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RESEARCH ARTICLE

COMPARATIVE EFFECT OF GRADED LEVELS OF TOASTED BAMBARA NUT WASTE AND SOYA BEAN HULLS ON GROWTH PERFORMANCE, HAEMATOLOGY, CARCASS AND CONFORMATIONAL TRAITSOF BROILER CHICKENS

[1,*]Udeh, F. U., [1]Ani, A.O., [3]Oyeagu, C. E., [1]Osita, C. O., [2]Igugo, R. U. and [1]Ngwu, P. E. C.

[1]Department of Animal Science, University of Nigeria Nsukka, Nigeria
[2]Enugu State University of Science and Technology, Enugu, Nigeria
[3]Department of Livestock and Pasture Science, University of Fort Hare, Alice, South Africa

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ABSTRACT

This study was conducted in two separate trials to compare the effects of graded levels of toasted Bambara Nut Waste (TBNW) and Soya Bean Hulls (SBH) on growth performance, haematology, carcass and linear measurement of broiler chickens. One hundred and twelve 28-day old broiler birds of Anak strain were divided into 7 groups of 16 birds each. The birds were assigned to 7 treatments of diets which include: a control, three Soya Bean Hulls (SBH) levels (10%, 20% and 30%), and three Toasted Bambara Nut Waste (TBNW) levels (10%, 20% and 30%) for 28 days (age 28-56 days). Each treatment was replicated twice with 8 birds per replicate. The result shows that final body weight, feed conversion ratio and protein efficiency ratio of finisher birds fed the diets containing 10% bambara nut waste was the best ($p<0.01$), and those on diet containing 10% soya bean hulls was significantly better than diets containing higher percentages of the test ingredients, as well as the control diet which is comparable with that of the diets containing 20% each of the test materials.There were no significant differences in average daily feed intakes of the birds fed graded levels of Bambara nut waste and those fed Soya bean hulls and there were no significant differences in average daily weight gain among treatments. The result of the haematological indices showed that broiler birds fed diets containing 10% of both Bambara Nut Waste and Soya Bean Hulls had the best White Blood Cell count. The birds fed diets containing 20% and 30% levels of Bambara Nut Waste had better White Blood Cell count than birds fed 20% and 30% levels of Soya Bean Hulls. The birds fed diets containing 10%, 20% and 30% levels of Bambara Nut Waste had better Packed Cell Volume percentage than those fed diets Soya Bean Hulls. The Packed Cell Volume values of birds fed Bambara Nut Waste were significantly different but statistically the same.The live weight, de-feathered weight, dressed carcass weight, weight of feathers, neck length, thigh length, thigh diameter, length of bird and weight of feathers varied significantly ($p<0.01$) while the shank length variations are insignificant. The live weight of the birds fed 10% level of bambara nut waste were significantly higher than the birds fed the control diet treatment and all other treatments. The live weights of birds fed 20% level of bambara nut waste were significantly higher than that of birds fed 20% levels of Soya bean hulls. The result of this study indicates that while soya bean hulls inclusion level of 20% and above may not be very promising in broiler diets, toasted bambara nut waste inclusion level of 10% is the best and is recommended along with soya bean hulls inclusion level of 10% for broiler diets. Up to 20% inclusion level of bambara nut waste in diets is promising, and is also recommended, especially for broiler finisher diets.

INTRODUCTION

One of the foremost, if not the most pressing challenge of poultry production in developing countries including Nigeria is the rising cost of feeds and feed ingredients which invariably leads to a sky-rocketing cost of production. Within the past twenty years, prices of commercial feeds in Nigeria have risen by about 2000% (Udedibie, 2003). This problem threatens to reduce the rate of growth and development of Nigeria's poultry industry.

