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Nutritional Evaluation of *Adansonia digitata* (Baobab Fruit) as a replacement for maize in the diet of Broiler Chickens

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Target Audience: Poultry Farmers, Animal Scientists, Poultry Nutritionists

Abstract

Feeding trial was carried out to investigate the nutritional value of Adansonia digitata (Baobab seed and fruit pulp) as feed resource using one hundred and fifty (150) day old broiler chicks. Maize meal was replaced with Baobab meal at 0, 20, 30, 40 and 50% replacement levels. The birds were equally and randomly allotted to the diets while water and other management practices were carried out accordingly. Daily feed intake and weekly weight gain were monitored while feed conversion ratio was estimated. At the end of 8 weeks, feacal and blood samples were collected and analyzed for nutrient digestibility and haematological parameters respectively. Birds fed 40% replacement level had best feed intake, weight gain, feed conversion ratio, protein efficiency ratio and least feed cost per body weight gain compared to other treatments control inclusive. Nutrient digestibility of the experimental birds was significantly ($P<0.05$) affected. The parameters measured increased as the inclusion level increased. The RBC, WBC, Hb and PCV were not significantly influenced ($p>0.05$) by level of BM while lymphocyte, monocyte and eosiniphil were significantly affected. It could be concluded that Baobab meal can be used up to 40% as a replacement for maize in the diets of broiler chickens without adverse effect on performance and health status of the birds. therefore be recommended that the test ingredient can be used to replace maize up to 40% without adverse effect on performance of the birds.

Keywords: *Adansonia digitata*, Broiler, Performance, Digestibility, Haematology

Description of Problem

The high cost of animal products in most African countries especially Nigeria can be attributed to high cost of livestock feed which generally accounts for 60 – 70 percent of the total cost of production (1). This is because the conventional feeds ingredients which are energy and protein sources; maize, soybean meal and groundnut cake are becoming more expensive due to competition between man and livestock animals as well as other factors such as other industrial uses. Disease management is another identified limiting factor in commercial poultry production in Nigeria (2). One of the identified alternative ways of solving this problem is through the use of non-

conventional sources of dietary protein and energy to augment the conventional feed sources with a view to reducing feed cost.

Baobab trees are indigenous to Nigeria and the seeds are readily and cheaply available particularly around the middle-belt and some parts of the far north (3). The seed has a relatively thick shell, which is not easily separated from the kernel (4). The kernel is edible but the difficulties of decorticating seem to have limited its use as food/feed and consequently large quantities go into waste. Studies by (5,3) have shown the potentials of baobab in supplying good quality food proteins for humans and livestock while (4) had reported on the composition of the baobab fruit pulp and leaves. The baobab seed and pulp was reported to have 18.4 and 3.2% crude protein; 3638 Kcal/kg and 3203Kcal/kg energy respectively (6). Aside the energy content of the pulp, it is also very rich in vitamin C (7). This singular property makes it serves as an anti-oxidant and ameliorate the effect of ANF found in the seed. It was concluded that the seed is a good sources of protein and fruit pulp is also good sources of carbohydrate and vitamin of different varieties. According to (8), baobab seed cake has been included in guinea fowl keets diets up to 5% without compromising growth performance, regardless of type and proportion of anti-nutritional factors (ANF) such as oxalate, phytate, saponin and tannins present (3).

The aim of this study was to assess the nutritional value of baobab meal as a replacement for maize in the diets of broiler chickens. Growth performance, nutrient utilization and hematological parameters were the response criteria.

Materials and Methods

Experimental Site

The experiment was conducted at the Broiler Unit of Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso, Oyo State.

Collection and processing of the test ingredient

The baobab fruits used for this study were gathered from baobab trees in Ogbomoso metropolis, Oyo State. The hard cover of the fruits were scraped off using scraping knife, before breaking and extraction of the pulp and seeds which were later sun dried to a constant weight (90% DM). The dried product was milled and stored in an air tight bag till the time of use, (because of its deliquescence nature and in order to prevent it from absorption of moisture and grow moldy).

Experimental Diets

Five experimental broiler diets were formulated at starter and finisher phases such that diet 1 served as the control (without baobab meal). The proportion of maize in diets 2, 3, 4 and 5 were replaced with 20%, 30%, 40% and 50% baobab pulp and seed meal respectively (Table 1).

Experimental Birds

A total of one hundred and fifty (150) day old broiler chicken (Marshal breed) was used for the experiment. They were randomly divided into 5 treatments of 30 birds per treatment. Each treatment was sub divided into 3 replicates of 10 birds per replicate.

