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GROWTH RESPONSE AND COST BENEFIT ANALYSIS OF MONGREL WEANER RABBITS FED DIETARY INCLUSION OF BAMBARA NUT SIEVATE TOASTED AT DIFFERENT DURATIONS

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ABSTRACT

A study to evaluate effect of toasting duration on proximate nutrient composition of Bambara nut sievate (BNS), growth response and cost-benefit of weaned mongrel rabbits fed dietary inclusion of BNS supplemented with Tridax procumbens. Raw BNS (5kg) was mixed with water (500 ml) and toasted thrice at three different durations (20, 30 and 40 minutes) at 50 -60°C. Thereafter, allowed to cool and analyzed for proximate nutrient composition, while metabolizable energy (ME) was calculated. Thirty (30) weaned rabbits (554.00 to 555.00 g) were allotted to 5 treatments of 6 rabbits with each rabbit serving as a replicate in a completely randomized design. Five diets were formulated using 20 kg each of BNS; T1, T2, T3, T4 and T5 to contain 0, raw BNS, BNS toasted for 20, 30 and 40 minutes, respectively. Growth response data used were feed intake (DFI), weight gain, FCR and mortality. Cost- benefit analysis was evaluated using cost per kg diet, cost of feed consumed, cost per kg weight gain, total cost of production and profit. Data were subjected to one-way analysis of variance (ANOVA) using SPSS. Results revealed that Raw and BNS toasted for 40 minutes had the highest and similar ME (2625.94 Kcal/Kg) while BNS toasted for 30 minutes recorded the lowest ME (2260.87 kcal/kg). DFI of rabbits fed BNS diets was highest (71.17 g) and lowest (60.57 g), on the control diet. Rabbits fed raw BNS diet had zero (0%) mortality. Cost per kg diet (₦203.34) was highest for rabbits on control diet. Rabbit fed diet containing BNS had the highest profit (₦602.74). It can be concluded that toasting BNS for 40 minutes improved ME, inclusion of 20 kg of BNS in rabbits' diet improved feed intake, healthiness (raw BNS) and profit.

Key words: Sievate, mongrel, Growth and Cost-benefit

INTRODUCTION

Animal protein intake by most people of developing countries such as Nigeria has consistently declined in recent years. Madubuike and Ekenyem (2001), rated cost of producing monogastric animals at 70-80% of the total cost of livestock production. The high cost of feed is solely attributed to stiff competition between man and his livestock for the available grains (Tegbe *et al.*1994). Global security challenges due to prevalent cases of boko haram, banditry, kidnapping among others have also deterred a good number of farmers from farming, presently with attendant negative consequences on the livestock industries. This menace has led to insufficient cereal and legume crops production generally, thus making their cost price as feed ingredients to skyrocket.

In an attempt to cushion this effect, different sources of feed ingredients that are less costly and underutilized are used in order to overcome the problem of protein shortages. Therefore, attention has now been re-focused on the production of animals that are prolific and

capable of effectively utilizing agricultural by-products (Igwebuike *et al*., 2005; Omoikhoje *et al*., 2005). Ahamefule *et al*. (2005) reported that in recent times, a case has been made for rabbit production, as a realistic approach to counter the animal protein deficit in the diet of Nigerians. Rabbit production is currently considered as one of such alternatives as the animal is highly prolific and known to thrive on a variety of feed ingredients (Balogun *et al.,* 2003).

It is therefore, important to use unconventional materials like Bambara groundnut sievate (BNS) that are obtained at little or no cost. BNS is a by-product of Bambara groundnut seeds processing. It is a sievate obtained after extracting the flour for human use. It contains 14-24% crude protein, 20% crude fibre, 5.36% Ether extract, 41.64% nitrogen free extract (Tempel, and Aliyu, 1994). Bambara groundnut sievate has no direct food use by man and are also carelessly disposed within and around the processing plants and thus, constitute environmental pollutants. However, recent studies have confirmed their potentials as feed ingredient in rabbits' production, reducing the cost of products and making them affordable to consumers (Ekenyem, and Onyenagoro, 2006).

Therefore, the aim of this study was to evaluate effect of toasting duration of BNS on its proximate nutrient composition, growth performance and cost-benefit analysis of mongrel weaner rabbits fed diets containing raw and varied duration toasted BNS supplemented with *Tridax procumbens.*

MATERIALS AND METHODS

Experimental Site

The study was conducted at the rabbitary Unit of the Livestock Teaching and Research Farm, College of Animal Science, Federal University of Agriculture, Makurdi, Benue State-Nigeria, Makurdi lies on the geological coordinates of latitude 7°44' North and longitude 8°22' East with an ambient temperature range of 17.3–35.6°C and relative humidity of 47-48% (Google Earth, 2021).

