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Effects of Graded Levels of Raw Baobab (*Adansonia Digitata*) Seed Meal on the Performance of Broiler Chicken

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Abstract: *This study effect of graded levels of raw Baobab (Adansonia digitata) seed meal on the performance of broiler chickens. 200-day-old broiler chicks were randomly assigned to five treatment groups, each consisting of 40 chicks, with four replicates (10 chicks per replicate) in a completely randomized design. The dietary treatments included different inclusion levels of raw baobab seed meal (RBSM) at 0%, 10%, 20%, 30%, and 40%. The proximate analysis of the raw baobab seed meal revealed a crude protein content of 32.25% and a crude fibre content of 7.10%. The results showed that the final body weight of chickens on the control diet was significantly higher (1344.40 g, $p < 0.05$) compared to those fed the treatment diets (RBSM). The chickens consuming RBSM had a poorer feed conversion ratio of ranged from 3.50 – 4.54. Moreover, key carcass characteristics, internal organ weights, and haematological indices were also significantly affected ($p < 0.05$).*

Keywords: poultry, raw baobab seed meal (RBSM), baobab, Adansonia Digitata.

INTRODUCTION

Poultry plays a significant role in the economy by providing food and generating wealth through job creation for our growing population (Alders *et al*., 2019). Conventional legume seeds have long served as a crucial source of protein for both humans and animals; however, their production is insufficient to meet the increasing protein demands, especially in developing countries like Nigeria (Melesse *et al*., 2013; Chisoro *et al*., 2018). To address the protein deficit in these regions, where animal protein is scarce and relatively expensive, recent research has focused on discovering novel and cost-effective sources of dietary proteins. Research on low-cost and locally available indigenous feed resources is crucial. It is essential to gather information about the nutritional qualities of these feed resources, particularly those that do not compete with human food and can support expanding intensive livestock production. One such promising alternative is the use of local indigenous multipurpose tree products and by-products, such as seed cakes and leaf meals (Magonka *et al*., 2018). Recent studies have focused on

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identifying alternative protein sources for poultry diets. One notable option is baobab seed (BS), which has shown considerable potential (Amerah *et al*., 2007; Melesse *et al*., 2013; Chisoro *et al*., 2018). Unfortunately, baobab seeds are not widely used, and a significant percentage goes to waste (Feedipedia, 2014; Shehu *et al*., 2021). The fruit contains several seeds surrounded by a whitish pulp that can be consumed as a sweet snack or made into a refreshing beverage by soaking it in water or milk. Despite its high nutritional value, there is limited information available on the potential of baobab seed as a protein source for poultry (Shehu *et al*., 2021). To reduce feeding costs for broiler chickens during both the starter and finisher stages, using baobab seed meal (BSM) is a viable option due to its availability and low cost. Therefore, it is important to investigate the effects of replacing soybean meal with baobab seed meal in the diets of broiler chickens for both growth stages.

MATERIALS AND METHODS

Experimental Site

The study was conducted at the Poultry Unit of Teaching and Research Farm of the Department of Animal Science and Range Management, Modibbo Adama University of Technology, Yola, Adamawa State, Nigeria, and it lasted for eight (8) weeks.

Experimental Animal, Management and Design

Two hundred (200) chicks (day-old) of mixed sex were subjected to standard management procedures. All the birds were housed in a deep litter system in an open-sided poultry house. Standard routine management activities were carried out. Water and feed were provided ad libitum. The birds were monitored under strict hygienic conditions, and mortality was recorded following occurrence during the study. The birds were randomly selected, weighed to obtain the initial body weight; thereafter, allotted to five (5) dietary treatments (T1, T2, T3, T4and T5). Each treatment was replicated four (4) times to contain ten (10) birds each in a Completely Randomized Design (CRD).

Experimental diet

Baobab seed was obtained from the local market in Girei, Adamawa State, Nigeria. The seeds were screened from stones and dirt. Raw seeds were milled and tagged raw baobab seed meal (RBSM) Five experimental diets were formulated containing raw baobab seed meal replacing soya beam at 0%, 10%, 20%, 30% and 40% representing T1, T2, T3, T4 and T5 respectively as shown in table 1 and 2.

