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Production of feed grade ash from empty palm bunch and evaluation of its growth performance effects in post- hatch broilers

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Abstract

The study was undertaken to produce a palm bunch ash containing low concentration of potassium and to determine its effects on post-hatch broilers performance. Empty palm bunches were collected from a palm oil mill, cleaned, dried, and ashed. Two methods were used to produce low potassium ash from palm bunch ash which includes soaking, filtering and drying method (SFA); sieving and drying method (SDA). Each of the three ash samples were replicated three times in a completely randomized design (CRD). Physicochemical analysis for bulk density (BD), water holding capacity (WHC), and mineral concentrations of the three ash samples were carried out, and the data generated subjected to analysis of variance (ANOVA) and significant means separated using the Duncan's Multiple Range Test. The result showed that the soaked filtered and dried ash (SFA) recorded lowest potassium, and also sodium values among the three ash samples and was therefore selected as the appropriate low K ash to be used in the feeding trial. 120 Abor Acre day old chicks were divided into four groups of 30 birds each, which were again replicated three times in a completely randomized design (CRD). Four experimental starter diets (T1, T2, T3, T4) were formulated such that the control had no SFA, whereas the other three diets contained graded levels of SFA at 0.05, 0.10, 0.15kg/100kg in partial replacement of common salt. The experiment lasted for 4 weeks. Proximate and mineral compositions of the experimental diets were determined while physiological responses were assessed using growth performance of the post hatch broilers. Final body weight, weight gains and average daily feed intake were significantly higher ($p>0.05$) for T2 birds after 7 days of feeding the starter diets. Supplementation of post – hatch broilers diets with SFA at the 0.05, 0.10 kg/100kg diet level are recommended for improved growth performance.

KEYWORDS:
Broilers; Palm Bunch Ash; Minerals; Poultry Feed

1 | 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 regulations and acid base balance among others (Borges et al., 2004; Unamba- Oparah et al., 2017). They are therefore essential for optimizing animal nutrition, health, physiology and biochemistry. Among these electrolytes, the monovalent ions (K+, Na+, Cl-) are the key ones involved in acid- base balance of the fluids, because they have higher permeability and greater absorption potential in the digestive tract than divalent ions (Unamba- Oparah et al., 2017).

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). These wastes have however been known to contain mineral elements when ashed (Akunna et al.,2013). Information about the use of plant ash as mineral supplement in poultry diets is limited. However, recently such ash supplementation has been shown to enhance certain mineral elements absorption from diets fed to broilers, pullets and rabbits (Iwu, 2013; Ebere, 2013; Nwogu, 2013; Ohanaka et al., 2022). Ohanaka (2016) reported better growth efficiency ratio (GER) in broilers at all growth phases of dietary palm kernel shell ash supplementation, indicating enhanced nutrient utilization. The study also reported reduced production costs with increasing palm kernel shell supplementation mostly due to reduction in feed intake of birds without drastic reduction in weight gain. In spite of these benefits, reduced feed intake resulting in poor laying performance by laying hens and inferior growth performance in broiler chicken has been linked with higher inclusion levels of plant in animal diets (Nwogu,2013; Ohanaka, 2016). This problem has been traced to the high dietary electrolyte balance values of diets supplemented with plant ash due to high levels of potassium, sodium and chlorine in such diets (Ohanaka, 2016; Unamba – Opara et al., 2017). It is therefore believed that the reduction of these minerals in the plant ash processed for livestock feeding will yield better results. It has been reported that potassium is the major soluble mineral in palm bunch ash (Okonkwo et al., 2018a; Duruanyim, 2017), a reasonable percentage will be dissolved in the discarded solution. The study was undertaken to produce a feed – grade palm bunch ash and to determine its growth performance effects on the post – hatch broiler chicks. Given the role of high nutrient feed in improving poultry yield, profitability and a robust agribusiness sector, this study closes an important loop in the Nigerian poultry industry. The study demonstrates a readily available and easily access avenue for producing more efficient feed that would inevitably help reduce the cost of feed in the poultry industry and catapult the indigenous bird business to new dimensions of profitability.

2 | 2. MATERIALS AND METHODS

2.1 | Production of palm bunch ash (PBA)

Palm bunches from which fruits had already been harvested were collected from a palm oil mill located at Umuagwo in Ohaji Egbema LGA, Imo State. The empty palm bunch was gathered, cleaned to remove sand and other particles and sundried for seven to fifteen days. Thereafter, the palm bunch was burnt on a cement slab at midday to produce the ash. The ash was allowed to cool for a day. The palm bunch ash (PBA) so produced was gathered into a polythene sac and sealed to prevent moisture absorption (Nwogu et al., 2013).

