



**Performance and Bioeconomics of Red Sokoto Goats fed Diets Containing Graded Levels of Baobab (*Adansonia digitata*) Seed Meal as Supplement to Crab Grass (*Digitaria horizontalis*)**

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**Abstract**

The study evaluated the performance and bioeconomics of Red Sokoto goats fed diets containing graded levels of baobab seed meal. Sixteen growing Red Sokoto goats aged between 7 to 9 months, with a weight range of 6.8 -7.5 kg were, randomly allotted into four (4) treatments of 4 goats each. Four concentrate diets were formulated containing 0, 5, 10, and 15 % baobab seed meal. The goats were fed 500 g *Digitaria horizontalis* (Crab grass) at 8 am and concentrate at 200 g/goat/day at 2 pm. Samples of the baobab seed meal, concentrate and forage were analysed for their proximate composition and the fibre into its fractions. Data were subjected to analysis of variance using the statistical package; SPSS version 23, and treatment means that were significant were separated using least significant difference (LSD) of the same statistical package. The experiment was conducted at the Small Ruminants Unit of the livestock Teaching and Research Farm, Department of Animal Science, Federal University, Kashere, Gombe state, Nigeria. values for most of the performance parameters were similar, feed conversion ratio ranged from 0.04 – 0.06 and were not significantly ( $P<0.05$ ) different. Cost of concentrate /Kg and cost benefit ratio values ranged from 179.37 to 200.07 Naira/kg and 1.24 – 2.48 and were significantly ( $P<0.05$ ) different in both cases with T4 (15% inclusion level) having the best. It was concluded that inclusion of baobab seed meal in supplement diets for Red sokoto goats up to 15% level of inclusion had no adverse effects on the performance of the goats. Inclusion of baobab seed meal in supplement diets for Red Sokoto goats led to a significant reduction of feed cost. Coked baobab seed meal can be included in supplement diets for Red Sokoto goats up to 15% level of inclusion to reduce the cost of feed per kg.

**Keywords:** Performance, Red Sokoto Goats, Baobab Seed Meal, Bioeconomics, Graded Levels, Crab Grass

**Introduction**

The long term survival of animal production in Nigeria depends to a large extent on the ability of the farmers to provide adequate feed materials in the right quantity and quality for animals in take (Ettu and Onwika, 2015). The National Agricultural Sample Survey opined that Nigeria has an estimated 72.5 million goats as against human populations of about 195,656,437 in 2018. This population of goats is next to poultry and contribute 24% of the meat supply in the

country. They are more prolific than cattle and hardier than sheep within the tropics. Wilkinson and lee (2018) in their research observed that goats have grasses as their natural diets which are numerous in the tropics, though most of the economically important grasses also supply food to humans (maize, guinea corn, millet e.t.c). This brings about competition between goats and human. Thus, there is need for alternative sources of feed for ruminants. Ocheja *et al.* (2023) reported that the production of meat and milk

by ruminants require high levels of protein and energy, this is also true for by products such as skin, fats, and fibre etc ( Abalaka *et al.*, 2021).

The African baobab tree (*Adonsonia digitata*), which is widespread all over the hot, dry regions of tropical African, are prevalent in the south of the Sahara and are commonly considered as an African symbol (Gebouer *et al.*, 2002). The tree is well adapted to the arid parts of central African and wide spread in the savannah regions of Nigeria (FAO, 1988). The bark, leaves and fruits are used in many part of Africa as food and in traditional medicine. Baobab seeds are rich in protein and contains sustainable amount of energy (Mwale and mupangwa, 2008). Baobab seed meal has been reported to have these composition; 19.50% CP, 15.60%CF, 13.40%EE, 44.60% NFE and 3.10 Ash (Oyoleke, *et al.* .2012). Though richly endowed nutritionally, Belewu *et al.* (2007) reported that baobab seeds also contain oxalates, phytate, and saponins. Baobab seed in addition contains 3 – 7% tannin and saponins, 2% phytate and 10% oxalate (Chisoro, and Assan, 2017). A readily available and fast means of assessing animals on a feeding trial may be use of blood sample analysis (Olabanji, *et al.*, 2007). It is therefore important to evaluate blood parameters particularly when unconventional feeds are feed to animals in order to determine the performance of such animals and the suitability of feeds on the species of livestock that is being used (Babatunde *et al.*, 1992). It has been suggested that the use of different methods to process less popular feedstuff will help to achieve their optimum benefits for ruminants (Osman, 2004).