Data Collection

Data were collected on feed intake, weight gain, carcass and internal organs characteristics, haematological and biochemical indices. Feed intake was determined as the difference between the leftovers and the quality of feed offered the previous day. Similarly, weight gain was defined as the difference between the final weight and the initial weight. Feed conversion ratio was measured as an index of feed utilization for each treatment group and calculated as the ratio of feed intake to weight gain. Two birds from each replicate were randomly selected for carcass and internal organs measurements. The birds were tagged according to their replicates and fasted for 8 hours to reduce gastrointestinal contents (Antyev *et al*., 2017). The birds were

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individually weighed and slaughtered. The slaughtered birds were defeathered completely, and the carcasses were plucked, and the heads, necks, and legs were removed, and the eviscerated weight was measured. The internal organs were carefully removed and weighed to determine their fresh weights. The internal organs' weight was expressed as the proportion of their body weight.

Statistical Analysis

All the data generated from this study were subjected to analysis of variance (ANOVA) using the General Linear Model of the Statistical Model Procedure (SAS Inst. Inc., NC, USA). Viability in the data was expressed as the standard error of the mean. $P<0.05$ is considered statistically significant. While differences between treatment means were separated using Duncan's Multiple Range Test (DMRT) (Duncan, D. B. 1995).

RESULTS AND DISCUSSION

Table 1 Ingredients and Percentage Composition of Broiler Starter Diet (1-4 Weeks)

	Graded inclusion levels of raw Baobab Seed Meal				
Ingredients	**T1 (0%)**	**T2 (10%)**	**T3 (20%)**	**T4 (30%)**	**T5 (40%)**
Maize	50.3	50.3	50.3	50.3	50.3
Soya bean	31	27.9	23.25	21.7	18.6
Baobab seed	**0**	**10**	**20**	**30**	**40**
Maize offal	10	10	10	10	10
Fish meal	6	6	6	6	6
Bone meal	2	2	2	2	2
Salts	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Methionine	0.1	0.1	0.1	0.1	0.1
Lysine	0.1	0.1	0.1	0.1	0.1
Total	**100**	**100**	**100**	**100**	**100**
Calculated	**Analysis**				
Crude protein	22.62	23.42	23.65	23.99	24.29
Crude fibre	4.28	5.13	5.96	6.83	7.68
Ether extract	4.71	8.62	8.74	8.87	8.98
Methionine	0.48	0.39	0.49	0.46	0.42
Lysine	1.23	1.33	1.41	1.48	1.56
Calcium	1.31	1.31	1.32	1.32	1.32
Phosphorus	1.11	1.09	0.94	1.04	1.01
ME(Kcal/kg) *	2834	2843	2939	35.2	3132

*Vitamin-Mineral premix provides per kg the following: 12.000.000 IU Vitamin A; 2.000.000 IU Vitamin D3; 10g Vitamin E; 2g Vitamin K3; 1g Vitamin B1; 5g Vitamin B2; 1.5 g Vitamin B6; 10g Vitamin B12; 30g Nicotinic acid; 10g Pantothenic acid; 1g Folic acid; 50g Biotin; 250g Choline chloride 50%; 30g Iron; 10g copper; 50g Zinc; 60g Manganese; 1g Iodine; 0.1g Selenium and Cobalt 0.1g.

GE: CP gross energy: crude protein

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Table 2 Ingredients and Percentage Composition of Broiler Finisher Diet (5-8 Weeks)

Graded inclusion levels of raw Baobab Seed Meal

Ingredients	**T1 (0%)**	**T2 (10%)**	**T3 (20%)**	**T4 (30%)**	**T5 (40%)**
Maize	55	55	55	55	55
Soya bean	25.3	22.8	20.3	17.71	10.12
Baobab seed	**0**	**10**	**20**	**30**	**40**
Maize offal	12	12	12	12	12
Fish meal	5	5	5	5	5
Bone meal	2	2	2	2	2
Salts	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Methionine	0.1	0.1	0.1	0.1	0.1
Lysine	0.1	0.1	0.1	0.1	0.1
Total	**100**	**100**	**100**	**100**	**100**
Calculated	**Analysis**				
Crude protein	20.04	20.68	21.32	21.98	22.92
Crude fibre	4.37	4.53	5.19	5.87	6.53
Ether extract	3.69	4.68	5.66	6.64	7.64
Methionine	0.43	0.47	0.51	0.56	0.6
Lysine	1.03	1.08	1.16	1.23	1.34
Calcium	1.24	1.25	1.25	1.25	1.26
Phosphorus	1.07	1.05	1.03	1	0.99
ME(Kcal/kg)*	2907	2966	3024	3083	3142