Collection and processing of Bambara groundnut Sievate (BNS)

The Bambara nut sievate was purchased from Wannune, Tarka Local Government Area of Benue State. Five kilograme (5 kg) of raw BNS was thoroughly mixed with 500 ml of water and toasted thrice at different durations (20, 30 and 40 minutes) at a temperature of between 50 - 60^0C using a big aluminium frying pan. The toasting material was turned frequently and cautiously to avoid charring. Laboratory thermometer was used to monitor the toasting temperature at two (2) minutes interval to ensure that the toasting temperature remained within the specified range. Thereafter, the toasted material was allowed to cool (25°C) before putting in the respective marked bags for use. Brewer's dried grain (BDG), salt, bone ash and vitamins, mineral premix were bought from Wurukum Market and Livestock shop within Makurdi. The materials that require particle size reduction were grounded using an electric grinding machine.

Determination of the Proximate Nutrient Composition of Bambara nut sievate

Bambara nut sievate (BNS) samples were analyzed for proximate nutrient composition according to the procedure reported by AOAC (1999) at the Animal Nutrition Laboratory, University of Agriculture, Makurdi-Nigeria. Metabolizable energy (ME) was calculated using the formular of Pauzenga (1985);

ME (Kcal/Kg) = (37x %CP + 81x % EE + 35.5 x NFE).

Experimental Animal, design and Management

Thirty (30) mongrel weaner rabbits weighing between 550.00-555.50 g were sourced from commercial rabbit farm within Makurdi. The animals were dewormed using Ivomec$^{(R)}$ at 0.2 ml per rabbit subcutaneously, embazin$^{(R)}$ Forte and neomycin were administered to take care of coccidiosis and other bacterial infections,

respectively. The animals were balanced for weight after acclimatization of 10 days. The rabbits were allotted to 5 treatments of 6 rabbits each with a rabbit per replicate in a Complete Randomized Design (CRD). The rabbits were intensively managed, housed individually in hutches (0.6 x 0.6 x 0.6 m) which were properly cleaned before the introduction of the experimental animals and provided with drinkers and feeders which were firmly fixed in order to prevent tipping over. Routine management such as cleaning of drinkers, feeders and hutches was done.

Experimental diets and feeding

Five experimental diets were formulated and coded T1, T2, T3, T4 and T5, respectively to contain 20% each of raw and different durations (20, 30 and 40 minutes) of toasted Bambara nut sievate (BNS) (Table 1). Feed and water were supplied to the experimental rabbits' *ad libitum*. Each rabbit was offered 200 g of *Tridax procumbens* daily.

Table 1: Ingredient and Proximate Nutrient Composition of Diets containing Raw and Varied duration of toasted Bambara nut sievate (BNS)

	Duration (Minutes) of toasting BNS included in the diets				
Ingredients	**Control**	**0**	**20**	**30**	**40**
Maize	31.33	14.28	14.28	14.28	14.28
Full fat soybean	19.67	16.72	16.72	16.72	16.72
Bambara nut sievate	0.00	20.00	20.00	20.00	20.00
Brewer's Dried Grains	30.00	30.00	30.00	30.00	30.00
Rice Offal	15.00	15.00	15.00	15.00	15.00
Bone Ash	3.00	3.00	3.00	3.00	3.00
Salt	0.30	0.30	0.30	0.30	0.30
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.20	0.20	0.20	0.20	0.20
Vitamin Premix	0.25	0.25	0.25	0.25	0.25
TOTAL	**100**	**100**	**100**	**100**	**100**
Determined Nutrient Composition:					
ME (kcal/kg)	2,245.72	2,203.73	2,220.89	2,427.24	2,390.21
Crude protein (%)	16.63	17.50	17.06	17.50	17.50
Crude fiber (%)	23.16	27.32	24.43	19.39	15.23
NFE (%)	36.96	31.06	33.37	38.36	37.91
Ether extract (%)	3.93	5.60	5.00	5.16	4.90
Ash (%)	8.98	7.99	9.09	8.39	14.45

NFE = Nitrogen free extract, ME = Metabolizable energy = (37 x %CP + 81X % EE + 35.55 X NFE).

