ISSN 0189-0514
J. Anim. Prod. Res. (2017) 29(1):136-151

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PERFORMANCE OF BROILER CHICKENS FED GRADED LEVELS OF TREATED (SOAKED) BAOBAB (*adonsoniadigitata*) SEED MEAL

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ABSTRACT

Three hundred day old broiler chicks of the Anak breed were used to evaluate the potential of treated baobab (*Adansoniadigitata*) seed meal (TBSM) on the performance of broiler chickens using a completely randomized design (CRD) with five treatments replicated three times. There were twenty chicks per replicate. The inclusion levels of treated seed meal in the diets were 0, 10, 15, 20 and 25% for treatments 1 (Control), 2, 3, 4 and 5 respectively. The experiment lasted for four (4) weeks each for the starter and finisher phases. In theStarter Phase**,** asignificantly (P<0.05) higher daily feed intake (50.84g) was recorded in birdsfed 25% TBSM while birds fed 0% TBSM consumed the least (47.20g). Birds fed diet 10% and 15% TBSM have significantly (P<0.05) higher live weights of 637.03g and 638.38g and daily weight gains of 20.48g and 20.53g. Feed conversion ratio follows similar trend as weight gain. Significantly (P<0.05) higher feed cost per kilogram (₦92.16) and feed cost consumed (₦121.80) with zero cost reduction was recorded in birds fed 0% TBSM. Mortality ranged from1.02 – 3.06%. Finisher Phase follows similar trends as in the starter phase.. The mortality ranged from 1.48 -3.32%. Higher mortality was recorded in bird fed 0% TBSM and postmoten examination does not revealed any diseases symptoms therefore death was associated with normally environmental changes that occurs at time of the study.. Significantly (P<0.05) higher revenue ₦1,584.53 and ₦1,583.62 and gross margin of ₦871.01 and ₦899.33 were recorded in bird fed 10% and 15% TBSM and lower revenue ₦1,411.24 and ₦1,406.52 was recorded in birds fed 20% and 25% TBSM but significantly (P<0.05) higher in gross margin and rate of return on investment when compared to birds fed 0% TBSM. The PCV, Hb, RBC and WBC ranged from 22.50-26.83%,7.25-8.90g/dl, 3.07-4.50 ($x10^6$ mm^3) and 2.53-2.83 ($x10^3$/ mm^3) while MCV, MCH and MCHC ranged from 86.67-90.13(fl), 59.02-60.26 (pg) and 33.06-33. 22% respectively. Significantly (P<0.05) higher values for most of this parameters were recorded in birds fed TBSM compare to control (0% TBSM). It can be concluded that feeding TBSM up to 25% to broiler chickens increased the performance of broiler chickens at both the starter and finisher phase respectively.

Key Words: Treated baobab seed meal, broiler chicken, performance.

INTRODUCTION

The total dependence on cereals as principal sources of energy and protein in poultry diets is the major problem militating against the expansion of poultry industry in Nigeria. Medugu*et al.* (2011) reported that the tremendous decrease in poultry production is as a result of high cost of protein and energy feedstuffs especially cereal grains (Maize) which form the bulk of energy in poultry feeds consequent upon competitive usage for industrial and human needs, coupled with

constant drought. Several workers have emphasized the need for utilizing unconventional feedstuff as alternative feed ingredients (Fanimo *et al*., 2007.). Not much has been done in evaluating the potential feed value of some multipurpose tree products such as Baobab *(Adansonia digitata)* as poultry feed. ICUC (2002) reported that the fruits are rich in vitamins C, B1, B2, calcium, phosphorous, iron, trace minerals and protein while the seed contain edible oils and more protein than groundnuts and is rich in the amino acid lysine, vitamin B1 (thiamine), calcium and iron (Obizoba and Amaechi, 1993). The pulp has been found to be highly digestible with low anti – nutritional factors (Nkafamiya *et al.,* 2007) The seeds contains relatively high amount of crude protein which range from 18.40 - 21.95% (Nkafamiya *et al*., 2007; Anene *et al*., 2012) while Gadanya*et al.* (2014) reported that baobab seed contains 45.57% crude protein and higher essential amino acids than most leguminous plants. . Baobab pulp and seeds have been in use for some purposes, due to their long shelf-life and high energy and protein content, both the pulp, seeds and the kernel can be important food sources in times of low crop yield and natural disaster (State of the World, 2011). The high nutrient content of baobab shows that it can be used as an alternative feed ingredient in livestock feeding, especially in Nigeria where the scarcity and the cost of the conventionally feed ingredient particularly energy and protein sources have nearly paralyzed most poultry industries. These necessitated the present study to investigate the possibilities of replacing expensive ingredients with TBSM in broiler feeds..