It is one such tree that can grow for years and capable of adapting to harsh conditions. Feed constitutes about 70% of the entire production and of the total cost; up to 95% is

required to meet the protein and energy requirements (Gadzirayi *et al.*, 2012; Mohanta, 2012). Voluntary intake, feed digestibility and animal performance can be improved by using alternative low quality multipurpose trees (Melesse *et al.*, 2011). Seed and leaf meals function as protein sources and aid in providing some essential vitamins, minerals, oxycaretenoids as well as bioactive compounds that function at cellular level (Melesse *et al.*, 2013). African baobab seeds have been shown to be a superb source of protein, with most of the essential and non-essential amino acids (De Caluwé *et al.*, 2010). From previous reports the baobab seed cake is a potential low-cost and locally available protein source for livestock feeding (Chimvurahwe *et al.*, 2011). The high cost of conventional protein sources has made their incorporation in small ruminant diets uneconomical, hence the increased focus on their replacement by researchers. This study was designed to evaluate the performance characteristics and bio economics of Red Sokoto goat fed diets containing graded levels of cooked Baobab seed meal.

## Materials and Methods

### Experimental site

The study was conducted at the Livestock Unit, Teaching and Research farm of Federal College of Horticulture Dadin-kowa, Gombe, Gombe State, Nigeria. Dadin-kowa, Yamaltu Deba Local Government Area is located in the savannah zone of North- Eastern Nigeria, on latitude 11<sup>0</sup>.30N and longitude 10.0<sup>0</sup> 20E and on altitude of 240m above sea level (GPS 2015), The is characterized by short rainy season (4-5 months) with annual rainfall of 760 to 1100 mm, and long dry season (6-7 months). The ambient temperature could be as low as 24<sup>0</sup>C during the dry cold season (October-January) and as high as 44<sup>0</sup>C during the dry hot season (February-May). (UBRBDA, 2022).

**Experimental Animals.**

A total of sixteen (16) red Sokoto goats aged between 7-9 months with an average weight range of 6.8 to 7.5kg were used. The animals were purchased within Dadin kowa, kwadon and kuri town markets and randomly allotted into four (4) treatments and each treatment was replicated 4 times. The animals were treated with Ivermectin for endo and ecto parasites control at 0.3 ml each and oxytetracycline, hydrochloride and procaine penicillin at 2.0 ml each to take care of scouring and nasal discharge and to provide a common health status.

**Procurement, Processing of Baobab Seed and Experimental Feed**

The Baobab seeds was purchased from Dadin kowa and kuri town market of Yamaltu Deba area of Gombe state. The seeds were washed clean and cooked in hot water at 100 degrees Celsius for 1 hour and sun dried, ground into meal using milling machine, and used to replace groundnut cake at different inclusion levels. Concentrate diet contained Maize offal (MO), Rice offal (RO), Groundnut cake (GNC), Egg shell meal (ESM), wood ash (Ash), Common salt and Cooked baobab seed meal, at different inclusion levels.

**Experimental Procedure**

The goats were weighed on arrival and randomly distributed into four (4) treatment groups, each treatment had four (4) goats, and each goat was served 500 g of forage at 8:00am followed by the concentrate of 200 g/day at 02:00pm. Forages were tied in small bundles and suspended from the top of each compartment within the reach of the animals. This reduced feed wastage and encouraged intake by the animals. The concentrate and the forages offered to the goats was weighed daily and the left over was also weighed and subtracted from the quantity of feed that was served to determine the feed intake of the animals. The experiment lasted for sixty-three (63) days (9 weeks) after two weeks of adjustment period.

The nutrient intake was calculated from the proximate composition of the concentrate and forages as well as the feed intake records. Concentrate diets were formulated at 0, 5, 10, and 15% of cook Baobab seed meal and replaced groundnut cake (GNC) as a supplement to *digitaria horizontalis* (Crab grass).