**1kg of vitamin premix contained vitamin B1, 1g Vitamin B2.6g; vitamin B12,0.02g' vitamin K3, 3g vitamin E.3g; Biotin, 0.05g; Folicated, 1.5g; Cholinechloride, 250g; Nicotinacid, 30g; Capantothenate, 15g; Co,0.4g: Cu, 8g: Fe, 32g 10.8G, Zn, 40g: Mn, 64g; Se. 0.16g; BHT, 5g*

T1= Control, **T2** = 20% raw Bambara nut seivate, **T3** = 20% raw Bambara nut seivate toasted for 20 minutes, **T4** = 20% raw Bambara nut seivate toasted for 30 minutes, **T5**= 20% raw Bambara nut seivate toasted for 40 minutes.

Data Collection

Effects of feeding diets containing raw and toasted BNS supplemented with T. procumbens on the growth performance of mongrel weaner rabbits.

Growth performance indices considered include; initial weight which was recorded prior to commencement of the study Feed intake was calculated by subtracting leftover feed from feed offered on daily basis. Daily weight gain was calculated by subtracting previous weight from the present weight. Feed conversion ratio was calculated by dividing feed intake by weight gain and mortality was calculated as the number of dead rabbits divided by total number of rabbits per treatment multiplied by 100.

Effects of different toasting duration of BNS supplemented with T. Procumbens on the cost benefit analysis of mongrel weaner rabbits.

Cost-benefit analysis parameters considered here include cost per kg diet which was calculated as the individual cost of feed ingredients used to formulate 100kg diet divided by 100. Total feed consumed was determined as total feed offered minus total feed leftover divided by total number of animals per treatment group. Cost of feed consumed was calculated as total feed consumed multiplied by their respective cost per kg diet. Total weight gain was calculated as final body weight minus initial body weight. Cost per kg weight gain was calculated as the total cost of feed that would produce 1kg of meat. Total production cost (₦) was calculated as the summation of cost (₦) of purchase of rabbit, Cost (₦) of feed consumed and medication cost (₦). Profit was calculated as the difference between selling and purchase price.

Chemical Analysis

Proximate nutrient composition of Bambara nut sievate and experimental diets were conducted at Animal Nutrition Laboratory of Federal University of Agriculture, Markurdi using standard procedure reported by the Association of Official Analytical Chemist (AOAC, 1999).

Statistical Analysis

Data obtained were subjected to one-way analysis of variance (ANOVA) using SPSS (2015) and means were separated ($P<0.05$) using Duncan Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

Effect of different toasting duration on proximate nutrient composition of Bambara nut sievate

Results on effect of different duration of toasting on proximate nutrient composition is presented in Table 2. Metabolizable energy (ME) was significantly ($P<0.05$) different among proximate nutrient composition considered in the present study. Raw and BNS toasted for 40 minutes had the highest and similar ME (2625.94 Kcal/Kg) while BNS toasted for 30 minutes recorded the lowest ME (2260.87 kcal/kg) value. Toasting of BNS for 30 minutes could possibly have activated some anti-nutritional factors which could have impeded the release of carbohydrate thus, lowering the energy contents of BNS. Further toasting of BNS for up to 40 minutes, however, could have finally inactivated such anti-nutritional factors as it is evidenced in the higher ME, though comparable to raw BNS in this study. Dry matter (DM), crude protein (CP), crude fibre (CF), nitrogen free extract (NFE) and ash ranged from 93.21 to 98.83%, 10.98 to 13.17%, 25.38 to 27.62%, 48.90 to 52.00%, 2.66 to 4.60%, respectively.

Bambara nut sievate toasted for 40 minutes recorded the highest (98.83%) numerical value for DM while BNS toasted for 30 minutes recorded the least (93.21%) value for DM. DM of the present study was higher than 86.10% reported by Amaefule *et al*. (2011) who fed graded levels of Bambara nut offal (BGO) diets to rabbits.

Table 2: Effect of different duration of toasting Bambara nut sievate (BNS) on its proximate nutrient composition

	Duration (Minutes) of toasting BNS included in the diets				
Parameters	**0**	**20**	**30**	**40**	**SEM**
Dry matter (%)	96.22	95.14	93.21	98.83	0.96
Crude protein (%)	13.17	11.71	10.98	13.13	0.51
Crude fibre (%)	25.96	25.38	27.35	27.62	0.78
NFE (%)	50.98	51.35	48.90	52.00	0.90
Ash (%)	2.88	4.60	4.53	2.66	0.37
ME (Kcal/Kg)	2,558.79[a]	2,443.62[ab]	2,260.87[b]	2,625.94[a]	51.03

[a,b,] Means with different superscripts in the same row are significantly different (P<0.05). NFE= Nitrogen free extract, ME= Metabolizable energy was calculated using Pauzenga 1985 (37x %CP + 81x % EE + 35.5 x NFE).

