Chemical Composition of Bush Mango (*Irvingia gabonensis)* Seed Waste and Effects on Performance in Starting Broiler Chicks.

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Abstract
The test ingredient bush mango seed waste (BMSW) was analysed for proximate composition and some mineral content. Thereafter a 4weeks feeding trial was carried out to estimate the ability of broiler chicks to utilize bush mango seed waste as a replacement for maize. The control had no BMSW while the subsequent treatment 2,3, and 4 had BMSW replacing maize at 25, 50 and 75% respectively. 120 birds were randomly assigned to the four treatment diets in a completely randomized design (CRM) and each treatment in three replicates with ten birds each. The proximate and mineral composition reflected that the BMSW has crude protein that relatively compares to maize. The essential minerals needed for the growth and development of young chicks are all present like calcium, magnesium, and phosphorus. The highest final weight of broilers at the end of the four weeks trials was form those placed on 50% BMSW with value of 1.72kg which was not significantly different (P<0.05) from those on control diet with value of 1.19kg. The least final weight recorded was from birds on 75% BMSW with value of 0.54kg. The broiler chickens showed significant (P<0.05) difference in average weekly and daily feed intake. Similarly the weekly and daily weight gain was also significantly (P<0.05) affected by the treatment diets. The highest weight gain of 61.43g was from 50% BMSW diet followed by control diet with 42,38g and least value of 20.95g was recorded from birds on 75% BMSW. The feed conversion ratio also showed significant difference with birds fed 50% test ingredient recording the best result with values of 1.39 compared to control with 2.45 conversion ratio. This study reveals that BMSW is adequate in basic nutrient and that 50% replacement of maize in broiler starter diet gave the highest live weight and better feed conversion.
Keywords: Bush mango seed waste, performance, broiler.

Introduction
Most studies on poultry nutrition simply deal with the substitution of one ingredient by another but making sure of maintaining a well balanced diet (Moghazy and Elwatak, 1982). This situation warrants the evaluation of agricultural by-products (non-conventional feedstuffs) and incorporation of suitable ones in poultry feeds. The use of agricultural by-products in poultry nutrition represents valuable means of the indirect production of food from waste (El-Boushy and Vanderpoel, 2003). Nigeria produces large qualities of agricultural and agro-industrial by-products which serve as alternative feed sources to conventional feed ingredients and had been proved valuable in supporting the performance of livestock and poultry birds (Babatunde and Oluyemi, 2000; Onu 2005; Uchegbu, *et al.*, 2010; Okosun and Eguaoje, 2017).

Rising feed cost and competition in consumption between human and animals for food items like maize strongly suggest alternative energy sources should be used partially or wholly to replace them in livestock diet to reduce cost of meat production and to make available the major cereals for human consumption.

One possible source of cheap energy is the use of agro by-products of some tropical legume – bush mango (*Irvingia gabonensis*). *Irvinga gabonensis* fruit is a broadly ellipsoid – drupe; yellowish and having very juicy fibrous pulp when ripe. Its stony nut encases an oil rich dicortyledonous kernel wrapped inside a brown seed coat. This brown shell or waste is mostly discarded as waste along with the mesocarp and other part which constitute over 80percent of the fruit and left to rot in dumps, pits or nearby bushes. Earlier

studies have been on the functional properties of the seed (Onimawo *et al*, 2003, Ogunsina *et al*, 2012; Adeyeye 2013). The shell component of the seed discarded as waste product is available in large quantity in the south, eastern and western part of Nigeria. This waste could be utilize as a poultry feed resource (Ducanut waste meal – DWM) to reduce feed cost and also curb the problem of environmental pollution that accompanies its disposal. Given the local popularity of *Irvingia gabonensis* fruit among the Esan people of Southern Nigeria and increasing acceptance of the soup prepared from its powdered kernels (Ogbono soup) in Nigeria and West African coasts; this study focused on the evaluation of chemical composition of ducanut seed coat waste meal (DSCWM) and its effect on performance in starting broiler chicks.