****Corresponding author:*Udeh, F. U.**
Department of Animal Science, University of Nigeria Nsukka, Nigeria.

This high demand led to consistent increase in the prices of broiler birds in Nigeria for example, which is principally due to high cost of feed. Consequently, and however, the sub-optimal animal protein intake among Nigerians has attained a crises status while an urgent need torevamp the situation is aptly imperative (Ekenyem, 2006). This is due to the high cost of livestock and livestock production which has limited the capacity of many average Nigerians to consume adequate quantity and quality of animal protein (Ekpo *et al.*, 2009). The demand for poultry products, chicken especially is steadily escalating, and will ultimately become significant if supply and quality of the said products are not increased, improved and maximized. A possible way of doing so is by reducing the

cost of production, while maintaining quality through the effective, rational and calculated use of cheaper and locally available materials as feed resources for feed production.Consequent upon these findings, animal nutritionists in Nigeria have been sourcing for alternative feedstuff and researching on them for the formulation of high protein, high energy diets in order to meet the high demand of animal protein in the country as well as reduce both cost of production and cost of purchase for producers (farmers) and consumers, respectively. This gave rise to the use of non-conventional (substitute) feedstuffs by animal nutritionists in Nigeria, for monogastrics (poultry, rabbits and pigs) especially, poultry and broiler birds chiefly, which the scope of this study encompasses. Knowing this, a study to improve the knowledge of animal scientists on the non-conventional feeds for the best performance of broiler birds, especially by comparative analysis is inevitable. This in particular, gave rise to this study which is comparative assessment of growth performance, haematology, carcass and conformational traits of broiler birds fed graded levels of toasted bambara nut waste and soya bean hulls as well as those fed with feed containing none of the above-mentioned non-conventional feedstuffs.Bambara nut (*Vigna subterrenea italis*) waste and soya bean hulls; by-products (wastes) of ground and sieved bambara nuts and soya beans respectively unequivocally falls under this category. It has been estimated that Nigeria produces about 100,000 tonnes of bambara nut annually (Amaefule and Ironkwe, 2007). This accounts for the availability of the wastes throughout the year and very cheap since the wastes are discarded after obtaining the flour and could constitute environmental hazard if no use is found for it. This waste also contains some nutritional parts of the bambara groundnut which could not be grounded to flour. However, since presence of anti-nutritional factors such as tannin, cyanogenic glycosides, etc. have been reported in it (Ani and Omeje, 2007), detoxification is needed, and consequently, done by toasting. By so doing, toasted bambara nut waste is ready for poultry production. Soya bean hulls on the other hand, obtained from hulled fried soya beans also contains some part of the seed should be ground to a palatable fine particle size that can easily be consumed by chicks or finisher birds.

MATERIALS AND METHODS

Study Location

The experiment was conducted at the poultry unit of the Teaching and Research farm, Department of Animal Science, University of Nigeria Nsukka. Nsukka is in Enugu state, Nigeria and lies between latitude 06^{o} 52' 24"N, Longitude 07^{o} 39' 23" E and 550 meter elevation above the sea level. Nsukka covered land Area of 17.52 sq mi (45.38 km^{2}) with a population of 309,633 people (Federal Republic of Nigeria Official Gazette, 2007). The climate in this area is humid tropical with average annual rainfall of 1680 – 1700mm. the mean ambient temperature is 26.6 ^{o}C (Breinholt *et al.*, 1981).

Experimental design

A total of 112-day old broiler chicks of Anak strain were used in two separate trials as from their 3 weeks of age to compare the nutritional importance of graded levels of toasted bambara nut waste (TBNW) and soya bean hulls (SBH) in the diets of broilers. Commercial broiler starter diets were supplied for the first 4 weeks of brooding while the test materials were provided from 28 day of age till termination of the experiment. The broiler finisher diets were formulated to contain 0% (control), 10%, 20% and 30% levels of soya bean hulls (T0, T1, T2 and T3, respectively) and 10%, 20% and 30% levels of toasted bambara nut waste (T4, T5 and T6, respectively). The percentage compositions of the feed ingredients are shown in the Table 1 while proximate compositions of the diets are shown Table 2 below. Parameter measured were weekly weight gained, feed intake, feed conversion ratio (FCR) and protein efficiency ratio. Initial weights of birds were determined by weighing them per replicates after three week brooding when the experiment began. Weight gain was determined by subtracting initial live weight from the final live weight. Weekly feed intake was determined by subtracting final weight of feeds from the initial weight of feeds. Feed and water were supplied at the hours of 8:00am and 4:00pm daily throughout the trial period. The birds were provided the same management conditions (floor space, temperature, light, vaccination programme), but were housed in separate cells in deep litter pens. The experiment lasted for a period of 28 days (4 weeks). At the 8th week of the experimental period, four birds per treatment (two per replicate) were randomly selected, weighed and humanely slaughtered for carcass evaluation and body measurement, while blood samples were aseptically collected with the aid of sterile syringe and needle into EDTA (ethylene-diamine tetraacetic acid) container for haematological profile.