**Table 1: Ingredients and nutrients Composition of the experimental diets**

Ingredient	Treatment			
	1(0%)	2(5%)	3(10%)	4(15%)
Maize offal	50.00	50.00	50.00	50.00
Rice bran	17.00	17.00	17.00	17.00
Groundnut cake	30.00	25.00	20.00	15.00
Cooked baobab seed	0.00	5.00	10.00	15.00
Egg shell Meal	2.00	2.00	2.00	2.00
Wood ash	0.50	0.50	0.50	0.50
Table salt	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00
Calculated	Nutrient	Content		
Crude protein	17.57	17.64	17.60	17.58
Fiber	13.5	14.0	14.50	15.00
Metabolisable energy (ME kcal/kg Diet)	2,840.71	2,829.04	2,817.37	2,805.70

**Data Collection**

**Feed Intake**

Feed intake of the experimental animals was obtained by weighing the quantities of supplemental concentrate and *digitaria horizantalis* (crab grass) offered daily at 08:00 am and at 02:00 pm, respectively, the leftover was weighed to obtain the voluntary feed intake by subtracting the left over from the initial feed given (Ocheja, 2020).

### Body Weight Gain

The bucks were weighed before the commencement of the experiment and repeatedly on weekly basis in the morning before feeding, to obtain weight changes using a Camry spring balance.

### Feed Conversion Ratio

This was computed by dividing the total weight gain (kg) by total feed intake (kg),

$$\text{FCR} = \frac{\text{Total weight gain (kg)}}{\text{Total feed intake (kg)}}$$

### Feed Cost Benefit and Bio Economics.

Current market price of the feed ingredient and cost of a kg of goat meat was used to calculate the feed bio economics, the cost benefit ratio was determined with the formular outlined by Ocheja( 2020).

$$\text{Cost benefit ratio} = \frac{\text{Actual cost of total feed intake (\#)}}{\text{Benefit / live weight gain}}$$

### Chemical Analysis

Samples of the cooked Baobab seed meal, concentrate diets and forages were analyzed for their proximate composition according to the method of AOAC (2000). The fibre was further analysed for Hemicellulose, cellulose, lignin, Acid detergent fibre, Acid detergent lignin, Neutral detergent fibre) using the methods of Van Soest *et al.* (1991).

### Experimental design and Statistical Analysis

The experimental design was completely randomized design (CRD). Data obtained from the study were subjected to a one way analysis of variance (ANOVA) using SPSS version 23(2015), and treatment means that were significantly different were separated using Least Significant Difference (LSD) using the same statistical package.

### Results and Discussion

The proximate composition of the concentrate diets and fiber fraction are summarized in Table 2: the concentrate diet had similar crude protein and energy values

across the treatments. Crude Protein content of about 17% was adequate for growing goats in the tropics and also above the critical crude protein requirement of 8% reported by Lakpini *et al.*( 2002). Crude fibre contents of the concentrate and test ingredient were within the range of 12.68 to 14.90% across the treatments which was similar to 12% crude fibre recommended for different physiological stages maintenance, pregnancy, lactation and growth. The maintenance requirement for energy remain the same for most goats except dairy kids.

Ether extracts of 3.07, 3.48 and 3.53% for T2, T3 and T4, respectively were within the recommended values (Maithison *et al.*, 1997). Hemicellulose values ranged from 12.20 - 13.57 % across the treatments including the test ingredient. Acid detergent fibre (ADF) and neutral detergent fibre (NDF) ranged from 17.25 - 18.05% and 29.10 - 30.41 across the treatments. All the above values did not follow any definite pattern.

The performance of the WAD goats supplemented with concentrate diet containing varying levels of CBSM is presented in Table 3. The initial weight gain of the animal showed no significant ( $p>0.05$ )

difference. Final weight gain, total weight gain and daily weight gain were significant ( $p<0.05$ ) across the treatment means, the values ranged from 8.43 – 9.20 kg, 1.20 –

**Table 2: Proximate Composition, Fiber Fraction of Experimental Diet and Baobab Seed Meal**

NUTRIENT (%)	Treatment				CBS
	1(0%)	2(5%)	3(10%)	4(15%)	
Crude proteins	17.58	17.02	17.51	17.57	18.28
Crude fiber	12.68	13.50	14.00	14.90	13.92
Nitrogen free extra	44.90	43.61	44.66	70.74	45.50
Ether extra	2.74	3.07	3.48	3.53	13.00
Ash	11.05	11.40	11.91	11.70	5.88
Dry matter	90.48	91.47	92.56	89.95	90.43
Moisture	9.57	8.53	7.44	10.05	9.57
Carbohydrate	62.22	62.12	68.88	62.82	63.58
Acid detergent fiber	17.25	18.05	17.58	17.50	17.45
Neutral detergent fiber	30.41	30.20	29.10	29.37	30.06
Cellulose	10.31	10.52	10.41	10.43	11.04
Hemicellulose	13.57	12.45	12.20	12.35	13.17
Lignin	6.20	6.22	6.35	6.40	6.54

