Growth Performance and Carcass Characteristics of Broiler Chickens Fed Palm Bunch Ash Supplemented Diets

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Abstract

Eight weeks feeding trial was carried out using a total of one-hundred-and-twenty-day old broiler chicks to assess the growth performance and carcass characteristics of broiler chicks fed palm bunch ash supplemented diets. Four experimental diets (T1, T2, T3, T4) were formulated such that the control had no palm bunch ash (PBA) whereas the other three diets contained graded levels of PBA at 0.05, 0.10, 0.15kg/100kg for starter and 0,10, 0.15, 0.20kg/100kg for finisher diets in partial replacement of common salt. Data on growth rate, live weight, feed intake and mortality were collected while feed conversion ratio was calculated. At the starter phase, T2 birds (0.10 kg PBA/100kg of feed) recorded significantly (P<0.05) higher final body weight (733.25g) and weight gain (993.94g). It followed the same trend in the finisher phase which also recorded significantly (P <0.05) higher final body weight (2700.00g) and weight gain (1966.75g). However, T4 (0.15kgPBA/100kg feed) birds in both phases recorded significantly higher (P<0.05) feed intake but without corresponding increase in weight compared to other groups. T2 group recorded significantly higher (P<0.05) dressed weight, breast, back formation and wings percentage values than the control, Therefore, PBA supplementation of broiler diets has positive effects on growth and edible carcass cut.

Keywords: Broiler chickens, Growth, palm bunch ash, minerals, carcass

Performance de Croissance et Caractéristiques des Carcasses de Poulets de Chair Nourris avec des Régimes Supplémentés en Cendres de Palme

Résumé

Un essai d'alimentation de huit semaines a été réalisé sur un total de poussins de chair âgés de cent vingt jours pour évaluer les performances de croissance et les caractéristiques des carcasses de poussins de chair nourris avec un régime enrichi en cendres de palme. Quatre régimes expérimentaux (T1, T2, T3, T4) ont été formulés de telle sorte que le contrôle ne contenait pas de en cendre de palme (CP), tandis que les trois autres régimes contenaient des niveaux progressifs de RCP à 0,05, 0,10, 0,15 kg/100 kg pour le démarrage et 0, 10, 0,15, 0,20kg/100kg pour les régimes de finition en remplacement partiel du sel commun. Des données sur le taux de croissance, le poids vif, la consommation alimentaire et la mortalité ont été collectées tandis que le taux de conversion alimentaire était calculé. Lors de la phase de démarrage, les oiseaux T2 (0,10 kg de CP/100 kg d'aliment) ont enregistré un poids corporel final (733,25 g) et un gain de poids (993,94 g) significativement plus élevés (P < 0,05). Il a suivi la même tendance dans la phase de finition qui a également enregistré un poids corporel final significativement (P <0,05) plus élevé (2 700,00 g) et un gain de poids (1 966,75 g). Cependant, les oiseaux T4 (0,15 kg de CP/100 kg d'aliment) dans les deux phases ont enregistré une consommation alimentaire significativement plus élevée (P < 0,05), mais sans augmentation de poids correspondante par rapport aux autres groupes. Le groupe T2 a

enregistré des valeurs de poids habillé, de formation de poitrine, de dos et d'ailes significativement plus élevées (P <0,05) que le groupe témoin. Par conséquent, la supplémentation en CP des régimes alimentaires des poulets de chair a des effets positifs sur la croissance et la découpe des carcasses comestibles.

Mots-clés : Poulets de chair, Croissance, cendres de palme, minéraux, carcasse

Introduction

Mineral electrolytes are commonly known to support a host of body physiologic functions and processes including synthesis of tissue proteins, maintenance of intracellular and extra cellular homeostasis, maintenance of ionic potential across cell membranes and organelles, driving of enzymatic reactions, osmotic pressure regulation and acid-base balance among others (Borges *et al*.,2004; Unamba- Oparah *et al*., 2017). Most of the natural feedstuff used in intensive poultry production contain some minerals. However, supplemental minerals are provided in various forms including salt, trace mineralized salt, oyster shell, limestone, bone meal and a wide variety of other forms (Power and Horgan, 2007; Oso *et al*., 2011). Majority of the minerals used in supplementing intensively farmed animals come from rocks and often are thought of as inert, inorganic substances. These naturally occurring minerals are most often mined in their most unstable states and later processed or used directly in animal feed manufacture (Rodrigues, 2010; Okoli *et al*., 2014).