Procurement and Processing of test materials

Both the bambara nut wastes and soya bean hulls were purchased from food grinding and processing plants in Orie Orba Market, Orba Udenu LGA and Ogige Market, Nsukka, Nsukka LGA, both in Enugu state. Other feed materials and ingredients like maize, groundnut cake, palm kernel cake, bone meal, fish meal, vitamin mineral premix, methionine, lysine and salt were sourced from Chidera Feed Mill at Onuiyi Link Road, Nsukka. Brewer's dried grains were sourced from Emeka piggery farm in Nsukka while Cassava root meal was sourced from Obollo Market and Ogige Market Nsukka. All the above mentioned ingredients were used to formulate the experimental diets. The bambara nut wastes were heated while being stirred in a large frying pan over burning firewood for about 20 – 25 minutes until a toasting aroma was perceived consistently, in order to remove some anti nutritional factors like tannin and cyanogenic glycosides. Most of the soya bean hulls acquired was made up of mostly coarse particles. They were collected immediately after grinding and sieving of soya bean seeds and kept in bags to prevent contamination by other food materials or by sand or dust particles. After acquiring them, the grinding plants were thoroughly cleaned of other food materials before the soya bean hulls were ground two times to a palatable fine particle size that can easily be consumed by chicks or finisher birds.

Proximate analysis of experimental diets: Proximate composition of the experimental diets was determined by the standard method of Association of Officials Analytical Chemist (A.O.A.C, 1990).The result of the proximate composition of the experimental diet was presented in Table 2.

Table 1. Composition of Experimental Broiler Finisher Diets (%)

	Inclusion levels of SBH (%)				Inclusion levels of BNW (%)		
	T0	T1	T2	T3	T4	T5	T6
	Control	10%	20%	30%	10%	20%	30%
Maize	28.60	25.60	24.00	21.60	25.80	23.80	20.80
Cassava Root Meal	23.40	21.40	18.40	15.00	20.20	16.40	12.00
Brewers' Dry Grain	6.00	6.00	4.00	4.00	5.00	4.00	4.00
Groundnut Cake	29.00	25.00	21.60	17.40	27.00	24.80	22.20
Soya Bean Hulls	0.00	10.00	20.00	30.00	0.00	0.00	0.00
Bambara Nut Waste	0.00	0.00	0.00	0.00	10.00	20.00	30.00
Palm Kernel Cake	6.00	5.00	5.00	5.00	5.00	4.00	4.00
Fish Meal	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Bone Meal	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Methionine	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Vit. Min. Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100	100	100
Calculated Value							
Crude Protein (%)	20.03	19.01	18.25	17.47	20.19	20.39	20.66
Crude Fibre (%)	4.91	9.16	13.14	17.46	6.32	7.71	9.35
Energy (Mcal/kg ME)	2.78	2.92	3.07	3.20	2.88	2.99	3.08
Cost of 1kg feed (N)	6829	6454	6173	5796	6582	6356	6053

Each kilogram Vit/min premix contains; Vit. A 3600,000iu, Vit. D3 600,000iu, Vit. E 4,000,000mg, Vit B1-B12 640, 1600, 600, 4.00mg, Pantothenic acid 2000mg,Biotin 300mg,Manganese 16000mg, Biotin 300mg, Manganese 16000mg,Selenium 80mg, Vit K3 600mg, Cobalt 80mg, Copper 1200mg, Zinc 12,000mg, Folic acid 200mg, Choline Chloride 70000mg, Antioxidant 500mg.