CBS = Cooked baobab seed meals

**Table 3: Effect of Feeding Graded Levels of Cooked Baobab (*Adonsonia digitata*) Seed Meal Based Concentrate Diets on the Performance of Red Sokoto Goat.**

Parameters	Treatment				SEM
	1(0%)	2(5%)	3(10%)	4(15%)	
Initial weight (kg)	7.13	7.23	7.13	7.04	0.17
Final weight (kg)	9.20 <sup>a</sup>	8.43 <sup>b</sup>	8.70 <sup>a</sup>	9.03 <sup>a</sup>	0.27
Total weight gain (kg)	2.07 <sup>a</sup>	1.20 <sup>b</sup>	1.57 <sup>a</sup>	2.10 <sup>a</sup>	0.28
Daily weight gain (g)	30.00 <sup>a</sup>	20.00 <sup>b</sup>	30.00 <sup>a</sup>	30.00 <sup>a</sup>	0.004
Daily weight gain (g/W <sup>0.75</sup> )	7.50 <sup>a</sup>	5.00 <sup>b</sup>	7.50 <sup>a</sup>	7.50 <sup>a</sup>	1.20
Daily conc. Intake (g)	105.9	118.3	102.0	102.9	10.69
Daily forage intake (g)	422.2	389.4	411.8	398.2	19.89
Total daily feed intake (g)	528.1	507.7	513.7	501.1	27.35
T. daily feed intake(g/W <sup>0.75</sup> )	132.02	126.93	128.43	125.27	5.25
Feed conversion ration	0.06	0.04	0.05	0.06	0.01

a,b = Means on the same row with different superscripts differ significantly ( $P<0.05$ ).  
SEM = Standard error of the Means.

2.10kg and 5.0 – 7.50 g/W<sup>0.75</sup> respectively. The lowest value of total weight gain was obtained at 5% inclusion levels (1.20kg), similar to the finding of Ocheja *et al.* (2020) on performance and feed bio economics of

growing West African dwarf goat fed diet containing graded levels of steam-treated cashew nut shell. The mean daily weight gain value of the study T1, T2, and T3 ranged from 20.0 -30.0 g/day, and there were

significant ( $P>0.05$ ) differences across the treatments. This implies that the diets containing the test ingredient sustained the goat and did not cause weight losses. Oloche *et al.* (2018) observed mean daily weight gain values were comparable with 12.46-19.21 g/day reported by Saka *et al.* (2016) for West African dwarf goats fed malted sorghum sprouts mixed with pineapple waste and slightly higher values of 14.59 - 23.00 g/day reported by Oloche *et al.* (2018) for WAD goats fed diets containing treated and untreated sweet orange (*Citrus sinensis* L.) peels with gamba grass as the basal diet. Higher mean daily weight gain values of 42.63- 64.76 g/day were reported for Kano brown goats feed *Gmelina arborea* leaves and supplemented with diets containing water soaked sweet orange peels (Oloche *et al.*, 2019). Feed intake is one of the most important factors affecting the productivity of small ruminants, if the voluntary intake is too low, the rate of production will be depressed (Forbes 1995). This implies that the treatments containing CBSM did not depress feed intake. Factors that affect feed intake include palatability and appetite. Palatability is the degree of acceptability of a feed to the taste of an animal and it is determined by the appearance, odour, taste, texture, temperature

and other sensory properties of the feed (Dhia, 2012). This indicates that all the dietary treatments which contained the CBSM were palatable and accepted by the goats like the control thus orchestrating the similarity ( $P<0.05$ ) in feed intake across all the treatments. Observed mean daily forage intake values of 389.4 – 422.2g and concentrate intake of 102.0 – 118.3 in this study were higher than 297.70-312.50 g/day reported by Oloche *et al.* (2018) for West Africa dwarf goats fed diets containing treated and untreated sweet orange (*Citrus sinensis*) peels with gamba grass as the basal diet and 294.41 - 313.70 g/day reported by (Idowu *et al.*, 2019) for West African dwarf goats fed unripe plantain peels as supplement for maize offal. Similar values of mean daily feed intake of 441.40-482.00 g/day were however reported (Oloche *et al.*, 2019) for Kano brown goats fed *Gmelina arborea* leaves and supplemented with diets containing water soaked sweet orange peels. No significant ( $p>0.05$ ) difference was observed for total feed intake (125.27 – 132.02 g/W<sup>0.75</sup>) and feed conversion ratio (0.04 – 0.06). The trend of the feed conversion ratio was similar to that reported by Okolo *et al.* (2012) for WAD goats fed cashew nut shell based diets.