*Vitamin-Mineral premix provides per kg the following: 12.000.000 IU Vitamin A; 2.000.000 IU Vitamin D3; 10g Vitamin E; 2g Vitamin K3; 1g Vitamin B1; 5g Vitamin B2; 1.5 g Vitamin B6; 10g Vitamin B12; 30g Nicotinic acid; 10g Pantothenic acid; 1g Folic acid; 50g Biotin; 250g Choline chloride 50%; 30g Iron; 10g copper; 50g Zinc; 60g Manganese; 1g Iodine; 0.1g Selenium and Cobalt 0.1g.

GE: CP gross energy: crude protein

Proximate composition of raw baobab seed meal

The proximate composition of baobab seed meal is presented in Table 1. This study revealed that the dry matter for raw baobab seed meal was 92.05%. It corresponds to 92.02% as reported by Abdullahi *et al*. (2017), and is lower than the 94.1% and 97.5% reported by Abdulazeez *et al*. (2019) and Shehu et al. (2021), respectively. This study also revealed that baobab seed is highly rich in protein (32.25% CP). Although the value obtained in this study is lower than 33.79, 38.71, and 48.43 as reported by Ghislain *et al* (2022, Abdullahi *et al* (2017 and Shehu *et al* (2021 respectively. And higher than the values (20.13CP, 20.4%, 21.36%, 22.81% and

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29.79%) reported by Danbature, *et al*, (2015), Oladunjoye *et al*, 2014, Abdullahi *et al*, (2017), Shehu *et al,* 2021, Abubakar *et al*, 2015 and Magonka *et al*, 2018. Respectively.

The crude fibre is the total of all those organic compounds of the plant cell membranes and supporting structures which chemical analysis of plant foodstuff remain after removal of crude protein, Crude fibre (CF) value (7.10%) obtained in this study is similar to 7.89% and 7.51% reported by Danbature *et al*, 2015 and Shehu *et al*, 2021, respectively. However, Magonka *et al*, 2018 and Ghislain et al, 2022 reported higher values of 8.20% and 16.9% respectively, while Abba *et al*, 2024 reported a lower value of 5.25%. The ether extract value (5.51%) obtained in this study agrees with Shehu *et al* (2021) and Magonka *et al* (2018, with the values 5.86% and 5.41%, respectively. Similarly, the nitrogen-free extract (NFE) level (43.02%) corresponds to 43.31% reported by Shehu *et al* (2021). It is, however, lower than 55.97% as reported by Abdullahi *et al* (2017). And higher than 10.47% as reported by Abdullazeez *et al* (2019). Ash content of the seed (4.02%) is within the ranges of 3.83 to 5.8% as reported previously (Gadanya *et al*, 2014; Serwa *et al*, 2019; Oladunjoye *et al*, 2014; and Abdullazeez *et al*, 2019) respectively.

The high level of protein recorded in this study qualifies baobab seeds as a potential protein supplement in broiler diets. A great variation in nutritional composition is reported for baobab seed in the literature. Abdullazeez *et al*, (2019). Assumed that the variations may be due to the quality of the sample, the provenance (origin) of the sample, the age of the sample, treatment before analysis, the storage conditions, the processing methods, probable genetic variation, the soil structure, and its chemical composition. Apart from the variability in the material, the accuracy and precision of analytical methods used may also be a factor.

Proximate composition of experimental broiler starter and finisher diets.

