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Performance and Serum Biochemistry of Broiler Birds Fed Egg Shell Meal and Bone Meal Inclusions

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Abstract
Ninety six (96) day old chicks, randomly allocated into four treatments with 3 replicates each containing eight birds were used for a 5-week feeding trail to evaluate the performance and serum biochemistry of broiler birds fed eggshell meal (ESM) and bone meal (BM). Four experimental diets T_1 (control diet), T_2, T_3 andT_4 containing 3.00%BM, 0.00%ESM, 2.00% BM,1.00%ESM,1.00%BM, 2.00%ESM, 0.00%BM and 3.00% ESM respectively, were formulated for both starter and the finisher diets. Completely Randomized Design was used and data obtained were subjected to ANOVA and significant means were separated using Least Significant Difference. At the starter phase, apart from Feed conversion ratio (FCR) and feed cost per kg gain, all other parameters were not significantly affected. Treatments 1 and 2 were significantly similar and higher than T_3 and T_4. All the parameters analysed at the finisher phase apart from initial weight and cost benefit ratio were significantly affected by the experimental diets. T_1 was significantly higher than the other treatments for final weight, weight gain, feed conversion ratio and feed cost per kg gain. None of the serum parameters analysed was significantly affected by the experimental diets. Treatments 2 and 1 are recommended since T_2 and T_1 had the best performance at starter and finisher phases respectively. The use of egg shell meal in place of bone meal is therefore advised since it is free and can replace bone meal in broiler diet.

Keywords: egg, shell, inclusions, broilers and performance

Introduction

Studies on the evaluation of alternative sources of feed have been more concerned with energy and protein stuffs. Not much has been made on local alternative sources for the major mineral nutrients like calcium and phosphorus. The main sources of calcium are oyster shells, bone meal, limestone and di-calcium phosphate (Iheukwumere and Emenalom, 2004). McDonald *et al*. (1992) noted that calcium and phosphorus represent the third most expensive nutrient after energy and protein. The diversions of bones into other uses like the manufacture of glass, gelatines and fertilizers have compounded the problem of organic sources of calcium and phosphorus in livestock industry especially bone ash (Adewoye, 1982).

According to Aduku and Olukosi (2000), Nigeria produces about 55.9million eggs annually; this implies that over 250 metric tons of the shells are produced as by-product. Eggshell meal can be available in large quantities from hatcheries (FAO, 2013). Eggshell could also be gathered free of charge in fairly large quantities from those who engage in the sales of fried egg, tea and bread, popularly known as *Mai shia.* The main ingredients in eggshell is calcium carbonate (the same brittle white stuff that chalk, limestone, cave stalactites, sea shells, coral and pearls are made of). The shell itself is about 95% calcium carbonate (which is also the main ingredient in sea shells). The remaining 5% includes calcium phosphate and magnesium carbonate and soluble and insoluble protein (Senese, 2010).

This study is worthwhile considering that egg shell is freely available in adequate quantity and will constitute environmental waste if not properly harnessed.

Materials and Methods

This study was carried out at the Poultry Unit of the Teaching and Research Farm of the Department of Animal Production, Kogi State University Anyigba, Kogi State. Anyigba is located in the derived savanna zone of Nigeria on latitude 7º30[1] N and Longitude 7º09[1] E. The area falls within tropical wet and dry climate region and guinea savannah with average annual rainfall of 160mm the daily temperature range is about 25 ºC-35 ºC (Ifatimehin *et al.,* 2011). The test ingredient (egg shell) was sourced locally from food vendors in Anyigba metropolis. The egg shells were washed with clean water without removing the shell membranes. The eggshells were sterilized with hot water and sun-dried. The eggshell were milled with a milling machine to form the eggshell meal and then mixed with the other ingredients to compound the broiler diets.