To produce low potassium PBA, two methods were used. In the first method, the ash was sieved to remove unburnt parts and charcoal 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, and designated the soaked and filtered ash (SFA). The undissolved solid product was then sundried for about 6 days and stored in a polyethylene sac until needed for analysis.

In the second method, the sieved PBA was dissolved in water to form a paste. The ash paste was spread on polythene sheet and allowed to dry for six days. Thereafter, the ash yield was calculated and was designed sieved, and dried ash (SDA).

2.2 | Physicochemical analysis of the raw and processed PBA

Physical characteristics (Bulk density, water holding capacity, specific gravity, etc.) of the various ash samples (RA, SFA & SDA). pH and mineral elements (Ca, Mg, K, P, Na, Mn, Zn, Cu, Fe and Co) of RA, SFA & SDA were determined respectively. Completely randomized design was used and parameter measurements were analyzed in triplicates and data generated was subjected to analysis of variance (ANOVA) and means separated using the least significant difference (LSD) method (SPSS).

2.3 | Experimental animals and design

One hundred and twenty (120) Abor Acre day old broiler chicks were purchased from a reputable local hatchery. The birds were divided into four groups of thirty birds and each group was further replicated three times with ten birds per replicate in a completely randomized design (CRD). The birds were reared under proper feeding, medication and vaccination management as practiced at the Teaching and Research Farm of FUTO. During the various stages of the experiment, each group of birds were assigned to the treatment diets (T1, T2, T3, T4). The birds were given feed and water ad libitum throughout the experimental period of four weeks of starter feeding.

2.4 | Preparation of experimental diets

The feed ingredients used in the diet formulation were purchased from a reliable source at Owerri, Imo State. Four experimental diets (T1, T2, T3, T4) were formulated and offered to the birds such that the control diet had no SFA, whereas the other three diets contained graded levels of SFA at 0.05, 0.10, 0.15 kg/100kg for starter in partial replacement of common salt (Tables 1). 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 SFA supplemented diets in broiler chicks (starter phase)

Ingredients	T1 Control	T2 0.05% SFA	T3 0.10%SFA	T4 0.15% SFA
Maize	42.00	42.00	42.00	42.00
Wheat offal	4.60	4.60	4.60	4.60
Soya bean meal	35.0	35.0	35.0	35.0
Brewers dried grain	7.52	7.52	7.52	7.52
PKC	5.00	5.00	5.00	5.00
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. Kcal/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

2.5 | Data collection

On the seventh day of life, one bird each was taken from each replicate to determine their growth performance according to the procedure of McDonald et al., 2011. These birds were thereafter slaughtered and used to determine gastro intestinal tract (GIT) and liver development as well as GIT content pH using the method described by Ohanaka (2016). The GITs of slaughtered birds were carefully dissected out according to the method described by Ukwu (2013) and Ohanaka (2016) with each segment (crop, proventiculus, gizzard, small intestine and large intestine) tied with cotton thread to prevent mixing of content. Thereafter, the segments were sectioned at the tied positions and their content expressed carefully into clean and labeled test tubes. The different segments without their digesta content were weighed using an electronic weighing balance (LP 402A), and their weights expressed as percentages of original body weight.

2.6 | Statistical Analysis

Data collected were subjected to 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).

3 | RESULTS AND DISCUSSIONS

3.1 | Characteristics of Palm Bunch Ash Production

Several studies have shown that palm bunch ash (PBA) contains important mineral elements necessary for the optimal growth of poultry. Okonkwo et al (2018b) and Duruanyim (2017) showed that the major minerals in the ash are K, Na and Mg, with K being high in concentration. The percentage ash produced from the palm bunch waste was 4.36%, indicating that the palm bunch is a highly combustible material. Duruanyim (2017) however reported a slightly lower ash yield (3.14%) from palm bunches gathered from the same study site. The ash yield from the present study is however much lower than the 10.88%, and 21.12% reported for plantain stalk ash (PBA), and plantain root base ash (PRA) respectively by Nwogu et al. (2012), and also the 24% ash yield recorded by Ohanaka (2016) for palm kernel shell. The values for the dried palm bunch waste, ash yield, and combustible material are shown in table 2.