MATERIALS AND METHODS

Experimental Site

The study was conducted at the Teaching and Research farm (Poultry unit) of the Department of Animal Science, Faculty of Agriculture,Ahmadu Bello University Zaria. Zaria is located within the Northern Guinea Savannah of Nigeria, on Latitude 11^{o} 12'N and Longitude 7^{o} 33'E at an altitude of 610m above sea level (Ovimap, 2014).

Source of Baobab Fruit

The fruit were harvested from villages in Mamudo district of Potiskum Emirate Council Yobe State of Nigeria.

Processing: Dried Baobab fruits were processed by cracking the hard shell of the baobab fruits using a small hammer to remove the inner contents (epicarp), and pounded using a mortar and pistil while the seed and pulp were separated using a sieve. The seeds were washed thoroughly with water to clean up the remaining pulp and sun dried before further pre-treatment as follows.

Cooking: The washed seeds were poured in a pot containing boiling water at a temperature of 100^{0}C and continuously heated for 5 hours. It was allowed to cool to room temperature before being removed for sun drying before milling.

Soaking: Cleaned seeds were poured in a container of clean water at the rate of 300g per 2.5 litres. The seeds were soaked for 5 days but water was changed daily. The seeds were sundried before milling.

Fermenting: Clean seeds were poured in a container of clean water at the rate of 300g per 2.5 litres and allowed to soak for 120 minutes and then fermented for 5 days in air tight polythene bags. The seeds were then spread on a clean mat for sun drying before milling

Roasting: Cleaned seeds were poured in a well heated pan and stirred continuously to obtain a uniform heating until the color changed from light brown to dark brown and then spread on a clean mat to allow to cool to room temperature before packing.

Determination of anti-nutritional factors

The anti- nutritional factors were carried in the laboratory of National Research Institute for Chemical Technology Zaria using methods described by AOAC (1996).

Experimental design and broiler management

Three hundred (300) broiler chicks (Anak) were purchased and brooded together for three days before allotted to five dietary treatments in a completely randomized design. The treatments were replicated three times with twenty chicks per replicate. The feeding trial lasted for four weeks for the starter and finisher phase respectively. The test ingredients as well as the diets were taken to the laboratory for proximate analysis before commencement of the experiment. Birds were vaccinated against Newcastle and Gumboro diseases. Feed and water were provided *ad libitum.*.

Experimental Diets

The composition and calculated analysis is presented in Tables 3 and 4. The Treated baobab seed meal (TBSM) was included at the levels of 0, 10, 15, 20 and 25% which were designated as treatments 1 (control) 2, 3, 4 and 5 respectively for both the starter and finisher diets which were isocaloric and isonitrogenous.

Data collection

Broiler performance: The birds performance such as feed intake, weight gain, feed conversion ratio were recorded weekly while mortality was recorded as it occurred and the cost of experimental diets were calculated based on the prevailing market price as at the time of the experiment.

Haematological analysis: Haematological indices such as pack cell volume (PCV), red blood cell (RBC), white blood cell (WBC) were determined using methods described by AOAC (1996) while mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were calculated using appropriate formulae described by Dancie and Lewis (1991).

Economic Analysis: A simple analysis was conducted to assess the cost effectiveness of the experimental diets. Only the cost of feed was used in the calculations with the assumption that all other operating costs remained constant. Cost of the feeds was calculated based on the market prices of ingredients.

Profitability of Production: The profitability of broiler production was estimated using budget analysis and profitability ratios (Adeoti and Olawumi, 2013). The budget analysis involves the deduction of the total variable cost (in Naira) from the total revenue of live birds (in Naira) to obtain the gross margin for each bird. The total variable costs of production are the cost of day old chicks, labour, feed, veterinary service, medication and other miscellaneous expenses. That is Gross margin is equal to Gross revenue minus Total variable cost. It was calculated by the given formula as follows:

$$GM = \sum_{i..1}^{n} PiYi - Ci$$

Where:

GM = Gross margin

Pi = Price per Kg of meat

$Yi = Total\ live\ weight\ in\ Kg\ of\ meat$

$Ci = Total\ variable\ costs\ incurred\ on\ bird$

I…n = Total number of birds.

