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OUTCOME OF CALCIUM AND PHOSPHOROUS MINERAL SOURCES ON PERFORMANCE, CARCASS AND BONES CHARACTERISTICS OF BROILERS

Ari, M. M., Gambo, D., Alu, S.E., Edwin, E.E., Aminu, R.A., Isa, J .M. and Yaduma, M.
Department of Animal Science, Faculty of Agriculture, Nasarawa State University, Nigeria.

Correspondence Email: arimaikano@yahoo.com, arimaikanom@nsuk.edu.ng

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ABSTRACT

This study was conducted to evaluate the effects of utilization of Bone meal, Limestone, Oyster shell and Egg shell as Calcium and Phosphorous mineral sources on performance, carcass and bones characteristics of broilers. A total of sixty (60) four (4) weeks old broiler chicks were raised on commercial chick mash (1- 30 d) prior to the commencement of the experiment and experimental diets were formulated to provide approximately 3050-3100 kcal/ME, 19-20% crude protein (CP) using the least cost feed formulation software feed win during the 21 d feeding trial period. The experimental birds were assigned to four (4) dietary treatments groups of two (2) replicates in a completely randomized design with 2.5 % inclusion of limestone), oyster shell, bone meal) and egg shell constituting the treatments. Significant ($P<0.05$) differences were observed in some performance parameters like feed intake (FI), weight gain (WG) and feed conversion ratio (FCR). Similarly some carcass parameters were also significantly affected by the experimental treatments. The effects on bone characteristics were significant ($P<0.05$). There was no consistent trend in the differences observed for all test Ca and P sources. It is therefore recommended that all the experimental calcium sources can be included to constitute up to 2.5% in the diet of broiler chicken. This will afford small scale poultry producers the control of using eggshell, bone meal, limestone and oyster shell as sources of calcium, phosphorus and other minerals for sustainable broiler chicken production.

INTRODUCTION

The major limitation to the growth of the poultry industry in Sub Saharan Africa (SSA) countries has consistently been attributed to the high cost of feed ingredients which constitutes about 70% of the total cost hence, the un ending evaluation of the alternative feed materials with potentials to serve as cost and nutritionally effective replacement of competitive and costly feed resource (Ari and Ayanwale, 2012). Yasothai and Kavithaa (2014) however observed that studies on the evaluation of alternative sources of feed have been more concerned with energy and protein feedstuffs without corresponding attention given to the evaluation of local alternative sources for the major mineral nutrients like calcium and phosphorus. This position was earlier presented by Tumova *et al.,* (2004) and Shastak (2012) who listed oyster shells, periwinkle shell, egg shell, bone meal, di-calcium phosphate and limestone as the important minerals sources that are always considered in livestock rations in SSA countries.

The utilization of cockerels as major sire in community poultry upgrade programmes and as good source of protein meat commanding high demand due to its meat flavour and toughness (Yakubu *et al.*, 2014 and Ari *et al*., 2016) is hinged on good quality feed with right mineral mix. Almeida and Bruno (2006) reported that bone tissue rigidity associated with Layers and cockerels' emanate from the deposition of calcium and phosphorus as hydroxiapatite during bone mineralization process as both minerals make up about 70% of the bone composition. However, emphasis is placed on the supply of large particle size calcium material resources (Nakano, 2003; Hunton, 2005) sources especially to layers and cockerels during growing and laying stages. These vital minerals are of important welfare and economic consideration for the poultry industry (Adebiyi *et al*., 2009) in view of their influences on the physiology, metabolism and performances of all classes of poultry and most importantly on bone structures and composition. There are however, observed effects in the use of some of these mineral sources in the diets of meat-type poultry which includes production and health concerns associated with minerals originating as by- products from animal origin like Bone meal, egg shell (Rath *et al*., 1999;Tion *et a*l., 2012) in spite of relative cost advantage.

