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Effect of Feeding Graded Levels of Baobab (*Adansonia digitata*) Pulp-Seed Meal on the Performance of Broiler Chickens

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ABSTRACT

The study was conducted to evaluate the performance of broiler chickens fed graded levels of baobab (Adansonia digitata) Pulp-seed meal. The experiments which lasted for four weeks for the starter and finisher respectively, three hundred broiler (Anak) chickens 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 intertubular space across the treatments group with 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. It can be concluded that BPSM is a suitable alternative feed ingredient for broiler chickens and though the inclusion of 40%BPSM gave better results for some parameters than the 0%BPSM, the optimum level of inclusion is 20%BSPM

Keywords *Baobab pulp plus seed meal, broiler chicken, Performance*

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° 12'N and Longitude 7° 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 fibres were manually removed and milled using a grinding machine. The processed pulp plus seed were packed in bags and stored before being used.

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.

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^{0}C 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.

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

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 by dipping into hot water for few minutes to soften the feather for easy removal. The defeathered birds were 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 transferred to 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?

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

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

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

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

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) 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 ≤ 5% CF) and finisher (19 – 21 CP and ≤ 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.

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. 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.

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 level. 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.

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.

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.

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

Table 3: Proximate composition of Starter and Finisher Diet

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

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

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)

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

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.

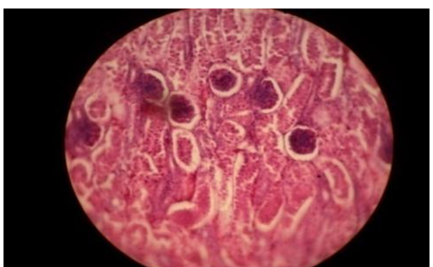


Plate 1:Photomicrograph of kidney showing congested intertubular space

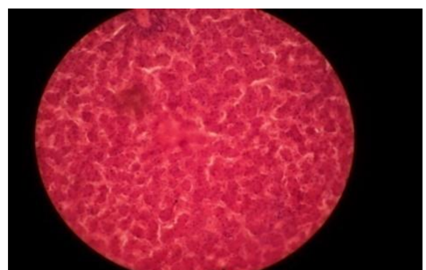


Plate 2: No observable findings this statement is inappropriate be more scientific

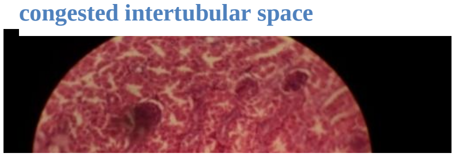
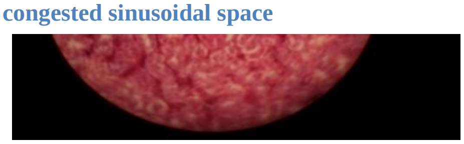


Plate 3: Photomicrograph of liver showing congested sinusoidal space



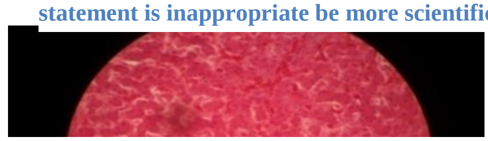


Plate 4: No observable finding this statement is inappropriate be more scientific

The proximate and Anti-nutrient composition of the experimental materials (Baobab Pulp, Seed and Pulp plus Seed) is presented in Table 4.1.

Crude Protein

The crude protein percentage was found to be 5.85%, 17.27% and 9.29% for the pulp, seed and pulp plus seed respectively. This shows that the pulp was mostly carbohydrate while the seed was predominately protein and pulp plus seed served as an intermediary between the pulp and seed in the supply of protein with the value similar to that of maize. The values of protein in the pulp and seed fell within the range of 2.5 – 17.0% and 14.40 – 36.70% respectively reported by Lockett *et al.* (2000) and Osman (2004). The crude protein of the pulp was also similar to 5.57% reported by Abdalla *et al*. (2010) for baobab pulp but slightly higher than 3.50% reported by Oyeleke (2012) for baobab pulp. The crude protern 17.27% recorded in baobab seed in this study were mostly lower than 19.50% and 21.95% reported by Oyeleke *et al*. (2012) and Nkafamiya *et al.* (2007) respectively for baobab seed. The seed contains relatively high amounts of protein and low carbohydrate while the pulp contains a high amount of carbohydrate and low protein while pulp plus seed contains intermediates values.