Materials and Methods

The brown shell after the breaking of the hard coat of dried African bush mango seed discarded as waste was collected from local processing centres or in–house ducanut seed processors in Ekpoma, Edo State, Nigeria. It was then milled to fine particles using a hammer mill to pass through a 2mm sieve to get fine powder, bagged and stored at room temperature to avoi
d moulding. Samples were taken to the nutrition laboratory at the Federal University of Technology, Akure Ondo State, Nigeria for proximate and mineral analysis. DSCWM was incorporated into broilers starter diets at varying levels stipulated in the study using the nutrient estimation of the proximate analysis for ration formulation.

Chemical Analysis.

The moisture content, ash, crude fibre and crude fat were determine using the method described by AOAC (2000). The crude protein was determined by Kjeldahl method. Energy value was determined using an Adiabatic oxygen bomb calorimeter (12149 Adiabatic calorimeter PARR instrument Co. Ilinois USA). Determination of mineral was carried out according to the method of AOAC (2000). The residual ash from ash content determination was leached with 5ml of 6M HCl. The volume was made up to 20cm^3 with distilled water. The resulting solution was directly used for the analysis. Calcium, magnesium, potassium, sodium, phosphorus, iron, zinc and manganese were determined using Atomic Absorption spectrophotometer. Determinations were carried out by direct aspiration of sample solution into air acetylene flame. The concentration of the mineral elements in the sample was them determined from a calibration curve.

Management of Experimental Birds and Design

A total of one hundred and twenty (120) day old Anak 2000 broiler chickens was used for the experiment. The birds were initially brood for two weeks and thereafter were randomly sub-divided into 4 dietary treatments of three replicates, with ten birds each in a completely randomized design (CRD). Feed and water was given to the birds *ad-libitum*. The birds were reared on deep litter in an open-sided wire mesh constructed poultry house to allow for adequate ventilation. At the 11th day Gomboro vaccine was administered to prevent Infections Bursal Disease (IBD) outbreak. On day 18th and 26th the first and second Lasota were administered to prevent Newcastle disease. Anti- coccidial drug was administered on the third, fourth and fifth week respectively to combat the outbreak of coccidiosis. Vitamins were administered immediately after every vaccination to reduce stress. Medications and other routine management practices were strictly followed. The birds were offered experimental diets and cool, clean water *ad-libitum* throughout the eight weeks period of the experiment.

Experimental Diets and Treatments

Four experimental diets were formulated to contain African bush mango seed hull (BMSH) to replace maize at 0, 20, 40 and 60% as T1, T2, T3 and T4 respectively. Treatment 1 was the control diet with no African bush mango seed waste (BMSW) while diets 2,3 and 4 contain African bush mango seed waste (BMSW)

supplementation of maize in control diet at 20, 40 and 60% respectively. All diet was formulated to be iso-nitrogenous and iso-caloric. The experimental diets composition is presented in table 1.

Table 1: Gross Composition of Experimental Broiler Starter diets.

	Inclusion levels of BMSH (%)			
	0	25	50	75
	Diets			
Ingredients	**1**	**2**	**3**	**4**
Maize	53.50	40.13	26.75	13.38
Ducanut waste meal	-	13.38	26.75	40.13
Soya bean meal	37.00	37.00	37.00	37.00
Wheat offal	5.00	5.00	5.00	5.00
Dicalcium phosphate	3.50	3.50	3.50	3.50
Salt	0.50	0.50	0.50	0.50
Premix **	0.50	0.50	0.50	0.50
Total	**100**	**100**	**100**	**100**
Calculated analysis:				
Crude protein (%)	**21.00**	**21.00**	**21.00**	**21.00**
Metabilization Energy (Kcal/kg)	**3000**	**3000**	**3000**	**3000**

