

## GROWTH PERFORMANCE AND HAEMATOLOGY INDICES OF BROILER BIRDS FED DIET CONTAINING GRADED LEVELS OF BIOCHAR

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### ABSTRACT

A total of 120 day-old broiler birds were used to investigate the effect of dietary inclusion of biochar on the growth and hematology indices of birds in a 56-day feeding trial. The birds were randomly assigned to 4 groups of 30 birds each, replicated thrice with 10 birds per replicate. The groups were randomly assigned to four diets in a Completely Randomized Design involving four levels (0, 2.5, 5.0 and 7.5%) levels of biochar. Treatments differ significantly ( $P < 0.05$ ) in final body weight, average daily weight gain and average daily feed intake did not differ significantly ( $P > 0.05$ ) in feed conversion ratio at the starter phase. However, at the finisher phase, significant differences ( $P < 0.05$ ) were observed among treatments in final body weight, average daily weight gain and feed conversion ratio. Final body weight, average daily weight gain and feed conversion ratio of birds fed 5.0% were significantly ( $P < 0.05$ ) higher than other treatment groups. Haemoglobin (HB), packed cell volume (PCV) and mean corpuscular hemoglobin concentration (MCHC) were not affected by treatments at the starter and finisher phases, respectively. Lymphocytes were significantly ( $P < 0.05$ ) increased by the treatments at starter phase and did not significantly ( $P > 0.05$ ) differ at finisher phase. The result of the present study showed that up to 5.0% dietary biochar improved growth and hematology indices of broiler birds.

**Keywords:** Wood charcoal, Growth performance, Haematological indices, Biochar

### Introduction

The production of sufficient animal protein has become a serious challenge to the livestock industry. Thus, there is need to increase animal productivity by making animal protein source available and affordable to the Nigerian population. Protein is a very important nutrient that is responsible for growth and its deficiency leads to growth depression.

In Nigeria and indeed many other countries, various feeds and additives are incorporated into poultry diets to ensure maximum productivity (Onunkwo, *et al.*, 2018). Biochar has a good adsorption capability of toxins and therefore has the potential to improve bird's health (Khadem, *et al.*, 2012); (Soetan, *et al.*, 2012). Moreover, most of these materials are not cited in scientific experiments, but are used locally, for instance biochar per kg diet prevents fatness and improve performance of broilers and layers (Onunkwo, *et al.*, 2018).

Biochar is a charcoal-like substance that's made by burning organic material from agricultural and forestry wastes (also called biomass) in a controlled process called pyrolysis. Although it looks a lot like common charcoal, biochar is produced using a specific process to reduce contamination and safely store carbon. According to Ayanwale, *et al.* (2006) pullets fed activated charcoal were high in economic returns and these were attributed to increased mineral intake and utilization enhanced by charcoal

supplementation and improved absorption capacity of charcoal for dietary fat. The health of the gut is one of the major factors governing the performance of birds and thus, the economics of poultry production and the profile of intestinal micro flora play an important role in the gut health (Ayanwale, *et al.*, 2006). Therefore, a stable gut micro flora predominantly made of lactic acid producing bacterial and protecting the host from pathogenic invasion or toxic substance is a prerequisite for gut health and adequate growth performance. Biochar has enormous absorptive properties; it acts curatively on the gastrointestinal tract, absorbing gases such as hydrogen sulphide and ammonia that are formed there, bacterial toxins as well as mycotoxins produced by fungi (Edrington *et al.*, 1997). Biochar is not digested in the gastrointestinal tract, and it binds various substances through physical interactions regardless of whether they are ionized or not. By binding of ammonia, biochar protects the intestine against alkalization. The mineral contained in biochar form bases with water, lower the surface tension of the digesta and emulsify fat, thereby supporting liver function and enabling digestion and assimilation (Majewska, *et al.*, 2011). Based on these inherent potentials of biochar, this study was therefore designed to investigate the effect of varying inclusion levels of biochar on growth performance and hematology indices of broiler birds given the wide availability of biochar in Nigeria.

## Materials and methods

The study was carried out at the poultry unit of the Department of Animal Science Research and Teaching Farm, Nnamdi Azikiwe University, Awka. The location lies between Latitude 6.24°N and 6.28°N and longitude 7.00°E and 7.08°E on the South Eastern part of Nigeria (Ezenwaji, *et al.*, 2013).

A total of 120-day old unsexed Ross 308 broiler chicks procured from Agrited farms, Ibadan, Nigeria were used for this study. The test ingredient was

obtained by piling up woody debris in a shallow pit of a garden bed and burnt until the smoke thins; the brush smolder was ground to powdered form. Four experimental diets were compound, and each treatment was replicated thrice with 10 birds per replicate in a Completely Randomized Design (CRD). Each treatment received dietary inclusion of biochar as follows: T<sub>1</sub> = control (0% biochar), T<sub>2</sub> (2.5% biochar), T<sub>3</sub> (5% biochar) and T<sub>4</sub> (7.5% biochar) as shown in Table 1.