Table 4.1: Proximate Composition and anti-nutritional content of Experimental Materials.

Nutrients	Pulp	Seed	Pulp plus 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
ME (Kcal/Kg)	3597.40	4222.76	3738.23
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. ME is calculated using formula described by Jansen (1989) (36.21 X %CP + 85.44 X %EE + 37.26 X %NFE).

Crude Fibre

The crude fibre percentages were 6.50%, 23.50% and 10.85% for the baobab pulp, seed and pulp plus seed respectively. The crude fibre obtained was lower than that obtained by Lockert *et al*. (2000) and higher than the result obtained by Nkafamiya *et al*. (2007) which were 49.72% and 6.71% respectively. The crude fibre percentage of the pulp (6.50%) was similar to 6.10% stated by Oyeleke *et al*. (2012) in baobab pulp, which was also higher than 4.46% reported by Abdalla *et al*. (2010) while crude fibre (23.50%) of the baobab seed recorded in this study were higher than 21.20% reported by Ajayi *et al*. (2003) for the baobab seed. The crude fibre of pulp plus seed (10.85%) was lower than that of the seed but higher than that of the pulp. The considerable amounts of crude fibre recorded in this study show that it will enhance easy movement of bolus in the large intestine and aid proper digestion in animals.

Ether Extract

The ether extract percentage recorded in this study were 7.45%, 19.07% and 12.25% for the baobab pulp, seed and pulp plus seed respectively. The ether extract values obtained 19.07% and 12.25% for the seed and pulp plus seed was within the range obtained by Osman (2004) and Danbature *et al*. (2014) which were 12..25% and 24.72% respectively while 7.45% ether extract obtained for the pulp was lower than the values obtained in the seeds, revealing that pulp has lower ether extract when compared to the value found in seed while pulp plus seed has intermediate values between the pulp and seed. The value of ether extract recorded in this study were found to be higher than 0.30%, 0.40% and 1.66% ether extract for baobab pulp and seed reported by Magdi and Osman (2004); Abdalla *et al* (2010) and Oyeleke (2012).

Ash

The ash percentage recorded were 6.50%, 4.89% and 4.40% for the baobab pulp, seed and pulp plus seed respectively. These values fell within the range of 1.9 – 6.50 and 4.0 – 6.40 for the pulp and seed respectively reported by Lockett *et al.* (2000) and Osman (2004). The ash was slightly higher than the value for pulp and seed reported to be 3.10% and 3.80% by Anene *et al*. (2010) and Oyeleke *et al*. (2012) for baobab pulp and seed. Indicating that it may have a reasonable quantity of mineral elements for building healthy body and proper functioning of body tissue of animal.

Nitrogen free extract

The Nitrogen free extract contents of pulp, seed and pulp plus seed were found to be 73.78%, 52.82% and 63.21% respectively. The values fell within the range of 46.60% - 87.70% and 5.20 – 56.80% for the pulp and seed respectively reported by Murray *et al*.(2001) and Osman (2004) The values of carbohydrate recorded in this study also agrees with the report of Nkafamiya *et al.* (2007) who cited carbohydrate content of baobab pulp and seed to be 73.20% and 52.53% respectively but slightly lower than 75.15 – 78.57% reported by Abdalla *et al*.(2010) recorded for baobab pulp while slightly higher than 44.60% Nitrogen free extract reported by Oyeleke *et al*. (2012) for baobab seed. The Nitrogen free extract values recorded for pulp plus seed was slightly lower than that of pulp but higher than that of seed; an indication that the pulp plus seed combined the advantage of the two. This agrees with the work of Magdi and Osman (2004) who reported that baobab is an excellent source of carbohydrate and also with the report of Danbature *et al*. (2014) who showed that the carbohydrate in baobab fruit does not vary much within geographical location. Achille *et al*. (2002) reported that carbohydrate concentration of baobab parts do not vary between the three climatic zones (Sudanian, Sudano-Guinean and Guineo-Congolian zones). This indicates that it could used as an alternative source of animal feed and could find immediate utility in mixed animal feed. The study also revealed that baobab pulp plus seed was intermediary between the pulp and seed in term of carbohydrate supply to the host animals.

CONCLUSION

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

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RECOMMENDATIONS

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

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