The composition of experimental diets for the two (2) phases of broiler growth, as presented in Table 4.2, showed that the crude protein value for the starter diet ranged from 22.20 – 23.79%. These values fell within the recommended protein requirement values of 20 – 23% as reported by Antyev *et al.* 2017. The finisher diets, on the other hand, had a range of 20.14 – 21.90%. The values agreed with 20.16 – 21.76 reported by Antyev *et al*. (2017). It also agreed with (Adamu 2018) for the finishing phase of broiler chickens. Therefore, it implies that the diets were properly mixed and hence young growing animal requires a greater amount of protein than adults (Oloche *et al.,* 2020). The crude fibre (CF) content of the experimental diets ranges from 5.32 – 7.80% for the starter phase and is higher than the 3 – 5% recommended by level for broiler chicken by Gyang *et al.* 2021 for positive growth response.

It is also in contrast with the opinion of Antyev *et al.* 2017 that it is necessary to maintain fibre level at 3.5% - 5% in the diets of animals. The crude fibre (CF) for the finisher phase ranged from 6.30% – 8.15%, although the crude fibre reported by other authors in their studies, however, supports the assertion that it increases and faster broilers' passage of digesta (Antyev *et al*., 2017, Oladunkoye *et al.,* 2014, and Ojediran *et al.,* 2014) reported higher values of 8.66 – 911%. Abubakar *et al.* (2015) reported a value of 12.15% for raw baobab seed. Ether extract (EE) value for the starter and finisher diets ranged from 6.84% – 8.22% and 7.15% – 8.46%, respectively. These values are higher than the 5 – 7% recommended by (NRC, 2024) in the diets of broilers.

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The ash content of both starter and finisher experimental diets ranged from 6.35% – 7.10% and 6.52% 7. 68%, respectively. The values of vitamins obtained for the seed meal were higher than those recommended for broiler chicken for the vitamin B complex, as reported by Antyev *et al.* (2017). The variation in values could be attributed to the processing methods and leaching of the vitamins through heating processes. The metabolizable energy (ME) ranged from 3098.77 - 3254.90 (kcal/kg) in the starter diets and 2789.42 - 3069.50 kcal/kg) for finisher diets, respectively. These values are in agreement with the values 3202.00 – 3216.00 kcal/kg reported by Mohammed *et al.,* (2015) However, Bah *et al.,* (2019), also reported 3010.84kcal/kg – 3069.93kcal/kg and 3033.66 - kcal/kg – 3138.47kcal/kg for starter and finisher broilers respectively is also with in agreement of the metabolizable energy (ME) reported in this study. The metabolizable energy in the present study agrees with 3193.00 kcal/kg reported by Wafar et al. (2020), who fed weaner rabbits with raw and fermented sorrel (Hibiscus sabdariffa L.) seed meal.

However, the metabolizable energy in the present study is higher than the recommended 2600 kcal/kg ME for broiler starter and 3000 kcal/kg ME for finisher diets, respectively, as reported by Salami and Odunsi (2017). The variations could be a result of the variation in the ingredients used in the feed formulation and their qualities.

Table 4 Proximate Composition of Raw Baobab Seed

	Percentage Composition
Nutrients	**Raw**
Dry Matter	92.05
Moisture	10.12
Crude protein	32.25
Ash	4.02
Ether Extract	5.51
Crude Fibre	7.10
Nitrogen Free Extract	43.02
ME (kcal/kg)	2989.62

*Metabolizable Energy =ME (kcal/kg) 37×% CP +81× % EE +35.5× % NFE. Calculated according to the formula of Pauzenga (1985), RAW – Raw Baobab Seed Meal

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Table 5. Proximate Composition of Experimental Broiler Starter and Finisher Diets

	Starter Diets					Finisher Diets				
Nutrients	**T1 0%**	**T2 10%**	**T3 20%**	**T4 30%**	**T5 40%**	**T1 0%**	**T2 10%**	**T3 20%**	**T4 30%**	**T5 40%**
Dry matter	88.95	88.97	88.99	89.94	90.40	88.60	88.67	88,76	88.94	88.95
Moisture	9.54	9.82	9.60	10.12	10.20	10.12	10.15	10.24	10.28	10.32
Crude fibre	5.32	5.34	5.74	6.54,	7.80	6.30	6.45	7.12	7.98	8.15
Crude protein	22.37	22.20	22.60	23.39	23.79	20.14	20.25	20.35	21.42	21.90
Ash	6.35	6.40	6.76	7.02	7.10	6.52	6.82	6.94	7.12	7.68
EE	6.84	6.98	7.45	7.99	8.22	7.15	7.56	7.96	8.20	8.46
NFE	43.60	45.20	47.62	50.11	51.62.	42.10	43.12	44.34	46.25	48.16
ME/(kcal/kg)	3254.90	3170.08	311O.54	3119.42	3098.77	2789.42	3O65.18	3069.50	3028.24	2933.08