The profitability ratios include the benefit cost ratio (BCR), the profitability index (PI) and the rate of return on investment (ROI). This was calculated as follows.

Benefit cost ratio (BCR) = $\frac{TR}{TC}$

Profitability index (P1) = $\frac{NP}{TR} = \frac{GM}{TR}$

Rate of return on investment (ROI) = $\frac{NP\ X\ 100}{TC} = \frac{GM\ X\ 100}{TC}$

Where

TR = Total revenue (value of the total live weight of a broiler

TC = Total cost of production of a broiler

NP = Net profit of a broiler production

Data Analysis

The data collected were subjected to analysis of variance (ANOVA) using the General linear Model of Statistical Analysis System (SAS) Computer software package (2002). Duncan multiple range test in the same software package was used to compare means.

The model for this design was as follows:

$X_{ij} = \mu + t_i + e_{ij}$

Where

Xij= any observation made in the experiment

μ =the population mean

t_i =Effect due to treatment added or treatment effect

Eij = Experimental error.

RESULTS AND DISCUSSION

Effect of pre-treatment on chemical composition of test ingredients

The effect of pre-treatment on anti-nutritional factors is shown in Table 1. The percentage reduction of trypsin inhibitor, saponin, phytate, tannin oxalate, alkaloid and flavonoid of cooked baobab were 90, 47.37, 91.86, 55.92, 93.17, 41.16 and 93.24% respectively Table 2. With the exception of saponin, all the anti – nutritional factors were significantly ($P<0.05$) reduced in the baobab seed. Cooking generally inactivates heat – sensitive anti – nutritive factors such as trypsin and chymotrypsin inhibitors and volatile compound (Akande and Febiyi, 2010). Carlini and Udedibie (1997) reported that it took two (2) hours boiling to completely eliminate trypsin inhibitor activity in Jackbean and three (3) hours of boiling to render the legume lectin free.

Trypsin inhibitor, saponin, phytate, tannin, oxalate, alkaloid and flavonoid of baobab seed when cracked and soaked for 1 day reduced by 95.77, 0.00, 59.30, 44.49, 76.79, 49.10 and 86.49% respectively. Soaking could be one of the processes used to remove soluble anti – nutritional factors (Akande*et al*., 2010). This also agrees with the report of Ahamefule and Odemelan (2008) who found that twenty four (24) hours soaking duration produced better results and would be preferred for tannin and cyanide feed ingredient.

The process of soaking baobab seed for 5 days reduced the anti – nutritional factors such as trypsin inhibitor, saponin, phytate, tannin, oxalate, alkaloid and flavonoid percentage by 95.38, 40.00, 80.81, 53.63, 81.57, 48.73 and 75.48% respectively, though there were no much differences between cracked and soaked for twenty four (24) hours and 120 hours soaking. These similarities exists because cracked seeds absorbed water more easily compared to intact hard baobab seeds which require several hours to absorb similar water in order to dissolve the water soluble anti – nutritional factors. The percentage reduction of anti – nutritional factors recorded in this study is higher than 65.75, 33.87, and 37.91% for the tannin, oxalate and trypsin inhibitors respectively in baobab seeds reported by Saulawa *et al*. (2014). The reasons might be as the result of cracking and longer soaking period used in this study.

Toasting of baobab seed resulted in a percentage reduction of 95.38, 80.00, 45.93, 51.52, 88.73, 40.07 and 90.75% for the trypsin inhibitor, saponin, phytate, tannin, oxalate, alkaloid and flavonoid respectively. This result revealed that toasting was the most effective method of saponin reduction when compared to the other treatments. This agrees with the report of Olaitan *et, al*. (2014) that roasting at 150^0C for 30 minutes significantly ($P<0.05$) decreased oxalate, phytate, tannin and saponin content of the Baobab seed but contrary to the work of Saulawa *et al*. (2014) who reported lower percentage reduction in toasted baobab seed compared with other treatments and also Amaefule *et al*, (2003) who reported that dry heating (toasting) was ineffective against tannin, phytate and oxalate.