There are many agricultural wastes materials generated from agricultural activities that are littered all over the environment. Some of these agricultural wastes constitute disposal challenge to farmers (Isreal and Akpan, 2016). Plant ash has been shown to be a rich source of macro (Ca, K, P, Na) and trace mineral elements (Fe, Cu, Zn), for improved mineral nutrition in livestock (Ndlovu, 2007; Saccomani *et al*., 2016; Ohanaka *et al*., 2022). Ash derived from plantain biomass has been shown to enhance dietary mineral elements, absorption and edible carcass development (Nwogu *et al*., 2014; Okoli *et al*., 2014). However, as the supplementation levels increases, it lowers feed intake and laying performance. More recent reports have shown enhanced growth, carcass and organ development in broiler starter and finisher chickens fed diets with supplemental palm kernel shell ash (Ohanaka *et al*., 2022). This is an indication that plant ash may have some promise in broiler production. There is need to evaluate the benefits of different ash sources in broiler production. The objective of this study is to determine the growth performance of broiler chickens to supplemental empty palm bunch ash.

Materials and method

Ash preparation and analysis

Palm bunches whose fruits had already been harvested were collected from a palm oil mill located at Umuagwo in Ohaji Egbema LGA, Imo State, Nigeria. The empty palm bunches were gathered, cleaned, sundried and ashed. The ash was sieved and thereafter mixed with water in a plastic bowl to dissolve it. The mixture was allowed to settle for about two days. Thereafter, the product was sieved through a cloth or polythene woven sack and the liquid allowed to drain out. The undissolved solid product was sundried for about 6 days. The mineral concentrations of the PBA material were determined using the Atomic Absorption Spectrophotometer (Spectrum Lab Model 23_A) as described by (AOAC, 2003). Concentrations of metals such as Calcium (Ca), Magnesium (Mg), Potassium (K), Phosphorus (P), sodium (Na), Manganese (Mn), Zinc (Zn), Copper (Cu), Iron (Fe), Cobalt (Co), Cadmium (Cd) Chromium (Cr) and lead were determined.

Experimental Birds and Diets

One hundred and twenty unsexed Abor Acre day old broiler chicks were purchased from a

reputable local hatchery. The birds were divided into four treatment groups of thirty birds and each group was further replicated three times with ten birds per replicate in a completely randomized design. Four experimental diets were formulated and were offered to the birds such that the control diet had no PBA, whereas the other three diets contained graded levels of PBA at 0.05, 0.10, 0.15 kg/100kg for starter and 0.10, 0.15, 0.2 kg/100kg for finisher feeds in partial replacement of common salt (Tables 1 and 2). All other ingredients were of equal proportions across the test diets. Again, the calculated nutrient values of the experimental diets were determined.

Table 1: Ingredient composition of PBA supplemented diets in broiler chicks (starter phase)

Ingredients	T1	T2	T3	T4
Maize	**42.00**	**42.00**	**42.00**	**42.00**
Wheat offal	**4.60**	**4.60**	**4.60**	**4.60**
Soya bean meal	**35.00**	**35.00**	**35.00**	**35.00**
Brewers dried grain	**7.50**	**7.50**	**7.50**	**7.50**
PKC	**5.00**	**5.00**	**5.00**	**5.00**
Fish Meal	**2.50**	**2.50**	**2.50**	**2.50**
Ash	**-**	**0.05**	**0.10**	**0.15**
Bone meal	**2.50**	**2.50**	**2.50**	**2.50**
Premix	**0.25**	**0.25**	**0.25**	**0.25**
Lysine	**0.20**	**0.20**	**0.20**	**0.20**
Methionine	**0.20**	**0.20**	**0.20**	**0.20**
Salt	**0.25**	**0.20**	**0.15**	**0.10**
Total	**100.00**	**100.00**	**100.00**	**100.00**
Nutrient calculated				
Crude protein	**24.00**	**24.00**	**24.00**	**24.00**
Crude fibre	**5.02**	**5.02**	**5.02**	**5.02**
Ash	**4.43**	**4.43**	**4.43**	**4.43**
Calcium	**0.96**	**0.96**	**0.96**	**0.96**
Phosphorus	**0.91**	**0.91**	**0.91**	**0.91**
Met. Energy (ME. Kal/kg)	**2725**	**2725**	**2725**	**2725**

