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Growth Performance and Apparent Nutrient Digestibility of Red Sokoto bucks fed Concentrate Diet Containing Baobab (*Adasonia digitata)* Seed Meal Fermented for Different Duration

Ikyume, T. T., Okebugwu, P. C. and Afele, T.
Department of Animal Production, College of Animal Science, Federal University of Agriculture, Makurdi, Nigeria

Abstract
The study was carried out to assess the growth performance and apparent nutrient digestibility of growing Red Sokoto bucks fed baobab seed meal fermented in water for different duration (WFBSM). Sixteen (16) Red Sokoto bucks with mean weight between 5-8 kg were balanced for weight and assigned to four (4) treatment groups, i.e., Control (No baobab seed meal inclusion), 24WFBSM (20 %/100 kg 24 hrs water fermented baobab seed meal inclusion), 48WFBSM (20 %/100 kg 48 hrs water fermented baobab seed meal inclusion), 72WFBSM (20 %/100 kg 72 hrs water fermented baobab seed meal inclusion). Animals were managed in individual pens and fed 1000 g Panicum maximum and 300 g concentrate daily at 09 h and 14 h respectively. The experimental design was a completely randomized design and the experiment lasted for 84 days. Result obtained indicate that duration of fermentation of baobab seed meal significantly ($p<0.05$) influenced forage intake, dry matter, crude protein, crude fibre, ash, acid detergent fibre (ADF) and acid detergent lignin (ADL) digestibility. Nitrogen detergent fibre (NDF) digestibility even though was influenced ($p<0.05$) by baobab seed meals inclusion, it was not affected ($p>0.05$) by the duration of fermentation of the seeds. Feed conversion ratio (FCR), concentrate intake and ether extract digestibility were not influenced by inclusion and duration of fermentation of baobab seed meal in the diet. All durations of water fermented baobab seed meal at 20% inclusion level improved nutrient utilisation compared to control, 20% inclusion of 24 hours water fermented baobab seed meal gave optimum feed conversion rate.

Keywords: Baobab seed, Fermentation, Red Sokoto bucks, Growth, Nutrient digestibility

Introduction
Feed intake is reported to be one of the important factors that impact animals' lifetime productivity and health (Bawa *et al.*, 2003). However, given the increased demand and high cost of conventional animal feed ingredients like soybean or ground nut cake, there has been continuous search for readily available and cheaper sources of other feed ingredients. The search for alternative feed resources has over the past decades renewed research interest in the use of tropical browses, herbs and medicinal plants as nutrient sources for ruminants (Okoli *et al.*, 2002).

One of such tropical plants is the baobab tree (*Adasonia digitata*). Baobab tree is drought and fire resistant. The trees provide fodder in different forms for animals. These include young leaves, fruits, seed and the oil meal which are consumed by livestock (Bosch *et al.*, 2004). Baobab seeds are reported to contain high concentrations of oxalates, phytates and saponins (Nkafamiya *et al.,* 2007; Belewu *et al*., 2008). While the levels of these anti nutritional factors may not pose a serious threat to ruminants, processing has been advocated to increase the amount to be included in the diet while also ensuring optimum productivity of animals (Ikyume, *et al.,* 2018). Water fermentation of the seed has been reported to give optimum cost/kg weight gain in West African Dwarf goats when baobab seed were included in their diet for up to 15 % (Ikyume, *et al*., 2018).
While more of the research has been on processing method (i.e. water fermentation)

ikyumett@uam.edu.ng

used to improve on the utilization of baobab seed in the diet of ruminants, not much has been done on the duration of fermentation that will ensure better performance. This research therefore, seek to assess the dry matter intake, weight gain and apparent nutrient digestibility coefficients in Red Sokoto goats when fed concentrate diet containing fermented baobab seed for different durations.

Materials and Methods

Experimental site

The study was carried out at the Teaching and Research Farm, University of Agriculture Makurdi, Nigeria. The site lies between latitude 7° 44' 1.50" N and longitude 8° 31' 17.00" E (Google earth, 2018).

Procurement and Processing of Baobab Seed

Baobab seeds were gathered from rural community in Taraba state, Nigeria between the months of December and January, 2017. The seeds were sun-dried for a week and divided into three groups. The three groups of the seeds were fermented in clean water for a period of 24, 48 and 72 hours respectively under airtight conditions. After 24, 48 and 72 hours respectively, the seeds were removed, dried under the sun to a constant moisture content and milled to make fermented baobab seed meal (24WFBSM, 48WFBSM and 72WFBSM, respectively).

