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Performance, Carcass Characteristic and Haematology of Broiler Chickens Managed on Alum Treated and Untreated Wood Shavings

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The aim of this study was to determine the effect of alum treated and untreated wood shaving on broiler chickens performance and carcass characteristic. A total of Two hundred and forty (240) day old Marshall Strain broiler chicks of mixed sexes were used for the study from the poultry unit of the Department of Animal Science teaching and research farm, Ahmadu Bello University, Zaria. The birds were fed on a common diet during this period and were subsequently weighed and randomly assigned to four treatment groups. The treatments were replicated three times with 20 birds per pen. They were housed under a deep litter system with 15kg wood shavings per pen in a completely randomised design. Aluminium sulphate (alum) was applied to the wood shavings by mixing it with alum thoroughly using hands covered with hand gloves. The rates of alum application was as follows: T1 control (normal wood shavings with no alum), T2 (5% alum by kg weight of wood shavings), T3 (10% alum by kg weight of wood shavings) and T4 (15% alum by kg weight of wood shavings). Data was collected on feed intake, weight gain and feed conversion ratio was determined weekly. At the termination of the experiment (day 56), two birds from each pen having representative weights for the group (6 birds per Treatment) were selected for carcass

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characteristics. In results there was no significant (P>0.05) difference in all the parameters measured such as initial weight, daily weight gain, daily feed intake, daily water intake, final weight, Total weight gained, cost/kg gain and feed conversion ratio (FCR). The result showed a significant (P<0.05) difference in heart and liver weight among the treatments. However, there was no significant (P>0.05) difference among all the treatments in prime cuts and percent of other visceral organs. In conclusion the application of Alum to wood shavings did not improve performance of broiler chickens significantly.

Keywords: Broiler; Alum; treated wood shavings; performance; carcass; and Haematology.

1. INTRODUCTION

Environmental concerns linked to intensive poultry production are increasing worldwide. The major environmental problems caused by poultry production are related with manure. The composition and quality of animal waste products, as well as manure management practices, are critical factors for determining emissions of potentially pollutant elements [1]. Environmental pollutants like ammonia inside broiler houses arise from the microbial breakdown of uric acid in the excreta [2]. Microbial mineralization of urea and uric acid in poultry litter results in the production of ammonia which can lead to decreased poultry performance, malodorous emissions and loss of poultry litter value as a fertilizer. The efficiency of this conversion is affected by different factors such as temperature, pH and moisture of the litter, properties of bedding material or ventilation flow and management techniques [3]. Increased moisture levels promote proliferation of microorganisms in the litter, increasing the production and volatilization of ammonia [4]. These microbes like *E. coli* and *Salmonella* also serve as the disease causative agents.

Research efforts have been geared towards finding suitable methods to decrease the spread of pollutants spread from poultry farms. Some results have shown ways that could modify the quality of poultry litter particularly in its nutritional aspects by adding various additives to the litter [5]. There is a need to explore more ways. One way to reduce the impact of these problems is through the use of chemical amendments to manure [6]. Moore and Miller [7] reported that chemical amendments could be added to poultry litter to reduce phosphorus solubility.

Selection of the best litter treatment is dependent on matching the characteristics of the product with treatment goals. Chemical, microbial and enzymatic litter treatments are being used to reduce ammonia and/or bacterial load in bedding materials however, the method of acidifying litter treatments currently dominates the market due to their efficacy in reducing ammonia and lowering litter pH which aids in suppressing microbial loads [8].

Keeping above in view the present study was designed to evaluate the effect produced on the performance, carcass characteristic and haematology of broiler chickens managed on alum treated and untreated wood shavings.

2. MATERIALS AND METHODS

2.1 Experimental Site and Location

The study was carried out at the poultry unit of the Department of Animal Science teaching and research farm, Ahmadu Bello University, Zaria. The pen is located in northern guinea savannah zone of Nigeria, latitude 11^0 09' 76'' N and longitude 7^0 38' 20'' E at an altitude of 610 mm above sea level. The climate is relatively dry with a mean annual rainfall of 700-1400mm, occurring between the months of April and September [9].

2.2 Experimental Birds and their Management

A total of two hundred and forty (n=240) day old Marshall Strain broiler chicks of mixed sexes were used for the study. The birds were brooded together using kerosene stoves and electric bulbs in two pens for the first one week due to extremely cold weather conditions. The birds were fed on a common diet during this period and were subsequently weighed and randomly assigned to four treatment groups. The treatments were replicated three times with 20 birds per pen. They were housed under a deep litter system with 15kg wood shavings per pen in a completely randomised design. Aluminium sulphate (alum) was applied to the wood shavings by mixing it with alum thoroughly using hands covered with hand gloves. The rates of

alum application was as follows: T1 control (normal wood shavings with no alum), T2 (5% alum by kg weight of wood shavings), T3 (10% alum by kg weight of wood shavings) and T4 (15% alum by kg weight of wood shavings). Feed and water were supplied *ad libitum* throughout the 56 days study period and routine vaccination schedule was administered.