**Table 4: Feed Bio Economics of Red Sokoto Goat Fed Graded Levels of Cooked Baobab (*Adonsoniadigitata*) Seed Meals.**

Parameters	Treatment				SEM
	1	2	3	4	
Cost of Supplement /kg (#)	200.07 <sup>a</sup>	193.18 <sup>b</sup>	187.30 <sup>c</sup>	179.37 <sup>d</sup>	2.11
Cost of Supplement Consume (#)	6673.80	7450.80	6423.90	6483.80	578.0
Cost of Forage / kg (#)	20.00	20.00	20.00	20.00	0.00
Cost of Forage Consume (#)	1335.0	1490.0	1285.0	1297.0	134.7
*Actual Cost of Feed Intake (#)	8008.80 <sup>b</sup>	8940.80 <sup>a</sup>	7708.90 <sup>c</sup>	7780.80 <sup>c</sup>	380.5
**Benefit / Live Weight Gain (#)	6240.0 <sup>a</sup>	3600.0 <sup>c</sup>	4700.0 <sup>b</sup>	6300.0 <sup>a</sup>	550.0
***Cost Benefit Ration	1.28 <sup>b</sup>	2.48 <sup>d</sup>	1.64 <sup>c</sup>	1.24 <sup>a</sup>	0.01

a,b,c = Means on the same row with different superscripts differ significantly ( $P<0.05$ ).

SEM = Standard error of the Means.

\* Cost of supplement intake plus cost of forage intake (on actual basis)

\*\* Total k gain multiplied by cost of a kg of Goat meat at N 2000

\*\*\* Actual cost of total feed intake (N) ÷ Benefit/ live weight gain



The Bio Economics data of growing red sokoto goats fed diets containing graded levels of cooked baobab seed meals is presented in Table 4. No significant ( $p>0.05$ ) differences were observed in the cost of forage and cost of forage consumed (#) across the treatment groups. This was in line with the reports of Ocheja *et al.* (2020) and Okolo *et al.*(2012). T1 (#1490.0) had the highest amount of forage consumed, similar to the report by Ikyume *et al.* (2018) who reported no significance ( $p>0.05$ ) difference, for WAD goats fed fermented baobab (*Adonsonia digitata*) seed meals. Significant ( $p<0.05$ ) differences were observed in the cost of supplement/ kg across the treatments, the amount spent ranged from #179.37 - #2007.07. The highest value (#200.07) was observed at 0% inclusion levels, the cost of supplement decreased with the increase in the inclusion of the test ingredient; 5% (#193.18), 10% (#187.30) and 15% (#179.37). Actual cost of total feed intake was highest at T2 (#8940.80) and were significantly ( $p<0.05$ ) different across the treatments and similar to the report of Ikyume *et al.* (2017), in the research. While significant ( $p<0.05$ ) differences across the treatment means were observed in Benefit / live weight gain, (#3600.0 - #6300.0), T2 (3600.0) had the lowest value and it was due to some factor affecting the goat during the research like health condition, ages and comfortability of the animals, while T4 (#6300.0) had the best and were significantly ( $p<0.05$ ) different across the treatments.

The significant reduction in the cost of supplement/kg was due to the inclusion of cooked baobab seed meals from T2 – T4. The trend in the results of actual cost of total feed intake, benefit/live weight gain and cost benefit ratio, is similar to the report of Ocheja *et al.* (2020) who fed WAD goats diets containing graded levels of steam – treated

cashew nut shell at 0%, 5%, 10% and 15% inclusion levels. This result showed that inclusion of cooked baobab seed meals in the supplement diets for goats had significance and positive influence on the cost of goat feeding.

## Conclusion

Inclusion of cooked baobab seed meal in supplement diets for Red sokoto goats up to 15% level of inclusion had no adverse effects on the performance parameters of the goats. Inclusion of baobab seed meal in supplement diets for Red Sokoto goats led to a significant reduction of feed cost/Kg.T4 (15%inclusion level of baobab seed meal) had the best cost benefit ratio

## Recommendations

Cooked baobab seed meal can be included in supplement diets for Red Sokoto goats up to 15% level of inclusion to reduce the cost of feeds per Kg.

Further research using other breeds of goats as well as other species of ruminants such as sheep and cattle is recommended.

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