*Metabolizable Energy =ME (kcal/kg) 37×% CP +81× % EE +35.5× % NFE. Calculated according to the formula of Pauzenga (1985)

EE - Ether extract, NFE – Nitrogen-free extract

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Effect of feeding different graded levels of raw baobab seed meal on the performance of broiler starter

The results of the performance of chicks fed the experimental starter diet are presented in Table 6. The average daily feed intake of chicks fed diets with inclusion levels of 10%, 20%, and 30% was significantly(P<0.05) lower than those on 40% and the control diet, respectively. The low feed intake observed could be attributed to the anti-nutritional factors present in baobab seed. According to Antyev *et al.* (2017), tannins are responsible for the astringent taste of feedstuffs, and chemical analysis indicated the presence of tannin in baobab seed meal. The results obtained for weight gain in the present study were superior to those of Abdulazeez *et al.* (2019), who evaluated baobab seed meal, with ADWG (g/b/d) 18.7, 16.81, 21.69, 21.14, and 17.01, respectively. This result was also inferior to Guluwa *et al.* (2017) with levels of toasted baobab seed meal. The body weight of birds fed the control diet (36.1g) was higher than those with baobab seed meal, which were statistically similar (P>0.05) but numerically different.

This finding is in agreement with the work of Guluwa *et al.* (2017) in that toasted baobab seed meal in the diet of broilers resulted in depression in the performance of broilers in terms of daily feed intake, weight gain, and final body weight. This result was in agreement with the findings of Rafiu *et al.* (2017), who fed baobab seed meal at a level of 10% in diet of guinea fowl and observed growth depression, the same author also reported that poor performance was observed in broilers fed baobab seed meal compared to those on control diet. However, the weight depression observed in the broiler birds fed experimental diet (raw baobab seed meal) was a result of their inability to tolerate up to these inclusion levels of 30% and 40%, respectively. The poor weight gain observed with 30 and 40 levels of inclusion of the raw baobab seed meal may be partly due to low feed intake as well as poor nutrient utilization, which was due to the effect of anti-nutrient factors present in most legumes Saulawa *et al.*, 2014)

Although most of the unconventional feed ingredients in poultry diets 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 in the GIT of the monogastric animal Rafiu *et al.,* 2017).

Effect of feeding different graded levels of raw baobab seed meal on the performance of broiler finishers

Table 7 contains the results of the growth performance of broiler finisher chickens fed baobab seed meal. There were no significant (P<0.05) differences among the variables measured, but there was a significant (P<0.05) difference for initial body weight and feed conversion ratio. Experience has shown that at higher inclusion levels of unconventional feed stuffs may alter the texture, colour, taste, and odour of diets may be altered; therefore, feed consumption will ultimately be affected by one of the above factors independently or in combination Antyev *et al.*, 2017). The survival ratio of the birds suggests that finisher broilers could tolerate processed baobab seed meal, but their performance will be greatly affected. The poor average daily weight in this study could be attributed to the sensitivity of chickens to tannin. Antyev *et al.* (2017) observed that the defense mechanism against tannins does not seem to exist in chickens. The result of the feed conversion ratio in the study with 10% inclusion level being the best, also

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agreed with the feeding trial on raw baobab seed meal Saulawa *et al.*, 2014), but the FCR was superior to that obtained by the author.