Experimental Design and Management

The experimental birds/treatments were

Table 1: Composition of experimental starter and finisher diets for broiler chicken

		Starter Diets				Finisher Diets					
Ingredient	**0%**	**20%**	**30%**	**40%**	**50%**	**0%**	**20%**	**30%**	**40%**	**50%**	**Baobab**
Maize	50	40	35	30	25	44	35.2	30.7	26.4	22	
Adansonia digitata	0	10	15	20	25	0	8.8	13.3	17.6	25	
Fixed ingredients	50	50	50	50	50	56	56	56	56	56	
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	
Labouratory analysis											
% crude protein	22.07	22.39	22.55	22.71	22.87	21.31	21.43	21.58	21.98	22.08	13.38
Metabolisable energy	3038.1	3022.6	3019.2	3010.1	3006.3	2840.5	2812.8	2798.9	2784.1	2771.1	3343.6

The fixed ingredients contains Soybean meal, Groundnut cake, Fish meal, Wheat offal, Palm kernel cake, Blood meal, Bone meal, and Oyster shell, Methionine, Lysine, Premix and Salt.

arranged in a completely randomized design. Experimental diets and water were provided *ad-libitum* for the birds. Vaccination and medication programs were carried out accordingly and other management practices were provided.

Data Collection

Data were collected on feed intake and weekly body weight changes while weight gain and feed to body gain ratio were estimated. At the end of the experiment (8 weeks), 4 birds per replicate were randomly selected and transferred to metabolic cage, allowed to acclimatize to the new environment for 4 days before their feacals were collected daily for 3 days. The feacal samples were oven dried 80^{0}C, weighed and kept in airtight material till the time of analysis. Blood samples (one bird per replicate) were also collected through the jugular vein into EDTA treated bottles and used to determine the haematological parameters.

Statistical Analysis

Data collected were analyzed using one-way analysis of variance (ANOVA) of SAS (9) software package and where significant differences indicated. Duncan's multiple range tests of the same package was used to separate the means.

Chemical Analysis

The test ingredient and experimental diets were analyzed for proximate composition according to AOAC (10). Metabolizable energy (ME) was calculated using the formula M.E (Kcal/kg) = 37 x % CP +81 x % EE + 35.5 x % NFE. Where CP = crude protein; EE = ether extract and NFE = nitrogen free extract (11).

Results

Table 2 shows the performance characteristics of broiler chicken fed baobab (baobab pulp and seed) meal based diets. Birds on 50% baobab meal (BM) as a replacement for maize had the highest ($p<0.05$) daily feed intake while feed consumption was similar among broilers on the other treatments. Average daily weight gain was significantly higher for birds on 30 or 40% BM than birds on other treatments. The least weight gain was recorded for birds on the control diet. Feed conversion ratio and protein efficiency ratio of the birds showed significant differences ($P<0.05$) with 30 or 40% BM fed broilers having the best ratios. The worst ratio was recorded for broilers on 50% BM replacement level.

Table 2: Growth performance of broiler ch icken fed with *Adansonia digitata* based diets

	0%	20%	30%	40%	50%
Initial weight	46.32±0.16	46.32±0.14	46.32±0.19	46.32±0.16	46.32±0.18
Ave daily gain	33.39±0.43^b	34.69±0.52^b	38.31±0.68^a	36.37±0.71^a	33.59±0.62^b
Daily feed intake	70.75±3.28^b	80.22±3.63^{ab}	79.94±3.42^{ab}	72.64±3.51^b	86.61±3.33^a
Feed conversion ratio**	2.12±0.21^b	2.31±0.19^a	2.09±0.15^c	2.00±0.14^c	2.57±0.17^a
Protein efficiency ratio	0.48±0.18^{ab}	0.55±0.14^{ab}	0.49±0.15^{ab}	0.43±0.17^b	0.56±0.12^a
Cost/kg feed	69.51±4.08	66.23±4.18	64.56±4.11	62.94±4.21	61.30±4.18
FeedCost//kg weight gain (N/kg)	159.50±3.34^b	162.50±3.31^a	149.91±3.34^{bc}	134.56±3.45^c	163.87±3.28^a

^{a,b,c} means along the same row with difference superscripts a significant difference ($p<0.05$)

Feed cost per kg feed decreased with increase in level of BM. Feed cost per kg weight gain showed the least value for broilers on 40% BM level.

The economic value (feed cost per kg body weight) of baobab pulp and seed favour its utilization as cheaper production cost compared to control was recorded and the least was obtained from 40% replacement level.

The results of nutrient digestibility study (Table 3) showed that all the parameters were significantly influenced by dietary treatments. However, they did not exhibit any definite patterns.

Haematological parameters of broiler birds fed varying dietary inclusion of baobab pulp and seed meal (Table 4) revealed insignificant differences ($P>0.05$) among RBC, WBC, HB and PCV while only the differential counts (Monocyte, lymphocyte and eosinophil) exhibited significant ($P>0.05$) variations. The significant difference ($P<0.05$) recorded also does not have definite trend.