Similarly, industrial application of calcium carbonate obtained from mussel and oyster shells as filler in polypropylene (Hamester *et al*., 2012) again provides another important focus for the need for diversification of calcium and phosphorous mineral sources to the poultry feed industry. The basic assumption of this study was that the utilization of calcium mineral sources by cockerels will differ with sources of calcium minerals in the diets. The study aimed at evaluating the effect of different calcium minerals sources on the performance, carcass and bone characteristics of broilers.

MATERIALS AND METHODS

This research was conducted at the Research and Teaching Farm of the Faculty of Agriculture, Nasarawa State University Keffi, Shabu Lafia Campus. The trial site is located in Guinea Savannah Zone, North Central of Nigeria and found on latitude 08^0 35N and longitude 08^0 33E (NIMET, 2008).

The test ingredients which comprised of bone meal, limestone, egg shell and oyster shell were sourced and processed. Bone meal was sourced locally within the Lafia abattoir and other locations within the Lafia metropolis. The collected Bone meal were cleaned up, sundried, burnt and crushed to small particle sizes, bagged and stored.

Limestone was procured already in coarse form from Jos, Plateau State and transported to Lafia.Oyster shell was procured from Sabon Gari market in Kano State, The raw oyster shell were cleaned to remove debris prior to boiling, drying, and crushing into coarse form.

Egg shell was sourced locally within Lafia metropolis from processed egg sellers. The collected egg shell was sundried and processed into powder form.

A total of sixty (60) four (4) weeks old broiler chicks raised on commercial chick mash (1- 30 d) prior to the commencement of the experiment were used. The experimental birds obtained from Munbolas Lynx Farms, Ibadan Nigeria were brooded together and subjected to the same routine management practices during the 21 d feeding trial period. The experimental birds were randomly selected and assigned to four (4) dietary treatment groups of two (2) replicates in a completely randomized design. The treatments included 2.5 % inclusion of limestone (T1), oyster shell (T2), bone meal (T3) and egg shell (T4).

The compounded experimental diets were formulated to provide approximately 3050-3100 kcal/ ME, 19-20% crude protein (CP) using least cost feed formulation software feed win as presented in table 2.

Data was collected for the following:

Performance evaluation. At the end of the feeding trial, feed intake, weight gain, feed conversion ratio, and survival percentages were assessed as measures of Performance according to methods adopted by (Ari *et al.*, 2012).

Carcass evaluation. At the end of feeding trial, two birds per treatment were randomly selected and fasted for about 8 h before slaughter. This was to reduce gut content and thus reducing the risk of contamination of the carcass during dressing without affecting meat quality. Measurements were taken on cut parts: breast, back, thigh, and drum stick.

Bone evaluation: The bones were obtained from thigh and the drum stick which comprises of the femur, tibia and tubular. The flesh was properly removed with the use of razor blade and sharp knife, weighed and labelled accordingly. The width and length of the bones were measured with the use of Vernier calliper and microscrew gauge for the length and diameter measurements respectively according to the methods described by Nkukwana (2012). The left and right tibia bones from each of the experimental groups were further sun dried for three (3) days before oven drying preparatory to ashing. The dried samples were pounded and placed in labelled crucibles before ashing using muffle furnace at 55^0C. The values of ash were obtained by difference between initial weight of crucible and weight of bones before ashing and the weight of crucible after ashing.

Data collected were subjected to one-way analysis of variance (ANOVA) using SPSS 20; Means were separated using the Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

The effects of different calcium source in performance of broilers (Table 3) shows that there were significant ($P<0.05$) differences in feed intake, weight gain and feed conversion ratio. The initial weight and survival percentage were however not significant. T2 was best for feed intake while T4 was best for weight gain. However, T1, T2 and T3 were all significantly better than T4. Carcass characteristics (Table 4) of broilers such as live weight, body weight gain, dressed weight, head, neck, wings, breast, back, thigh, drum stick and shank were all not significant.