Fermentation of baobab seed for 5 daysresulted in percentage reductionsof 61.34, 5.26, 33.72, 42.56, 76.79, 40.43 and 61.53% for trypsin inhibitor, saponin, phytate, tannin, oxalate, alkaloid and flavonoid respectively. This agrees with the work of Nnam and Obiakor (2013) who reported that fermentation reduced the anti – nutritional factors especially phytate and tannin of baobab seeds. These are however contrary to the report of Oladele and Oshodi (2008) who observed an increase in the phytate and tannin as the results of fermentation for six (6) days. Fermentation process results in decreased in phytate, oxalate, tannin and cyanide content with subsequent increased in nitrate and vitamin C (Sani*et al*., 2013). Decrease in phytate due to fermentation

helps in ensuring the bio availability of minerals such as calcium, magnesium, iron and zinc (Umar *et al.*, 2011)

Table 1: Proximate Composition and anti-nutritional content of Pulp, Seed and Pulp-Seed

Nutrients	**Pulp**	**Seed**	**Pulp - Seed**
Crude protein	5.85	17.27	9.29
Crude fibre	6.50	23.50	10.85
Ether Extract	7.45	19.07	12.25
Ash	6.50	4.89	4.40
NFE	73.78	52.82	63.21
Anti-nutrients			
TIA (IU/mg)	0.011	0.26	0.10
Saponin (%)	0.41	0.95	0.57
Phytate (mg/100g)	1.11	1.72	1.17
Tannin (mg/100g)	0.018	7.26	0.031
Oxalate (mg/100g)	0.007	2.93	0.112
Alkaloid (%)	2.82	5.54	3.32
Flavonoid (%)	1.26	13.62	3.34

TIA = Trypsin inhibitor activity, NFE = Nitrogen Free Extract

Table 2: Effect of pre-treatment on anti-nutritional contents of baobab seeds

Indices	**Try**	**%Red**	**Sap**	**%Red**	**Phy**	**%Red**	**Tan**	**%Red**	**Oxa**	**%Red**	**Alk**	**%Red**	**Flav**	**%Red**
Raw	0.26		0.95		1.72		7.26		2.93		5.54		13.62	
Cooked	0.03	90.00	0.50	47.37	0.14	91.86	3.20	55.92	0.20	93.17	3.26	41.16	0.92	93.24
C/S/day	0.01	95.77	0.95	0.00	0.70	59.30	4.03	44.49	0.68	76.79	2.82	49.10	1.84	86.49
S/5 days	0.01	95.38	0.57	40.00	0.33	80.81	3.41	53.03	0.54	81.57	2.84	48.73	3.34	75.48
Roasted	0.01	95.38	0.19	80.00	0.93	45.93	3.52	51.52	0.33	88.73	3.32	40.07	1.26	90.75
F/5 days	0.10	61.54	0.90	5.26	1.14	33.72	4.17	42.56	0.63	76.79	3.30	40.43	5.24	61.53

C/S = Cracked and Soaked; S = Soaked; F = Fermented; Try = Trypsin inhibitor (TUI/mg); Sap = Saponin (%); Phy = Phytate (mg/100g); Oxa = Oxalate (mg/g); Alk = Alkaloid (%); Flav = Flavonoid (%) %Red = percent reduction.

Table 3: Gross Composition of the experimental diets (starter)

		TBSM	Inclusion	(%)	SEM
Ingredient					
	0	**10**	**15**	**20**	**25**
Maize	56.95	49.40	46.50	43.00	40.00
TBSM	00.00	10.00	15.00	20.00	25.00
G/nut cake	20.00	19.00	18.00	17.00	16.50
SBC	19.00	16.55	14.45	12.22	10.95
Bone meal	3.00	3.00	3.00	3.00	3.00
Lime stone	0.30	0.30	0.30	0.30	0.30
Salt	0.30	0.30	0.30	0.30	0.30
Meth	0.20	0.20	0.20	0.20	0.20
*Pre-mix	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Calculated analysis					
ME (Kcal/Kg	2907.80	2908.98	2909.29	2910.58	2912.15
C/ protein (%)	23.14	23.17	23.26	23.36	23.38
Crude fibre (%)	3.84	4.35	4.81	5.29	5.76
EE (%)	4.07	4.79	5.49	6.20	6.95
Calcium (%)	1.23	1.24	1.24	1.24	1.25
Phosphorus (%)	0.85	0.81	0.80	0.79	0.78
Lysine (%)	1.02	1.09	1.14	1.24	1.25
Methionine (%)	0.55	0.56	0.57	0.58	0.59
Cost (₦)	92.16	80.12	67.48	56.13	44.74

TBSM = Treated Baobab Seed Meal, G= Ground, SBC = Soyabean Meal, Meth = Methioinine, ME = Metabolisable Energy, C= crude, EE = Ether Extract

*Premix supplied/kg: Vit.A=100000IU, Vit.D3=2000IU, Vit.E=23000mg, Vit.K3 =2000mg, Vit.B1 = 1800mg, Vit.B2 =5500mg, Niacin = 27,500mg, Panthothenic Acid = 7500mg, Vit.B6=3000mg, Vit.B12=15mg, Folic Acid = 750mg, Biotin H2 = 60mg, Choline chloride=300000mg, Cobalt=200mg, Copper= 3000mg, iodine=1000mg, Iron=20000mg, Manganese=40000mg, Zinc=30000mg, Selenium=200mg, Anti-oxidant= 1250mg.