Numerically, raw (13.17%) and BNS toasted for 30 minutes (10.98%) had the highest and lowest values for CP. CP value of the present study is lower compared to 19.22% CP reported by Amaefule *et al*. (2011). Similarly, Ani (2008) reported CP of 17% for BGO which is higher than the value for BNS in the present study. Numerical CF values were highest (27.62%) and lowest (25.38 %) for BNS toasted for 30 and 20 minutes, respectively. CF value was higher than 19.22% for CF reported by Amaefule *et al*. (2011). Similarly, Amaefule and Osuagwu (2005) reported a lower CF value of 11.30% for BGO compared to the CF of BNS in the present study. NFE was numerically highest (52.00%) for BNS toasted for 40 minutes while BNS toasted for 20 minutes recorded the lowest (48.90%) NFE value. NFE obtained in this study is comparatively lower than 57.12% reported by Amaefule *et al*. (2011) for NFE. NFE of the present study was comparable with the NFE of BGO (55.75%) reported by Ukpabi *et al.* (2008). Ash values were numerically highest and lowest for BNS toasted for 20 and 40 minutes, respectively. These values are higher than 2.00% for ash reported by Amaefule *et al*. (2011). Ash in the present study compared favourably with 3.32% for BGO reported by Ukpabi *et al.* (2008). The differences in these parameters could be possibly attributed to variation in the variety of Bambara nut seed and processing effect as well as the extent of sieving to obtain the flour for consumption (Amaefule *et al*., 2011).

Effects of feeding diets containing raw and toasted BNS supplemented with *T. procumbens* on the growth performance of mongrel weaner rabbits.

Growth response of feeding rabbits with dietary inclusion of raw and different duration of toasted BNS is presented in Table 3. Daily feed intake and mortality were significantly (P<0.05) influenced among growth performance parameters in the present study. Daily feed intake of rabbits fed diets containing BNS was highest and similar (71.17g) while rabbits on control diet had the lowest value (60.57g) for daily feed intake. These results agreed with the work of Nwakpu and Okeke (2016) who reported significant influence (P<0.05) in feed intake of rabbits fed diets containing toasted Bambara nut. This further compared favourably with feed intake of 70.12 -103.33 g reported by Nwakpu and Okeke (2016). This implies that daily feed intake increased from control diet to diets with BNS inclusion. This could be as a result of low energy of BNS hence, animals eat to meet their daily energy requirement. Rabbits fed diets containing BNS toasted for 30 minutes recorded the highest mortality (50%) while rabbits fed diet containing raw BNS recorded no mortality (0.00 %). Mortality did not follow a

definite pattern of variation among the treatment groups. Zero mortality recorded in rabbits fed diet containing raw BNS could be imputed to the positive effects of low quantity of phytochemicals such as tannin, phenol, phytate among others which help to get rid of harmful bacteria in the digestive tract of animals when consumed below threshold that the animal can tolerate.

Table 3: Growth response of weaner mixed breeds of rabbit fed dietary inclusion of raw and different duration of toasted Bambara nut sievate.

	Duration (Minutes) of toasting BNS included in the diets					
Parameters	**Control**	**0**	**20**	**30**	**40**	**SEM**
Initial body weight (g)	555.33	555.00	554.00	554.00	554.60	1.46
Daily Feed intake (g)	60.57[b]	69.26[a]	69.31 [a]	71.17[a]	70.08[a]	1.36
Daily body weight gain (g)	12.18	11.51	12.07	12.58	12.64	0.41
Final body weight(g)	1,663.33	1,604.33	1,652.33	1,699.33	1,700.33	37.35
FCR	5.09	6.03	5.94	5.72	5.63	0.20
Mortality (%)	16.00[c]	0.00[d]	16.00[c]	50.00[a]	33.00[b]	5.40

[a,b,c,d] Means with different superscripts in the same row are significantly different (P<0.05). FCR= Feed conversion ratio.

