Journal of Animal Husbandry and Dairy Science
Volume 2, Issue 1, 2018, PP 30-36

Growth Performance, Blood Profile and Economics of Production of West African Dwarf (WAD) Goats Fed Fermented Baobab (Adansonia Digitata) Seed Meal

Ikyume, T. T*., Eigege, N. N., Bashi, D. T., Oche, N. P., Abdulraheem, A. I., Ojabo, M. and Akalika, I. P.

Department of Animal production, College of Animal Science, Federal University of Agriculture, Makurdi Benue State, Nigeria.

***Corresponding Author:** Ikyume, T. T, Department of Animal production, College of Animal Science, Federal University of Agriculture, Makurdi Benue State, Nigeria.*

ABSTRACT

Wild plants and cultivated native species in Africa have great potential to reduce high cost of feeding livestock. One of these plants grown in the Africa are Baobab. Twelve (12) West African Dwarf (WAD) goats with mean average body weight 7.639±0.249 kg were used in 56 days feeding trial after 14 days of adaptation to examine the effect of fermented baobab seed meal addition in diet on performance, blood characteristics and economic analysis. Three experimental diets (control, WBb-15 and PBb-15) were formulated with palm kernel cake (PKC) replaced with water-fermented and palm wine-fermented baobab seed.

Results indicated no significant (p>0.05) difference in daily body weight change, forage intake, total feed intake, Feed Conversion Ratio (FCR), red blood cell (RBC) and white blood cell (WBC), however concentrate intake, packed cell volume (PCV), total protein, cost/kg weight gain were significantly (p<0.05) affected by fermented baobab seed inclusion. While all diets used in the study were satisfactory, inclusion of 15 % water fermented baobab seed meal gave optimum cost/kg weight gain when fed WAD goats.

Keywords: *Baobab seed, fermentation, economic analysis, haematological parameters, serum indices, performance, WAD goats;*

INTRODUCTION

Livestock play an integral role in the livelihood of poor farmers by providing economic, social and food security. FAO (2011) has predicted that based on 2010 statistics, the world would need 73% more of meat and 58% more of milk in 2050, perhaps these values for developing countries will be 1095 and 116%, respectively. To meet this demand, huge quantity of feed resources will be required; challenging sustainability of the feed production systems. The traditional ruminant production system characteristic of tropic countries has depended mostly on the use of native grasses, legumes and some foliage (Komwihangilo *et al.*, 2001). This has become a challenge especially in the dry seasons when the forages undergo a sudden reduction in terms quantity and quality (Chairez *et al.*, 2006).The attendant effect of this reduction in quantity and quality of the forages is a reduction in weight of ruminants gained during the rainy season. A restriction on the productivity of goats despite ability to survive decrease in natural forage in dry season has been reported (Kronberg and Malechek, 1997; Pfister and Malechek, 1986).

The use of roughages and concentrates has been identified as the major helping tool for dry season feeding. Products such as cane tops, bagasse, brewers' grains and crop residues from local farms have been advised for ruminant maintenance during critical period (FAO, 1997). Ruminants are said to perform better when feedstuffs are strategically combined to supplement their feeding on roughages which are the most abundant basal feed for ruminants. The expensive nature of conventional feedstuffs as a result of competition between man and livestock (Ogunbosoye and Babayemi, 2010) makes this combination difficult. Ultimately, the critical economic situation of marginal farmers in developing countries often makes it impossible for them to afford concentrates for commercial feeding. Hence, the need for use of local natural resources with less competition with man is advocated as sustainable alternatives (Baraza, *et al.,* 2008; Gurbuz and Davies 2010).

Reports have indicated that lots of less popular native crops species of which baobab is one are high in nutrients and could possibly relieve critical food shortages if given adequate promotion and research attention (Murray, *et al.*, 2001). Longvah *et al.* (2000) suggested that toxicological evaluation and methods of processing that will enhance their use as food/feed ingredient are necessary in order to achieve optimum utilization. Many studies have evaluated the use of baobab for the supplementation of ruminants (Ilori, *et al.,* 2013; Okunlola, *et al.*, 2015). However, little has been done in processing of baobab seed in order to ensure optimum benefits as feed for ruminants.