Table 4: Gross Composition of the experimental diet (finisher)

	TBSM Inclusion (%)				
Ingredient	**0**	**10**	**15**	**20**	**25**
Maize	59.95	52.20	48.95	45.80	42.30
TBSM	00.00	10.00	15.00	20.00	25.00
G/nut cake	19.00	18.00	17.95	17.85	17.75
Soyabean meal	17.00	15.00	14.00	12.30	10.90
Bone meal	3.00	3.00	3.00	3.00	3.00
Lime stone	0.30	0.30	0.30	0.30	0.30
Salt	0.30	0.30	0.30	0.30	0.30
Methionine	0.20	0.20	0.20	0.20	0.20
Pre-mix	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Calculated analysis					
ME (Kcal/Kg	2952.55	2956.25	2955.76	2955.67	2960.14
Crude protein	21.34	21.88	21.95	21.96	21.98
Crude fibre	4.28	5.17	5.61	6.05	6.48
Ether extract	4.13	4.91	5.67	6.44	7.21
Calcium	1.22	1.24	1.25	1.27	1.29
Phosphorus	0.83	0.81	0.80	0.78	0.77
Lysine	1.07	1.02	1.13	1.18	1.23
Methionine	0.52	0.56	0.57	0.58	0.59
Cost (₦)	88.77	70.94	68.07	54.12	46.43

Bio-mix finisher supplied/kg: Vit.A=8500IU, Vit.D3=1500IU, Vit.E=10000mg, Vit.K3=2000mg, Vit.B1=1500mg, Vit.B2=1600mg, Niacin=4000mg, Panthothenic Acid=20000mg, Vit.B6=5000mg, Vit.B12=1500mg, Folic Acid=10mg, Biotin H2=500mg, Choline chloride=175000mg, Cobalt=200mg, Copper=3000mg, iodine=1000mg, Iron= 20000mg, Manganese=40000mg, Zinc=30000mg, Selenium=200mg, Anti-oxidant= 1250mg

Performance Characteristics

Starter Phase

The performance of broiler chickens fed graded levels of treated baobab (*Adansonia digitata*) seed meal during the starter phase (0-4 weeks) is shown in Table 5.

The average daily feed intake ranged from 47.20 – 50.84g/day. Significantly ($P<0.05$) higher daily feed intake (50.84g) was recorded in birds fed 25% TBSM while birds fed 0% TBSM consumed the least (47.20g).Daily feed intake of birds fed diets15% and 20% TBSM are similar.. This indicated that TBSM increased broiler intake linearly across the treatments group, This agrees with the work of Chimvuramahwe *et al.* (2011) who reported that baobab seed cake diet was acceptable to broiler chicks even at the highest inclusion level, they attributed this to the good aroma of the cake but contradicts the report of Jerry *et al.* (2013) who found that feeding of

graded levels of baobab seed meal based diet up to 30% to broiler starter had no effect on feed intake

The final weight and daily weight gain were ranged from 608.25 – 638.38g and 19.45 – 20.53g respectively. Birds fed diet contained 15% TBSM has the higher final weight and daily weight gain values but no significant (P>0.05) differences were observed across the treatment groups except birds fed 25% and 0% TBSM which found to be similar (P>0.05) with each other. The results agreed with the work of Jerry *et al.* (2013) who found significant (P<0.05) difference in weight gain in broiler chicken fed varying level of Baobab seed meal at the starter.

