ISSN 0189-0514

J. Anim. Prod. Res. (2017) 29(1):152-166

National Animal Production Research Institute
Ahmadu Bello University
P.M.B 1096, Shika-Zaria,
Kaduna State, Nigeria.
Email: japr@napri.gov.ng
Website: http://journals.napri.gov.ng

EFFECT OF FEEDING GRADED LEVELS OF BAOBAB (*ADANSONIA DIGITATA*) PULP-SEED MEAL ON THE PERFORMANCE OF BROILER CHICKENS.

[1]Lawan, A., [2]Olugbemi, T. S., [2]Duru, S. and [2]Onimisi, P. A.

[1]Department of Animal Health and Production Yobe State College of Agriculture Gujba. P.M.B. 1104 Damaturu. GSM No. 08032980124.

[2]Department of Animal Science Faculty of Agriculture Ahmadu Bello University Zaria.

Email: melelawan@yahoo.com. or lawanmele@gmail.com

ABSTRACT

The study was conducted to evaluate the performance of broiler chickens fed graded levels of baobab (*Adansonia digitata*) Pulp-seed meal. The study was carried during the starter and finisher phases of growth ,with the during each phase lasting for four weeks. Three hundred Anak broiler chicks were allotted to five treatments replicated thrice with 20 birds per replicate in a completely randomized design. The inclusion levels of the test material in the diets were 0, 10, 20, 30, and 40% baobab pulp-seed meal for treatment 1 (Control), 2, 3, 4 and 5. Data collected were subjected to analysis of Variance and significant differences among treatment means were compared using the Dunnet Test. The results of experiment during the starter phase showed significantly ($P<0.05$) higher feed intake of 46.03g in birds fed 40% BPSM. Higher ($P<0.05$) average daily weight gain (24.89g and 25.01g) were recorded in birds fed 10% and 20% BPSM and birds fed 10% and 20% BPSM were more efficient in feed utilization than other groups. During the finisher phase, significantly ($P<0.05$) higher average daily feed intake of 144.95g was recorded in birds fed 40% BPSM while significantly ($P<0.05$) higher daily weight gain of 52.25g was recorded in birds fed 20% BSPM. Birds fed the test diet were more efficient in feed utilization compared to 0% BPSM, 30% and 40% BPSM. Higher feed cost and mortality were recorded in birds fed 0% BPSM in both phases. Significantly ($P<0.05$) higher apparent nutrients digestibility were recorded in birds fed test diets. The best ($P<0.05$) carcass characteristics were recorded among birds fed 20% BSPM. The kidney showed congestion and inter-tubular space in 3,2, 1, 2 and 1 out of 6 kidney samples from birds fed 0% BPSM, 10% BPSM, 20% BPSM, 30% BPSM and 40% BPSM respectively. The result of this study showed that BPSM is a suitable alternative feed ingredient for broiler chickens and that the optimum level of inclusion is 20%BSPM

Key Words: Baobab pulp seed meal, broiler chicken, feed intake, growth , carcass characteristics

INTRODUCTION

Food insecurity and hunger worldwide and particularly in developing countries like Nigeria have continued to receive attention from experts and Governments (Babatunde *et al.*, 2007). Consequently, several conferences and World food summits on human nutrition have debated the issue of eradicating extreme poverty and hunger. FAO (1995) asserted that the most critical in the global food basket crises is animal protein. Animal protein is crucial for normal physical and mental development of human beings as a deficit has serious adverse effects on the economic development of the country in term of reduction in human productivity, incidence of high infant

mortality, malnutrition and related diseases. Broiler industry represents the fastest and most economical means of bridging the animal protein shortage gap. In addition, it contributes to the national domestic products (GDP), provides gainful employment and income to sizeable proportion of the populace thereby alleviating poverty and improving the welfare of the population (Adebayo and Adeola, 2005). High cost of poultry feed has continued to be the major problem in Nigeria as feed cost is about 65 – 75% (Nworgu *et al*., 1999) therefore, all reasonable and practical options deserve thorough consideration. This has necessitated the renewal of interest in exploring the feasibility of incorporating neglected or underutilized energy and protein feedstuffs. Many nutritional scientists have tried in this direction especially industrial and agricultural by products but little so far has been done with multipurpose trees such as Baobab (*Adansonia digitata*), fruit that contents high nutrients, including vitamin C, riboflavin, niacin, pectin and citric, malic, and succinic acids, while the oil from the seeds contains vitamins A, D and E (Besco *et al*., 2007). This research is aimed at seeking for an alternative to the inadequate and expensive conventional feedstuffs. Feed cost is the largest single item in broiler production as it accounts for 65 - 75% of the total production cost (Opara, 1999). The major source of energy and protein in the poultry diet is now very expensive due to low production in the drier areas of the tropics with irregular supply due to constant drought and famine which pose a great threat to the future broiler production. Therefore, it has become very imperative to intensify efforts in search for cheaper, abundant and locally available alternative that have little or no dietary value to man (Odunsi *et al.,* 2002). Several researches have been conducted to evaluate the use of non conventional feedstuff especially grains and grain like, by- product and industrial waste which are mostly climate dependent but little have so far been done with multipurpose trees such as the baobab which is similar or even higher in nutrient content when compared to maize in terms of energy, protein, minerals, amino acid and vitamins. It is a Long life tree in the World with long history of utilization in human diet but of little significance in animals especially poultry diets.