Discussion

Significant increase in feed intake as the inclusion level of baobab pulp and seed increased as observed in this study was contrary to the reduction in feed intake as the level of baobab seed meal increased earlier reported (12). This could be due to variations in composition of the test ingredient. Baobab seed meal had large quantity of hard pericarp of the seed and high fibre content and, at higher inclusion level, could have imposed a physical limitation on the quantity of feed consumed by the chicken (12). The Pulp and seed ingredient had lower fibre and high value of mineral and vitamin C (7). This might have been responsible for higher acceptability, better average daily gain

Table 3: Effect of different inclusion lev el of baobab pulp and seed on nutrient digestibility of broiler chickens

% Utilization	0%	20%	30%	40%	50%
Crude Protein	89.72±0.17^{b}	89.48±0.12^{b}	92.19±0.18^{ab}	86.42±0.16^{c}	93.14±0.15^{a}
Crude Fibre	41.08±0.16^{b}	62.97±0.12^{a}	43.05±0.17^{b}	32.28±0.23^{c}	67.12±0.11^{a}
Ether Extract	87.99±0.44^{d}	96.03±0.23^{b}	95.92±0.23^{b}	92.51±0.25^{c}	98.12±0.21^{a}
Ash	37.99±0.25^{d}	64.52±0.17^{b}	61.03±0.18^{b}	50.75±0.23^{c}	78.29±0.15^{a}
Dry matter	86.03±0.17^{b}	83.96±0.17^{b}	94.04±0.23^{a}	86.30±0.18^{b}	66.25±0.12^{c}
Nitrogen Free Extract	82.35±0.11^{b}	81.71±0.11^{b}	76.72±0.15^{c}	81.53±0.12^{b}	89.05±0.11^{a}

^{a,b,c} means along the same row with difference superscripts a significant difference ($p<0.05$)

Table 4: Haematological parameters of broiler chicken fed varying inclusion level of baobab meal

Parameters	0%	20%	30%	40%	50%
RBC (x $10^{6}mm^{3}$)	5.40±0.28	5.70±0.24	5.25±0.31	5.25±0.28	5.35±0.25
WBC (x $10^{3}mm^{3}$)	9.05±0.24	9.50±0.36	9.70±0.28	8.40±0.26	9.30±0.27
HB (g/l)	10.80±0.19	11.45±0.20	10.50±0.22	10.45±0.19	10.80±0.20
PCV (%)	33.00±0.52	34.50±0.57	31.50±0.53	31.50±0.55	32.50±0.55
POLY (%)	19.00±0.70	22.50±0.71	22.00±0.70	21.00±0.75	21.00±0.72
MONO (%)	1.50±0.34^{d}	2.50±0.55^{b}	2.00±0.57^{c}	3.00±0.52^{a}	2.10±0.56^{c}
LYMPH (%)	71.00±2.86^{b}	71.20±2.82^{b}	72.00±2.55^{a}	71.00±2.61^{ab}	70.50±2.79^{b}
EOS (%)	3.50±0.43^{c}	4.00±0.50^{ab}	4.00±0.49^{ab}	5.00±0.49^{a}	3.50±0.45^{c}

^{a,b,c} means along the same row with difference superscripts a significant difference ($p<0.05$)

and better feed conversion ratio as the inclusion level increased.

Though the nutrient digestibility of baobab pulp and seed based diets were not consistent with increasing level of inclusion, Baobab pulp and seed based diets were more digestible than the control. This was contrary to steady decrease in the protein and fat retention as reported by (6). Most of unconventional feed ingredients in poultry diet were recommended not to exceed 10% inclusion level as a result of anti-nutritional factor(s) present which might impair or interfere with nutrient digestibility and assimilation in the GIT of the monogastric animals (13). (14) reported growth depression in guinea fowl keets fed 10% baobab seed meal while (15) reported poor performance in broilers chicken fed baobab seed meal compared to those fed control diet. However, the weight depression observed in broiler birds fed 15% inclusion level of baobab seed meal based diet may indicate their inability to tolerate up to this inclusion level. This was contrary to the success recorded in this study where inclusion level of baobab pulp and seed ranges from 10 to 25% gave a promising result (16). Thus, indicating that utilization potential of baobab pulp and seed meal as feed ingredient is of high value.

The report on haematological characteristics was in line with significant ($P<0.05$) differences in the differential counts across the treatments reported by (12). However, HB, RBC, PCV and WBC were statistically ($P>0.05$) similar, contrary to when only baobab seed was used (12). The haematological and biochemical components variations were influenced by quality and quantity of the feed supply and other factors present in the feed especially toxic substances (ANF) or constituents which affect the formation of the blood and level of availability of mineral components (6). Baobab pulp is very rich in essential micro nutrients (sodium, potassium, calcium and magnesium) and vitamins (vitamin C, thannin and riboflavin) which enhance the immune function of the animal (17, 18). It was observed that increasing baobab pulp and seed level lead to increase in the percentage of monocytes and others (compared to control diet) in the blood. Monocyte plays an important role in healing process so their number increases during healing process (19) and/or fighting against diseases. Alternatively, increase in differential counts could be as a result of ANF leading to decline in defense mechanism to combat stress especially when fed for a long period (20). However, zero mortality recorded indicated that the birds could tolerate. Baobab pulp and seed meal to a largedr extent.

Conclusion and recommendation

The use of baobab pulp and seed meal based diets for broiler chicken up to 40% replacement level had positive effect on the performance of the birds and better digestibility potential. It could therefore be recommended that Nigerian Government should encourage animal scientist with financial back-up and facilities to enable them conduct more research work on un-exploited indigenous wild plants for animals and man usage

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