The feed conversion ratio recorded in this study ranged from 2.32 – 2.61with the lowest value recorded in birds fed15% TBSM though found to be insignificantly (P>0.05) different from all the treatment groups except birds fed 20% and 25% TBSM

The cost per kilogram of feed, total feed cost consumed and cost reduction ranged from ₦44.74 – ₦92.16, ₦65.69 – ₦121.80 and ₦0.00 – ₦56.11 respectively. Significantly (P<0.05) higher feed cost per kilogram (₦92.16) and feed cost consumed (₦121.80) with zero cost reduction was recorded in birds fed 0% TBSM while significantly (P<0.05) lower feed cost per kilogram (₦44.74) and total feed cost consumed (₦65.69) with highest cost reduction (₦56.11) was recorded in bird fed 25% TBSM but was similar (P>0.05) with birds fed 20% TBSM).

The mortality recorded in this study ranged from 1.02 – 3.06%. The overall mortality recorded in this experiment was less than the accepted 10% mortality rate in raising broiler chicken, from day old up to 28 days of age. Few mortality observed during the experiment was as the result of high environmental temperature (35^0C – 40^0C) because of higher anti-oxidant present in TBSM.

Table 5: Performance of broiler chickens fed treated baobab seed meal (Starter phase)

		TBSM	**Inclusion**	**(%)**		**SEM**
Parameter	**0**	**10**	**15**	**20**	**25**	
I.Live weight (g)	63.62	63.61	63.63	63.61	63.62	0.01
F.I/.Day (g)	47.20^{c}	48.53^{b}	47.68^{b}	48.81^{ab}	50.84^{a}	0.75
Final Weight (g)	627.86^{ab}	637.05^{a}	638.38^{a}	623.81^{ab}	608.25^{b}	10.90
W/Gain/Day (g)	20.15^{a}	20.48^{a}	20.53^{a}	20.01^{a}	19.45^{b}	0.39
FCR	2.34^{a}	2.36^{ab}	2.32^{a}	2.43^{b}	2.61^{c}	0.07
F/Cost/Kg (₦)	92.16	80.12	67.48	56.13	44.74	
T.Feed Cost (₦)	121.80	108.87	90.02	76.71	65.69	
Cost Red. (₦)	0.00	12.93	31.78	45.09	56.11	
Mortality (%)	3.00^{a}	1.02^{b}	1.12^{b}	1.22^{b}	3.06^{a}	0.14

Means within row with different superscript differ significantly (P<0.05); I = Initial, W = Weight, FCR = Feed Conversion Ratio, F = Feed, T = Total, Red = Reduction

Finisher Phase

The performance of broiler chickens fed graded levels of treated baobab (*Adansoniadigitata*) seed meal during the finisher phase (4 - 8 weeks) is shown in Table 6. Birds fed 25% TBSM recorded the highest daily feed intake which was significantly (P<0.05) different from birds fed 0% TBSM but was found to be similar (P>0.05) with the rest of the treatment groups suggesting that TBSM generally increased feed intake of broiler chickens. This agrees with the work of Jerry *et al.* (2013) who found that feed intake was significantly (P<0.05) higher as the dietary levels of Baobab seed cake inclusion increased. Similarly Sola-Ojo*et al.* (2013), reported least feed intake in broiler chicken fed control (0%) decorticated undefatted roasted baobab seed meal (DURBSM). This results was contrary to the work of Marizuihuru (2008) who reported significantly (P<0.05) higher feed intake when guinea fowl keet fed Baobab seed cake based diet. The results is also contrary to the work of Sola-Ojo (2011) who reported lower feed intake in layers chickens fed Baobab seed meal.

Table 6: Performance of broiler chicken fed treated baobab seed meal (Finisher phase)

		TBSM	**Inclusion**	**(%)**		SEM
Parameter	**0**	**10**	**15**	**20**	**25**	
I/Weight (g)	621.13	621.43	621.42	622.20	622.38	4.18
F/intake/Day (g)	123.07^{c}	132.81^{b}	133.96^{ab}	135.41^{ab}	136.63^{a}	1.38
Final Weight (g)	2047.53^{b}	2263.58^{a}	2262.31^{a}	2016.06^{b}	2009.31^{b}	27.77
W/Gain/Day (g)	48.99^{b}	56.86^{a}	56.82^{a}	47.99^{b}	47.75^{b}	0.98
FCR	2.54^{b}	2.35^{a}	2.36^{a}	2.84^{c}	2.92^{c}	0.06
F/Cost/Kg (₦)	88.77	70.94	68.07	54.12	46.43	
T/Feed Cost (₦)	305.89	266.61	253.13	205.55	177.62	
Cost Red. (₦)	0.00	39.28	52.76	100.34	128.27	
Mortality	3.32^{a}	1.52^{c}	1.50^{c}	1.48^{c}	2.55^{b}	0.09

abc = Means within row with different superscript differ significantly (P<0.05); I = Initial, W = Weight, FCR = Feed Conversion Ratio, F = Feed, T = Total, Red = Reduction