MATERIAL 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 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 fruits were harvested from villages in Mamudo district of Potiskum Emirate Council Yobe State of Nigeria.

Processing

Dried Baobab fruits were processed by cleaning the hair on the fruit, cracking, opening the hard shell of the baobab fruits using a small hammer to remove the inner contents (epicarp), the pulp and seed. After removal from the hard shell, the fibre was manually removed and milled using a grinding machine. The processed pulp plus seed were packed in bags and stored until required for feeding.

Proximate analysis

The methods of the Association of Official Analytical Chemists (AOAC, 2006) were used for determination of dry matter, crude fibre, protein and fat content of the samples. Nitrogen free extract was determined by the difference of the sum of all the proximate composition from 100%.

Experimental design and management

Three hundred (300) broiler chicks (Anak) were purchased and subsequently weighed and allotted to five dietary treatments on the third day. The birds were housed in a deep litter system in a completely randomized design. The treatments were replicated three times with twenty chicks per replicate. The feeding trial lasted for four weeks each for the starter and finisher phase respectively, during which, feed and water was provided *ad libitum*.

Experimental Diets

The test ingredients were included at 0, 10, 20, 30 and 40%of diets 1 (control), 2, 3, 4 and 5 respectively (Tables 1 and 2). The diets were isonitrogenous and isocaloric (23% CP; 2900Kcal/kg) and fell within the recommended range of 22 - 24% crude protein and 2900 – 3000Kcal/kg metabolisable energy as reported by Aduku (2005) for broiler chickens.

Table 1: Gross composition of the experimental diets (starter)

	INCLUSION OF BPSM (%)				
Ingredient (%)	**0**	**10**	**20**	**30**	**40**
Maize	56.95	47.90	38.45	29.45	20.45
BPSM	0.00	10.00	20.00	30.00	40.00
G/nut cake	20.00	19.00	18.00	17.00	16.50
Soya bean meal	19.00	19.00	19.00	19.00	19.00
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
Lysine	0.00	0.00	0.00	0.00	0.00
*Premix	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Calculated					
ME (Kcal/Kg)	2899.95	2912.98	2904.09	2913.25	2935.20
C/protein (%)	23.13	23.21	23.23	23.30	23.56
Crude fibre (%)	3.84	4.16	4.46	4.78	5.14
Calcium (%)	1.18	1.28	1.28	1.38	1.25
Phosphorus (%)	0.66	0.64	0.62	0.61	0.59
Lysine (%)	1.02	1.12	1.21	1.31	1.42
Methionine (%)	0.55	0.55	0.53	0.50	0.48
Cost (₦/Kg)	91.00	82.77	78.41	73.07	69.49

BPSM = Baobab Pulp Seed Meal G= Ground, ME = Metabolizable Energy, *Bio-mix: starter, 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 2: Gross composition of the experimental diets (finisher)

Ingredient (%)	0%	10%	20%	30%	40%
Maize	60.00	51.95	41.95	32.95	23.95
BPSM	0.00	10.00	20.00	30.00	40.00
G/nut cake	20.00	20.00	20.00	20.00	20.00
Soybean meal	15.95	14.00	14.00	13.00	12.00
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
Lysine	0.00	0.00	0.00	0.00	0.00
Pre-mix	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Calculated					
ME (Kcal/Kg	2934.98	2956.92	2958.38	2970.35	2982.31
C/ protein (%)	21.95	21.57	21.94	21.93	21.91
Crude fibre (%)	3.80	4.17	4.57	4.95	5.33
Ether extract (%)	4.13	4.91	5.67	6.44	7.21
Calcium(%)	1.08	1.08	1.18	1.28	1.28
Phosphorus (%)	0.64	0.62	0.60	0.59	0.57
Lysine (%)	1.07	1.09	1.10	1.18	1.26
Methionine (%)	0.53	0.50	0.48	0.46	0.44
Cost (₦/Kg)	91.00	82.77	78.41	73.07	69.49

BPSM = Baobab Pulp Seed Meal G= Ground, ME = Metabolizable Energy 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

PARAMETERS DETERMINED IN THE EXPERIMENTS

Broiler performance

Feed intake, weights, 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 price as at the time of the experiment.