2.3 Experimental Diets and Materials

Broiler starter and finisher diets were formulated to meet the nutrient requirement of broilers [10] and used in feeding the experimental birds throughout the period of the study in both experiment one and two. The experimental diets are shown in Table 1. The alum used was obtained from the Sabon-gari market in Zaria, Kaduna State.

2.4 Data Collection

2.4.1 Growth parameters

Feed intake, weight gain and feed conversion ratio was determined weekly. Feed intake was calculated by the difference between supplied feed and feed left in each pen. Weight gain was determined as the difference between the weight of the bird in the week under consideration and the previous week. Feed conversion ratio was calculated as the ratio of feed intake and weight gain within each week for each pen. Mortality was recorded as they occurred and body weight was recorded. Mortality percentage was calculated by dividing the number of birds that died within a period by the initial number of birds placed and multiplying by 100.

2.4.2 Carcass evaluation

At the termination of the experiment (day 56), two birds from each pen having representative weights for the group (6 birds per Treatment) were selected. The selected birds were bled, dressed and eviscerated. Prime cuts and organs were separated and weighed individually they were expressed as percentage of carcass and live weight respectively.

2.4.3 Blood sample collection and haematological analysis

At the termination of the experiment (day 56), two birds from each pen having representative weights for the group (6 birds per Treatment) were selected and 1.5ml of blood was taken via the wing vein. Haematological parameters were analyzed by an auto haemo analyzer (BC2800 vet auto haemo analyser) at the Clinical Pathology Laboratory, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria. The parameters determined were red blood cell (RBC) count, white blood cell (WBC) count, total protein (TP), packed cell volume (PCV), haemoglobin (Hb), deferentials mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC).

2.5 Statistical Analyses

All the data collected from the experiment were subjected to analysis of variance (ANOVA) using the general linear model of statistical analysis system (SAS, 2001) software package and the mean separation was done using Duncan multiple range test.

2.6 Performance of Broiler Chickens Raised on Alum Treated and Untreated Wood Shavings

Table 2 shows the performance of broiler chickens raised on alum treated and untreated wood shavings. There were no significant ($P>0.05$) differences in all the parameters measured such as initial weight, daily weight gain, daily feed intake, daily water intake, final weight, Total weight gained, cost/kg gain and feed conversion ratio (FCR). The non-significant difference in performance among all the treatment groups recorded is similar to that obtained by Choi and Moore (2008) and Choi (2004) who reported no significant difference in broiler performance raised on aluminium chloride treated litter. However, there were significant ($P<0.05$) difference among treatment groups in terms of mortality. Mortality in the control group (0% alum treated wood shaving) was significantly ($P<0.05$) higher with 8.33% mortality, were as there was no mortality in all the alum treated litter groups (5%, 10% and 15% alum treated wood shavings). This might be due to the poor hygienic state of the wood shavings and lack of the ameliorating effect of alum as in other groups. The post-mortem result indicated that poor hygiene is one of the contributory factor of mortality in this group (0% alum treated wood shaving). This result agrees with the report of Forbes and Robert [11] that alum treatment to broiler litter results in lesser mortalities.

Table 1. Ingredients composition and calculated analysis of the experimental diets

Ingredients	Composition (%)	
	Starter (0 – 4 weeks)	Finisher (5 – 8 weeks)
Maize	51.90	54.50
Groundnut cake	16.00	22.20
Soya bean cake	25.00	15.00
Palm oil	2.00	3.40
Lime stone	1.00	0.90
Bone meal	3.00	2.80
Common Salt	0.30	0.30
Premix*	0.25	0.30
Lysine	0.25	0.30
Methionine	0.30	0.25
Total	**100.00**	**100.00**
Calculated analysis		
Crude protein (%)	23.20	21.80
Metabolisable energy (kcal/kg)	2929	3037
Ether extract (%)	6.57	7.74
Crude fibre (%)	4.18	3.78
Calcium (%)	1.23	1.13
Available Phosphorus (%)	0.52	0.49
Lysine (%)	1.13	1.19
Methionine (%)	0.96	0.86
Feed cost (₦/kg)	91.80	88.00