TABLE 2 Ash yield from palm bunch waste

Parameters	Values
Initial weight dried palm bunch waste (kg)	378
Weight of Ash after combustion (Kg)	16.5
Percentage ash yield (%)	4.36
Combustible material (Kg)	361.5
% combustible material	95.63

3.2 | Physical characteristics of PBA

The physical characteristics of the three different types of PBA produced in this study are summarized in table 3. These included the raw ash (RA), the soaked, and filtered ash (SFA), and the sieved, and dried ash (SDA) preparations. The moisture content (MC) of the RA, SFA, and SDA were 18.18, 17.31, and 19.79% respectively indicating relatively poor drying. The values are much higher than the 10.30 and 8.40% moisture recorded for palm bunch, and plantain peel ashes respectively by Duruanyim (2017), and the 7.30% reported for palm kernel shell ash by Ohanaka (2016). The SFA however recorded the lowest MC with dry matter content of 82.69%.

The packed bulk density (PBD), and loose bulk density (LBD) values recorded for the SFA were significantly higher ($p<0.05$) than the values recorded for the other two ash types, with the LBD value from RA also being significantly lower ($p<0.05$) than that of SDA. The variations across the ash types show that the treatments influenced the bulk density values of the palm bunch ash. The PBD value recorded for SFA is higher than that of raw PBA (Duruanyim, 2017), coconut shell ash (CSA) (Iwu et al., 2013), and palm kernel shell ash (Ohanaka, 2016).

The SFA recorded a significantly higher ($p<0.05$) specific gravity than the other ash types, indicating again the impact of the treatments on the ashes. Ohanaka (2016) and Iwu et al. (2013) however reported similar specific gravity values with those of RA and SDA. The SFA again, recorded the highest water absorption capacity (WAC), which was similar to the value of 0.897g water/ g ash reported for palm kernel shell ash by Ohanaka (2016). The value is however lower than the 2.10g water/g ash reported for CSA by Iwu et al. (2013) and the 11.88g water/g ash reported by Duruanyim (2017) for PBA, indicating that because of its high WHC, the ash could serve as an absorbent material. The SFA also returned the highest swelling power, and the lowest oil absorption capacity which were again significantly different from the others ($p<0.05$). These finding suggest that the soaking, and filtering treatment results in major changes in the physical characteristics of the palm bunch ash.

TABLE 3 CaptionPhysical characteristics of PBA

Parameters	RA	SFA	SDA	SEM
Moisture (%)	18.18^{ab}	17.31^{b}	19.79^{a}	0.44
PBD (g/ml)	0.600^{b}	0.990^{a}	0.587^{b}	0.71
LBD (g/ml)	0.317^{c}	0.663^{a}	0.450^{b}	0.05
Specific gravity	0.650^{b}	1.007^{a}	0.657^{b}	0.06
WAC (%)	0.734^{c}	0.860^{b}	0.114^{a}	6.09
OAC (%)	119.62^{b}	114.85^{b}	141.31^{a}	4.34
Swelling power (%)	142.98^{b}	163.99^{a}	115.95^{c}	7.04
Total solid	81.82^{ab}	82.69^{a}	80.21^{b}	0.45
Solubility %	0.00	0.00	0.00	0.00
Color intensity	VCS	VCS	VCS	VCS

Means with different superscript on the same horizontal row are significantly different @p< 0.05*Legend: PBD= Packed bulk density; LBD = Loose bulk density; WAC = Water absorption capacity; OAC = Oil absorption capacity; VCS = Very Colorless Solution

3.3 | Mineral characteristics of palm bunch ash

The results of the mineral content of palm bunch ash show that the raw palm bunch ash (RA) contained very high level of potassium followed by Ca, P, and Mg. However, soaking, filtering, and drying reduced the value of K in the two other samples (SFA, and SDA) significantly ($p<0.05$). The lowest K value of 119,900 mg/kg was however recorded in SDA, indicating that the desired K reduction was achieved through the two treatment methods. The treatments on the other hand tended to significantly increase ($p<0.05$) the concentrations of P, Ca, Mg, Mn, Cu, Fe and Cr, in the ashes while reducing the concentrations of K, Cd and Pb. The SFA treatment was able to significantly ($p<0.05$) reduce the Na concentration below the control value, while the SDA treatment increased it from 15800 to 87000 mg/kg. These results are in agreement with the reports of Ochetim (1998), Iwu (2013), Nwogu (2013), Ohanaka (2016), Duruanyim (2017), and Okonkwo et al (2018a) that wood ash is an excellent source of minerals.