Digestibility trials

At the end of the experiment, 9 birds per treatment having representative weights (3 birds per replicate) were selected from the five treatment groups for digestibility trial and caged individually, after an adjustment period of three days. Droppings were collected on a daily basis for seven days while feed intake over the period was recorded. The faecal samples were oven dried at about 105^0C for 18 hours to reduce the moisture content and to bring the faeces to a constant weight. The total collection were pooled, weighed and ground, the representative

samples of the faeces and experimental diets were taken to laboratory for proximate analysis according to the procedure of AOAC (2006). They were assayed for apparent digestibility of crude protein, ether extract, crude fiber, and nitrogen free extract. The result was used to calculate the digestibility.

$$\text{Nutrient digestibility} = \frac{Nutrient\ intake - Nutrient\ in\ feaces \times 100}{Nutrient\ intake}$$

Carcass analysis and histopathology

At the end of the experiment, three birds representing the average weight were selected from each replicate (nine birds per treatment), labeled and then starved over night but water was provided. The weight of the birds was recorded in the morning before slaughter. Birds were defeathered and eviscerated. The parameters measured were carcass weight and organ weights were expressed as percentages of the carcass weight. The liver and kidney tissue samples were collected and put in a well labeled sample bottle containing 10% formalin (fixative). The samples were taken to the histological laboratory of Faculty of Veterinary Medicine Ahmadu Bello University Zaria for histopathological examination.

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 cost remained constant. Cost of the feeds was calculated based on the market prices of ingredients, which was called incidence cost that is actually the cost of feed to produce a kilogram of broiler (relative cost per unit weight gain) and lower the value the more profitable using that particular feed. Which was calculated as follows:

$$IC = \frac{Weight\ of\ broiler}{Cost\ of\ feeding}$$

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

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

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

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) to analyze the data generated. Duncan multiple range test in the same soft ware package was used to compare means.

The model used was:

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

Where:

X_{ij}= 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

Table 3, shows the ingredient, calculated and nutrients composition of the fed diets, this shows that the energy, crude protein, crude fibre, ether extract, nitrogen free extract and minerals levels contained in both diets are sufficient to meet the requirement of broiler chicken (NRC, 1994) at both the starter and finisher phase that is falls within the general nutrients recommended for broiler starter (22 – 24% CP and $\leq$ 5% CF) and finisher (19 – 21 CP and $\leq$ 5% CF) (NRC, 1994). It also agrees with the work of Rafiu *et al* (2008) who recommended 5.82 – 6.63 and 6.20 – 6.77 for the percentage crude fibre and ether extract respectively, similarly 5.22 – 6.42 for ash. There were slightly increased in both nutrients as the BPSM increased this shows the advantage of BPSM inclusion in broiler diet but it did not have much influence on the nutritive of the diet even at 40% inclusion.

Table 3: Proximate composition of Starter and Finisher Diet

Parameters										
DM	94.14	93.99	94.49	94.49	94.26	94.03	92.39	94.15	94.28	93.96
CP	23.73	23.59	23.67	23.53	23.45	21.26	21.24	21.23	21.20	21.29
CF	4.88	4.77	4.23	4.72	4.66	5.82	5.85	5.36	5.97	5.86
EE	5.37	5.86	5.85	5.95	5.74	5.56	5.72	5.87	5.79	5.73
ASH.	7.44	7.22	6.77	7.93	7.88	7.06	7.20	7.51	7.40	6.98
NFE	58.64	59.08	59.48	58.34	58.27	60.47	59.87	59.91	59.03	60.48
ME	3395	3445	3461	3424	3401	3384	3375	3388	3349	3399

ME is Calculated using McDonald (1995) Formula: 37 X %CP+ 81.10 X %EE + 35.5 X %NFE

Starter Phase

The effect of feeding graded levels of baobab pulp plus seed meal on the performance of broiler chickens during the starter phase (0-4 weeks) is shown in Table 4.

The average daily feed intake recorded in this study ranged from 41.26 – 46.03g. The higher ($P<0.05$) feed intake was recorded in birds fed 40% BPSM diet. This can be attributed to the high fiber in the hard seed coat (pericarp) and therefore high concentration of this fiber in this diet resulted in birds increasing their feed consumption as a way to compensate for reduced indigestible nutrients in the feed. This agrees with the work of Rafiu *et al.* (2012) who found a significant ($P<0.05$) increase in feed intake across the treatment groups when baobab pulp and seed meal were fed to broiler chickens.