Baobab tree (Adasoniadigitata) is a drought and fire resistant. Baobab trees provide fodder for animals: young leaves, fruits, seed and the oil meal are consumed by livestock (Bosch *et al.*, 2004). Baobab seed is rich in protein and contains substantial amount of energy (Mwale *et al.,* 2008). Baobab seeds contain high concentrations of oxalates, phytates and saponins (Nkafamiya *et al.,* 2007; Belewu *et al.*, 2008). Osman (2004) also found trypsin inhibitors in baobab seedWhole seeds containamylase inhibitors and tannins (Iboeli*et al.,* 1997; Osman, 2004). Although the anti nutritional factors may not pose a challenge to ruminants as they have capacity to handle to some extent, better utilization can be ensured if the seeds are processed (Gurbuz and Alarslan 2017). Ilori *et al.* (2013) recommended maximum inclusion level of 10 % baobab whole fruit for optimum performance of WAD goats. Baobab pulp and seed at 30% level of inclusion gave better milk mineral composition from Red Sokoto goats while only 20% inclusion in the diet of Red Sokoto goats was recommended for highest milk yield (Okunlola*et al.,* 2015). Hence, the objective of this study is to evaluate the performance of WAD goats fed fermented baobab seed meal as supplement to Palm kernelcake.

Materials and Methods

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).

Baobab seed were gathered from rural community in plateau state, Nigeria between the months of December and January, 2017.The seeds were sun-dried for a week. A part of the seeds were fermented in clean water for a period of 24 hours under airtight conditions. After 24 hours it was removed, dried under the sun to a constant moisture content and milled-water-fermented baobab seed meal (WFBSM). A second part was fermented in palm wine: water mixture (1:10 litres) also for a period of 24 hours under airtight conditions. After 24 hours, it was removed, dried under the sun to a constant moisture content and milled- palmwine-fermented baobab seed meal (PFBSM)

Experimental Treatments and Diets

Twelve WAD weaned bucks with average live weight of 5-8 kg were sourced from a small holder goat farm around Makurdi and environs. They were housed individually in an experimental pen with aluminum roofing sheet and cemented floor with wood shavings as bedding materials. The animals were dewormed and treated against ecto-parisite 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. Three diets were formulated with both WFBSM and PFBSM replacing Palm kernel meal (PKC) at 15 %. Feed was offered daily 09 h and 14 h comprising 500g Gmelina leaves (*Gmelina arborea*) at 9.00 h and 200g concentrate diet at 14.00 h respectively. The WAD bucks were randomly allotted to three treatment diets in a completely randomized design. The diets were labelled Control (No baobab seed meal inclusion), WBb-15 (15 % inclusion water fermented baobab seed meal) PBb-15 (15 % inclusion of Palm wine fermented baobab seed meal). [Table1]. The experiment lasted for 56 days after 14 days adaptation.

Date was collected on feed intake, weight change and feed conversion ratio (FCR). Blood samples were collected via the jugular vein of each of the goats using needle and syringe at the end of the study for haematological and serum analysis. Blood sample for hematological indices were emptied into sample bottles containing ethylene tetra acetic acid (EDTA), to prevent blood clothing while those for serum biochemistry were collected without anti-coagulant. Red blood cell (RBC) and white blood cell (WBC) were measured using the improved Neubauer haemocytometer after appropriate dilution (Schalms*et al.*, 1985). Packed cell volume (PCV) and hemoglobin (Hb) were determined using micro haematocrit method and cyanmet hemoglobin method respectively. Mean corpuscular volume (MCV), mean corpuscular hemoglobin concentration (MCHC) and mean corpuscular hemoglobin (MCH) were calculated from PCV, Hb and RBC values (Schalm et al, 1986).

Serum total protein concentration was determined by Biuret colorimetric reaction (Burties *et al.*,1999), Total cholesterol was also determined according to method of Fried wald *et al*. (1972), serum albumin concentration was determined as described by Douman(1971)

The prevailing market prices of the ingredients at the time of the study were used to calculate the cost of 1 kg feed consumed and the cost of 1 kg feed consumed/weight gain. The cost of baobab seed was determined from the cost of labour and transportation. The economic performance was determined by computing the feed cost/kg (Naira/kg) as described in Ikyume *et al*. (2017)

Table1. *Gross composition of experimental diet*

Item (Kg)	Control	WBb-15	PBb-15
Fixed Ingredients	70	70	70
PKC	30	15	15
WFBSM	-	15	-
PFBSM	-	-	15
Total	100	100	100
Analysed composition			
Dry matter	84.09	87.63	86.64
Crude protein	16.58	15.43	14.97
Ether extract	17.20	17.67	21.55
Ash	6.69	8.25	7.07
NDF	47.23	42.37	43.45
ADF	38.96	41.68	40.34
ADL	11.34	12.32	11.98

Fixed items: Maize offal-46 Kg, Rice offal-10 Kg, Soyabean meal-10 Kg, Bone meal-3 Kg, Vitamin premix-0.5 Kg, Salt-0.5 Kg. WBb-15 (15 % inclusion of water fermented baobab seed meal), PBb-15 (15 % inclusion of palm wine fermented baobab seed meal), WFBSM- water fermented baobab seed meal, PFBSM- palm wine fermented baobab seed meal

Statistical Analysis

The data generated were subjected to analysis of variance using SAS (2000) statistical software and differences in means were seperated using Duncan's Multiple Range Test at ($p<0.05$) level of probability.

