonly used to help diagnose illness in animals (Vetstreet, 2011). It acts as a pathological reflector of the status of exposed animals to toxicant and other conditions (Olafedehen *et al.*, 2010).

Haematology refers to the study of the

members and morphology of the cellular elements of the blood-the red cells (erythrocytes), white cells (leucocytes) and the platelets (thrombocytes) and the use of the results in the diagnosis and monitoring of disease (Merck Manual, 2012). Haematological studies are of ecological and physiological interest in helping to understand the relationship of blood characteristics to the environment (Ovuru and Ekweozor, 2004). It is also useful in the diagnosis of many diseases as well as investigation of the extent of damage to the blood (Togun *et al.*, 2007). Measurement of haematological parameters provides valuable information in this regard and routinely used in human's and animal's medicines, but unfortunately due to lack of information, blood profile has not been widely used in avian medicine (Talebi *et al.*, 2005). The comparison of haematological indices expands the diagnostic capabilities, allowing for a comprehensive blood monitoring (Gryzinska *et al.*, 2013). Serum is the yellow watery part of the blood that is left after blood has been removed (Burtis *et al.*, 2006). It is extracted from blood samples by centrifuging the sample to separate cellular components and coagulation factors of blood from the liquid part (Hannu and Hanna, 2014). Serum biochemistry refers to the chemical analysis of blood serum. There are many substances in serum, including proteins, enzymes, lipids, hormones, etc. testing for these various substances provides information about organs and tissues in the body as well as the metabolic state of the animal. If a test result is abnormal, it may indicate the presence of disease (Kristiina and Margo, 2015). Haematological and serum analyses are essential to monitor the health status of poultry in general and broilers in particular, although rarely offer sufficient information outline on etiologic diagnosis (Trinca, 2013).

Materials and methods

Experimental location and duration

The research was carried out at the Poultry Unit of the Teaching and Research Farm of Federal University of Technology Owerri Imo State while the laboratory analysis on the blood samples were performed at Links medical laboratories in Owerri, Imo state. Owerri is the capital of Imo state located in the south-eastern part of Nigeria. It lies between latitude 4041 and 6031 and longitude 60151 with an average rainfall of 2500mm, temperature between 26.5°C – 27.5°C and during the wet season, it has a mean annual relative humidity of 70-80% (Adeyemi, 2011). The experiment lasted for the duration of eight weeks.

Collection of experimental material

The different litter materials that were used were locally sourced. While the groundnut hulls were gotten from Bauchi state (also

available in Owerri but its quantity is affected by season). The coconut husks were first manually shred to extract the fibres which were used as litter while the other materials were used as gotten. The wood shavings served as the experiment control material.

Experimental diet

Four experimental diets were formulated such that all the treatments contain the same ingredient levels; its only source of variation is the litter materials. The diets were balanced for crude protein and caloric content as per the requirement of this class of birds in the tropics (Sansbury, 1980).

Experimental birds and design

A total of 120, one day-old broiler chicks were used for the experiment. The birds were divided into four treatments (T1= wood shavings, T2= groundnut hull, T3= coconut husks and T4= rice hulls) and they

Table 1: Ingredient composition of the broiler finisher diet

Ingredients	T1 (Wood shavings) (control)	T2 (Groundnut hulls)	T3 (Coconut husks)	T4 (Rice hulls)
Maize	60.00	60.00	60.00	60.00
Soybean meal	20.00	20.00	20.00	20.00
Wheat offal	8.00	8.00	8.00	8.00
Palm kernel cake	3.50	3.50	3.50	3.50
Fish meal	2.50	2.50	2.50	2.50
Blood meal	2.00	2.00	2.00	2.00
Bone meal	3.00	3.00	3.00	3.00
Common salt	0.25	0.25	0.25	0.25
Vitamin/premix	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
TOTAL	100.00	100.00	100.00	100.00
Chemical Composition (% of DM)				
Moisture content		10.09		
Mineral matter/ash content		6.85		
Crude fat/ ether extract		15.90		
Crude protein		20.00		
Crude fibre		4.00		
Methabolizable energy (kcal/g)		2.38		

* To provide the following per kg: vit. A, 1500iu; vit. D₂ 1600iu; Riboflavin, 90mg; Biotin, 0.25mg; pantothenic acid, 11.0mg; vit. k, 3.0 mg; vit. B, 22.5 mg; vit. B₁, 60.3mg; vit B₁₂, 8.0mg; Nicotinic acid, 8.0mg; Fe, 5.0mg; Zn, 4.5mg; Mn, 10.0mg; Co, 02mg; Se, 0.01mg.