**Table 1: Gross Composition of broiler chicken diet containing graded level of biochar**

INGREDIENTS	T1 (0%)	T2 (2.5%)	T3 (5.0%)	T4 (7.5%)
Maize	50.00	48.10	45.00	40.50
Soybean Meal	25.00	23.90	24.00	25.00
Wheat Offal	1.00	0.10	0.10	1.00
Fish Meal	3.00	3.50	4.00	3.00
Groundnut Cake	15.00	15.60	15.00	16.00
Biochar	0.00	2.50	5.00	7.50
Palm Oil	2.00	2.30	2.90	3.70
Bone Meal	2.00	2.00	2.00	2.00
Limestone	1.00	1.00	1.00	1.00
Methionine	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
Salt	0.20	0.20	0.20	0.20
*Vitamin Premix	0.30	0.30	0.30	0.30
Total	100.00	100.00	100.00	100.00
Crude Protein	22.39	22.20	22.30	22.28

\*Vitamin premix per 2.5kg of diet: Vit A, 10,000IU, Vit D3, 2,000 I.U, Vit E, 23,000mg, Vit K3, 2,000mg; Vit B1, 1,800; VitB2, 5,500mg; Niacin, 27,500; Panthonic acid, 7,500; Vit B6,(pyridoxine) 3,000mg; Vit B12, 15mg; Folic acid, 750mg; Biotin H2, 60mg; Cholin Chloride, 300.000mg; Cobalt, 200mg; Copper,3.0mg; Iodine,3,000mg;Iron,1000.00mg;Manganese,20,000mg; Selenium, 40,000mg; Zinc, 200mg; Antioxidant,1,250mg .

Initial body weight of the broiler chicks was measured on arrival. Feed intake was measured daily, and the body weight and other growth parameters of the broiler birds were measured and obtained weekly. At the end of the experiment, blood samples were collected from the wing vein of one bird per replicate. 2ml of blood were collected into labelled bottles containing Ethylene Diamine Tetracetic Acid (EDTA) and analyzed for haematological parameters. This was done using separate syringe for each replicate to prevent contamination of the blood samples. A total of twelve birds were used. The parameter accessed were: Packed cell volume (PCV), Haemoglobin concentration, Red blood cell count (RBC), White blood cell count (WBC) and Leucocyte differential Count. The data were subjected to ANOVA (Analysis of Variance) using SPSS Computer Software Package (version 13). Also, significant differences between means were separated using Duncan New Multiple Range Test (Duncan, 1955).

## Results and Discussion

The growth performance response is shown in Table 3. The result showed that the average daily weight gain (ADWG), average daily feed intake (ADFI) and feed conversion ratio (FCR) were not significantly

different for all treatment group ( $P>0.05$ ) except the control. T<sub>3</sub> had the highest average daily weight gain followed by T<sub>4</sub>, T<sub>2</sub> and least in T<sub>1</sub>. The superior growth performance observed in the birds on biochar inclusions can be attributed to the adsorbent features of the biochar in the gut of the birds, arresting toxins and anti-nutritional factors that will interfere with absorption of nutrients by the birds' intestinal walls. Hence, the birds had ample supply of nutrients from the feed with minimal obstruction in their absorption. This agrees with the report of Majewska, *et al.* (2003) and Soetan, *et al.*, (2012) who observed that after 7 weeks of growth, birds which received supplemental biochar were about 1-6.5% heavier, had 5.9% better feed conversion efficiency and 1.6% better survival rate than the control group without biochar. Broilers on diet T<sub>4</sub> had highest feed intake followed by those on diet T<sub>3</sub> and T<sub>2</sub> while the feed intake of broiler birds on T<sub>1</sub> (control) was least. This is in line with the report of Majeswka, *et al.* (2009) who reported that turkeys given charcoal supplemental feeds were 5.9% heavier and had 6.5% better feed conversion ratio than the control birds. Survival in the groups that received biochar was 99% as compared to the 87.3% in the control group. This opposes the report of Kana, *et al.* (2014) and Jiya, *et al.* (2013) who reported that from

2% and higher levels of inclusion, dietary biochar is capable of depressing growth rates and final body weights of broiler chickens. The FCR of T3, T2 and T4 are not significantly different ( $P>0.05$ ). This

supports the fact that there was improved performance in terms of feed conversion ratio with inclusion of biochar at different levels than the control.