Table 4: Effect of feeding graded levels of baobab pulp - seed meal on the performance of broiler chickens (Starter)

Parameters	**0%**	**10%**	**20%**	**30%**	**40%**	**SEM**
I/ weight (g)	78.64	78.63	78.63	78.30	78.64	0.05
F/I/Day (g)	41.26^{b}	41.75^{b}	43.02^{b}	43.14^{b}	46.03^{a}	2.48
F/Weight (g)	727.27^{b}	763.63^{a}	778.79^{a}	690.29^{c}	614.56^{d}	7.61
W/G/Day (g)	23.17^{b}	24.89^{a}	25.01^{a}	21.84^{c}	19.49^{d}	0.22
FCR	1.78^{a}	1.71^{a}	1.72^{a}	1.97^{b}	2.39^{b}	0.11
F/ Cost (₦/Kg)	115.48	105.48	94.60	84.40	74.00	
T/F/C (₦/Kg)	133.41	123.21	113.95	101.95	95.39	
C/Red. (₦/Kg)	0.00	10.20	19.46	31.46	38.03	
Mortality	0.00^{b}	0.00^{b}	0.00^{b}	0.00^{b}	0.55^{a}	0.00

abcd = Means within the row with different superscript differ significantly ($P<0.05$) I = Initial, F = Final, W/G = Weight gain, F/I = Feed intake, FCR = Feed Conversion Ratio F = Feed, T/F/C = Total Feed Cost, C = Cost

The final weight ranged from 614.56 – 778.79g and daily weight gain ranged from 19.49 – 25.01g with the 10 and 20% BPSM having the highest values for these two parameters. This implies that chicks cannot effectively utilize the test ingredient above 20% as their underdeveloped gastro intestinal tract cannot sufficiently digest fibrous materials.

The feed conversion ratio ranged from 1.71 – 2.39 with the 0, 10 and 20% BPSM diets being the more efficient. Efficiency declined beyond 20% BPSM implying that chicks cannot effectively utilize BPSM beyond 20% level of inclusion.

The feed cost per kilogram of feed produced, total feed cost consumed by the birds and cost reduction ranged from ₦74.00 - ₦115.48, 95.39 – ₦133.41 and ₦0.00 – ₦38.03 respectively. Highest cost of feed per kilogram (₦115.48), total feed cost (₦133.41) and zero cost reduction were recorded in birds fed 0% BPSM and lowest values of ₦74.00, ₦95.39 and ₦38. 03 were recorded in birds fed 40% BPSM. This implies that BPSM inclusion in broiler diets can substantially reduce cost of feed thereby increasing the profit margin of the farmer.

Finisher Phase

The effect of feeding graded levels of baobab pulp plus seed meal on the performance of broiler chickens during the starter phase (5-8 weeks) is shown in Table 5.

The daily feed intake ranged from 136.70 – 144.95g with the higher ($P<0.05$) values recorded in birds fed 30 and 40% BPSM and lowest in birds fed 0% BPSM. This implies that feed intake increased linearly as the test material increased in the diets. This can be said to be as a result of increasing fiber content in the BSPM diets resulting in birds increasing their feed consumption as a way to compensate for reduced indigestible nutrients in the feed. This is in agreement with the work of Ezeagu (2005) and Bolu and Olatunde (2009) but contrary to reduced feed intake reductions reported by Saulawa *et al*. (2012) and Anene *et al.* (2012). The differences with the other workers might be due to the fact that the present work used pulp and seed meal in contrast to raw seeds which could have diluted the effect of anti – nutritional factors in the test material.

Table 5: Effect of feeding graded levels of baobab pulp - seed meal on the performance of broiler chickens (finisher)

Parameters	**0%**	**10%**	**20%**	**30%**	**40%**	**SEM**
I/ weight (g)	817.02	817.05	817.03	817.03	817.03	1.32
F/ intake/Day(g)	136.70^{d}	137.30^{c}	139.16^{a}	139.27^{ab}	144.95^{a}	0.13
F/Weight (g)	2027.20^{c}	2149.65^{b}	2281.37^{a}	2144.01^{b}	1981.00^{d}	12.41
W/Gain/Day (g)	43.21^{d}	47.59^{b}	52.25^{a}	47.41^{c}	41.55^{c}	0.13
FCR	3.16^{c}	2.83^{b}	2.66^{a}	2.93^{b}	3.61^{d}	0.03
Feed Cost (₦/Kg)	115.48	104.45	92.65	81.69	44.94	
T/F/Cost (₦/Kg)	443.00	401.50	361.00	313.70	182.40	
C/Reduction(₦/Kg)	0.00	41.49	82.01	129.41	260.64	
Mortality	4.45^{a}	1.15^{c}	1.46^{c}	2.06^{b}	2.24^{b}	0.24

I = Initial, F = Final, W/G = Weight gain, F/I = Feed intake, F = Feed, T/F/C = Total Feed Cost, C = Cost, abcd = Means within the row with different superscript differ significantly ($P<0.05$)

Final weight and daily weight gain ranged from 1981 – 2281.37g and 41.35 – 52.25g respectively. The highest (P<0.05) values were recorded in the 20%BSPM group while the lowest for final weight was among the 40% BPSM and daily weight gain 305 and 40% BSPM .

