GROWTH RESPONSES AND LINEAR MEASUREMENTS OF STARTING BROILER CHICKS ON DIETARY INCLUSION LEVELS OF BIOCHAR AND ALUM

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ABSTRACT
The aim of this study was to assess the effects of inclusion of biochar and alum in the ration of starter broiler chicks on their growth and linear body development. Two hundred and eighty-eight 1-day-old Cobb chicks were obtained from a reputable hatchery. The chicks were divided into six treatments with 4 replicates each and 12 chicks per replicate. Data generated were subjected to a 2 x 3 factorial analysis in a Completely Randomized Design. Results revealed that dietary supplementation of biochar and alum had no significant impact ($p>0.05$) on growth indices of broiler chicks. Breast girth decreased ($p<0.05$) with increasing levels of biochar in the diets. Increasing dietary inclusion of alum improved ($p<0.05$) body length and shank width whereas, it lowered breast girth and height of the broiler chicks. It was concluded that inclusion of biochar and alum in the diets of broiler chicks enhanced some morphological parameters of the birds.

Key words: Alum, Biochar, Broiler chicks, Growth indices, Linear body

INTRODUCTION
About 25% of all the cereals in the world are estimated to be annually affected by mycotoxins contaminations (Mézes *et al.*, 2010). The contamination can occur while crops are still in the field, during storage and when feeding animals (Wild *et al.*, 2015). When animals consume contaminated feed for an extended period, they are associated with numerous health-related complications and diseases notably the teratogenic, immunosuppressive disorders, carcinogenic and mutagenic effects while also gastrointestinal activity impairment and overall reduced production (Misihairabgwi *et al.*, 2017). Human beings contact the mycotoxins through the contaminated animal products including milk, eggs, meat, and liver (Sobrova *et al.*, 2010). The use of absorbents like biochar, activated carbon and other non-charcoal to mitigate the effects of contamination of mycotoxins in the ration of farm animals have shown good results in reducing the assimilation of toxic compounds in the bloodstream (Dakovic *et al.*, 2005). Biochar is cheap, sustainable, environmentally friendly and nutrient rich organic additive, derived from organic carbon-rich materials produce by pyrolysis. Likewise, some reports in literature indicated that dietary supplementation of aluminum resulted to force-molt in Japanese quail hen, decrease in plasma inorganic phosphorus (Hussein et al., 1988), decrease in fertility and increase in shell thickness of laying birds (Wiser et al., 1990). Hahn and Guenter (1986) observed that dietary supplementation of aluminum exerted negative effect on phosphorus metabolism as it forms insoluble aluminum phosphate in the intestinal tract of laying hens. Despite aforementioned information in dietary utilization of biochar and alum in domestic bird production, field studies are still largely empirical, leaving a large knowledge gap in relevant mechanisms of operations. This present study explored the effects of dietary inclusion of biochar and alum in starting phase of growth of broiler chickens.

MATERIALS AND METHODS
Preparation of test ingredients
Alum (hydrate aluminum sulphate) was gotten from a reputable market in Abeokuta, Ogun State. It was broken down into smaller pieces and later ground into fine particles with the use of a blender. The alum was incorporated into the broiler diet at the rate of 230 g/100 kg feed. While biochar was

obtained through the process of pyrolysis at temperature of over 650ºC. Bamboo stems were harvested within the University environments where the study was carried out. The harvested bamboo stems were cut into sizeable lengths of less than 60 cm. They were fed into pyrolysis kiln to undergo pyrolysis at temperature of 650ºC. An infra-red temperature was used to determine the operating temperature within the kiln. The resultant biochar product was then stored, and subsequently crushed before utilized in feed formulation at the rates of 0, 1 and 2%.

Experimental Birds and their Management

The experimental site used for this present study was the Poultry Unit of the Directorate of University Farms of Federal University of Agriculture, Abeokuta, Ogun State, Nigeria. Two hundred and eighty-eight (288) 1-day-old Cobb Strain broiler chicks were purchased from a reputable Hatchery. On arrival, the birds were administered anti stress and distributed into 6 treatments in 2 x 3 factorial layout with 4 replicates per treatment and 12 birds per replicate. Wood shavings were used as bedding materials at 2 cm height. Vaccination of the birds were adhered strictly based on the breeder's recommendation. Feed and water were offered *ad libitum* throughout the 28 days duration of the study. The nutrient composition of the starter mash used for the study include 23% crude protein and metabolizable energy of 2700 kcal DE/kg.