The values recorded for final weight and daily weight gain ranged from 2009.31 – 2263.58g and 47.75 – 56.86g respectively. Significantly (P<0.05) higher final weight were recorded in birds fed 20 and 15% TBSM while significantly (P<0.05) lower values were recorded in birds fed 25, 20 and 0% TBSM. This study contradicts the finding of Chimvuramahwe *et al.*(2011) who reported that feed containing baobab seed meal depressed the growth rate of broiler chicken. Mwale*et al.* (2008) also observed a decrease in the weight gain of guinea fowl keet at 10 and 15% inclusion level of Baobab seed meal. The differences that exist between this study and the mentioned works may be attributed to the processing method employed before feeding the birds with the test ingredient. Emiola *et al.* (2003) reported that improved utilization of protein of oil

and seed cake as a result of good processing technique prevented formation of protein – iron complexes that could inhibit protein digestion.

The values recorded in this study ranged from 2.35 – 2.92. Lower value of 2.35 was recorded in birds fed 10 and 15% TBSM which was significantly (P<0.05) different from birds fed 0%, 20 and 25% TBSM. This disagreed with the report of Anon (2013) who reported that feed utilization efficiency was better at 0% BSM inclusion levels and poorer utilization of feed was observed at 20% BSM inclusion levels. The differences might be as a result of raw baobab seed meal being used in the other study while this study used treated baobab seed meal which significantly improved feed utilization as the result of significant reduction in anti-nutritional factors present in the seed.

The mortality recorded in this study ranged from 1.48 -3.32%. Significantly (P<0.05) highest mortality rate was recorded in bird fed 0% TBSM; this indicates how effective the test material in combating deleterious agents that affect the survival of broiler chicken. Mortality recorded during the experiment was as the result of normal environmental change as the post mortem examination revealed no sign of diseases infection. The result obtained from this study was in line with the report of McDouglad and Malquision (1980) who stated that losses due to heat stress could be substantial during prolonged period of hot weather (heat stress), particularly with birds over four weeks of age. Also, Ubosi (1986) stated that mortality is usually high in the sub-sahelian zone of Nigria during the hot season.

The values recorded for this study ranged from ₦46.43 –₦ 88.77, ₦177.62 – ₦305.89 and ₦0.00 – ₦128.27 for the feed cost, total feed cost and cost reduction respectively and followed similar trends as in the starter phase.

Economic Analysis

The economics of broiler production is presented in Table 7. The total feed cost to raise the broiler chickens from 0 – 56 days ranged from ₦243.31 - ₦427.69. Higher feed cost ₦427.69 was recorded in birds fed 0% TBSM while lower values ₦243.31 was recorded in birds fed 25% TBSM which indicates a feed cost reduction of ₦184.38, which was in line with the main objective of usage of unconventional feed stuffs as reported by some workers (Bolu *et al.,* 2009). The total production cost ranged from ₦628.01 – ₦720.00while the selling price of the live birds was ₦700.00 per kilogram therefore the mean total revenue that accrued from the sales of the live birds ranged from ₦1,406.52 – ₦1,584.53 with gross margin ranged from ₦713.24 – ₦899.31. Higher revenue and gross margin was recorded in bird fed 10% and 15% TBSM while lower revenue was recorded in birds fed 20 and 25% TBSM but significantly (P<0.05) higher in gross margin and rate of return on investment when compared to birds fed 0% TBSM though significantly (P<0.05) lower than birds fed 10% and 15% TBSM in mention indices. Both benefit cost ratio and production index were increased with the increased level of inclusion of TBSM though were found to be similar (P>0.05) across the treatment groups. The percentage rate of return on investment followed a similar trends with the rest of mentioned parameters. This study agrees with the work of Chimvuramahwe*et al.*(2011) who reported that birds fed 10% Baobab seed cake have highest gross margin thereby significantly increased profit.