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were all given a common environment except for the types of litter. Each treatment was subdivided into three replicates of 10 birds each in a completely randomized design. The birds were all fed *ad-libitum* two feeding phase (starter ration for the first four weeks and finisher ration for the last four weeks) as shown in Table 1. The birds were also given fresh water *ad-libitum*. The litters were also periodically turned when the top looks saturated with droppings to discourage caking. Water was strictly prevented from dropping on the litters while taking care of the birds and this ensured a quality litter material that is dry.

Blood collection and analysis

At the end of the experiment, one bird was randomly selected from each replicate to give 3 birds per treatment with total of 12 birds selected. The blood was collected from the jugular vein and blood sample of about 2.5ml in a 5ml sterilized syringe was collected per bird for haematological analysis and another 4.5ml of blood per bird for serum biochemical analysis. The samples for haematology was transferred into a universal bottle containing ethylene diamine tetra acetic acid (EDTA) and mixed thoroughly to prevent the blood from clotting while the blood samples for serum biochemical analysis was transferred into universal bottle without EDTA. Haemoglobin Concentration (Hb) was determined using Sahl method and the value recorded in g/100mls (WHO, 1980) RBC and WBC using the improved Neubauer haemocytometer as described by Dacie and Lewis (1991). PCV was determined by the microhaematocrit method, while mean Corpuscular volume (MCV), mean Corpuscular haemoglobin MCH and mean Corpuscular haemoglobin MCHL were calculated using the appropriate formulae. The second set of bottles without EDTA was centrifuged in a macro centrifuge to obtain Serum for biochemical analysis. Total protein was

determined, using the burette method as described by Doumas (1975); urea by dimethylmonoxide method as described by Varley *et al.* (1980). Serum potassium (K) and Sodium (Na⁺) were determined by the Calorimetric method, while serum cholesterol was by a modification of Libermann. Burchard test.

Data collection and analysis

Data obtained on haematology and serum biochemistry were subjected to statistical analysis using completely randomized design (CRD) and treatments were differentiated by one-way analysis of variance (ANOVA) with statistical package (IBM, SPSS version 20). Means were separated by Duncan's multiple range tests (Duncan, 1955).

Results and discussion

The results on performance of broiler finisher managed intensively on different litter materials is shown on Table 2, there was no significant difference ($P>0.05$) in the birds' performance parameter represented above between the treatments. Though the performance of the birds in relation to their total feed consumed, total body weight gain and feed conversion ratio is not part of the aim of this study, they were evaluated to establish the claim by Sigroha *et al.* (2017), that there were no significant difference ($P<0.05$) in the broilers mean cumulative weight gain, mean cumulative feed consumption and mean cumulative feed FCR at the finisher level.

Haematological indices

The Haematological indices of finisher broilers raised on different litter materials are presented in Table 3. The Hb values compared favourably ($P>0.05$) with that of control. PCV values of T₄ compared favourably well with the control. Significant differences existed ($P<0.05$) between the PCV value of T₄ and the other treatments, with T₄ recording the highest value of (32.43%). According to Edozien

and Switzer, (1977) Hb and PCV are very sensitive to levels of protein intake as the value increases with increase in dietary protein concentration suggesting that the birds received normal diets throughout the experiment. There were also no significant ($P>0.05$) differences among the treatments in RBC showing no form of RBC damage

in the birds Jain (1986) TWBC of all the treatment groups compared favourably with that of the control. The lymphocytes and Neutrophils were not affected by the bedding materials. Showing that the litter conditions did not adversely affect the health and welfare of the birds (Lister, 2009).