** Vitamin A 1.300.000IU, Vitamin D3 250.000IU, Vitamin E 1.500mg, Vitamin K3 200mg, Vitamin B1 200mg, Vitamin B6 400mg, Vitamin B12 1.500g, Niacin 3.000mg, Calcium pantothenate 1.00mg, Bioin 10.00g, Folic acid 50.00g, Choline chloride 70.000mg, Iron 3.000mg, Copper 800mg. Manganese 8.000mg, Zinc 5,000g, Selenium, 15.000g. Cobalt 20.000g, Coccidiostatic-Avatec 15% 50.000mg Methionine 40.000mg, Antioxidant BHT 10.000mg

Performance Characteristics

During the feeding trial, daily feed consumption and weigh changes were recorded while weight gain and feed conversion ratio were estimated. Daily feed intake was determined by subtracting the weight of leftover of feed from the initial weight of feed supplied.

i.e. Feed intake =Feed given – Left over of feed

Weekly weight gain was determined as the difference between the weight at the beginning of the week and the weight at the end of each week.

Feed conversion ratio was estimated as the ratio of the feed intake to that of the weight gain.

$$\text{i.e. Feed conversion ratio} = \frac{\text{Feed Intake (g)}}{\text{Weight gain (g)}}$$

Statistical Analysis

All the data collected were subjected to analysis of variance (ANOVA), and difference between mean treatments were separated using Duncan's multiple range test (DMRT) at 5 percent level of probability. All statistical procedures were according to Steel and Torrie, (1990) using SPSS version 20.

Results

Proximate Composition of Bush Mango Seed Waste Compared to Maize

The proximate composition of Bush mango seed waste (*Irvingia gabonesis*) meal as compared to maize (*Zea mays*) is shown in Table 2. Percentage moisture content was higher (12.00%) in maize compare to

(8.9%) recorded in bush mango seed waste. Percentage crude protein content was higher in maize with an average value of 9.8%, compare to 5.33% recorded in bush mango seed waste. Crude fibre content of bush mango seed waste was higher (3.2%) compared to maize with crude fibre content of 2.40%. Percentage either extract was (22.8%) in bush mango seed waste but lower in maize with an average value of (4.2%). Percentage crude ash was higher in bush mango seed waste with an average value of 8.00% while a lower value of (1.9%) was reported for maize. Nitrogen free extract value was higher (69.7%) in maize compare to (51.77%) recorded in bush mango seed waste. Higher metabolizable energy value of 3885.95kcal/kg was recorded in bush mango seed waste compare to 3315.45kcal/kg reported for maize.

Some Mineral Elements Composition in Bush Mango Seed Waste (BMSW)

Composition of some mineral elements in the milled BMSW is shown in table 3. From this study bush mango seed waste may be a fair source of macro elements like calcium, potassium and iron. The value reported in this study for calcium, magnesium and potassium are 5130, 972.50 and 4338 mg/kg while values of 344.70, 756.80, 1252.30, 39.40 and 128.10 mg/kg was reported for sodium, phosphorus, iron, zinc and manganese respectively.

Table 2: Proximate composition of (BMSW) compared to maize

Parameters	*BMSW	Maize.
Moisture	8.90	12.00
Crude Protein	5.33	9.80
Crude Fibre	3.20	2.40
Ether Extract	22.80	4.20
Crude Ash	8.00	1.90
NFE	51.77	69.70
Metabolizable energy	3885.95	3315.45

**Analysed

Table 3: Some Minerals Content of BMSW

PARAMETERS	**UNITS**	**BMSW**
Calcium	mg/kg	5130.00
Magnesium	mg/kg	972.50
Potassium	mg/kg	4338.00
Sodium	mg/kg	344.70
phoshorus	mg/kg	756.80
Iron	mg/kg	1252.30
Zinc	mg/kg	39.40
Manganese	mg/kg	128.10

Performance Characteristic Studies of Broiler Chicken Fed Bush Mango Seed Waste Based Diet.