This implies that broiler chickens performed better on diets containing 20% BPSM level. The overall performance of broiler chickens increased proportionally to the level of BPSM up to 30% and decreased beyond this levels. This might be due to the present of hard peri carp of baobab seed in the feed and also could be attributed to the cumulative effects of anti – nutritional factors to toxic level since baobab seed contained some anti – nutritional factors such as tannin, oxalate, phytate and saponin (Nkafamiya *et al.* 2007). Birds have better utilization of the nutrients with increase in age (Adeosun *et al*., 2013). Sola-Ojo (2013) similarly reported birds fed with higher inclusion levels of dehulled roasted baobab seed meal had higher body weight than other fed lower inclusion levels.

The values recorded for feed conversion ratio ranged from 2.66 – 3.61. The lowest (P<0.05) values (2.66 and 2.83) were recorded in birds fed 20% and 10%BPSM. It was however observed that birds on 30% BSPM were more efficient than the 0%BSPM birds indicating that birds at the finisher phase can effectively utilize BPSM up to 30% compared with 20% BPSM maximum limit at the starter phase. This may be due to full development of gastro intestinal tract which aid effective digestion of fibrous materials. The significant (P<0.05) differences in FCR observed between 0% BPSM diet and diets containing 10, 20 and 30% BPSM is a clear testimony of the efficacy of BPSM in replacing conventional feed ingredient in the broiler diets and is in agreement with work of Rafiu *et al.* (2012) who reported that birds placed on inclusion levels of 10, 15, and 20% baobab pulp and seed meal based diets had better (P<0.05) feed conversion ratio compared to control and Saulawa *et al*. (2012) reported that on feed was converted more efficiently by birds fed 10% raw baobab seed meal among the diets containing test feedstuff.

Feed cost per kilogram of feed produced, total feed cost consumed per birds and cost reduction ranged from ₦44.94 – ₦115.48, ₦182.40 – ₦443.00 and ₦0.00 – ₦260.64 respectively. It followed a similar trend as the starter phase. This implies that diets containing BPSM were less expensive compared to 0% BPSM (control). It also resulted in a substantial cost reduction across the treatment groups when BPSM was included in the broiler diets. This is in line with the main objective of the inclusion of unconventional feedstuff in broiler diets.

A mortality of 0.55% occurred in 40% BPSM and no mortality was recorded in the remaining treatments during the starter phase. At the finisher phase, the death of birds cut across all the treatment groups with the percentage mortality of 4.45, 1.15, 1.46, 2.06 and 2.24 for 0, 10, 20, 30 and 40% BPSM respectively. The death was not associated with any diseases condition as no clinical symptoms were observed in the postmortem examination; there were extreme hot ambient temperature (35 - 40 ^{0}C) at period of death. Samara *et al.* (2014) reported mortality rate can severely be affected by the heat stress condition especially during the last weeks of an experiment. The significantly (P<0.05) lower mortality rates in the birds fed diets containing BPSM compared to 0% BPSM (control) is an indication of how effective BPSM reduced mortality under unfavorable conditions as baobab contains high levels of antioxidant especially vitamin C and E, that reduces mortality under extreme environmental stress. This agrees with the report of Chimvuranhwe *et al*. (2011) who recorded 2% overall mortality of broiler chicken fed graded levels of *Adansonia digitata* seed cake and Roussan *et al*. (2008) who reported that there

was significantly lower mortality rate under cycling heat stress when vitamin C was supplemented.

Apparent Nutrient Digestibility

The effect of feeding graded levels of baobab pulp plus seed meal on the apparent nutrient digestibility of broiler chickens is shown in Table 6.

The nutrients digestibility ranged from 81.53 –88.68, 77.60 – 84.48, 68.81 – 80.06, 80.06 – 86.94, 70.42 – 77.92 and 88.78 – 92.50% for the Dry matter, Crude protein, Crude fibre, Ether extract, Ash and Nitrogen free extract respectively (Table 5). The 20% BPSM birds were found to be significantly ($P<0.05$) higher all treatments groups in the mentioned parameters except in the dry matter, ether extract and nitrogen free extract digestibility which were found to be similar ($P>0.05$) with 0% BPSM and 10% BPSM respectively. The birds fed 40% BPSM were significantly ($P<0.05$) lower in most nutrients digestibility than all the other treatment groups though similar ($P>0.05$) to 30% BPSM; this implies that nutrient digestibility increased with the increasing levels of BPSM in broiler chickens diet up to 20% inclusion of BPSM and then slightly declined afterward. This result agrees with the report of Rafiu *et al*, (2012) who reported that higher nutrient digestion in diet containing BPSM in feeding broiler chicken with baobab seed when compared with the control diet. This result shows that BPSM beyond 20% in the broiler diet has detrimental effects on nutrient digestibility.