The order of mineral abundance in the different ash samples are shown in figure I. Most of the changes in positions of the minerals as a result of the treatments occurred among the macro- minerals, and the heavy metals. Specifically, Pb and Cr could not be detected after the SDA treatment, while only Pb was lost after the SFA treatments. The treatments however did not affect the positions of micro minerals relative to the RA ash. The K remained the most abundant mineral in the ashes irrespective of the treatment method, SFA treatment moved P from position 3 to 4, while the SDA treatment moved it further to position 5, indicating major losses in phosphorus concentration. The SDA treatment also resulted in a major shift in the Na from position 5 to 2 relative to the raw ash. These results indicate that both SFA, and SDA with their significantly reduced K values could be used as low K ash supplement in poultry diets.

The SFA also recorded a much lower Na, Ca, Mg and P value than the SDA. Overall, the total anion contents from the macro - mineral (P, Ca, Mg, K and Na) across ash sample types were 338,100 mg/kg for raw ash (RA), 330,400 mg/kg for the soaked, filtered and dried ash (SFA) and 379,000 mg/kg for the soaked and dried ash (SDA) (Fig.2 & 3). Therefore, the SFA with its much lower K, and Na content as well as lower overall total cations content may be used to formulate diets with better electrolyte balance in poultry feed (Unamba- Oparaet al., 2017), thereby ameliorating the problem of reduced feed intake arising from increased inclusion levels of plant ash in poultry diets. Since the formular for the dietary electrolyte balance (DEB) is[(K+) +(Na+) -(Cl-) (Mercks, 2005; Mushtaq et al., 2013), the sum of K and Na in the various ash samples highlights further the efficiency of SFA, over the SDA samples in reducing the cation content of the raw ash.The mineral concentrations in the three samples of PBA are summarized in table 4.

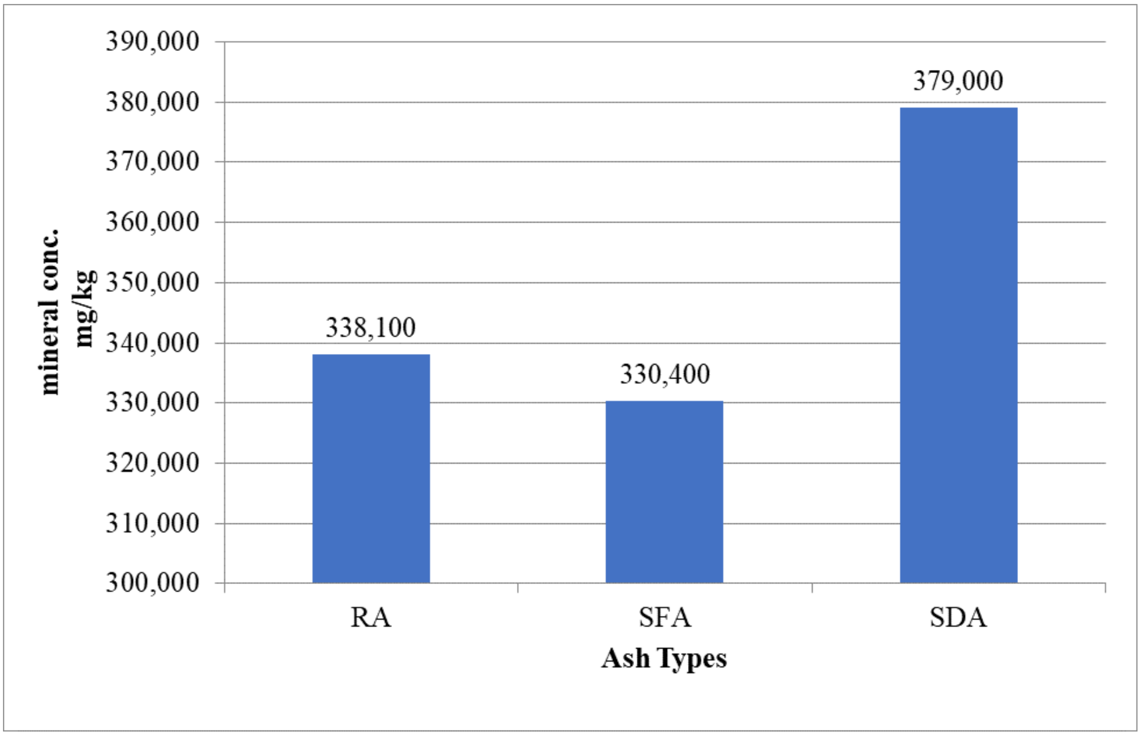
TABLE 4 Mineral concentrations in the palm bunch ash