Table 2. Proximate Analysis of Experimental Broiler Finisher Diets

		Inclusion Levels of SBH			Inclusion Levels of TBNW		
Parameters	Control	10%	20%	30%	10%	20%	30%
	T0	T1	T2	T3	T4	T5	T6
Moisture	10.13	9.23	7.83	5.75	9.83	9.04	6.33
Crude Protein (%)	20.76	19.34	18.87	17.94	20.19	19.84	19.32
Crude Fibre (%)	5.65	8.79	10.75	16.16	6.75	7.05	8.15
Ether Extract (%)	0.30	1.70	2.00	2.20	2.30	0.55	1.85
Ash (%)	6.75	9.20	6.30	6.80	6.10	9.65	7.45
NFE (%)	56.41						
Gross Energy (Mcal/kg)	2.89	2.88	3.11	3.27	3.02	2.89	2.95

NFE = Nitrogen free extract

Statistical analysis: Data collected were subjected to analysis of variance (ANOVA) for completely randomized design (CRD) as described by Steel and Torrie (1980) and Akindele (2004) using a Stat Graphic Computer Package (SPSS, 2007) model. Significantly different means were separated using Duncan's New Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

The crude protein value of the test materials used in this study was presented in Table 2 and agreed with the range (19.10 to 20.58% obtained by Ocheja *et al.* (2012) in Bambara nut waste. The value also agreed with the value recorded by Ezuoke (2003), Amaefuleand Iroanya (2004), but higher than the value of 16.19% CP recorded by Amaefule and Osuagwu (2005). The average value of crude fibre agreed with the average value 11.30% obtained byAmaefule and Osuagwu (2005).

Growth performance of broiler finisher fed graded levels of SBH and TBNW experimental diets

The results of the growth performance of broiler finishers fed graded levels of bambara nut waste and soya bean hulls are presented in Table 2. The result indicated highly significant difference ($P<0.01$) among treatments on final body weight, feed conversion ratio and protein efficiency ratio, however, there were no significant differences ($p>0.05$) in daily feed intakes and average daily weight gain among the treatments.

Final body weight decreased with increase in the test materials. It varied from (1700 to 2100g) in birds fed soyabean hull and (1800 to 2350g) in birds fed toasted bambara nut waste. However, 10% inclusion of both test materials had the highest value in final body weight with 2.00kg and 2.35kg for SBH and TBNW respectively. The result of the final body weight obtained in this study agreed with values reported byOcheja *et al.*(2012) who also used graded levels of Bambara nut waste in raising broilers and also agreed with the report of Ironkwe and Ukanwoko (2012). It was higher than the values (1200.54 to 1490.77g) reported by Ani *et al.* (2012) who fed broiler chickens with raw Bambara nut waste. Higher final body weight of birds fed graded levels of TBNW may be attributed to higher crude protein content of the test material which was higher than crude protein content of SBH. However, SBH contained higher crude fibre which may have contributed to poorer utilization of the feed. The effect of higher fibre content of SBH was justified by higher daily feed intake recorded in 30% SBH diet.Ironkwe and Ukanwoko (2012) had earlier reported similar observation.Daily feed intake were not significantly ($p>0.05$) influenced by both test materials. Though, daily feed intake was numerically higher 146.88g in T3 (30%) SBH and 137.50g in T5 (20%) TBNW. Birds on T6 30% TBNW had the highest average daily weight gain (51.45g) and birds on T4 had lowest value (41.86g) in the same test material.The increase in daily feed intake of birds on 30% SBH may be attributed to the fibrous and bulky nature, coupled with the low nutrient (energy) content.

Table 3. Performance of Broiler Finishers fed Graded Levels of Bambara Nut Waste and Soya Bean Hulls

		Inclusion Levels of SBH			Inclusion Levels of TBNW			
Parameters	**Control**	**10%**	**20%**	**30%**	**10%**	**20%**	**30%**	
	T0	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**SEM**
Initial Body Wt.	1074	1080	1072	1074	1076	1073	1077	0.00^{NS}
Final Body Wt. (g)	2100^{b}	2000^{bc}	1750^{de}	1700^{e}	2350^{a}	1900^{cd}	1800^{de}	60.27**
Daily Feed Intake (g)	153.13	125.00	131.25	146.88	106.25	137.50	134.38	3.92^{NS}
Av. Daily Wt. gain (g)	48.89	47.21	47.57	43.75	41.86	49.11	51.45	1.28^{NS}
Feed Con. Ratio	3.13^{bc}	2.64^{d}	2.76^{cd}	3.37^{a}	2.53^{e}	2.80^{cd}	2.62^{d}	0.12**
Protein Eff. Ratio	1.83^{b}	1.99^{a}	1.99^{a}	1.70^{d}	1.95^{a}	1.75^{c}	1.85^{b}	0.19*

a, b, c-Row means with different superscripts are significantly different at 1% or 5%. * = p<0.05 and ** = p<0.01, SEM = Standard Error of Mean.