Table 6: Effects of feeding graded levels of baobab pulp - seed on nutrients digestibility of broiler chickens

Parameters	0%	10%	20%	30%	40%	SEM
Dry matter	87.38^{ab}	86.56^{ab}	88.68^{a}	86.23^{b}	81.53^{c}	0.49
C/ protein	81.12^{c}	82.76^{b}	84.48^{a}	77.11^{c}	77.60^{d}	0.40
Crude fibre	75.45^{b}	80.66^{a}	78.42^{a}	68.81^{c}	65.88^{d}	1.37
Ash	73.94^{b}	77.01^{a}	77.62^{a}	73.96^{b}	70.42^{c}	1.23
NFE	91.48^{a}	92.06^{a}	92.50^{a}	90.14^{b}	88.78^{c}	5.73

^{abcd} = Means within the row with different superscript differ significantly ($P<0.05$)
C = Crude, NFE = Nitrogen Free Extract

Carcass Characteristics

The effect of feeding graded levels of baobab pulp plus seed meal on carcass characteristics of broiler chickens is shown in Table 7. Carcass weights ranged from 1450g – 1783.33g. The higher ($P<0.05$) carcass weight was recorded in birds fed 20% BSPM while the lower were from 40% and 0% BSPM.

The internal organs weight express as percentage carcass weight such as heart (0.58%), gizzard (3.25%), liver (2.64%), and Kidney (0.52) and gastro intestinal tract (249.67cm) which were significantly ($P<0.05$) lower than birds fed diet 5 (40% BPSM). The significant increase in carcass characteristic was the total reflection of live weight which was significantly higher in birds fed diets containing BPSM. This study agrees with the findings of Sahin and Kucuk (2003) who reported that supplemental ascorbic acid increase performance and yield better carcass

quantity and quality in birds reared under heat stress condition and Sola-ojo *et al*, (2014) who reported a significant increased in carcass components as the DURBSM increased in the broiler chicken diets but contrary to the work of Oladunjoye *et al*. (2014) who found no significant difference of carcass characteristic as the results of increased level of BPSM in the rabbit diets. The major reason for this disagreement between the two studies might be as the result of the species differences used in the two experiments.

Table 7: Effects of feeding graded levels of baobab pulp plus seed on Carcass characteristics of broiler chickens

Parameters	0%	10%	20%	30%	40%	SEM
L/Wt (g)	2000.00^{b}	2233.33^{a}	2266.70^{a}	2173.30^{a}	2000.00^{d}	18.10
C/Wt (g)	1458.33^{d}	1700.00^{b}	1783.33^{a}	1611.33^{c}	1450.00^{d}	14.05
Dress (%)	72.90^{d}	76.12^{b}	78.66^{a}	74.13^{c}	72.50^{d}	0.72
Organs express as percentage carcass weight						
Heart (%)	0.51^{c}	0.54^{b}	0.58^{a}	0.50^{c}	0.50^{c}	0.01
Giz. (%)	2.54^{d}	3.20^{ab}	3.34^{a}	3.25^{a}	3.08^{c}	0.10
Liver (%)	2.62^{a}	2.48^{b}	2.49^{b}	2.35^{c}	2.64^{a}	0.04
Kid. (%)	0.46^{b}	0.51^{a}	0.52^{a}	0.46^{b}	0.45^{b}	0.01
GIT (Cm)	218.83^{b}	248.33^{a}	249.67^{a}	253.83^{b}	244.67^{a}	6.68

^{abcd} Means within the row with different superscript differ significantly ($P<0.05$)
L/Wt = Live weight; C/Wt = Carcass weight; Giz = Gizzard; Kid = Kidney; GIT = Gastro Intestinal Track.

Histopathology

The histological changes observed in broiler chicken exposed to BPSM based diets are shown in plates 1, 2, 3 and 4. The clinical examination revealed that one out of six liver samples collected showed mild liver congestion and sinusoidal space in birds fed 0, 10 and 20% BPSM while no congestion and sinusoidal space were observed in birds fed diet 30% BPSM and 40% BPSM.

The kidney examination shows the congestion and intertubular space across the treatments group with 3, 2, 1, 2 and 1 out of 6 kidney sample collected from birds fed 0, 10, 20, 30 and 40% BPSM respectively. Since liver is the first contact organ before kidney in the detoxification and elimination of foreign substance in the body. It is therefore logical to reason that BPSM toxicity might not be the cause but rather stress factors. Stress challenges the homeostatic state of the organism, thus the stress responses includes complex responses to maintain a steady state. Prime examples of such response are increased heart rate and increased blood flow to muscle, brain and heart (Ewing *et al*., 1999). This might cause congestion in kidney, liver and lung (Worapol and Suchint, 2004). High body temperature may cause circulatory rupture then hemorrhage in various organs such as lung, kidney, liver and heart (Worapol and Suchint, 2004). Oxidative stress is caused by free radical, reactive which damage DNA, biomembrane lipid, proteins and other macromolecules (Lu et *al*., 2010). However free radical can be scavenged by the used of antioxidant, this was supported by the present study in the absent of defects at higher inclusion level of BPSM might be as result of higher antioxidant property of BPSM especially higher Vitamin C and E.