Parameters	RA	SFA	SDA	SEM
P (mg/kg)	$30,200^c$	$37,800^b$	$46,300^a$	2332.73
Ca (mg/kg)	$55,500^c$	$74,700^b$	$77,300^a$	3436.90
Mg (mg/kg)	$26,900^c$	$41,800^b$	$48,500^a$	3204.60
K (mg/kg)	$209,700^a$	$164,300^b$	$119,900^c$	12664.31
Na (mg/kg)	$15,800^b$	$11,800^c$	$87,000^a$	12221.47
Mn (mg/kg)	1283.01*c*	1817.54^b	2136.44^a	124.65
Fe (mg/kg)	1038.92^b	1448.22^a	1474.15^a	70.66
Cu (mg/kg)	204.02^c	303.17^b	374.35^a	24.76
Zn (mg/kg)	375.25^c	507.92^b	586.29^a	30.87
Co (mg/kg)	0.00	0.00	0.00	0.00
Cr (mg/kg)	2.32^b	108.98^a	0.00^c	17.97
Cd (mg/kg)	4.57^a	3.51^b	2.67^c	0.38
Lead (mg/kg)	39.83^a	0.00	0.00	6.64

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

Figures
RA=K>Ca>P>Mg>Na>Mn>Fe>Zn>Cu>Pb>Cd>
SFA=K>Ca>Mg>P>Na>Mn>Fe>Zn>Cu>Cr>Cd
SDA=K>Na>Ca>Mg>P>Mn>Fe>Zn>Cu>Cd

FIGURE 1 The order of mineral concentrations in the three ash samples



3.4 | Proximate composition of SFA broiler starter supplemented diets

The results of the proximate composition of the experimental broiler starter diets are presented in table 5. The moisture values of the starter diets ranged from 12.00 to 12.50%, while the dry matter values ranged from 87.50 to 88%. Optimal moisture content of 12 - 15% has been recommended for poultry feeds produced in the tropics to prevent growth of fungal organisms (Okoli et al., 2007; Uchegbu et al., 2008), indicating that the moisture range in the diets is optimal. The crude protein (CP) content of the starter diets ranged from 23.66 -28.52% and were higher than the optimal range for broiler starter diets, especially for the Abor Acre broilers used in this study (Abor Acre, 2012). The T3 value was significantly higher ($p<0.05$) than the CP values of the other diets with T2, and T4 also being significantly higher ($p<0.05$) than the control value. It is possible that the variations in the CP contents may be due to inappropriate mixing of the ingredients, since the calculated value was 24.00% for each diet. Crude fat values in this study ranged from 3.15 – 4. 21%. The T2 and T3 diets recorded significantly higher ($p< 0.05$) values than T1 and T4. The reduction in the crude fat content of T4 may be attributed to the absorptive property of the SFA. These values were however lower than the range of 5.8 – 8.4% reported for commercial broiler starter diets produced in Nigeria (Okoli et al., 2007). Overall, the CP, crude fat, crude fiber, and total ash were significantly higher ($p<0.05$) in T2 and T3 diets than in the control diet but decreased in the T4 diets. The T2 diet also recorded significantly higher nitrogen free extract (NFE) than the other diets ($p<0.05$). The proximate fat, fiber, ash and NFE contents of the diets were however within the recommended dietary values for starter broilers production in the hot humid tropical environments (SON, 2003; Okoli et al., 2007).