Table 4. Haematological Profiles of Broiler Finisher Birds fed Graded Levels of Bambara Nut Waste and Soya Bean Hulls

		Inclusion Levels of SBH			Inclusion Levels of TBNW			
Parameters	**Control**	**10%**	**20%**	**30%**	**10%**	**20%**	**30%**	
	T0	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**SEM**
WBC Count ($X10^3/mm^3$)	18900.00^{e}	23200.00^{a}	20500.00^{c}	19400.00^{d}	22900.00^{a}	21400.00^{b}	23300.50^{a}	472.3*
PCV (%)	29.00^{bc}	26.00^{c}	28.00^{bc}	21.00^{d}	31.00^{ab}	30.00^{ab}	33.00^{a}	1.05 *
Hb Conc. (g/100ml)	9.67^{cd}	8.67^{e}	9.33^{cd}	7.00^{f}	10.34^{ab}	10.00^{ab}	11.00^{a}	0.35 *
MCHC (%)	33.33	33.33	33.32	33.34	33.34	33.33	33.33	0.00^{NS}
MCH (pg)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	0.00^{NS}
MCV (m^3)	9.01	9.00	9.00	9.01	9.01	9.01	9.00	0.02^{NS}
RBC Count ($X\ 10^6/mm^3$)	3.22^{cd}	2.89^{e}	3.11^{cd}	2.33^{f}	3.45^{ab}	3.33^{ab}	3.67^{a}	0.12 *

a, b, c-Row means with different superscripts are significantly different at 1% or 5%. * = p<0.05 and ** = p<0.01, SEM = Standard Error of Mean, White Blood Cell = WBC, Packed Cell Volume = PCV, Haemoglobin = Hb, Mean Cell Haemoglobin Conc. = MCHC, Mean Cell Haemoglobin = MCH, Mean Cell Volume = MCV, Red Blood Cell = RBC.

Table 5. Carcass and conformationalcharacteristicsof broiler finishers fed graded levels of Toasted bambara nut waste (TBNW) and Soya bean hulls (SBH)

		Inclusion Levels of SBH			Inclusion Levels of TBNW			
Parameters	**Control**	**10%**	**20%**	**30%**	**10%**	**20%**	**30%**	
	T0	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**SEM**
Live Weight (g)	2100.00^{b}	2000.00^{bc}	1750.00^{de}	1700.00^{e}	2350.00^{a}	1900.00^{cd}	1800.00^{de}	60.27**
De-feathered wt. (g)	1830.00^{b}	1765.00^{f}	1550.00^{bc}	1525.00^{e}	2050.00^{a}	1675.00^{cd}	1625.00^{d}	160.9**
Dressed weight (g)	1528.85^{b}	1190.00^{g}	1431.00^{c}	1274.80^{f}	1727.85^{a}	1344.30^{d}	1308.25^{e}	46.52**
Wt. of feathers (g)	120.10^{c}	125.00^{c}	145.15^{b}	137.50^{b}	155.00^{a}	120.50^{c}	110.50^{d}	4.14**
Shank Length (cm)	9.105	9.05	9.01	9.005	9.05	9.01	9.055	0.02^{NS}
Neck Length (cm)	14.05^{a}	13.05^{b}	13.01^{b}	12.05^{c}	13.10^{b}	14.005^{a}	13.05^{b}	0.18*
Thigh Length (cm)	9.505^{b}	9.05^{c}	9.005^{c}	9.01^{c}	10.00^{a}	9.01^{c}	9.005^{c}	0.102*
Thigh Diameter (cm)	17.005^{b}	15.10^{d}	16.05^{c}	17.80^{a}	17.25^{b}	17.05^{b}	16.01^{c}	0.24*
Body Length (cm)	24.005^{a}	23.10^{b}	23.05^{b}	23.025^{b}	24.25^{a}	23.10^{b}	23.005^{b}	0.14*

a, b, c-Row means with different superscripts are significantly different at 1% or 5%. * = p<0.05 and ** = p<0.01, SEM = Standard Error of Mean.