These results collaborate the findings of Grace (2015) who reported that anti-nutrient in Bambara nut possess anti-helminthic, antimicrobial and antioxidant potentials which help rabbits on diet containing raw BNS to remain healthy throughout the study period. Similarly, Ansari *et al.* (2013) also reported that phytochemicals such as tannin, phenol in plants possesses antimicrobial activities that suppress proliferation of pathogenic bacteria, thus maintaining a healthy bird when added to their feeds.

Daily body weight gain, final body weight and feed conversion ratio (FCR) ranged from 11.18 to 12.64 g, 1604.33 to 1700.00 g and 5.09 to 6.03, respectively. Daily body weight gains in the present study fell with range of 10.90-13.25 g reported by Nwakpu and Okeke (2016) for rabbits. FCR obtained in this study was lower compared to 6.17 to 7.81 reported by Nwakpu and Okeke (2016) for rabbits. This implied that daily weight gain, final body weight and FCR of these rabbits were unaffected by these dietary treatments.

Effects of different toasting duration of BNS supplemented with *T. procumbens* on the cost benefit analysis of mongrel weaner rabbits.

Cost-benefit analysis of rabbits fed dietary inclusion of raw and different duration of toasted BNS is presented in Table 4. Cost/kg diets was highest (₦203.34) for rabbits fed control diet while rabbits fed diets containing BNS had lower cost per kg diet while rabbits fed diets containing raw Bambara nut sievate recorded the lowest (₦141.86) value for cost per kg diet. These results are in consonance with the findings of Amaefule *et al*. (2011) who reported that inclusion of Bambara nut offal (BGO) in rabbit diets decreased feed cost per kg. Similar observation had been made earlier by Amaefule and Osuagwu (2005) that inclusion of BGO in pullets' diets considerably reduced the feed cost.

Table 4: Cost-benefit analysis of rabbit fed dietary inclusion of raw and different duration of toasted Bambara nut sievate

	Duration (Minutes) of toasting BNS included in the diets				
Parameters	**Control**	**0**	**20**	**30**	**40**
Purchase cost/rabbit (₦)	1,500.00	1,500.00	1,500.00	1,500.00	1,500.00
Cost/Kg diet (₦)	203.34	141.86	156.86	156.86	156.86
Total feed consumed (kg)	5.51	6.30	6.31	6.48	6.38
Cost of feed consumed (₦)	1,120.40	893.72	989.79	1,016.45	1,000.77
Total body weight gain (g)	1,108.00	1,049.33	1,098.33	1,145.33	1,145.73
Final body weight (g)	1,663.33	1,604.33	1,652.33	1,699.33	1,700.00
Cost/Kg weight gain (₦)	1,011.19	851.71	901.18	887.47	873.48
Medication (₦)	276.67	276.67	276.67	276.67	276.67
Total Production cost (₦)	2,897.26	2,670.58	2,766.46	2,793.12	2,777.44
Profit (₦)	602.74	829.42	733.54	706.88	722.56

Each rabbit was sold at ₦3,500

Total feed intake of rabbits increased from control diets to diets containing raw BNS. Rabbits fed diets containing BNS toasted for 30 minutes and control had the highest (6.48 kg) and lowest (5.51 kg) total feed consumed, respectively. Cost of feed consumed decreased with inclusion of BNS in the diets. Rabbits fed control diet and diet containing raw BNS recorded highest (₦1120.40) and lowest (₦893.72) cost for feed consumed, respectively. Final and total body weight gain followed a similar trend. Rabbits fed diets containing BNS toasted for 40 minutes had the highest final body weight (1700.00 g) and body weight gain (1145.73 g) while those fed diets containing raw BNS recorded the lowest final body weight (1604.33 g) and body weight gain (1049.33 g) among the treatment groups. Cost per kg weight gain was highest (₦1011.19) for rabbits fed control diet while rabbits fed diets containing BNS recorded the lowest (₦851.71 to ₦901.18) values which is in line with the work of Amaefule *et al*. (2011) who observed lower cost per kg weight gain for rabbits fed diets containing BGO.

Total production cost reduced from rabbits fed control diet to rabbits fed diets containing BNS. Total production cost was highest for rabbits (₦2,897.26) fed control diet while it ranged from ₦2,670.58 to ₦2,793.12 for rabbits fed diets containing BNS which is in agreement with the report of Amaefule *et al*. (2011) who found out that inclusion of Bambara nut offal in rabbits' diets decreased total feed cost. Profit increased from rabbits fed control diet to those fed diets containing BNS. The least profit (₦602.74) was recorded for rabbits fed control diet while rabbits fed diets containing BNS recorded profit ranging from ₦706.88 to ₦829.42. This further buttress the findings of Amaefule *et al*. (2011) that reduction in feed cost due to inclusion of BGO increased farmers' income and profit. Similarly, Ukpabi *et al.* (2008) also observed that reduction in feed cost of broiler chicken due inclusion of BGO will go a long way to improve farmers' profit margin.