Vitamin premix contains the following per kg of feed: Vit A = 5,000,000IU, Vit D3 = 1,000,000IU, Vit E = 1875IU, Vit K = 1255gm, Thiamin (B1) = 0.6255gm, Riboflavour = 1.875gm, Calcium panthothenate = 2.8kg, Nicotinic acid = 5.625gm, Pyridoxin = 0.625gm, Vit B12 = 5gm, folic acid = 0.31gm, Biotin = 0.1gm, Cholin chloride = 150gm, methionine = 75gm. Manganese = 5gm, Iron = 10gm, Copper = 1.5gm, Iodine = 0.5gm, Cobalt = 1.0gm, Selenium = 0.05gm, Antioxidiane 50gm, Antimold = 7.5gm, Nigrovin = 10gm, lysine = 75gm.

Table 2: Ingredient composition of PBA based diets in broiler chicks (Finisher phase)

Ingredients	T1	T2	T3	T4
Maize	**50.00**	**50.00**	**50.00**	**50.00**
Wheat offal	**5.28**	**5.28**	**5.28**	**5.28**
Soya bean meal	**25.00**	**25.00**	**25.00**	**25.00**
Brewers dried grain	**8.17**	**8.17**	**8.17**	**8.17**
PKC	**5.65**	**5.65**	**5.65**	**5.65**
Fish meal	**2.50**	**2.50**	**2.50**	**2.50**
Bone meal	**2.50**	**2.50**	**2.50**	**2.50**
Premix	**0.25**	**0.25**	**0.25**	**0.25**
Lysine	**0.20**	**0.20**	**0.20**	**0.20**
Methionine	**0.20**	**0.20**	**0.20**	**0.20**
Salt	**0.25**	**0.15**	**0.10**	**0.05**
Ash	**-**	**0.10**	**0.15**	**0.20**
Total	**100.00**	**100.00**	**100.00**	**100.00**
Nutrient calculated				
Crude protein	**22.00**	**22.00**	**22.00**	**22.00**
Crude fibre	**5.3**	**5.3**	**5.3**	**5.3**
Ash	**4.02**	**4.02**	**4.02**	**4.02**
Calcium	**0.91**	**0.91**	**0.91**	**0.91**
Phosphorus	**0.85**	**0.85**	**0.85**	**0.85**
Met. Energy (ME. Kal/kg)	**2705**	**2705**	**2705**	**2705**

Vitamin premix contains the following per kg of feed: Vit A = 5,000,000IU, Vit D3 = 1,000,000IU, Vit E = 1875IU, Vit K = 1255gm, Thiamin (B1) = 0.6255gm, Riboflavour = 1.875gm, Calcium panthothenate = 2.8kg, Nicotinic acid = 5.625gm, Pyridoxin = 0.625gm, Vit B12 = 5gm, folic acid = 0.31gm, Biotin =

0.1gm, Cholin chloride = 150gm, methionine = 75gm. Manganese = 5gm, Iron = 10gm, Copper = 1.5gm, Iodine = 0.5gm, Cobalt = 1.0gm, Selenium = 0.05gm, Antioxidiane 50gm, Antimold = 7.5gm, Nigrovin = 10gm, lysine = 75gm.

Data collection and analysis

The initial live weights of the birds were taken at the beginning of each experiment and at weekly intervals thereafter. Feed intake, weight gain and feed conversion ratio were determined according to the procedures of McDonald *et al*. (2011). At the end of the finisher phase of the experiment (8weeks), a bird from each replicate of the groups was randomly selected, weighed and slaughtered after fasting them overnight and used for the determination of carcass. The slaughtered birds were allowed to bleed cleanly before processing. The cuts that are determined included breast muscle, thigh, drumstick, wing, back formation and shank. The weight of each of these were expressed as percentages of live weight of the bird. Data collected on the different parameters were subjected to statistical analysis using analysis of Variance (ANOVA) and differences between the treatment means were compared using the Duncan's Multiple Range Test using Statistical Package for Social Sciences (SPSS) User's Guide, Version 24.00. (SPSS, 2012).