Four experimental diets T_1, T_2, T_3 and T_4 were formulated for the starter phase with 23% crude protein and finisher phase with 20% crude protein. Bone meal and egg shell meal were included at ratios; 3.00: 0.00, 2.00: 1.00, 1.00%: 2.00 and 0.00%: 3.00% respectively in the broiler starter and finisher diets. A multipurpose enzyme (Bergazym p.) was added at 0.63 g per 25 kg of feed. All micro-nutrients were included at the recommended levels to meet the requirements of the birds as prescribed by Oluyemi and Robert (2000). A total number of 96 day old chicks were purchased and used for this study. Each treatment had 24 birds and each treatment was replicated thrice with 8 birds per replicate. Heat was provided with kerosene stoves and charcoal stove, feed and water were provided to the broilers *ad libitum* while additional illumination was provided at night using electricity. Also, the broiler chicks were pre-fed for duration of two weeks before the commencement of the starter phase which lasted for two weeks and were fed for duration of three weeks for the finisher phase respectively. Blood samples for serum analysis were collected at the end of the feeding trial into Ethylene Diamine triacetate (EDTA) free bottles. Samples were taking for analysis at Grimmard Hospital, Anyigba, Kogi State as described by Riesman and Frankel (1957).

Data obtained were subjected to one way analysis of variance (ANOVA) contained in SPSS (2010). Significant mean levels were separated using Least Significant Difference.

Results and Discussion

In Table 1, (starter phase), only FCR and feed cost per kg gain were significantly ($p<0.05$) affected by the experimental diets. All other parameters were not significant ($p>0.05$) affected. Feed conversion ratio and feed cost per kg gain for T_1 and T_2 were significantly similar and higher than those of T_3 and T_4. For the finisher phase as shown in Table 2, all the parameters apart from initial weight and cost benefit ratio were significantly ($p<0.05/p<0.01$) affected by the experimental diets. The final weights and total weight gainfor birds on T_1 and T_3 were statistically similar and higher than the others. Feed conversion ratio and feed cost per kg gain were significantly better for birds on T_1. There was no significant difference ($p>0.05$) in all the serum parameters analysed as shown in Table 3.

Table 1: Performances of broiler starter fed eggshell meal and bone meal

Parameters	T_1	T_2	T_3	T_4
INWT (g)	327.33± 1.20	327.67± 1.20	326.33 ±3.76	322.33 ± 3.84
FWT (g)	719.67±10.71	761.00±5.00	719.67±22.24	703.67 ± 6.96
TWTgain (g)	392.34±11.67	433.33±5.81	393.34±21.06	381.34±2.91
WG/WK (g)	196.17±5.83	216.67±2.95	196.67±10.53	190.67±1.45
WG/Day(g)	28.02 ±0.83	30.95±0.42	28.09±1.50	27.33 ±0.21
TFI(g)	1404.33±18.82	1478.67±11.35	1543.00±36.72	1666.33±11.39
TFI/WK(g)	702.17±9.41	739.33±5.67	739.33±5.67	833.17±5.61
TFI/Day(g)	100.31±1.34	105.62±0.81	110.22±2.62	119.02±0.81
FCR	3.58±0.10 ^{a}	3.41±0.09^{a}	3.92±0.13^{b}	4.36±0.08 ^{c}
FC/Kg(₦)	87.29±0.59	85.70±0.01	84.09±0.12	82.49±0.58
FC/Kg gain(₦)	312.50±0.00^{a}	292.24±0.12^{a}	329.63±0.00^{b}	359.66±0.57^{c}

abc Means in the same row with different superscripts differ significantly ($p<0.05$).