Table 2: Performance of broiler finisher birds raised on different litter materials

Parameter	T ₁ (Wood shavings)	T ₂ (Groundnut hulls)	T ₃ (Coconut husks)	T ₄ (Rice hulls)	SEM
Total Feed Intake (g)	4470.40	4464.40	4456.70	4627.40	+107.30
Daily Feed Intake (g)	158.99	159.44	159.49	165.26	3.86
Initial weight (g)	1345.00	1435.00	1390.00	1430.00	+58.95
Final weight (g)	2693.30	2663.30	2613.30	2709.30	+83.24
Total weight gained (g)	1348.30	1228.30	1223.30	1279.30	+70.56
FCR	3.32	3.66	3.67	3.62	+0.23
PER	1.51	1.37	1.37	1.38	0.08

Means within the same row without superscripts are not significantly different ($P>0.05$)

Table 3: Haematological value of broiler finisher birds raised on four different litter materials

Parameter	T ₁ (Wood shavings) (control)	T ₂ (Groundnut hulls)	T ₃ (Coconut husks)	T ₄ (Rice hulls)	SEM
PCV (%)	30.57 ^b	29.70 ^b	29.07 ^b	32.43 ^a	+0.44
HB (g/dL)	16.17	14.80	15.63	16.63	+0.44
RBC (x10 ¹² /L)	2.57	2.66	2.49	2.71	+0.04
MCV (fl)	119.11	111.66	116.93	120.35	+1.67
MCH (pg)	62.99	55.74	62.88	61.52	+1.69
MCHC (g/dL)	52.90	49.89	53.79	51.27	+1.37
TWBC (x10 ⁹ /L)	119.47	120.03	123.37	126.20	+1.28
LYM (x10 ⁹ /L)	103.15	104.80	108.13	109.47	+1.20
NEUT (x10 ⁹ /L)	15.92	14.44	14.43	16.00	+0.69

^{ab}Means within the same row with similar superscripts are significantly different at $P<0.05$

Serum biochemical analysis

Serum biochemical indices

The serum biochemical indices of the birds are shown in Table 4. Serum biochemical result showed no significant differences ($P>0.05$) in the serum protein between the treatment, supporting the work of Isaac *et al.* (2013) which states that animals with good blood composition are likely to show good performances this can also be attributed to the high protein efficiency ratios and better feed conversion recorded in all the treatments indicating that the bedding materials did not pose any threat to the birds (Kristina and Margo 2015). Serum albumin and globulin also indicated no

significant difference in all the treatments indicating availability of protein (Hoffenberg *et al.* 1966). Uric acid of the treatments T₁ – T₃ maintained similar trend apart from T₄ with slightly lower value of 9.00u ldl ($P<0.05$) storing indicating a possibility of proper renal function and efficient excretion of uric acid whose high levels in the blood can be detrimental (Ehilich, 2016). Age of birds is a factor influencing serum biochemical indices of birds. Oluyemi *et al.* (2002) reported that growing chickens (8-10 weeks) had significantly greater aspartate amino transferase and alanine transferase values than adult (50 – 80 weeks) birds. The values

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recorded for ALT, AST and ACP in this study might be as a result of age. (Arslan *et al.* 2011). The serum haematological and

serum biochemical indices records in this study showing that the condition of the litters did not adversely affect the health and welfare of the birds (Leister, 2009).

Table 4: Biochemistry result of broiler finisher birds raised on four different litter materials

Parameter	T ₁ (Wood shavings)	T ₂ (Groundnut hulls)	T ₃ (Coconut husks)	T ₄ (Rice hulls)	SEM
Creatinine (mg/dL)	0.28	0.28	0.28	0.25	+0.01
Uric acid (mg/dL)	10.20 ^a	10.10 ^a	10.93 ^a	9.00 ^b	+0.25
Calcium (mg/dL)	8.43	7.93	8.20	8.07	+0.16
Phosphorus (mg/dL)	0.73 ^b	2.50 ^a	0.37 ^b	1.03 ^b	+0.28
Protein (g/dL)	3.40	3.10	3.20	3.07	+0.10
Albumin (g/dL)	1.93	1.80	1.73	1.77	+0.05
Globulin (g/dL)	12.33	1.20	1.47	1.30	+0.07
ALT (IU/L)	12.33	13.67	7.67	11.67	+1.30
AST (IU/L)	59.67	63.00	64.00	64.00	+1.04
ALP (IU/L)	219.33 ^{ab}	193.33 ^b	351.33 ^{ab}	327.67 ^a	+27.57

^{ab}Means within the same row with similar superscripts are significantly different at P<0.05

Conclusion

The study showed that groundnut hulls, coconut husks and rice hulls can be used as alternative bedding materials in poultry production without any damage on the performance and blood parameters of the experimental birds. The author also suggested that further research should be carried out on litter materials while putting into consideration the litter depth.

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