The performance parameters of broiler chickens as affected by the treatment diets are shown in (Table 4). The treatment diets significantly ($P<0.05$) affected the average weekly feed intake, average daily feed intake, average weekly and daily gain as well as feed conversion ratio. The average initial weights at commencement of trial was statistically ($P>0.05$) similar and no mortality was recorded throughout the starter phase of the experiment. Average weekly feed intake was highest ($P<0.05$) among broiler chickens

fed the control diet with an average value of 726.67g/bird, followed by comparable value of 576.67 and 596.67g in those fed 25% and 50% Bush mango seed waste (BMSW) respectively. The lowest values of 573.33g/bird were those placed on 75% BMSW. Average daily feed intake was significantly higher (P<0.05) among broiler chickens fed the control diet with an average value of 103.81g/bird, followed by similar values (82.38 and 85.24g/bird in those fed 25 and 50% Bush mango seed waste (BMSW) respectively, while lowest value of 81.90g/birds was recorded in those placed on 75% BMSW. Average weekly weight gain was significantly (P<0.05) highest among broiler chickens maintained on 50% BMSW with a mean value of 430.00g/bird followed by 296.67g/bird fed 0% BMSW, which was not significantly different (P>0.05) from 273.33g/bird in those fed 25% BMSW. The lowest mean value of 146.67g/bird was recorded in those placed on diets 4. Average daily weight gain also showed significant (P<0.05) variation among birds fed the treatment diets with highest value recorded among broiler chickens maintained on 50% BMSW with a mean value of 61.43g/birds followed by 42.38g/bird in birds fed the control, and then by 39.05g in birds fed 25% BMSW replacement of maize. Feed conversion ratio significantly (P<0.05) differ among birds fed the various treatment diets with treatment 3 at 50% BMSW replaced of maize having the best conversion ratio of 1.39. The control diet and 25% BMSW replacement had compared conversion values of 2.45 and 2.11 (P>0.05) while poorest feed conversion with a value of 3.91 was obtained from broiler chickens placed on 75% BMSW replacement of maize.

Table 4: Performance Characteristic Studies of Broiler Chicken Fed Bush Mango Seed Waste Based Diet:

Parameters	Inclusion levels of BMSH(%)				
	0	25	50	75	
	Diets				
	1	2	3	4	SEM±
Ave. initial weight (g/bird)	55.66	57.33	55.33	56.00	0.56
Final weight (kg/bird)	1.747	1.673	2.273	1.100	0.98
Ave. Final weight gain (kg/bird)	1.19^{ab}	1.10^{c}	1.72^{a}	0.54^{d}	0.87
Ave, Weekly feed intake (g/bird)	726.67^{a}	576.67^{b}	596.67^{b}	573.33^{b}	1.04
Ave. daily feed intake (g/bird)	103.81^{a}	82.38^{b}	85.24^{b}	81.90^{b}	1.03
Ave, Weekly weight gain (g/bird)	296.67^{b}	273.33^{b}	430.00^{a}	146.67^{c}	1.00
Ave. Daily weight gain (g/bird)	42.38^{b}	39.05^{c}	61.43^{a}	20.95^{d}	1.17
Feed conversion ratio	2.45^{b}	2.11^{b}	1.39^{c}	3.91^{a}	1.23
Mortality(%)	0.00	0.00	0.00	0.00	0.00

abcd: means in the same row with vary super script differ significantly (P<0.05)
SEM± Standard error of mean

Discussion

The lower moisture content values recorded in bush mango seed waste compared to maize could be as a result of longer period of sun drying compared to maize purchased at the open market. This finding is supported by earlier report of Adeyeye, (2013) who observed lower moisture content of 6.00%. The higher crude protein observed for maize compared to bush mango seed waste could be as a result of the fibrous nature of the test material compare to maize with lower fibre. However the value reported was lower compared to the value as reported by Adeyeye, (2013). The higher fiber values recorded in bush mango seed waste compared to maize connote higher cellulose they contain which could serve as an absorber of water and provide roughage for better functioning of the alimentary system as well as combine with intestinal cholesterol for excretion in the feces (Makkar and Goodchil, 2006). The higher ether extract value