This seems to corroborate the report of Pond *et al*. (1974) that feed consumption and the quantity of feed required per kg of gain in pigs increased with increase in the dietary fibre. They attributed such increase to the bulky nature and low total digestible nutrient of the feed (Ani *et al.,* 2012). However, average daily feed intake in this study increased numerically with increase in percentage composition of the test materials. Ironkwe and Ukanwoko (2012) had similar observation and reported that higher feed intake recorded for birds fed diets containing 50.14% composite cassava meal could be attributed to the higher crude fibre content and lower energy levels of the diets. Average daily weight gain was not significantly (p>0.05) affected by the inclusion levels of the diets. This agreed with the findings of Muhammad *et al.* (2012) who obtained no significant difference in daily weight gain of broilers fed partially cooked sweet potato meal. On the contrary, Adeyemo *et al.* (2013) obtained significant differences in daily weight gain (139.67 – 413.15g/bird) in broiler chickens fed *Aspergillus niger* Hydrolysed cassava peel based diet. The result of average weight gain indicated that SBH and TBNW are comparable in nutrient supply and utilization, and either of the two can be used in broiler production to achieve the same result. Clearly, a number of scientific researches and commercial field observation regarding the inclusion of feed components of cheaper sources with no serious deleterious consequences are available in literatures(Oruwari *et al.*, 1995; Atteh, 2000; Adebiyi, 2007; Kayode, 2009; and UNEP, 2009). Feed conversion ratio varied significantly (P<0.01) among treatments. Birds on 30% inclusion of both test ingredients had the worst conversion ratio but the birds on 10% inclusions had a better feed conversion ratio. However, the result was within the range reported by Ndelekwute *et al.* (2014) and Muhammad *et al*. (2012). The feed conversion ratio of the birds fed diets containing 30% inclusion SBH and 20% of bambara nut waste compared favourably with that of the birds fed control diet. The birds fed the diet containing 10% soya bean hulls (T1) and 10% TBNW (T4) performed significantly better than birds fed diets containing higher percentages of the test ingredients but are comparable to birds fed diets containing 20% bambara nut waste. Feed conversion ratio in this study was higher than values reported by Adeyemo *et al.* (2013). Birds on levels of TBNW had better feed utilization than those on levels of SBH. Recently, Kalmendal *et al.* (2011) reported that 30% inclusion of sunflower cake (a high-fiber feed ingredient) in a cereal-based diet for broiler chickens impaired FCR, but 20% inclusion did not. This suggests that there may be critical dietary fiber-specific inclusion levels for chickens of different ages. Liu *et al.* (2011) had reported improved feed utilization (FCR) in broiler chickens on diets with inclusion of chicory (*Cichorium intybus* L.) which helped

in breaking down fibrous materials in the diets. Improved feed utilization observed in birds on TBNW could be attributed to the palatability, low fibre and good aroma impacted to the feed material by toasting during processing. Protein efficiency ratio was significantly ($p<0.05$) influenced among the treatments of both SBH and TBNW. T1 and T2 of SBH had (1.99) PER and compared favourably with T4 of TBNW which had (1.95) PER while T6 of TBNW compared favourably with the control group. T3 30% of SBH had the least PER of (1.70). The result showed that content of the test materials were not well utilized, hence, significant increase in the final body weight. However, protein efficiency ratio of finisher birds fed the diet containing 10% bambara nut waste was the best, and those on diet containing 10% soya bean hulls was significantly ($p<0.05$) better than diets containing higher percentages of the test ingredients, as well as the control diet which is comparable with that of the diet containing 30% of TBNW. This could be due to higher crude protein content of bambara nut waste compared to soya bean hulls. The result was in agreement with Ironkwe and Ukanwoko (2012) and Ani *et al.* (2012).High levels of fibre, tanninand cyanide adversely affect digestibility and utilization of nutrients by birds(Esonu and Udedibie, 1993), hence, the observed poor feed conversion ratio, protein efficiency ratio and weight gain manifested generally in the final finishing weights of the broilers.