TABLE 5 Proximate composition of experimental starter diets for broilers

Parameter	T1 Control	T2 0.05% SFA	T3 0.10% SFA	T4 0.15% SFA	SEM
Dry matter content %	87.56	88.00	87.50	87.58	0.20
Moisture %	12.44	12.00	12.50	12.42	0.09
Crude Protein %	25.61^c	23.66^d	23.52^a	26.72^b	0.51
Crude fat %	3.60^b	4.00^a	4.21^a	3.15^c	0.13
Crude fibre %	3.10^a	3.05^a	2.92^b	3.07^a	0.03
Total Ash %	12.54^c	13.02^b	15.78^a	12.47^c	0.41
NFE	42.71^b	44.05^a	36.06^c	42.17^b	0.93

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

3.5 | Seventh day performance characteristics: Growth performance

The results in table 6 showed the growth performance within seven days of feeding. At the end of seven days of feeding, both the final body weight, weight gains and average daily feed intake values were significantly higher in the T2 and T3 ($p<0.05$) chicks than the control chick values. The T4 results were however, inferior to the control results, but similar in feed intake, and feed conversion ratio (FCR). T2 and T3 also recorded significantly better FCR than T4. These results show that the birds fed diets supplemented with SFA at 0.10 and 0.15 kg/100kg diet outperformed the control, and the T4 birds. According to Gardner (2008), if broiler chicks achieve a seventh day body weight of 160 g or more, which is about 4.5 – 5 times the day-old chick weight, it indicates a good start. The final body weight results (102.36 – 120.75g) in this study are much lower. The increase in initial weight (2.56 – 3.07) is also much lower than the published temperate values. The values were however similar to the range of 2.69 – 3.11 reported in Abor Acre broilers fed diets supplemented with palm kernel shell ash (Ohanaka, 2016). Ukwu (2013) have shown that several stressors such as poor transport conditions, the hot humid tropical environment, low quality rations and delayed access to feed and water could cause the decrease in early growth of exotic chicks.

TABLE 6 Seventh day growth performance of broilers fed the SFA supplemented diets

Parameter	T1	T2 T3	T4	SEM	
	Control	0.05%	0.10%	0.15%	
		SFA	SFA	SFA	
Initial weight	40.10^{a}	39.31^{b}	40.21^{a}	40.05^{a}	0.11
Final weight	108.15^{c}	120.75^{a}	120.29^{b}	102.36^{d}	2.38
Weight gain	68.14^{c}	81.44^{a}	80.08^{b}	62.31^{d}	2.43
Av. daily weight gain	9.37^{c}	11.63^{a}	11.44^{b}	8.90^{d}	0.35
Av. Daily feed intake	15.10^{c}	15.70^{a}	15.45^{b}	15.05^{c}	0.09
FCR	1.55^{ab}	1.35b	1.35^{b}	1.69^{a}	0.06

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

3.6 | GIT and liver development

Table 7 showed the GIT and liver development after one week of feeding. The T2 birds recorded significantly higher ($p<0.05$) percentage proventriculus, gizzard, and liver weights than the other groups. The T2 birds also recorded significantly lower ($p<0.05$) crop weight than the others, while the T4 birds recorded significantly higher ($p<0.05$) value than the others. There was however no SFA treatment effect on the percentage intestinal weights. Ukwu (2013) reported that GIT had superior weight development over the overall body weight in broilers fed for 96 hours. At the end of this period, GIT increased in weight by 82.97%, while the body weight increased by 61.27%. Yadav et al. (2010) reported that GIT increase is driven more by proventriculus, gizzard, and small intestine increases than crop and large intestine increases. This implies that the higher crop, and intestinal weights recorded in the T4 birds should be seen as evidence of inferior GIT development, when compared with the other groups (Yadav et al., 2010; Ukwu, 2013). Ohanaka, (2016) reported the range of 0.90 – 1.32%, 4.15 – 4.93% and 4.63 – 5.42% for the proventriculus, gizzard and intestines from chicks fed diets supplemented with palm kernel shell ash. These value ranges are slightly lower than the results of the present study.

TABLE 7 Seventh day growth performance of broilers fed the SFA supplemented diets

Parameter	T1	T2 T3	T4	SEM	
	Control	0.05%	0.10%	0.15%	
		SFA	SFA	SFA	
Live weight (g)	133.83	122.33	127.27	119.33	2.69
Crop weight (%)	0.26^{c}	0.14^{d}	0.48^{b}	0.84^{a}	0.08
Proventriculus (%)	0.75^{b}	1.33^{a}	0.79^{b}	0.56^{b}	0.10
Gizzard weight (%)	3.99^{b}	5.44^{a}	3.95^{b}	4.46^{b}	0.22
Intestinal Weight (%)	6.44	7.94	6.53	7.02	6.98
Liver weight (%)	2.52^{b}	3.28^{a}	2.37^{b}	2.52^{b}	0.14