recorded in bush mango seed waste is a pointer to the fact that bush mango seed is very high in fat compared to maize. Onimawo (2003) reported in his proximate composition of bush mango seed a value of 7.70% crude fat which was lower to the one reported in this study. This can be adduced to the fact that the test sample used in this study is a combination of both the hull and other waste probably from the seed available at the processing unit. Metabolizable energy was higher in bush mango seed waste compared to maize and this is traceable to the high fat content in the test ingredient compare to maize with lower fat content. This finding also collaborates with the report of Adeyeye, (2013). The higher crude ash content recorded in bush mango seed waste compared to maize indicate that the test ingredient is a better source of mineral compare to maize. Ogunlana *et al.,* (2012) however reported lower crude ash content for bush mango kernel. Bush mango seed waste (BMSW) in this study may be a fair source of the macro elements like calcium, magnesium, potassium, phosphorus and iron; making the product useful in food system. High amount of calcium, magnesium and phosphorus have been reported to reduce blood pressure (Ranhotra *et al* 1998). Bush mango seed cotyledon and its products may serve this purpose. The assertion here from this study is that BMSW could serve as a mineral supplement in feed formulation for livestock.

The significant ($P<0.05$) increase in the average weekly and daily feed intake of birds fed the control comparable to those of other treatments with lower values could be as result of reduced palatability. This finding is line with the report of Nikolakakis *et al.,* (2014) who reported a significant variation in the feed intake of broiler chickens fed graded levels of sesame seed waste based diet. The least value recorded among those fed diet 4 (75% BMSW) could be attributed to the high concentration of fibre of the bush mango seed hull compared to that of maize it was replacing. It has been documented that high amount of crude fiber in broiler diets can have negative effects on feed intake, weight gain and/or feed conversion ratio (Kras *et al.,* 2013; Kalmendal *et al.,* 2011). The significant ($P<0.05$) variation in the weekly and daily weight gain value with highest mean recorded in those on 50% BMSW could be ascribed to the quality level, palatability as well as the higher synergy of nutrient by the ingredient at that level of incorporation. This finding is supported by the report of Magareth *et al.,* (2017) who reported a significant variation in the weight gain values of broiler chickens fed varying levels of Rain tree (*Sarmania saman)* seed meal. The reduction in the weight gain of broiler chickens fed 75% bush mango seed waste could be due to the reduced feed intake and the inability of the birds to utilize the diets as a result of poor digestion and absorption probably due to the high fibre content of the diet. The significant ($P<0.05$) variation in the values recorded for feed conversion ratio among birds fed the dietary treatments with the least and best value recorded among birds fed the 50% BMSW replacement of maize points to the fact that the inclusion of the basal diet at 50% level, synergistically improves the quality of the feed. But this finding negates the report of Farran *et al.,* (2000) who reported no significant variation in the feed conversion ratio of broiler chicks fed graded levels of sesame seed hull. However, the zero mortality rate recorded among broiler chickens fed the treatment diets at the starting phase reveals that the various inclusion levels of the test ingredient tested in this trial does not have any detrimental effect on the health status and biological productivity of the birds.

Conclusion

This study reveals that BMSW is adequate in basic nutrient that can partially replace the more sort maize. The performance indices pointed that 50% supplementation of maize with BMSW gave the highest live weight, better weight gain, best feed conversion ratio and no mortality; revealing that bush mango seed waste is a good potential alternative in terms of nutrient availability for maize replacement in starting broiler production.

REFERENCES

Adeyeye, E.I. (2013). Proximate, mineral and antinutrient composition of dika nut *(Irvingia gabonensis)* Kernel. *Elixir Food Science* 58: 14902 – 14906.

AOAC Methods (2000). Official Methods of Association of Official Analytical Chemists. In P. Cunnif (Ed.), Vol.11, 17th Ed., Arlington, V.A., USA. Pp.137.