Haematological indices of broiler finishers fed graded levels of SBH and TBNW experimental diets

The results of the haematological profile of broiler finishers fed graded levels of soya bean hulls (SBH) and Toasted bambara nut wastes (TBNW) are shown in table 4.The results indicate that the haematological values examined fall within the normal range for broilers as recommended by Coffin (1957) and Ross and Jones (1978).It showed that there were significant ($p<0.05$) differences among treatments on WBC count, PCV, Hb concentration and RBC count while MCHC, MCH and MCV were significantly ($p>0.05$) affect by the test materials. This was contrary to the findings of Ocheja *et al.* (2012) who reported no significant ($P>0.05$) dietary effect of PCV, HB, RBC, Eosinophil and basophil in broilers fed Bambara nut waste (BNW). WBC count varied significantly ($p<0.05$) among treatments with highest value recorded in T6 30% TBNW while the lowest value ($19400x10^3/mm^3$) was obtained in T3 (30% SBH) and the recorded values did not follow any particular trend (Ocheja *et al.,* 2012). However, results for these parameters were comparable with the values earlier reported by Annongu and Olawuyi, (2005) for pullet chicks and Abimbola, (2007) for broiler chicks. The significant increase in WBC was as a result of the response of the defense mechanism of the birds to handle contents of ANFs inthe test materials. Packed cell volume (PCV) varied across the treatments and was significantly ($p<0.05$) affected by the two test materials with T6 (30% TBNW) recording highest value (33.00%) while lowest value (21.00%) was recorded at T3 (30% SBH).Birds on graded levels of TBNW recorded higher PCV values than those on SBH diets,however, T2 (20% SBH) compared favourably with the control group. These values were higher than values reported by Olajide (2012) who recorded no significant difference among the haematological parameters evaluated. The values of PCV which fell within the recommended range for normal chickens (Mitruka and Rawnsley, 1977) were indications of adequate nutrition for these birds. Ikhimioya *et al*. (2000) and Oladele *et al* (2001) linked lower values of this parameter to inadequate nutrition. Similar trend was observed in haemaglobin concentration. It was noticed that T6 recorded highest value (11.00g/100ml), followed by T4 (10.34g/100ml) from TBNW diets and the lowest T3 (7.00g/100ml) from SBH diets. The values of haemoglobin concentration increased among birds fed levels of TBNW than birds on levels of SBH diets. This may partly be attributed to the increased utilization of TBNW in the different dietary treatments. The values obtained in this study are comparable with the values in Annongu and Olawuyi, (2005) and Olajide (2012).Red blood cell (RBC) count was significantly ($p<0.05$) affected by the diets and optimum value ($3.67x10^6/mm^3$) was recorded in T6 (30%) TBNWwhile lowest value was recorded in T1 (10%) SBH. Result showed that groups of birds fed TBNW diets had better RBC count than those fed SBH diets. However, values agreed with the findings of Olajide (2012) but lower than values reported by (Ocheja *et al.,* 2012). The general increase in PCV, RBC and WBC of those rabbits fed with diet containing TBNW and SBH seem to mean that the test materials helped in boosting the immune system of the rabbits. This present study disagrees with the work of Omitoyin (2006), in which poultry litter diets reduced the haematological parameters of fish and caused anaemia and the reduction of immune system of the fishes. Blood is a good indicator to determine the health of an organism (Joshi *et al*., 2002). It also acts as pathological reflector of the whole body; hence hematological parameters are important in diagnosing the functional status of exposed animal to toxicants (Joshi *et al*., 2002). It is proposed that TBNW and SBH in feeds can be used to manage birds that are immunosuppressed and anaemic. This is because of the drastic increase in PCV and total RBC count as well as increased WBC count stimulated by the feeds containing TBNW. Mean cell haemoglobin concentration (MCHC), Mean cell haemoglobin (MCH) and Mean cell volume (MCV) were not significantly ($p>0.05$) affected by both TBNW and SBH. This agreed with the findings of Olajie (2012) who obtained no significant effect on MCHC, MCV and MCH in broiler chickens.