Results and discussion

Mineral concentration in palm bunch ash

Mineral concentrations in the palm bunch ash are shown in table 3. The major minerals were K (164,300.00mg/kg), Ca (74,700.00mg/kg), P (37,800.00mg/kg) and Mg (41,800.00mg/kg) with Cadmium having the lowest (3.51mg/kg). The result is in agreement with some previous work (Nwogu *et al*., 2014; Van Ryssen and Ndlovu, 2018; Ohanaka *et al*., 2022) that K, Ca, Mg and P are the major mineral components in plant ash, The high concentration of K indicate the possibility of these plants to be natural accumulators of potassium (Ohanaka *et al*., 2022).

Table 3: Mineral concentrations in the palm bunch ash

Parameters	PBA
P (mg/kg)	**37,800**
Ca (mg/kg)	**74,700**
Mg (mg/kg)	**41,800**
K (mg/kg)	**164,300**
Na (mg/kg)	**11,800**
Mn (mg/kg)	**1817.54**
Fe (mg/kg)	**1448.22**
Cu (mg/kg)	**303.17**
Zn (mg/kg)	**507.92**

Co (mg/kg)	**0.00**
Cr (mg/kg)	**108.98**
Cd (mg/kg)	**3.51**
Lead (mg/kg)	**0.00**

Growth performance characteristics of starter broilers

The growth performance data of broiler chicks fed PBA supplemented diets for starter phase is shown in table 4. T2 birds recorded significantly higher ($p<0.05$) final body weight, and weight gains. Again, T3 and T4 birds ate significantly more feed ($p>0.05$) than the control birds, while T2 feed intake was also similar to that of the control, T3 and T4. The best FCR was recorded by T2 indicating that the birds in this group ate similar amount of feed with the other groups to produce better growth performance results. The high feed intake of birds in T4 was however without corresponding increase in weight, compared to the other groups.

Table 4: Growth performances of broiler chicks fed starter diets supplemented with PBA

Parameters	T1	T2	T3	T4	SEM
Initial weight (g)	**40.01**	**39.31**	**40.21**	**40.05**	**1.38**
Final weight (g)	**701.02^{b}**	**733.25^{a}**	**667.00b^{c}**	**667.50^{bc}**	**18.6**
Weight gain (g)	**661.01^{b}**	**693.94^{a}**	**626.79^{b}**	**627.45^{b}**	**17.95**
Avg. daily weight gain (g)	**25.68^{a}**	**25.62^{a}**	**24.94^{b}**	**20.36^{c}**	**0.71**
Feed intake (g/bird/day)	**45.00^{b}**	**48.15^{ab}**	**49.48^{a}**	**51.34^{a}**	**0.93**
Feed conversion ratio (FCR)	**1.79^{b}**	**1.75^{b}**	**1.80^{b}**	**1. 93^{a}**	**0.09**

Means with different superscript on the same horizontal row are significantly different @$p< 0.05$

The present results of increasing feed intake in response to increasing ash supplementation level is contrary to the earlier reports of the reverse trend by Nwogu *et al*. (2014) and Ohanaka *et al*. (2018b) in laying hens, and broilers. The higher feed intake by the T3 and T4 birds however did not correspond to better growth performance results. The growth performance results tended to reduce beyond 0.15kg/100kg diet (T3) supplementation level although values were still similar to the control diets.

The growth performance results of broiler finisher chickens, fed diets supplemented with PBA are shown in table 5. At 8 weeks (4 weeks of finisher diets), T2 recorded the best final body weight (2700.00g) and weight gain (1966.75g) but similar feed intake with T4, which were significantly higher than the values recorded in the other groups. The T3 groups recorded the second-best values, although, it also returned the best FCR, which was significantly lower than others. The T4 group again, recorded the most inferior growth performance results with the

exception of its feed intake results which was significantly high and similar to the T1 and T2 values. Saccomani *et al*. (2016) fed firewood ash as calcium source to broilers for the first 21 days of life, and reported no adverse effects on the feed intake, final body weight, body weight gain, and FCR. Ohanaka et al. (2022) reported much lower 6-, and 8-weeks final body weight ranges (1227.78 – 1541.57g, and 2025.93 – 2346.25g respectively), and weight gains (534.66 – 748.53g and 1312.43 – 1497.46g respectively) in broiler fed diets supplemented with palm kernel shell ash than the corresponding values recorded in this study.