**Composition of premix supplies the following per kg of feed: Vit. A = 12000IU, Vit. E = 15000IU, Vit. D_3 = 2500IU, Vit. C = 30,000mg, Folic acid = 100mg, Nicotine acid = 5000mg, Panthotenic acid = 15000mg, Fe = 1750mg, I = 40,000mg, Zn = 50,000mg, Mn = 100mg, CU = 1500mg, Cu = 200mg, Si = 100mg, Biotin = 600mg, Metabolisable energy calculated according to formulae of Peuzenga (1985). M.E = (37 x %CP) + (81 x %EE) + (35.5 x %NFE)*

Table 2. Effect of alum treated and untreated wood shaving on broiler chickens performance

	Treatments				
	Alum Inclusion Level (%)				
Parameter	0	5	10	15	SEM
Initial Weight (g)	103.30	103.30	103.30	103.30	0.180
Final Weight(g)	2380.00	2430.00	2430.00	2450.00	28.250
Daily Feed Intake (g)	100.70	107.20	107.90	106.00	0.930
Daily Water Intake (ml)	289.20	296.50	276.80	271.50	3.337
Daily Weight Gain (g)	41.30	42.50	41.20	42.40	1.380
Total Weight Gain (g)	2310.00	2330.00	2330.00	2340.00	11.277
FCR	2.36	2.26	2.32	2.24	0.601
Cost/kg Gain (₦)	213.26	214.86	213.67	210.32	2.2977
Mortality (%)	8.33^{a}	0.00^{b}	0.00^{b}	0.00^{b}	0.8333

^{abc} = Means on the same row with different superscripts are significantly (P<0.05) different FCR = Feed conversion ratio. SEM = Standard error of mean

2.7 Carcass Characteristics of Broiler Chickens Raised on Alum Treated and Untreated Wood Shavings

Table 3 shows the carcass characteristics of broiler chickens raised on alum treated and untreated wood shavings. The result showed a significant (P<0.05) difference in heart and liver weight among the treatments. However, there was no significant (P>0.05) difference among all the treatments in prime cuts and percent of other visceral organs which is expected as result of no significant variation (P<0.05) in performance of the birds in terms of feed intake, weight gain and FCR. The heart (%) was significantly (P<0.05) higher in birds in the control group (0% alum treated wood shavings) compared to 10% and 15% alum treated wood shavings groups but

similar to 5% alum treated wood shaving group. The liver (%) was significantly (P<0.05) higher control group (0% alum treated wood shaving) compared to 15% alum treated wood shaving group but similar to 5% and 10% alum treated wood shavings groups. The higher heart and liver percentages may be attributed to possible hypertrophy. This result agrees with the report of Abeke *et al*. [12] who reported that hypertrophy of organs may occur as a result of the body's attempt to increase protein availability or in the process of detoxifying toxic substances in the body.

2.8 Haematological Parameters of Broiler Chickens Raised on Alum Treated and Untreated Wood Shavings

The result of the effect of alum treated and untreated wood shavings on the haematological parameters of broiler chickens is presented in Table 4. The result showed that there was significant (P<0.05) differences among the alum treated wood shavings groups (5%, 10% and 15% alum treated wood shavings) compared to the control untreated wood shaving group (0% alum treated wood shavings) for packed cell volume (PCV), haemoglobin (Hb), total protein (TP), red blood cell (RBC), white blood cell (WBC), heterophil, lymphocyte, monocyte, eoisinophil, mean cell volume, mean corpuscular haemoglobin and mean corpuscular haemoglobin concentration. The packed cell volume, red blood cells, and lymphocytes were significantly (P<0.05) higher in the alum treated wood shavings group compared to the control (0% alum treated wood shaving).The significantly lower packed cell volume, haemoglobin and red blood cell observed in the control group was below the normal range as reported by Jain, (1993) and Chinrasri and Aengwanich, (2007) who reported normal range for PCV, haemoglobin and red blood cell to be 29.75-31.87%, 8.22-8.88g/dl and 4.7-4.78x10^{12}/l respectively, an indication that the birds were anaemic, hence proving the presence of immune challenge.. The haemoglobin concentration was significantly (P<0.05) higher for birds in 15% alum treated wood shavings compared to the other treatments. The total protein, white blood cells, mean corpuscular haemoglobin, heterophil, monocyte and eosinophils were significantly (P<0.05) higher in the control (0% alum treated wood shavings) compared to the alum treated wood shavings groups (5%, 10% and 15% alum treated wood shavings). These levels (i.e. white blood cell, heterophil, monocyte and eosinophil) are above the normal range reported Jain, [13] and Chinrasri and Aengwanich, [14] who reported normal range for white blood cell, heterophil, monocyte and eosinophil to be 2.57-2.72x10^{9}/l, 15.83-18.3%, 3.00-4.38% and 3.6-4.2%respectively, indicating that the birds had immune challenge. This may