Carcass and conformational characteristics of broiler finishersfed graded levels of Toasted bambara nut waste (TBNW) and Soya bean hulls (SBH)

The results of carcass and conformational characteristics of broiler finisher chickens fed graded levels of bambara nut waste and soya bean hulls are presented in Table 5. The result showed that live weight, de-feathered weight, dressed carcass weight, weight of feathers, neck length, thigh length, thigh diameter, length of bird and weight of feathers varied significantly ($p<0.05$) among treatments while the shank length was not significantly ($p>0.05$) affected. The mean live weight of the birds fed 10% level of bambara nut waste was significantly higher in all the parameters measured than those birds fed the control diet and all other diets. Similarly, the groups fed soya bean hull (SBH), group on 10% inclusion level performed significantly better ($p<0.05$) than other inclusion levels. The results of live weight and dressed weight agreed with the findings of Ani and Omeje (2013) who also obtained significant effect on carcass characteristics when raw Bambara nut was fed to broilers, however, values obtained in this study were lower than ranges 2520.00 – 3120.00gand 2210.00 – 2703.00g they respectively reported for the parameters. The value of live weight is in agreement with the

values 1.52 – 1.97kg reported by Olajide (2012).The marked effect of dietary levels of TBNW and SBH was significant decrease in live body weight and dressed carcass weight, especially as the level of the test materials in the diets increased beyond 10%. Perhaps the anti-nutritional factors (ANFs) in the TBNW could have been responsible for the observed reduction. These might have increased in concentration with increase in the level of TBNW in the diets. In an earlier report (Emenalom *et al* 2004) reduction in the carcass weights of birds fed dietary raw velvet bean (*Mucunapruriens*) was attributed to ANFs in the raw velvet beans. The role of ANFs in growth depression and reduction in carcass weight in broiler birds as a result of low nutrient availability had been earlier documented (Iyayi and Yahaya, 1999). In addition, high fibrous nature of SBH may have also contributed to the reduced carcass yield as fibrous feed is associated with bulkiness and low nutrient content. Increasing levels of the test ingredients did not result in any significant increase in the relative weights of live birds and dressed carcass. This disagrees with earlier observation in broilers fed raw velvet bean (Carew *et al.,* 1998).Reduced carcass yield obtained in this study could as well be attributed to nutrient loss due to heat used for toasting during processing of the test material. The result of the conformational characteristics of broiler finishers shows significant differences ($p<0.05$) among dietary treatments in neck length, thigh length, thigh diameter and body length, and was in agreement with the report of Ani and Omeje (2013) who obtained significant difference in conformational characteristics of broiler finisher. The values of shank length and body length were higher than mean values 7.59±0.03cm and 14.75±0.01cm reported by Ojedapo *et al.* (2012) in broilersfed Soaked Wild Cocoyam Corm-based Diets. Conformational performance was optimum at 10% inclusion levels of SBH and TBNW, except neck length which was highest at 20% inclusion level of TBNW and compared favourably with the control diet. Increasing levels of SBH and TBNW in thediets significantly reduced the lengths of body, neck, shank, thigh and thigh diameter of birds. The decrease in shank length and thigh length is in consonant with earlier report (Songunle *et al.,* 2005). The reduction in these external growth indices might be as a result of growth depression observed in these birds as reported by Ani and Omeje (2007). Antinutritional factors (ANFs) such as protease inhibitors, haemaglutinins, tannins and cyanogenic glycosides in the Bambara nut (Doku and Karikari, 1981; Enwere, 1998) had been implicated for growth depression in animals (Ensminger *et al.,* 1996). The result obtained in the present study tends to suggest that inclusion of more than 10% TBNW and SBH in the diets of broiler finishers could have deleterious effects on the growth of some of the birds' external organs.

Conclusion

The results obtained in this study indicated that TBNW and SBH hadsignificant effect ($p<0.05$) on growth performance, haematological indices, carcass and conformational characteristics of broiler chickens. The result showed that 10% inclusion levels of SBH and TBNW performed better than other inclusion levels. Higher inclusionlevels of the test materials indicated decrease in almost all the parameters evaluated. It is therefore recommended that TBNW and SBH be used at 10% level of inclusion in broiler diets for optimum performance.

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