Experimental Animals, Management and Experimental Design

Sixteen Red Sokoto (RS) bucks with average live weight of 5-8 kg were sourced from small holder goat farmers around Nasarawa State, Nigeria. They were housed individually in an experimental pen with aluminium roofing sheet and cemented floor with wood shavings as bedding materials. The animals were dewormed and treated against ecto-parasite using Ivomec (1 ml/50 kg body weight) and also given antibiotics (Streptopen®) during the three weeks period of acclimatization in the experimental pens to ensure sound/uniform health and stability before the commencement of the research. Four diets were formulated to contain raw baobab seed meal and 24, 48 and 72 hrs water fermented baobab seed meal (0WFBSM, 24WFBSM, 48WFBSM, 72WFBSM, respectively) replacing Palm kernel meal (PKC) at 20 %. Feed was offered daily at 09 h and 14 h comprising 1000 g of *Panicum maximun* at 9.00 h and 300 g concentrate diet at 14.00 h respectively. The RS bucks were randomly allotted to four (4) treatment diets in a completely randomized design. The diets were labelled Control (No baobab seed meal inclusion), 24WFBSM (20 % inclusion of 24 hrs water fermented baobab seed meal), 48WFBSM (20 % inclusion of 48 hrs water fermented baobab seed meal), 72WFBSM (20 % inclusion of 72 hrs water fermented baobab seed meal), [Table1]. The experiment lasted for 84 days after 7 days adaptation. Digestibility trial was conducted towards the end of the 84 days.

Data Collection

Weight change and feed intake

Weight changes of the bucks were obtained on weekly basis by determining the average weight of the bucks per treatment for the week and subtracting from the previous week. Feed intake was determined by subtracting feed left over from feed offered to the animals. Feed conversion ratio (FCR) was determined by calculating the ratio of total feed consumed in kg to total weight gain in kg per treatment.

Apparent Nutrient Digestibility

The procedure for data collection during apparent nutrient digestibility is as described in Ikyume, *et al.* (2017). The digestibility coefficients (d) of nutrients were calculated as follows:

$$Coefficient\ of\ Digestibility\ (d) = \frac{Nutrient\ intake\ (\frac{g}{d}) - Faecal\ nutrient\ excretion\ (\frac{g}{d})}{Nutrient\ intake\ (\frac{g}{d})}$$

Chemical Analysis
The proximate composition of the feed and faecal samples were determined according to AOAC (1995) and fibre fractions by the method of Van Soest *et al.* (1991).

Table 1. Gross composition of experimental diet

	Treatments			
Parameter (%)	**T_1(0WFBSM)**	**T_2 (24WFBSM)**	**T_3(48WFBSM)**	**T_4(72WFBSM)**
Maize offal	36	36	36	36
Palm kernel cake	30	10	10	10
Rice offal	10	10	10	10
Soybean meal	10	10	10	10
Cassava peel meal	12	12	12	12
***Baobab seed meal	-	20	20	20
Bone meal	3	3	3	3
Vitamin premix	0.5	0.5	0.5	0.5
Salt	0.5	0.5	0.5	0.5
Total	**100**	**100**	**100**	**100**
Determined Analysis				
Dry matter	86.53	87.49	87.45	87.61
Crude protein	14.32	14.13	14.10	13.90
Ether extract	16.59	17.54	17.32	17.55
Ash	8.11	8.32	8.21	8.33
NDF	42.34	42.29	41.78	41.35
ADF	41.52	41.73	41.12	41.15

***Baobab seed meal included at 20 % were fermented in water for 24 hrs, 48 hrs and 72 hrs for 24WFBSM, 48WFBSM and 72WFBSM respectively

Statistical analysis
The data generated from this work were subjected to analysis of variance using SAS (2000) statistical software. Significantly different means were separated using Duncan's Multiple Range Test at ($P<0.05$) level of probability.

Results
Growth performance
Table 2 shows the growth performance parameters of Red Sokoto bucks fed diet containing baobab seed meal fermented for different duration. The *Panicum maximum* intake was significantly ($p<0.005$) different among the treatments with the value declining with water fermented baobab seed meal inclusion. Animals on control had relatively higher *Panicum maximum* intake (526.04 g/day) with a reduced intake of *Panicum maximum* found in the fermented baobab seed meal groups. Other parameters measured were not affected by inclusion of baobab seed meal fermented at different duration in the diet. Total feed intake and feed conversion ratio numerically decreased at inclusion of baobab seed meal fermented for different duration in the diet. Concentrate intake increased numerically as the water fermented baobab seed meal was added to the diets compared to control group. The increase was such that the larger the duration of fermentation, the less the intake of the diets.

Apparent nutrient digestibility
Result of nutrient digestibility in Red Sokoto goats fed diet containing baobab seed meal fermented in water for different duration is presented in Table 3. All the parameters measured except for ether extract were significantly ($p<0.05$) different across the

various treatment groups. Dry matter, crude protein, crude fibre, ash, acid detergent fibre and acid detergent lignin digestibility improved with increasing duration of fermentation, although the values were similar to the control diet (no inclusion of baobab seed meal) while neutral detergent fibre digestibility was not influenced by the duration of fermentation even though neutral detergent fibre digestibility reduced at fermented baobab seed meal inclusion. On the other hand, inclusion of fermented baobab seed meal in the diets did not significantly ($p>0.05$) influence digestibility of ether extract.