Table 2: Performances of broiler finisher fed eggshell meal and bone meal

Parameters	T_1	T_2	T_3	T_4
INWT(g)	719.67±10.71	761.00±5.00	719.67±22.24	704.67±7.13
FWT(g)	2172.67±92.45^{a}	1909.67±30.95^{b}	1999.00±29.51 ^{a}	1926.00±66.25^{b}
TWTGAIN(g)	1453.00±81.45^{a}	1148.67±30.60^{b}	1279.33±24.52^{ab}	1221.33±60.84^{b}
WG/WK(g)	484.33±20.45 ^{a}	382.89±7.65 ^{b}	426.44±6.13^{ab}	407.15±15.21 ^{b}
WG/DAY(g)	69.19±3.89 ^{a}	54.70±1.46 ^{b}	60.92±1.68^{ab}	58.16±2.81 ^{b}
TFI(g)	3244.00±13.61^{c}	3267.67±48.17^{c}	3448.33±54.56^{b}	3831.33±13.86^{a}
TFI/WK(g)	1081.33±3.40 ^{c}	1089.22±12.04^{c}	1149.44±13.64 ^{b}	1277.11±3.47 ^{a}
TFI/DAY(g)	154.48±0.65 ^{c}	155.60±2.29 ^{c}	164.21±2.60 ^{b}	182.44±0.67 ^{a}
FCR	2.24±0.12 ^{a}	2.85±0.12^{ab}	2.69±0.09^{b}	3.14±0.21^{c}
FC/Kg(₦)	67.21±0.58	65.61±0.00	64.99±0.58	63.39±0.58
FC/kg gain(₦)	150.55±0.01^{a}	186.99±0.58^{ab}	174.82±0.06^{b}	199.04±0.58^{c}
CBR	1.17± 0.032	1.08± 0.032	1.12± 0.04	1.09± 0.067

abc means in the same row with different superscripts differ significantly ($p<0.05$), INWT(g); initial weight FWT(g); final weight, TWTGAIN(g);weight gain WG/WK; weight gain per week, WG/DAY(g); weight gain per day, TFI(g); total feed intake, TFI/WK(g); total feed intake per day. FCR; feed conversion ratio FC/kg (₦); feed cost per kg, FC/Kg gain (₦); feed cost per kg gain CBR; cost benefit ratio.

Generally, the similarities in some of the parameters for birds on control diet (T_1) and those fed the test diet (egg shell meal) as in T_2 and T_3 (for parameters like FCR and feed cost per kg gain in the starter phase and final weight and total weight gain for the finisher phase) suggest that egg shell compared favourably with bone meal. Egg shell meal did not have any adverse effect on the birds. Results from this study disagrees with the report of Rahman *et al*. (2003) who fed poultry birds with hatchery by-product (egg shell) instead of fish meal and recorded significant increase in weights. At the starter phase birds on $T_1$and T_2 converted less feed to more flesh. At the finisher phase, birds on $T_1$and T_3 gained more weight than those on the other treatments. The non-significance in the serum parameters could also mean that the inclusion of eggshell meal did not have any adverse effect on them.

Table 3: Serum biochemistry of broilers fed bone meal and eggshell meal

Parameters	T_1	T_2	T_3	T_4
U (mmol/L)	1.65±5.91	1.45±13.08	1.32±9.85	1.46±11.81
Ch (mg/dl)	105.58±22.01	130.03±36.70	87.40±8.86	69.12±19.02
Cr (iu/l)	42.12±4.49	69.53± 8.12	61.53±11.87	48.57±3.75
P (g/L)	74.77±18.34	92.55±3.31	74.87±16.62	87.00±14.55
GL (mmol/L)	11.05±1.26	11.75±0.33	11.25±2.43	11.48±1.03

U: Urea, Ch: Cholesterol, Cr: Creatnine, P: Protein and GL: Glucose

Conclusion

Egg shell meal can be utilized by broiler chicken when properly processed and sun dried. This process does not have any adverse effect on the performance and serum biochemistry of broiler birds. Treatments 2 and 3containing bone meal and egg shell meal inclusion at graded levels of 2.00 and 1.00 and 1.00 and 2.00 respectively are recommended. The utilization of egg shell to furnish calcium and phosphorus in broiler diet is strongly advocated since egg shell is free and readily available.

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