Data Collection

Growth performance

Body weight gain and feed intake were recorded at weekly intervals on pen basis. Feed intake was determined by collecting weighing the left-over feed and deducting them from the feed offered, on weekly basis. The feed conversion ratio was calculated as feed intake per unit body weight gain.

Linear body measurement

Data on linear body measurement parameters were obtained on fortnight basis on the following parameters: body length was determined from the tip of the beak to the end of the last tail feather. Breast girth measurement involved the circumference of the breast muscle round the deepest region of the breast. Wing length was assessed from the bend of the wing to the tip of the longest primary feather. Shank length was measured from the hock joint to the bottom of the feet.

Statistical Analysis

Data generated were subjected to one-way Analysis of Variance in 2x3 factorial layout using Minitab 17.0 Statistical Package and significant differences among means ($p<0.05$) were separated using Tukey-Krammer's mean comparison procedure of the same statistical package.

RESULTS

Main and interactive effects of dietary inclusion of Biochar and Alum on growth performance of broiler starter chicks

Table 1 shows the main effects of dietary inclusion of biochar and alum on growth indices of broiler starter chicks. Growth parameters of broiler starter chicks were not significantly ($p>0.05$) influenced by dietary inclusion of biochar and alum. Likewise, the interaction between dietary inclusion of biochar and alum had no significant ($p>0.05$) impact on growth indices of broiler starter chicks (Table 2).

Main effects of dietary inclusion of Biochar and Alum on the linear body measurement of broiler starter chicks

Table 3 shows main effect of dietary inclusion of Biochar and Alum on linear body measurement of broiler chicks. Dietary inclusion of biochar had no significant ($p>0.05$) impact on linear body measurements of broiler chickens at 0-28 days except breast girth of the birds that reduced significantly with increasing dietary inclusion levels of biochar. Breast girth, body length, height and shank width were significantly ($p<0.05$) influenced by dietary inclusion of alum at 0-28 days of chicks' rearing. Breast girth and height were longer in broiler chicks on diets that did not contain alum while body length and shank width were higher in broiler chicks on diet containing 230 grams of alum when compared to those on diet without alum inclusion.

Table 1: Main effects of dietary inclusion of Biochar and Alum on the growth performance of broiler chickens

	Biochar					Alum			
Parameters	0	1	2	SEM	P	0	230	SEM	P
Initial Weight (gm)	46	44.58	44.52	0.62	0.29	45.71	44.4	0.62	0.14
Final Weight (gm)	879	862.1	881.4	8.05	0.62	880	869	8.05	0.52
Feed Intake (gm)/day/bird	42	41.6	44.26	2.17	0.89	42.12	43.1	2.17	0.84
Weight Gain(gm)/bird/day	54.8	53.91	54.67	3.18	0.99	54.79	54.1	3.18	0.93
FCR	1.32	1.33	1.38	0.02	0.27	1.32	1.38	0.02	0.16

Table 2: The interactive effects of Biochar and Alum on the growth performance of broiler chickens

Biochar	0		1		2			
Alum	0	230	0	230	0	230	SEM	P
Initial Weight (gm)	47.96	44.08	43.12	46.04	46.04	43.00	0.62	0.03
Final Weight (gm)	887.7	870.9	867.9	856.2	884.4	878.4	8.05	0.97
Feed Intake (gm)/day/bird	41.51	42.49	41.77	41.44	43.07	45.45	2.17	0.98
Weight Gain(gm)/bird/day	54.83	54.75	54.74	53.08	54.79	54.54	3.18	1.00
FCR	1.30	1.34	1.31	1.34	1.34	1.42	0.02	0.81

Interactive effect of dietary inclusion of Biochar and Alum on linear body measurement of broiler starter chicks

The interactive effects of dietary inclusion of biochar and alum had no significant effects on most of linear body measurements of broiler starter chicks except body length which differed significantly ($p<0.05$). Broiler chicks on dietary inclusion of alum or combination of biochar and alum had comparable body length means which were longer in length than their counterparts on no alum diets across all levels of inclusion.