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

4 | APPLICATIONS AND IMPLICATIONS OF THE STUDY

Essentially, the success of poultry production depends on adequate feeding of quality feeds. Thus, any improvement in the performance of broilers and layers due to their diet is capable of increasing profitability. An important component of feed quality that has received limited industrial and research attention is the mineral quality of poultry diets formulated with alternative fed raw materials (Lopez- Alonso, 2012). Although birds have minimum requirement for the monovalent minerals (Na, K, Cl) provided by natural ingredients and electrolytes salts, the proper dietary balance should exist in order to help maintain acid-base homeostasis and best live performance

Most of the common sources of dietary electrolytes to the animals are electrolyte salts which are usually mixed as feed additives. Over formulation of poultry diets routinely with these mineral salts has been a common practice (Ohanaka et al., 2022). This is to ensure that adequate levels are fed and requirement met. However, high feed cost and mineral excretion in manure with the environmental pollution has raised serious concerns. The most reasonable solution to excessive mineral excretion is to make them more biologically available (Wang et al., 2019; Ohanaka et al., 2022). However, the commercially developed organic trace minerals/ chelated products which are readily in the market are very expensive and may not be easily assessed by small holder farmers in low-income countries like Nigeria (Ohanaka et al., 2022) They are even becoming scarce due to importation costs. Plant ash and in particular, palm bunch ash has been shown to be a rich source of macro (Calcium (Ca), Potassium (K), Phosphorus (P) and Sodium (Na) and trace elements (Iron (Fe), Copper (Cu), Zinc (Zn) for improved nutrition in livestock. It is cheaper, readily available and accessible.

CONCLUSION

This study was aimed at utilizing plant waste as a useful mineral source for efficient animal feeding. It therefore produced palm bunch ash that has reduced potassium and sodium concentration and also yielded a lower overall total anion. It was therefore supplemented in partial replacement of common salt. The T2 (0.10kg/100kg diet) and T3 (0.15kg/ 100kg diet) fed birds recorded superior values in growth and GIT development of post hatch broilers.

REFERENCES

1. Akunna, T. O., Ahaotu, E. O., Osuji, C. N. and Ibeh, C. C. (2013). Production of soap using palm bunch ash. International Journal of Applied Sciences and Engineering. 1(2): 79-82.
2. Duruanyim, V. O. (2017). Effects of plantain peels and oil palm bunch ash treatment on the physico chemical and organoleptic quality of beef. M. Sc. Thesis, Federal University of Technology, Owerri, Nigeria.
3. Ebere, C. S. (2013). The effects of coconut shell ash supplementation on aspects of the physiology of male rabbits. M. Sc. Thesis, Federal University of Technology, Owerri, Nigeria.
4. Iwu, A. N. (2013). The effects of coconut shell ash supplementation on aspect of the physiology of female rabbits. M.Sc. Thesis, Federal University of technology Owerri. Nigeria.
5. Iwu, A. N., Ebere, C. S., Ogbuewu, I. P., Etuk, I. F., Opara, M. N., Uchegbu, M. C., Okolie, I. C., Iheukwumere, F. C. and Herbert, U. (2014). Coconut shell ash as a mild agonist of reproductive organ development and sex hormone release in growing rabbits. Journal of Medical Science, 13: 563-570.
6. Lopez-Alonso, M. (2012). Trace minerals and livestock: Not Too Much Not Too Little. Veterinary of Science, 18:704 – 825.
7. McDonald, P., Edwards, R. A., Greenhalgh, J. F. D., Morgan, C. A., Sinclair, L. A. and Wilkinson, R. G. (2011). Animal Nutrition. Seventh edition. Prentice Hall. London
8. Merck's Veterinary Manual. (2005) www.merckvetmanual.com/mvm/index.htm.l.
9. Mushtaq, M., Pasha, T., Mushtaq, T. and Parvin, R. (2013). Electrolytes, dietary electrolytes balance and salts in broilers: An updated review on growth performance, water intake and litter quality. World's Poultry Science Journal. 69: 789-802.
10. Nwogu, C. M., Etuk, I. F. and Okoli, I. C. (2012). Ash from plantain stalk and root base as possible sources of organic minerals for poultry production. International Journal of Tropical Agriculture and Food System,6: 22-26.
11. Nwogu, C.M. (2013). Physiological responses of pullets fed commercial diets supplemented with varying levels of plantain stalk and root base ashes. M.Sc. Thesis, Federal University of Technology, Owerri, Nigeria.