**Table 2: Growth performance of broiler birds containing graded level of biochar**

Parameter	T1 (0%)	T2 (2.5%)	T3 (5.0%)	T4 (7.5%)	P-VALUE
Initial weight (g/bird)	46.23±36.82	46.38±27.82	46.78±26.52	46.50±23.96	0.014
Final weight (g/bird)	1369.9±78.32 <sup>a</sup>	1942.1±73.75 <sup>b</sup>	2187.8±115.58 <sup>b</sup>	2026.8±85.43 <sup>b</sup>	0.001
Total body weight gain (g/bird)	1323.67±61.0 <sup>0<sup>a</sup></sup>	1895.72±48.04 <sup>b</sup>	2140.22±89.31 <sup>b</sup>	1980.3±79.23 <sup>b</sup>	0.001
Average daily weight gain(g/bird)	23.64±2.18 <sup>a</sup>	33.85±1.72 <sup>b</sup>	38.21±3.19 <sup>b</sup>	35.36±2.83 <sup>b</sup>	0.001
Average daily feed intake per bird(g)	80.13±1.77 <sup>a</sup>	105.07±1.20 <sup>b</sup>	116.92± 6.57 <sup>b</sup>	121.02±6.41 <sup>b</sup>	0.001
Total Feed Intake(g/bird)	2243.60±49.4 <sup>9<sup>a</sup></sup>	2942.0±33.50 <sup>b</sup>	3273.70±183.86 <sup>b</sup>	3388.40±179.34 <sup>b</sup>	0.001
FCR	3.38±0.11 <sup>b</sup>	3.10±0.06 <sup>a</sup>	3.05±0.05 <sup>a</sup>	3.42±0.07 <sup>b</sup>	0.018

abc: means on the same row with different superscripts are significantly different ( $P<0.05$ )

The results of the haematological parameters of broiler birds fed graded level of biochar is presented in Table 4. There were significant differences ( $P<0.05$ ) in all the parameters considered except for packed cell volume (PCV), haemoglobin (HB) and mean corpuscular haemoglobin concentration (MCHC) across all dietary treatment. The PCV values (28.67% to 30.00%) obtained in this study fall within the normal range (27% to 33%). This showed that the PCV obtained in this study showed that it was not toxic at the level used (Odunsi, *et al.*, 2007). All the test diets had better values of Hemoglobin indices which agree with Odunsi, *et al.* (2007), who stated that charcoal addition increased the hemoglobin which supported better blood formation. Hemoglobin has the physiological function of transporting oxygen to tissues of the animal for oxidation of ingested food so as to release energy for the other body functions as well as transport of carbon (iv)oxide out of the animal body (Isaac, *et al.*, 2013). An increase in haemoglobin may imply higher production of red blood cells to compensate for low blood oxygen levels due to poor heart or lung function or marrow dysfunction. An increase in Hemoglobin may imply higher production of red blood cells to compensate for low blood oxygen levels due to poor heart or lung function or marrow

dysfunction (Kana, *et al.*, (2014). The MCV, MCH, and MCHC all fell within the normal values for broiler chickens as recommended by Essien and Idorenyin, (2018). The higher RBC obtained for birds fed T3 diet compared with control diet T1 implied that birds on 5% wood charcoal had high oxygen carrying capacity. The values of red blood cells (RBC) are usually positively related to the dietary protein level. RBCs are responsible for the transportation of oxygen and carbon dioxide in the blood as well as synthesis of haemoglobin, therefore higher mean values obtained from birds on T3 and T2 test diets is an indication of a greater function and better state of health for the broiler birds. The leucocytes components (WBC, lymphocytes and neutrophil) did not differ significantly. Essien and Idorenyin, (2018) reported that bacterial and viral illness affect the number of white corpuscles and the ratio between the different types of white corpuscles and the percentages of the various types in healthy animals vary little but are greatly modified in sick animals. The results of the present study clearly indicate that the birds were not at stress and had no bacteria or viral illness hence the non-significant leucocytes values observed among the treatment.

**Table 3: Haematology parameters of broiler bird fed graded level of biochar**

Parameter	T1 (0%)	T2 (2.5%)	T3 (5.0%)	T4 (7.5%)	P-VALUE
Packed cell volume (%)	28.67±3.67	30.00±1.73	28.67±2.40	29.33±3.28	0.984
Haemoglobin (g/dl)	9.53±1.23	10.00±0.58	9.53±0.79	9.73±1.11	0.983
Red blood cell count	4.20±0.42 <sup>c</sup>	3.60±0.10 <sup>a</sup>	4.33±0.45 <sup>c</sup>	3.87±0.09 <sup>b</sup>	0.000
Platelet count (x10 <sup>9</sup> /L)	198.33±4.41 <sup>d</sup>	140.67±5.21 <sup>c</sup>	102.67±3.71 <sup>b</sup>	57.00±5.29 <sup>a</sup>	0.000
MCV (fl)	74.77±2.90 <sup>a</sup>	90.83±4.59 <sup>ab</sup>	88.37±11.17 <sup>ab</sup>	78.67±22.88 <sup>a</sup>	0.0042
MCH	21.83±3.67	29.20±2.19	31.20±10.60	42.80±12.89	0.435
MCHC	33.24±0.04	33.32±0.00	33.26±0.07	33.16±0.06	0.238
WBC (x10 <sup>9</sup> /L)	3.58±0.21	3.67±0.45	3.97±0.43	3.47±1.02	0.559
Lymphocytes%	54.00±5.78	55.00±7.51	58.33±11.78	60.00±5.77	0.28
Neutrophils%	60.00±5.77	48.00±7.51	45.00±13.86	40.00±5.77	0.482

**Conclusion**

The result of the present study showed that up to 5% dietary inclusion of biochar led to improvement in growth performance and haematological indices of broiler birds. However, at 2.5% level of inclusion dietary biochar may not have a lowering effect on packed cell volume, Hemoglobin and mean corpuscular hemoglobin concentration.

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