Babatunde, B.B. and Oluyemi, A. (2002). Comparative digestibility of three commonly used in fibrous ingredient in maize-Soya bean meal – fish meal diet by broiler chicks. *Tropical Journal Animal Science* 3(1): 33-43.

Ekundaya, F.O.; Oladipupo, O.A. and Ekundayo E.A. (2013). Studies on the effects of microbial fermentation on bush mango (*Irvingia gabonensis) seed cotyledons. 2.*

El—Boushy R.Y. and Vanderpoel F.B. (2000). Handbook of Poultry feed from waste processing and use. (2nd Ed.) Natherlands Pp. 301-310.

Farran, M.T.; Uwayjan, M.A.; Miski, M.A.; Akhdar, N.M. and Ashkarian, V.M. (2000). Performance of broilers and layers fed graded levels of sesame waste. *Journal of Applied Poultry Research* 9: 453-459.

Kalmenda, R; Elwinger, K; Holm, L. and Tauson, R. (2011). High-fibre sunflower cake effects on small intestinal digestion and health in broiler chickens. *Br. Poult Sci.* 52:86-96.

Kras, R.V.; Kessler, A.M.; Ribeiro, J.D.; Henn, S.I.; Dos, H.D. and Bockor, L. (2013). Effect of dietary fibre and genetic strain on the performance and energy balance of broiler chiken. *Rev. Bras. Cien. Avic.* 15:15-20.

Makker, H.P.S. and Goodchild, A.V. (2006). Quantification of Tannins: A Laboratory Manual, International Centre for Agricultural Research in the Dry Areas, Aleppo, Syria.

Margaret, A.S.; Armstrong, D. and Dadson A. (2017). Growth performance and economic evaluation of broiler chicken fed with rain tree (*Samanea saman)* seed meal. *Journal of Applied Animal Research*. 45(1):1-8.

Moghazy, M.E. and Elwatak, S.A. (1982). Some neglected feedstuffs from vegetable and fruit wastes. *Journal of World Poultry Science* 38:18-25.

Nikolakakis, E.B.; Eleni, K.A. and Paraskevi, M. (2014). Effect of dietary sesame seed wastes on broiler performance, carcass traits and lipid oxidation of the meat. *Europ. Poult. Sci*. 78: ISSN 1612 -9199, pp. 1-9.

Ogunlara, O.E.; Ogunlara, O. and Farombi, O.E. (2012). *Morinda lucida.* Antioxidant and reducing activities of crude methandic stem bark extract *Adv. Nat. Appl. Sci.* 2: 49-54.

Ogunsina, B.S.; Koya, O.A. and Adeosun O.O. (2008). Deformation and fracture of dika nut *(Irvingia gabonebsis)* under uni-axial compressive loading. *Int. Agrophs.* 22:249-253.

Okosun, S.E. and Eguaoje, S.A. (2017). Growth performance carcass response and cost benefit analysis of cockerel fed graded levels of cassava (*Manihol esculenta)* grit supplemented with Moringa (*Moringa olifera)* leaf meal. *Annual Research International* 14(1): 2619 – 2628.

Onimawo, I.A.; Oteno, F.; Orokpo, G. and Akubor, P.I. (2003). Physiochemical and nutrient evaluation of African bush mango (*Irvingia gabonensis)* seeds and pulp. *Plant foods for Human Nutr.* 58:1-6.

Onu, S.O. (2005) Evaluation of the performance of Broilers fed different agro-industrial by-products. *Proc. of 30th Ann. Conf. Nig. Soc. of Animal Production.* 169-171.

Ranhotra, G.S.; Gelroth, J.A.; Leinen, S.O.; Vras, M.A. and Lorenz, K.J (1998). Nutritional profile of some edible plants from Mexico. *J. Food Comp. and Analysis* 11:298-304.

Steel, R.G.D. and Torrie, J.H. (1990). Principle and procedure of statistics. A Biometrical Approach 3rd Edition. Mac.Graw Hill Book Co. N.Y.