Effects of different mineral sources on bone characteristics (Table 5) were significant ($P<0.05$) for femur weight, tibia/fibular weight, left and right weight of bone ash. Femur length, femur/tibia length, femur diameter and femur/tibia diameter were however not significant. Values of weight of femur bones were the highest in T1 at 5.55g. Also, the weight of tibia and fibula is highest in T1 (8.40g) and lowest in T2 (5.45g). The same occurrence in the length of femur, tibia and fibula bone was observed which indicate that T1 has the highest value (7.18g) and lowest in T4 (6.21g). However, for the diameter of the femur bone, T4 has the highest value (7.53g) while T2 has the lowest value (6.22g). Diameter of the tibia and fibula had the highest value of 6.56g in T4 and the lowest value of 5.24g in T2. The weight of the ash of right indicate the highest value at T2 (4.00g) and lowest in T4 (2.50g). However, the left ash shows that the treatment with the highest value was T1 (4.00g) and the one with the lowest was T4 (2.00g)

The utilization of egg shell by broilers as obtained in this studydoes not have detrimental effects on the birds. This result is supported by the previous reports of other researchers (Froning and Bergquist, 1990; Scheideler, 1998) in which feeding chicken eggshells as a Ca source to laying hens did not have detrimental effects on BW, feed intake, and egg production. There were significant ($P<0.05$) differences in feed intake, weight gain and feed conversion ratio in this findings across treatments as similarly reported by Skinner *et al.* (1992) and Kingori (2011).

The all non significant ($P<0.05$) differences of carcass characteristics of broilers chicken (table 4) from the present study also confirm the findings of Scheideler (1998) who reported that dried chicken eggshells could be used as the sole Ca source in poultry (broilers or layers) diets without detrimental effects. This same worker also noted that dried chicken eggshells had no effects on egg weight, albumen weight, yolk weight, and egg specific gravity.

There were significant ($P<0.05$) differences in some bone parameters (femur weight, tibia/fibular weight, left and right weight of bone ash). From the result, it shows that limestone (T1) have the highest value for all bone parameters (both the significant and non significant) followed by bone meal as similarly reported by Omole *et al.,*(2005) and Skinner *et al*., (1992). Skinner et al. (1992) worked on the effects of calcium and nonphytate phosphorus level fed during 42 to 56 days of age on performance and bone characteristics of male broilers.

CONCLUSION

Based on the results obtained in this study, it was concluded that though limestone and bone meal has the potentials of producing best percentages of bone characteristics of broiler chicken, the inclusion of bone meal, limestone, oyster shell, and egg shell up to 2.5% level in the diet has no adverse effect on performance, carcass and bones characteristic of broilers.It is therefore recommended that all the calcium sources used in this experiment can be used as alternate source in the diet of broiler chicken up to 2.5% and thus giving small scale poultry producers the option of using eggshell, bone meal, limestone and oyster shell as sourcesof calcium, phosphorus and other minerals for broiler chicken.

Table 1: Proximate Nutrient Composition of the Mineral Sources

MINERALS	ME (K/cal)	CP (%)	LYS (%)	METH (%)	CF (%)	Ca (%)	P (%)
Limestone	3049.88	19.02	0.72	7.84	5.19	1.18	0..44
Bone meal	3087.38	20.04	0.77	0.67	7.98	0.63	5.19
Oyster shell	2700/2800	18.9	0.05	0.15	4.16	4.05	0.57
Eggshell	3100	16	0.2	0.15	4.4	3.4	0.75