Plate 1: Photomicrograph of kidney showing congested intertubular

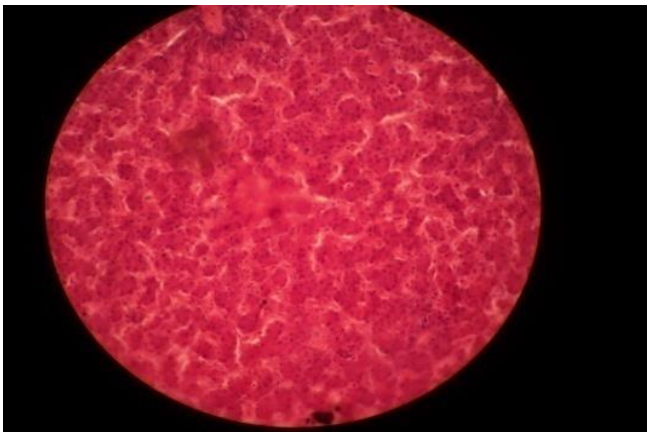


Plate 2: No observable findings



Plate 3: Photomicrograph of liver showing congested sinusoidal space

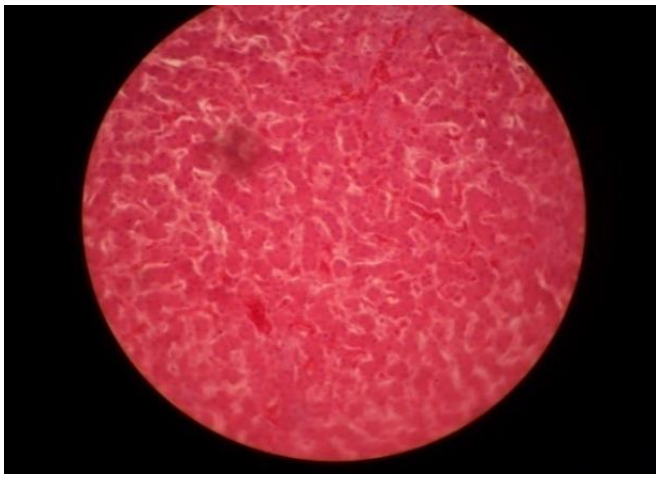


Plate 4: No observable finding

CONCLUSION AND RECOMMENDATION

This study indicates that baobab Pulp plus seed meal was beneficial up to 40%BSPM on the performance, feed cost reduction and general well being of broiler chickens but the optimum levels of inclusion was 20%BSPM. 20% BPSM is recommended in broiler chicken diets. Further studies are recommended to investigate the possibilities of using baobab fruit products as source of micro ingredients in poultry industry. Further research is also recommended to assess the physic-chemical and organoleptics properties of broiler chickens fed with baobab fruit products

REFERENCES

Adebayo, O.O. and Adeola, R. G. (2005). Socio economic factors affecting poultry producers in Eigbo Local Government area of Osun State. *Journal of Human Ecology*. 18(1): 39 – 41**.**

Adeosun., S.I., Ogundipe., S.O. and Omage, J.J. (2013). Effects of synthetic ascorbic acid and baobab fruit pulp meal supplementation as source of ascorbic acid for layers diets during cool wet season (Livestock improvement and health management). *Journal of Advances in Agricultural Science and Technology.* 1(2): 24 – 27.

Aduku A.O. (2005). Tropical Feeding stuff Analysis Table. Department of Animal Science, Ahmadu Bello University, Zaria.

Anene, A., Olivia, C.A. and Chison, O. (2012). Nutritive value and utilization of baobab (*Adansonia digitata*) seed meal as plant protein source in the diet of Juveniles of *clarias gariepinus. Journal of Research in Biology* 2(4): 348 – 354.

AOAC (1996).Official methods of analysis of the association of official analytical chemicals W. Horwitz (ed) 18th edition. Washington D.C.

Babatunde, R.O., Omotosho, O.A. and Sholotan, S.O. (2007). Socio-economic characteristic and food security states of farming households in Kwara State, North central part. *Journal of Nutrition.* 6: 49 – 58.

Besco, E., Braccioli, E., Vertuani, S., Ziosi, P., Brazzo, F., Bruni, R., Sacchetti, G. and Manfredini, S. (2007). The use of photo chemical for the measurement of the integral anti-oxidant capacity of Baobab products. *Journal of Food Chemistry*. 102 (4): 1352 – 1356.

Bolu, S.A. and Olatunde, A. A. (2009). Response of broilers to different sources of vitamin C. *Journal of Agricultural Resource and Development*. 2(1): 7-13.