Table 7: Effects of feeding graded level of treated baobab seed on the haematological indices of broiler chickens

		TBSM	Inclusion	(%)		SEM
Parameter	**0**	**10**	**15**	**20**	**25**	
PCV (%)	22.50^{c}	25.00^{ab}	26.83^{a}	24.67^{ab}	24.33^{bc}	1.18
Hb (g/dl)	7.47^{ab}	8.53^{a}	8.90^{a}	8.08^{a}	7.25^{b}	0.35
RBC	3.67^{b}	3.73^{ab}	4.50^{a}	4.05^{ab}	3.07^{c}	0.25
WBC	2.71	2.53	2.83	2.67	2.77	0.16
Hetr. (%)	7.93^{e}	8.93^{d}	11.85^{b}	14.50^{a}	11.17^{c}	0.16
Lym (%)	19.56^{b}	19.62^{b}	19.69^{ab}	19.85^{a}	19.88^{a}	0.11
MCV (fl)	86.67^{bc}	90.33^{a}	88.17^{ab}	85.33^{c}	88.00^{b}	1.10
MCH (Pg)	59.02^{b}	60.26^{a}	59.99^{a}	59.74^{b}	50.07^{b}	0.37
MCHC (%)	33.06^{bc}	32.97^{bc}	32.97^{c}	33.22^{a}	33.16^{a}	0.04

^{abcd}Means within row with different superscript differed significantly (P<0.05).PCV = Pack cell volume, Hb = Haemoglobin; RBC ($x\ 10^{6}\ mm^{3}$). = Red blood cell count; WBC ($x10^{3}/mm^{3}$) = White blood count; Hetr = Hetrophil; Lym = lymphocytes;MCV = Means corpuscular volume; MCH = Means corpuscular heamoglobin; MCHC = Means corpuscular heamoglobin Concentration

Haematological indices

The haematological Indices are presented in Table 8. The haematological indices ranged from 22.50-26.83%,7.25-8.90g/dl, 3.07-4.50 ($x10^{6}\ mm^{3}$), 2.53 – 2.77 ($x10^{3}\ mm^{3}$), 7.93 – 14. 50%, 19.56 – 19.88%, 85.33 – 90.33 fl, 50.07 – 60.26 Pg and 32.97% for PCV, Hb, RBC, WBC, hetrophyl, lymphocyte, MCV, MCH and MCHC respectively. Birds fed TBSM were significantly (P<0.05) higher in the mentioned indices compared with control (0% TBSM). The increased in the values as the inclusion level of TBSM increased showed enhanced quality of blood as higher values have been correlated with the nutritional status of the animal (Iheukiwumere, 2008). The WBC was nonsignificantly (P>0.05) different across the treatment groups. Low level of WBC recorded indicates absent of nutritional stress on the experimental birds. The significantly (P<0.05) higher heterophyll and Lympocytes in birds fed TBSM compared with the control (0% TBSM), is an indication of adequate production of antibodies and no bacterial infection, stress or anti-nutritional properties in the diet containing TBSM in broiler chicken diets.

Table 8: Economic analysis of broiler chickens fed treated baobab seed meal

		TBSM	Inclusion	(%)		SEM
Parameter	**0**	**10**	**15**	**20**	**25**	
LW (g)	2047.53^{b}	2263.58^{a}	2262.31^{a}	2016.06^{bc}	2009.31^{c}	4.61
T/F/C(₦)	420.02^{a}	415.45^{ab}	395.06^{bc}	380.94^{c}	355.61^{d}	2.97
T/P/C (₦)	720.00^{a}	720.03^{a}	684.31^{b}	664.20^{c}	628.01^{d}	1.40
TR (₦)	1,433.27^{b}	1,584.53^{a}	1,583.62^{a}	1,411.24^{c}	1,406.52^{c}	1.87
GM (₦)	713.24^{c}	871.01^{a}	899.33^{a}	747.04^{b}	778.51^{b}	4.40
BCR	1.99	2.22	2.31	2.12	2.24	0.10
PI	0.50	0.555	0.57	0.53	0.55	0.01
ROI (%)	99.06^{d}	122.08^{b}	131.42^{a}	112.47^{c}	123.96^{ab}	1.17

^{abcd}Means within row with different superscript differ significantly (P<0.05), L/W = Live weight; T/F/C = Total feed cost; T/P/C = Total production cost; TR = Total revenue; GM = Gross margin; BCR = Benefit cost ratio; PI = Profit index; ROI = Rate of return on investment.

CONCLUSION

It can be concluded that Treated Baobab seed can be included in broiler chickens diets up to 25% but the optimum levels of inclusion was 15%. It has the advantage of increased performance and reduced feed cost of broiler chickens thereby increasing profitability and protein supply to the greater populace especially in the developing countries like ours in which fed cost is a major constraint in poultry production.

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