Table 2: Composition of Experimental Diets

Feed ingredient (kg)	T1	T2	T3	T4
Maize	52.04	52.04	52.04	52.04
GNC	32.01	32.01	32.01	32.01
Maize bran	5	5	5	5
Rice bran	2.5	2.5	2.5	2.5
Methionine	0.1	0.1	0.1	0.1
Lysine	0.1	0.1	0.1	0.1
Premix	0.25	0.25	0.25	0.25
Salt	1	1	1	1
Fish meal	1.5	1.5	1.5	1.5
Palm oil	3	3	3	3
Limestone	2.5	0	0	0
Oyster shell	0	2.5	0	0
Bone meal	0	0	2.5	0
Egg shell	0	0	0	2.5
Total	100	100	100	100
Calculated analysis				
ME	3049.88	3100	3087.38	3100
CP %	19.02	19	20.04	19
Lysine %	0.72	0.95	0.77	0.95
Methionine %	0.39	0.44	0.40	0.44
EE	7.84	10	7.98	10
CF	5.19	5	5.19	5
Ca	1.18	0.9	0.63	0.9

*premix, the vitamin- mineral premix supplied the following per 100kg of diet. Vitamin A 15,000 I.U, Vitamin D3 3000,000 I.U, Vitamin E 3000 I.U, Vitamin K 2.50mg, Thiamine, (B1) 200mg Riboflavin (B2) 600mg Pyridoxine (B6) 600mg, Niacine 40.0mg, Vitamin B1 2mg, Panthothenic acid 10.0mg, Folic acid 100mg, Biotic 8mg, Choline 50g, Anitioxidant 12.5g, Manganese 96g, Zinc 6g, Iron 24g, Copper 0.6g, Iodine 0.14g, Selenium 24g, Cobalt 214mg.

Table 3: Effect of the calcium sources on performance of broilers

Parameters	T1	T2	T3	T4	SEM
Feed intake	387.68c	464.64a	440.71b	432.86b	4.25*
Initial weight	775.00	950.00	1062.50	962.50	39.72NS
Weight gain	273.79c	200.00bc	362.50ab	395.64a	21.07*
FCR	2.33a	3.02a	2.91a	1.18b	0.86*
Survival	95.61	95.32	93.29	95.00	0.86NS

meansfollowed by the same letter(s) are not significantly different (p>0.05) ; SEM: Standard Error of Mean

Table 4: Effect of the different minerals sources on the carcass characteristics of broilers

Parameters	T1	T2	T3	T4	SEM
Live weight (Kg)	1.8	1.3	1.9	1.5	0.21NS
Weight gain (Kg)	1.35	0.85	1.45	0.9	0.32 NS
Dressed weight (Kg)	1.6	1.2	1.7	1.3	0.43 NS
Head (g)	43.7	33.3	37.1	37.6	0.44 NS
Neck (g)	86.8	61.5	60.9	77.0	0.22 NS
Wings (g)	123.1	92.0	101.9	118.5	0.33 NS
Breast (g)	324.6	202.0	221.9	243.2	0.65 NS
Back (g)	237.1	142.2	175.9	210.5	0.47 NS
Thigh (g)	169.3	122.8	142.0	143.0	0.14 NS
Drum stick (g)	159.6	105.8	108.2	133.5	0.55 NS
Shank (g)	80.6	57.8	65.2	82.0	0.65 NS

Table 5: The effects of different mineral sources on bone characteristics of broilers

Parameters	T1	T2	T3	T4	SEM
Femur weight (g)	5.55 a	3.65 b	4.55 a	4.50 a	0.37*
Tibia/Fibula weight (g)	8.40 a	5.45 b	6.60 ab	7.20	0.66*
Femur length (cm)	7.19	6.64	6.48	6.21	020NS
Tibia/Fibula length (cm)	9.96	9.28	9.51	9.97	0.26NS
Femur diameter (mm)	6.71	6.22	7.22	7.54	0.46 NS
Tibia/Fibula diameter (mm)	6.28	5.24	5.91	6.56	0.30 NS
Left weight of ash (g)	4.00a	3.00ab	3.00ab	2.00b	0.31*
Right weight of ash	3.00ab	4.00a	3.00ab	2.50b	0.23*

meansfollowed by the same letter(s) are not significantly different (p>0.05) ; SEM: Standard Error of Mean

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