Discussion

Growth performance

Masafu (2006) described feed intake as a measure of acceptability and palatability and consumption by an animal. Also feed quality could determine the amount of feed an animal will consume. This is because an animal will eat more to meet its nutrient requirement. The increase in concentrate intake in the supplemented groups would be to meet the protein requirement of the animal since fermentation has been observed to reduce the protein content of baobab seed (Ikyume *et al*., 2018). This increase in concentrate intake would have been responsible for the decrease in forage intake in the supplemented groups. On the whole total feed intake in the control group was marginally higher than the fermented baobab seed meal groups. The result of forage and concentrate intake in this study contrast that of Ikyume *et al*. (2018) who observed no differences in forage intake and a significant increase in concentrate intake when fermented baobab seed meal was included in diet of West African Dwarf (WAD) goats at 15 % . The differences amongst the two reports could be attributed to breeds used in the various studies. However, in these two studies, forage and concentrate intake had an inverse relationship. Non-significant daily weight change in this study is in contrast with Idayat (2012) who reported significant differences in the daily weight in WAD rams fed 25% baobab bark inclusion in diet. The difference between the daily weight change in this report and that of Idayat (2012) could be adjured to the specie differences and kind of baobab component used. However, the result of weight change and feed conversion ratio (FCR) in this current study agrees with that of Ikyume *et al*. (2018) who did not observe significant changes in weight and FCR when fermented Baobab seed meal was fed to WAD goats. FCR marginally improved in baobab seed meal supplemented groups but began to drop as the duration of fermentation of the seed increased.

Apparent nutrient digestibility

Nutrient digestibility is a measure of nutrient appreciation during feeding. Overall high values obtained in this study are indication that all diets used in the study were appreciated by Red Sokoto goats. This is evident given the high values of feed conversion ratio (10.25-11.96) obtained during the study. Improved digestibility in dry matter, crude protein, crude fibre, ash, acid detergent fibre (ADF) and acid detergent lignin (ADL) with increase in duration of fermentation may be indication of improved diet quality in its physical and chemical forms (Ibrahim *et al.,* 2018) given that anti-nutritional factors in the baobab seed may have reduced as duration of fermentation increased, thereby making nutrients available for utilization by the animals.

Conclusion

From the result obtained from this study, it can be concluded that while fermentation of baobab seed in water for 24, 48 and 72 hours respectively to be included in diet of Red Sokoto goats at 20 % showed favourable potentials, the inclusion of 20 % of 24 hours fermented baobab seed meal gave optimum performance when fed to the goats. It could be recommended from the results obtained from both growth and apparent nutrient digestibility that, baobab seed could be fermented for just 24 hours and included in the diet of Red Sokoto goats for up to 20 % without any detrimental effect on the growth performance of the animals. Further studies

to increase amount of baobab seed meal fermented in water for 24 hours that can be included in the diet of the animals is advocated.

Table 2. Growth performance characteristics of Red Sokoto goats fed diet containing baobab seed meal fermented for different duration

	Treatments				
Parameter	0WFBSM	24WFBSM	36WFBSM	48WFBSM	SEM
Initial weight (Kg)	7.05	7.09	6.98	6.73	0.36^{NS}
Final weight(kg)	11.77	12.29	11.73	11.28	0.48^{NS}
Weight change (kg)	4.72	5.20	4.76	4.55	0.30^{NS}
Daily weight change (g)	52.44	57.75	52.83	50.53	3.29^{NS}
Daily concentrate intake (g)	94.35	133.37	119.55	115.04	13.51^{NS}
Daily forage intake (g)	526.04^{a}	426.72^{b}	452.44^{b}	441.69^{b}	12.23^{*}
Total feed intake (g)	620.38	560.09	571.98	556.73	17.05^{NS}
FCR	11.96	10.25	11.30	11.13	0.43^{NS}

[ab]Means with different superscript along the same row differ significantly ($p<0.05$)
NS = Not significant ($p>0.05$)
* = Significant ($p<0.05$)
SEM = Standard Error of Mean
WFBSM = Water Fermented Baobab Seed Meal
FCR = Feed Conversion Ratio

Table 3. Apparent Nutrient Digestibility of Red Sokoto goats fed diet containing baobab seed meal fermented for different duration

	Treatments				
Parameter	0WFBSM	24WFBSM	36WFBSM	48WFBSM	SEM
Dry matter	71.72^{a}	64.03^{b}	70.62^{a}	70.72^{a}	1.12*
Crude protein	76.06^{a}	73.05^{b}	75.10^{a}	74.92^{a}	0.41*
Crude fibre	73.21^{a}	67.58^{b}	70.77^{a}	71.34^{a}	0.69*
Ether extract	76.49	73.59	74.98	75.79	0.48^{NS}
Ash	65.19^{a}	51.80^{b}	58.77^{ab}	62.78^{a}	1.81*
Neutral detergent fibre	67.64^{a}	54.32^{b}	59.10^{b}	58.36^{b}	1.62*
Acid detergent fibre	60.51^{a}	32.57^{b}	53.83^{a}	55.18^{a}	3.47*
Acid detergent lignin	65.97^{a}	49.54^{c}	57.25^{b}	61.76^{ab}	2.04*

[abc]Mean with different superscript along the same row differ significantly ($p<0.05$)
NS = Not significant ($p>0.05$)
* = Significant ($p<0.05$)
SEM = Standard Error of Mean
WFBSM = Water Fermented Baobab Seed Meal

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