Table 6. Effects of Raw Baobab Seed Meal on Performance of Broiler Chicken (1- 4 Weeks) Starter Phase

Inclusion levels

Parameters	T1 (0%)	T2 (10%)	T3 (20%)	T4 (30%)	T5 (40%)	SEM
Initial weight (g/bird)	368.15^{c}	58.10$_{bc}$	350.11^{bc}	370.20^{b}	395.66^{a}	3.82^{ns}
Final weight (g/bird)	1344.40^{a}	1289.52^{b}	1104.02^{ab}	1090.52^{ab}	1017.60^{c}	13.20**
Weight gain (g/bird)	982.10^{a}	964.80^{b}	956.92^{b}	860.92^{c}	820.42^{d}	12.78**
ADWG (g/bird)	36.18^{a}	32.25^{c}	34..15^{b}	34.25^{b}	30.38^{d}	1.10^{ns}
Total Feed intake (g/bird)	2616.22^{a}	2488.26^{b}	2142.03^{ab}	2082.18^{c}	2062.04^{d}	105.05*
ADFI (g/bird)	82.84^{a}	70.34^{b}	69.46^{ab}	66.32^{ab}	64.30^{c}	3..77**
FRC	3.34^{c}	3.50^{b}	3.52^{b}	3.60^{a}	3.66^{a}	0.42*
Mortality (%)	0.20^{bc}	1.20^{c}	3.20^{b}	3.32^{b}	4.50^{a}	0.79**

Abc Means on the same row with different superscripts are significantly different (P < 0.05), (P< 0.01), (P < 0.001). SEM Standard error mean $^{*=}$(P< 0.05), $^{**=}$(P<0.01)

RAW = Raw Baobab Seed Meal, ns = non-significant, SEM = standard error of mean

FCR = feed conversion ratio

Table 7. Effects of Raw Baobab Seed Meal on Performance of Broiler Chicken (5 – 8 Weeks) Finisher

Inclusion Levels

Parameters	**T1 0%**	**T2 10%**	**T3 20%**	**T4 30%**	**T5 40%**	**SEM**
Initial body weight (g/bird)	130.12^{d}	138.50^{a}	136.80^{b}	135.86^{c}	136.85^{b}	11.24*
Final weight (g/bird)	1490.50^{a}	1350.10^{c}	1220.12^{c}	1190.55^{d}	1140.90^{b}	182.14^{ns}
Weight gain (g/bird)	985.50	963.60	909.00	870.88	860.60	65.34^{ns}
ADWG (g/bird)	32.36	31.64	31.64	30.20	29.10	2.45^{ns}
Feed intake (g/bird)	3267.02	2418.10	2519.50	2726.40	2144,54	208.75^{ns}
ADFI (g/bird)	94.80	90.75	89’06	83.44	80.36	6.64^{ns}
PCR	3.24^{ab}	3.54^{ab}	4.24^{b}	4.50^{a}	4.52^{a}	0.45*
Mortality (%)	0.26^{b}	2.50^{ab}	4.54^{a}	4.52^{a}	5.51^{a}	0.76**

Abc Means on the same row with different superscripts are significantly different (P < 0.05), (P< 0.01), (P < 0.001). SEM Standard error mean $^{*=}$(P< 0.05), $^{**=}$(P<0.01)
ADWG = Average daily weight gain, ADFI = Average daily feed intake
ns = non-significant, SEM = standard error of mean, FCR = feed conversion ratio.

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Carcass yield and internal organ characteristics of broiler chickens Fed raw baobab seed meal

The results on carcass indices for experiment one is presented in Table 8. The variable recorded among the treatment diets for all the carcass indices was statistically not significant (P 0.05) for all parameters except live weight, plucked weight, eviscerated weight, breast, thigh weight, heart, kidney, large intestine weight, and abdominal fat. The dressing percentage obtained in the study was slightly higher than that of Yakubu and Alfred 2014 for toasted sesame seed meal.

The poor carcass quality of birds on raw baobab diets could be due to a reduction in feed intake, impairment in the utilization of nutrients attributed to the anti-nutrients in baobab seed. Ademulegun *et al.* (2020) and Antytev *et al.* (2017) demonstrated that nutrition exerts several influences on the development of carcass traits, organs, and muscular growth in broilers. The lower plucked weight and dressing percentage of broiler fed baobab seed diets may have resulted from their smaller live weight as reported by Ademulegun *et al.* (2020), since the surface area and the weight determine the number of feathers and viscera required, respectively.