Table 3 Main effects of dietary inclusion of Biochar and Alum on linear body measurement of broiler chickens

	Biochar					Alum			
Parameters (cm)	0	1	2	SEM	P	0	230	SEM	P
Body length	25.86	26.57	26.36	0.47	0.56	24.64^{b}	27.88^{a}	0.39	0.00
Back length	19.47	18.52	18.86	0.62	0.55	19.40	18.50	0.51	0.22
Breast girth	29.82^{a}	29.05^{ab}	27.18^{b}	0.75	0.04	29.78^{a}	27.59^{b}	0.61	0.02
Shank Length	7.57	9.05	8.20	0.58	0.47	7.079	8.24	0.47	0.09
Shank Width	12.40	12.05	12.69	0.33	0.67	12.03^{b}	12.89^{a}	0.27	0.03
Height	22.55	29.05	23.19	0.41	0.48	23.42^{a}	22.17^{b}	0.33	0.01
Toe to Back length	20.86	29.05	22.23	0.94	0.38	20.70	21.65	0.77	0.39
Wing length	16.19	19.05	15.61	0.26	0.15	15.63	15.91	0.21	0.19

^{ab}Means on the same row with different superscripts are significantly ($p<0.05$) different

Discussion

The non-significant means in the growth performance indices of the broiler chickens' (main and interactive effects) points to the optimum nutrient intake of the birds during the rearing period irrespective of the treatment group which must have promoted the welfare of the birds thereby impeding the negative effects of nutrient dilution by addition of biochar and alum. This observation is in-line with the investigation of Kutlu *et al.* (2001) who reported that 2.5, 5.0 and 10% dietary inclusion of oak charcoal had no significant

Table 4: Interactive effects of Biochar and Alum on linear body measurement of broiler starter chicks

Biochar (%)	0		1		2			
Alum (230 gm/100 kg}	0	230	0	230	0	230	SEM	P
Body length (cm)	25.48[b]	26.25[a]	24.39[b]	28.75[a]	24.06[b]	28.65[a]	0.67	0.01
Back length (cm)	20.26	18.68	18.25	18.79	19.69	18.04	0.88	0.37
Breast girth (cm)	31.25	28.39	29.41	28.69	28.66	25.69	1.06	0.49
Shank Length (cm)	7.51	7.63	6.70	7.71	7.03	9.38	0.82	0.39
Shank Width (cm)	12.21	12.59	12.15	12.42	11.72	13.66	0.47	0.15
Height (cm)	23.48	21.63	22.71	22.55	24.06	22.33	0.58	0.27
Toe to Back length (cm)	21.1	20.61	20.31	20.56	20.69	23.76	1.33	0.38
Wing length (cm)	16.29	16.09	15.05	16.16	15.56	15.48	0.37	0.15

[ab]-Means on the same row with different superscripts are significantly ($p<0.05$) different

effects on growth parameters of broiler chickens. Whereas, the results varied from the studies of Evans *et*
al. (2015, 2017) and Kajetan et al. (2020) that reported significant increase in feed conversion ratio and reduction in body weight gain of broiler chickens on diets containing additive biochar. Prasai *et al*. (2016, 2018) also reported significant higher egg production, egg weight and improved feed efficiency of laying
birds on dietary inclusion of biochar. The findings of Druga *et al.* (2010) indicated that dietary supplementation of aluminum oxide in broiler chickens caused significant decrease in body weight gain and feed intake of the birds. The differences observed in the present study and abovementioned studies could be linked to differences in materials used in biochar production and methods of production of biochar and as well strains of broiler used for the studies.
The significant decrease in breast girth of the broiler chickens with increasing dietary inclusion of biochar could be attributed to higher arsenic content of biochar as explained by Evans et al. (2015). Alum inclusion in the diets of broiler chickens improved the body length, breast girth, shank width and height of broiler chickens. The improvement in body length and shank width could be attributed to better feed consumption of the birds on dietary inclusion of alum although not significant. This observation contradicts the suggestion of Cherroret *et al.* (1995) that reduction in body weight of young rats on aluminum chloride diets recorded lower feed intake, resulting to decline in weight gain of the rats. The slight improvement in feed intake in this present study must have resulted to compensatory effects that could have resulted to improvement in body length and wider shank width. The decrease in breast girth and height of the chicks with dietary inclusion of alum could not be explained by the authors of this present study.

CONCLUSION

Dietary inclusion of biochar and alum did not influence growth indices parameters of broiler chickens. Whilst dietary inclusion of biochar enhanced the breast girth, likewise, dietary inclusion of alum improved body length and shank width whereas decreasing breast girth and height of the birds.
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