Chimvuranhwe, J., Musara, J.P., Mujuru, L., Gadzirayi. C.T., Nyakudya, I.W., Jimu, L., Katsvangra, C.A.T., Mupangwa, J.F., and Chivheya, R. (2011). Effects of feeding graded levels of Baobab (*Adansonia digitata)* seed cake on the performance of broiler chickens. *Journal of Animal and Plant Science* 11 (3): 1442 – 1449.

Ezeagu, I.E. (2005). Baobab (*Adansonia digitata*). Seed protein utilization in young albino rats biochemical ingredients and performance characteristics. *Animals Research International*. 2(1): 240 – 245.

Ewing, S. A., Lay, D. C. Jr. and Borell, E. V. (1999). Farm Animal Well – Being. Simon & Schuster Company, New Jersey.

FAO. (1995). Hand book on development in Nigeria from 1999 – 2006, Rome.Pp 210.

Lu, M.B., Zhang, Y.E., Zhao, C.F., Zhou, P.P. and Yu, L.J. (2010). Analysis and identification of astaxanthin and its carotenoid precursors from Xanthophyllomyces dendrorhous by high performance liquid chromatography. *Z. Naturforsch. C*., 65: 489-494.

Nkafamiya, H., Aliyu, B.A., Manji, A.J. and Modibbo, U.U. (2007).Degradation properties of wild *Adansonia digitata* and prosopis African oils on storage. *African Journal of Biotechnology* 6(6): 751 – 755.

Nworgu, F.C., Adebowale, E.A., Oredein, O.A. and Oni, A. (1999).Prospects and economics of broiler chicken production using two plant protein sources. *Tropical Journal of Animal Science*. 2(1): 159 – 166.

Odunsi, A.A., Akande, T.O., Yusuph, A.S. and Salami, R.I. (2002). Comparative utilization of high inclusion rates of four agro- industrial by products in the diet of egg types chickens a cautionary approach to international market export of baobab fruits. Ecology of Food and Nutrition 49: 145–172.

Oladunjoye,I.O., Akinlade, M. and Lawal, Z. (2014). Performance Digestibility, Carcass and Blood profile of Grower Rabbits Fed Baobab (*Adansonia digitata*) pulp and seed meal. *Indian Journal of Fundamental and Applied Life Sciences* 4(2): 234-240.

Opara, C.C. (1999). Studies on the use of *Alconia condiofolia* leaf meal as feed ingredients in poultry diets. Msc. Thesis Federal University of Technology, Owerri. Pp. 115 – 118.

Ovimaps (2015). Ovilocation map; Google earth imaginery. Date 6th march 2014.

Rafiu, T.A., Okunlola, D.O., Shitu, M.D., Ookanola, G.O. and Falodun, T.T. (2012). Digestibility and growth performance of broiler chickens fed varying dietary meal of baobab (*Adansonia digitata*) pulp and seed based diets. In: *Proceeding 17th Annual Conference of the Animal Science Society of Nigeria* from 9th – 13th September 2012 held in Abuja Nigeria. Pp. 442 – 445.

Roussan, D.A., Khwaldeh, G.Y., Haddad, P.R. Shaheen, I.A., Salameh. G. and Al Rifai, R. (2008). Effect of ascorbic acid acetylsalicylic and sodium bicarbonate and potassium, chloride supplementation in water on the performance of broiler exposed to heat stress *Journal of Applied Poultry Resource.* 17: 141 – 144.

Sahin, K. and Kucuk, O. (2003). Zinc supplementation alleviates heat stress in laying japanense quail. *Journal of Nutrition.* 33: 2808 –2811.

Samara, S.T., Kamel, M.A.H. and Ibrahim, M.I. (2014). The effect of dietry supplementation of some antioxidants on performance oxidance stress, and Blood parameters, in Broilers under natural summer condition. *Journal World Poultry Resource.* 4(1): 10-19.

SAS (2002). Statistical Analysis System, Inc. User`s Guide. Statistic version for windows.SAS Software, version 9.2 Cary, North Carolina USA.

Saulawa, I.A., Ukachukwu, S.A., Onwudike, O.C., Garba, M.G. and Aruwaya, A. (2012). Effect of quantitative replacement of raw baobab (*Adansonia digitata*) seed meal for soya bean meal in broiler finisher diet. *Proceeding 17th Annual Conference of the Animal Science Society of Nigeria* from 9th – 13th September 2012 held in Abuja Nigeria. Pp. 525 – 528.

Sola-Ojo, F.E., Toye, A.A., Bolu, S.A.O., Ojo, V., Okukpe, K.M., Alli, O.I., Adeyemi, K.D. and Garba, S.O. (2013). Effects of Baobab (*Adansonia digitata*) seed meal on growth and Morphometric Traits in Broiler Chickens *MSEB Journal.* 13 (1&2): 29-32.

Worpol A. and Suchint, S. (2004). Pathology of heart, liver and kidney in broilers under chronic heat stress Sohgklanakarin *Journal of Science Technology*. 26 (3): 417 – 424.