Table 8. Carcass Yield and Internal Organs Characteristics of Broiler Chicken Fed Raw Baobab Seed Meal

	Inclusion Levels					
Parameters	**T1 (0%)**	**T2 (10%)**	**T3 (20%)**	**T4 (30%)**	**T5 (40%)**	**SEM**
Live wt (g)	1490.25^{a}	1437.10^{a}	1312.11^{b}	1204.12^{b}	1200.40^{c}	69.12^{**}
Plucked wt (g)	1345^{a}	1214^{b}	11.24^{c}	10.70^{d}	1152.30^{c}	62.25^{**}
Eviscerated wt (g)	1125^{a}	1021^{b}	965^{c}	914.20^{c}	1032.40^{b}	54.67^{**}
Carcass wt (g)	980.50^{a}	900^{a}	895^{b}	890^{b}	865^{c}	56.10^{**}
Dressing %	65.79^{b}	62.63^{c}	68.21^{b}	73.91^{a}	72^{a}	5.10^{**}
Head wt (g)	38.20^{b}	38.24^{b}	37.65^{c}	38.05^{b}	39.05^{a}	2.38^{**}
Neck wt (g)	76.45^{a}	61.36^{b}	55.56^{c}	50.53^{c}	54.10^{c}	1.04^{**}
Breast wt (g)	235.80^{a}	199.43^{b}	180.75^{c}	165.65^{bc}	192.28^{b}	15.05^{**}
Wings wt (g)	118.72^{b}	114.76^{c}	108.49^{dc}	110.44^{d}	119.80^{a}	6.72^{**}
Thighs wt (g)	184.34^{a}	154.64^{b}	148.68^{c}	146.46^{c}	86.16^{d}	8.12^{**}
Drumstick wt (g)	186.44^{a}	146.80^{b}	132.60^{c}	144.45^{b}	132.24^{c}	7.80^{**}
Back wt (g)	96.12^{b}	100.26^{a}	98.24^{b}	96.10^{b}	104.70^{a}	7.96^{**}
Chest wt (g)	92.42^{a}	82.30^{b}	70.90^{c}	69.74^{d}	86.50^{b}	7.45^{**}
Shanks wt (g)	62.12^{b}	72.20^{a}	68.80^{b}	72.60^{a}	68.60^{b}	4.54^{**}
Heart wt (g)	8.36^{a}	7.45^{b}	7.88^{b}	6.64^{c}	7.40^{b}	0.56^{**}
Liver wt (g)	28.40^{a}	20.40^{c}	28.42^{a}	18.56^{d}	28.88^{a}	2.89^{*}
Lungs wt (g)	8.54^{b}	8.14^{b}	9.14^{a}	7.10^{c}	7.42^{c}	1.04^{*}
Gizzard wt (g)	50.23^{b}	79.10^{a}	42.70^{c}	40.56^{c}	51.40^{b}	4.15^{*}
Kidney wt (g)	8.42^{a}	7.43^{b}	6.56^{c}	6.44^{c}	8.48^{a}	1.08^{ns}
Large intestine wt (g)	5.80^{b}	6.45^{a}	4.11^{c}	4.54^{c}	3.24^{d}	0.46^{*}
Large intestine L (cm)	8.40^{a}	10.20^{a}	8.65^{b}	8.16^{b}	8.80^{b}	0.31^{*}
Small intestine wt (g)	65.45^{a}	64.52^{a}	65.99^{a}	61.68^{a}	58.12^{b}	6.67^{*}
Small intestine L (cm)	167^{b}	182^{a}	165.12^{b}	156.45^{c}	168^{b}	10.16^{*}
Caeca weight	7.15^{a}	6.38^{b}	6.30^{b}	5.75^{c}	6.23^{b}	1.66^{*}
Caeca L (cm)	25.00^{d}	29.15^{a}	28.50^{b}	27.44^{c}	28.40^{b}	1.56^{*}
Abdo fat wt	38.26^{a}	12.76^{cd}	20.80^{b}	16.64^{d}	18.80^{c}	3.10^{**}

Abc Means on the same row with different superscripts are significantly different ($P < 0.05$), ($P< 0.01$), ($P < 0.001$). SEM Standard error mean * = ($P< 0.05$), ** = ($P<0.01$)

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