12. Nwogu, C.M., Nwogu, R.K., Etuk, I.F., Okoli, I.C and Madubuike, F.N. (2014). Growth performance, carcass and organ characteristics of pullets fed plantain ash supplemented commercial diets. Media Peternakan. 37(1) 43-49.

13. Ochetim, S. (1988). Small-scale farming in Zambia. How to prepare local poultry feed. Misset International Poultry, 2(2): 36 – 37.

14. Ohanaka, A. U. C. (2016). Physiological response of broilers to dietary inclusion of palm kernel shell ash. MSc. Thesis, Federal University of Technology, Owerri, Nigeria.

15. Ohanaka, A. U. C., Etuk, I. F. and Okoli, I. C. (2015). Seventh day performance data as indicators of the value of palm kernel shell ash (PKSA) as a mineral supplement in broiler feeding. Proceedings of the 49th Annual Conference of the Agricultural Society of Nigeria, November 3-6, Asaba, Nigeria. Pp: 850-853.

16. Ohanaka, A.U.C., Duruanyim, V.O., Etuk, I.F., Uchegbu, M.C. and Okoli, I.C. (2017). Physico- chemical composition of palm kernel shell ash (PKSA) as a potential mineral supplement in livestock nutrition. Proceedings of the 42nd Annual Conference of the Nigerian Society for Animal Production, 42: 785- 789.

17. Ohanaka, A.U.C., Nwogu, C.M., Ogbuewu, I.P., Etuk, I.F., Uchegbu, M.C. and Okoli.I.C.(2022). Growth Performance and Carcass characteristics of Broiler Chickens fed supplemented palm kernel shell Ash. Nigerian Journal of Animal Science and Technology. Vol. 5 (2): 28 – 39.

18. Okoli, I. C., Nwogu, C. M., Etuk, I. F., Omede,A. A., Ogbuewu, I. P., Aladi, N. O., Okoro, V. M. O., Opara, M. N., Ezema, C., Uchegbu, M. C., Ekenyem, B. U., Anyanwu, G. A., Okeudo, N. J., Udedibie, A. B. I., and Madubuike, F. N. (2014). Plantain ash enhances dietary mineral elements absorption in pullets. Iranian Journal of Applied Animal Science, 4 (2): 69 – 72.

19. Okonkwo, F.O., Achonwa, C. C. and Nwogu, C.M. (2018a). Mineral concentration in different parts of Elaeis guineensis ashed at 1000 and 6500c for the production of dietary minerals. Proceedings of the 43rd Annual Conference Nigerian Society for Animal Production, Pp: 1509 -1511.

20. Okonkwo, F.O., Achonwa, C. C., Nwogu, C.M. and Okoli, I.C. (2018b). Mineral concentration in different parts of Cocos nucifera ashed at 1000 and 6500c for the production of dietary minerals.Proceedings of the 43rd Annual Conference Nigerian Society for Animal Production,, Pp: 1487 -1489.

21. Rynsberger, J.M. (2009). Physiological and nutritional factors affecting protein digestion in broiler chickens. A MSc. Thesis submitted to the college of Graduate studies and Research, Department of Animal and Poultry Science, University of Sastatchewan, Saskatoon, SK, Canada.

22. Rynsburger, J.M. and Classen, H. L. (2007). Effect of age on intestinal pH of broiler chickens. University of Saskatchewan, Saskatoon, SK, Canada.

23. Ukwu, P.C. (2013). Influence of stressors on day old chicks' development in the hot humid tropical environment of southeastern Nigeria. MSc. Thesis, Federal University of Technology, Owerri, Nigeria.

24. Wahlstrom, A. (2013). The importance of seven- day weight. World Poultry, 29 (3): 25 -26.

25. Wang, G., Liu, L., Wang, Z., Pei, X., Tao, W., Xiae, Z and Ao, T. (2019). Comparison of inorganic and organically bound trace minerals on tissue mineral deposition and feacal excretion in broiler breeders. Biological trace element research 189 (1): 224-232

26. Yadav, G.B., Kadam. A.S., Pachpande, A.M., Lambate, S.B., Lonkar, V.D. and Maini, K.R. (2010). Post hatch histo-morphological studies of small intestinal development in chicks fed with herbal Early chick Nutritional Feeding activity in groups of newly hatched broiler chicks effects of strains and hatching time. Poultry Science, 89 (7): 1336 – 1344.

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