Table 3. Effect of alum treated and untreated wood shaving on broiler carcass characteristics of broiler chickens

	Treatments				
	Alum Inclusion Level (%)				
Parameter	0	5	10	15	SEM
Live weight (g)	2433.00	2433.00	2433.00	2466.00	2.280
Dressed Weight (g)	2200.00	2216.00	2250.00	2260.00	23.031
Carcass Weight (g)	1683.00	1726.00	1730.00	1746.00	22.042
Dressing Percentage (%)	90.41	91.08	92.47	91.61	1.607
Prime Cuts expressed as percent of liveweight					
Breast (%)	25.86	26.03	26.06	26.50	0.514
Wings (%)	10.86	10.66	10.66	10.73	0.072
Back (%)	17.95	17.40	17.38	16.66	0.420
Thigh (%)	16.30	16.30	16.53	16.56	0.143
Drum Stick (%)	14.53	15.06	14.83	14.93	0.160
Organs expressed as percent of live weight					
Spleen (%)	0.15	0.14	0.14	0.14	0.003
Heart (%)	0.45^{a}	0.44^{ab}	0.43^{b}	0.43^{b}	0.004
Liver (%)	2.28^{a}	2.27^{ab}	2.27^{ab}	2.26^{b}	0.005
Lungs (%)	0.99	0.98	0.97	0.97	0.005
Kidney (%)	0.67	0.60	0.60	0.59	0.030

^{abc} = means on the same row with different superscript are significantly (P<0.05) different SEM = Standard error of mean

Table 4. Effect of alum treated and untreated wood shavings on broiler haematological parameters

	Treatments				
	Alum Inclusion Level (%)				
Parameter	0	5	10	15	SEM
Packed Cell Volume (%)	28.33^{b}	31.00^{a}	31.33^{a}	31.67^{a}	0.2721
Haemoglobin (g/dl)	7.97^{c}	8.53^{b}	8.57^{b}	8.80^{a}	0.0659
Total Protein (g/dl)	5.73^{a}	3.67^{b}	3.73^{b}	3.60^{b}	0.0860
Red Blood Cell (10^{12}/l)	4.17^{b}	4.70^{a}	4.77^{a}	4.80^{a}	0.0585
White Blood Cell (10^{9}/l)	8.20^{a}	2.97^{b}	3.00^{b}	2.93^{b}	0.0659
MCV (fl)	68.00	65.96	65.74	66.02	0.7114
MCH (pg)	19.12^{a}	18.16^{b}	17.98^{b}	18.34^{b}	0.2948
MCHC (g/dl)	28.09	27.53	27.35	27.79	0.2948
Differencial					
Lymphocyte (%)	61.00^{b}	78.33^{a}	78.00^{a}	78.67^{a}	0.4303
Heterophil (%)	19.67^{a}	14.67^{b}	15.00^{b}	14.33^{b}	0.2151
Monocyte (%)	11.00^{a}	3.67^{b}	3.40^{b}	3.27^{b}	0.2964
Eosinophil (%)	8.33^{a}	3.33^{b}	3.60^{b}	3.73^{b}	0.1691

^{abc} = Means on the same row with different superscript are significantly (P<0.05) different, MCV = Mean corpuscular volume, MCH = Mean corpuscular haemoglobin, MCHC = Mean corpuscular haemoglobin concentration, SEM = Standard error of mean

also explain the high mortality rate observed in this group. Though significantly lower percent lymphocyte was observed in control (0% alum treated wood shaving), in absolute terms, birds in this treatment (Control) have higher lymphocyte concentration than birds in other treatment i.e. due to the significantly higher white blood cell concentration (8.2 x 10^{9}/l) than other treatments. All the haematological parameters measured such as packed cell volume, haemoglobin, total protein, red blood cell, white blood cell, heterophil, lymphocyte, monocyte, eoisinophil, mean cell volume, mean corpuscular haemoglobin and mean corpuscular haemoglobin concentration in the blood of birds in 5%, 10% and 15% alum treated wood shavings were within the normal range hence could be classified as healthy. This is in agreement with the report of Chinrasri and Aengwanich, [14] and Bush [15].

3. CONCLUSION

In conclusion the application of Alum to wood shavings did not improved the performance of broiler chickens significantly.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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