CONCLUSIONS

It can be concluded that toasting BNS for 40 minutes improved ME. Inclusion of 20 kg of BNS in rabbits' diet improved feed intake and profit margin. However, inclusion of raw BNS in rabbits' diet prevents mortality.

RECOMMENDATION

Twenty (20) Kilogramme of BNS, especially raw can be included in the diets of rabbits to prevent mortality and improve profit margin of farmers.

REFERENCES

Ahamefule, F. O., Ibeawuchi, J.A. and Nwankwo, D.I. (2005). Utilization of sun-dried, fermented and ensiled cassava peel meal-based diets by weaner Rabbits. *Nig. J. Anim. Prod.* 30 (1): 26-31

Amaefule, K. U. and Osuagwu, F. M. (2005). Performance of pullet chicks fed raw Bambara ground nut offal diets as replacement for soyabean and maize. *Livestock Research for Rural Development*, 17, Art, #5, http://www.cipav.org.co/lrrd17/03/amae17036.htm.

Amaefule, K.U., Mbanu, U.E. and Amaka, V. (2011). performance and Nutrient utilization of growing rabbits fed graded levels of raw Bambara ground nut offal diets. *Pakistan Journal of Nutrition*, 10(5): 463-469.

AOAC (1999). Official Methods of Analysis. 15th edition Association of Analytical Chemist, Washington, D.C. USA.

Balogun, O. O., Adeniji, A. A. and Azua, T. A. (2003). Protein and energy values of maize and millet-milling wastes for rabbits. *Nig. J. Anim. Prod.* 30 (1):26-31.

Duncan, D. B. (1955). multiples range and F-Test. Biometrics, 11:1-42.

Ekenyem, B. U. and Onyenagoro, C. P. (2006). Replacement value of Bambara nut *Voandzeia subterranea* sievate for soybean meal *Glycine max* on the performance of finisher broiler chicken. *International Journal of Poultry Science*, (5): 381-384.

Grace, E. (2015). 'Health benefits of Bambara nut seed (Eastern Nigeria Okpa)' Assessed online at www.gracenogfoundation.org. Retrieved 21th May, 2016.

Igwebuike, J. U., Kwari, I. D., Aliyu, J. and Nadab, J. (2005). Replacement value of Sorrel Seed meal for groundnut cake in the diets of growing rabbits. *Annals of Borno* 21/22: 154 164.

Madubuike, F. N. and Ekenyem, B. U. (2001). Non-ruminant livestock production in the tropics. *Gust Chuks Graphics, Owerri, Nigeria*, pp: 185.

Nwakpu, P. E. and Okeke, A. C. (2016). Effect of quantity feed restriction using raw and toasted Bambara nut on the performance of weaner rabbits. *International Journal of Agriculture Innovation and Research, 5(3):441-447.*

Omoikhoje, S. O., Bamgbose, A. M., Aruna, M. B. and Uwagbale, A.A. (2005). Response of starter broiler fed graded levels of cooked Bambara groundnut meal. *Proc.39thconf. Agric. Soc. Nig.*, University of Bennin, Benin Pp. 120-121.

Pauzenga, U. (1985). Feeding parent stock. *Zootech. International*. Pp 22-25.

Statistical Package for Social Science (2015). IBM SPSS Incorporation Statistics for Windows Version 23.0 Armonk, New York. IBM Corp.

Tegbe, T. S., Attah, B. and J. O. Jegede, (1994).. Utilization of Agro Industrial by-products (Rice and wheal offal) on diets of pigs. 9th Ann. *Conf. Nig. Soc. Anim.*

Temple, V. J and Aliyu, R. (1994). Proximate composition of the cream coloured decorticated seeds of Bambara groundnut (*Voandzeia subterranea* (L.) Thouras). *Biological Science Research Communication.* 6: 51-54.

Ukpabi, U. H., Amaefule, K. U. and Amaefule, O.M. (2008). Performance of broiler chickens fed raw Bambara ground nut offal diets supplemented with lysine and methionine. *International Poultry Science*, 7(12): 1177-1181.

www.googleearth.com (2021).