Table 5: Growth performances of finisher broilers fed diets supplemented with PBA

Initial weight (g)	**701.02**	**733.25**	**667.00**	**667.50**	**18.6**
Final weight (g)	**2550.00^{b}**	**2700.00^{a}**	**2500.00^{b}**	**2320.00^{c}**	**41.39**
Weight gain (g)	**1848.98^{b}**	**1966.75^{a}**	**1833.00^{b}**	**1652.50^{c}**	**35.09**
Avg. daily weight gain (g)	**66.04**	**70.24**	**65.45**	**59.02**	**1.01**
Feed intake (g/bird/day)	**129.17^{ab}**	**133.16^{a}**	**130.53^{b}**	**134.12^{a}**	**4.85**
Feed conversion ratio (FCR)	**2.62^{b}**	**2.88^{b}**	**2.39^{c}**	**2.93^{a}**	**0.24**

Means with different superscript on the same horizontal row are significantly different @P< 0.05

Carcass characteristics of broiler chickens fed PBA supplemented diets

The carcass characteristics of the birds fed PBA are shown in table 6. The T2 birds recorded significantly better values for all the carcass parameters measured with the exception of percentage weight of the head. The T2 values were significantly higher ($p<0.05$) than the control values except in its carcass weight, percentage thigh, and drumstick weights, which were similar. Again, the T2 values were significantly higher ($p<0.05$) than the values recorded in the other SFA supplemented group, except in their percentage breast, drumstick, and shank weights which were also similar. The results tend to suggest that the SFA supplementation promoted better breast, drum stick, and shank development, irrespective of the level of supplementation. Nwogu (2013) reported similar improvements in edible carcass parts in pullets fed diets supplemented with plantain stalk, and root base ashes. Ohanaka (2016) also reported similar results in broilers fed palm kernel shell ash supplemented diet, with effects being most evident on the thigh, wing, drum stick and shank values. These effects may be partially attributed to better bone formation in these carcass parts. The present range of 81.88 – 85.22% dressed weight is higher than the value range of (72.38 – 75.75%) reported by Ohanaka (2016) for broilers fed palm kernel shell ash supplemented diets. Egenuka *et al*. (2013) also reported a lower range of (60.98 – 66.52%) for palm kernel cake fed broilers, while Obikaonu *et al*.(2013) also reported a range of 72.02 – 76.24% for broilers fed graded levels of Neem leaf meal. These results highlight the better carcass yield from the SFA supplemented broilers produced in this study.

Again, the breast weight results (21.52 – 22.93%) and drum stick (11.56 – 11.93%) were much higher than the range (16.78 – 18.96% and 9.54 – 10.54%) reported respectively by Ohanaka, (2016), indicating better edible cuts from the SFA supplemented birds.

Table 6: Carcass characteristics of finisher broilers fed SFA supplemented diets

Parameters	T1	T2	T3	T4	SEM
Live weight (g)	2550.00^{b}	2700.00^{a}	2500.00^{b}	2320.00^{c}	40.17
Carcass weight (g)	2088.00^{ab}	2301.00^{a}	2050.00^{bc}	1900.00^{c}	1.53
Dressed (%)	81.88^{b}	85.22^{a}	82.00^{b}	81.90^{b}	1.83
Breast (%)	18.42^{c}	22.93^{a}	22.23^{a}	21.52^{ab}	1.53
Back formation (%)	18.32^{b}	20.32^{a}	17.78^{c}	17.43^{c}	2.21
Wings (%)	8.67^{b}	9.63^{a}	8.93^{b}	8.52^{b}	1.10
Thigh (%)	11.66^{a}	11.52^{ab}	10.73^{c}	9.69^{c}	0.86
Drum stick (%)	9.64^{ab}	11.56^{a}	11.93^{a}	11.86^{a}	0.86
Neck (%)	3.61^{b}	4.95^{a}	3.93^{b}	4.22^{a}	0.45
Shank (%)	3.74^{c}	4.84^{a}	5.06^{a}	4.60^{ab}	0.52
Head (%)	2.44^{c}	2.63^{c}	3.53^{b}	3.76^{a}	0.15

Means with different superscript on the same horizontal row are significantly different @P< 0.05

Conclusion

This study was aimed at utilizing plant waste (PBA) as a useful mineral source for efficient animal feeding. It was concluded that PBA inclusion may yield more desirable result in meat type birds especially when included at 0.05kg/100kg feed and 0.10kg/100kg feed respectively.

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