Results

Performance of WAD Goats Fed Fermented Baobab Seed Meal

Result of growth performance of WAD goats fed fermented baobab seed meal is presented in table2. All parameters measured were not significantly ($p>0.05$) different except for concentrate intake which showed a significant ($p<0.05$) difference across the treatment groups. Highest feed intake (131.11 g) was observed in the water fermented group (WBb-15) while the least concentrate intake (99.82 g) was observed in control group. Total daily feed intake marginally increased ($p>0.05$) in the treatment groups. Daily feed intake was highest (626.58 g) in WBb-15 group and least (544.14 g) in the control group. Daily weight change was between the ranges of 37.28 g- 58.26 g. The highest daily weight change (58.26 g) was observed in WBb-15 while the least value (37.28 g) was observed in the control group. FCR marginally improved across treatment groups and ranged between 12.14 and 17.19. The best conversion (12.14) was observed in the WBb-15 group while the least (17.19) was in the control group.

Result of haematological parameters of WAD goats fed fermented baobab seed meal is shown in table3. PCV was significantly ($p<0.05$) different across treatment groups and increased with fermented baobab seed inclusion. The highest PCV (33.12 %) was observed in WBb-15 group with the least (22.40 %) observed in the control diet. All other parameters measured were not significantly (p>0.05) different across the treatment group and did not indicate any particular order of marginal differences.

Table2. *Growth performance of WAD goats fed fermented baobab seed meal*

Parameter	Control	WBb-15	PBb-15	SEM
Initial weight (g)	7587.50	7572.50	7760.00	249.37
Final weight (g)	9675.00	10835.00	10032.50	308.58
Weight change (g)	2087.50	3262.50	2272.50	294.83
Daily weight change (g)	37.28	58.26	40.58	5.27
Daily Conc. Intake (g)	99.82^{b}	178.36^{a}	131.11^{ab}	14.35
Daily forage Intake (g)	444.32	448.22	439.32	6.73
Total feed intake (g)	544.14	626.58	570.43	17.89
FCR	17.19	12.14	12.51	1.81

^{ab}Means with different superscript on the same row differ significantly (p<0.05) WBb-15 (15 % inclusion of water fermented baobab seed meal), PBb-15 (15 % inclusion of palm wine fermented baobab seed meal).

All the parameters measured were not affected (p>0.05) by feeding of fermented baobab seed meal in diet except total protein which was significantly (p<0.05) among the treatment groups. Even though total protein was significantly different between control group (70.50 g/l) and group fed palm wine fermented baobab seed group (60.50 g/l), the same was not with the water fermented baobab seed group (70.50 g/l). While albumin, cholesterol and creatinine marginally (p>0.05) increased with fermented baobab seed supplementation, globulin and triglyceride marginally (p>0.05) decreased with baobab seed inclusion. Urea did not follow a particular trend as the highest value (16.25 mmol/l) was observed in PBb-15 group while the least value (14.05 mmol/l) was found in WBb-15 group with the control group having a value of 15.01 mmol/l.

Table3. *Haematological parameters of WAD goats fed fermented baobab seed meal*

Parameter	Control	WBb-15	PBb-15	SEM
PCV (%)	22.40^{b}	33.12^{a}	29.33^{a}	2.02
RBC (X 10^{6}/µl)	3.15	3.46	2.79	0.21
Hb (g/dl)	11.45	11.70	9.45	0.58
WBC (X 10^{3} /µl)	18.70	23.50	26.35	4.12
Lymphocyte (%)	74.50	67.50	77.00	3.97
Monocyte (%)	3.50	3.00	3.00	0.31
Eosinophil (%)	0.50	1.00	1.00	0.31
Neutrophil (%)	21.5	28.50	19.00	4.21
MCH (pg)	36.6	33.75	35.05	1.02
MCV (fl)	83.45	96.10	110.50	5.69
MCHC (g/dl)	44.35	35.40	31.65	2.97

^{ab}Means with different superscript on the same row differ significantly (p<0.05) WBb-15 (15 % inclusion of water fermented baobab seed meal), PBb-15 (15 % inclusion of palm wine fermented baobab seed meal).

Table4. *Serum indices of Wad goats fed fermented Baobab seed meal*

Parameter	Control	WFBSM-15	PFBSM-15	SEM
Total protein (g/l)	70.59^{a}	70.50^{a}	62.50^{b}	1.82
Albumin (g/l)	31.70	32.60	36.20	2.45
Globulin (g/l)	38.80	37.90	26.30	3.87
Cholesterol (mmol/l)	3.25	3.90	5.15	0.44
Urea (mmol/l)	15.01	14.05	16.25	0.57
Triglyceride (mmol/l)	1.06	1.01	0.26	0.34
Creatinine (µmol/l)	5.55	5.85	7.65	0.74

^{ab}Means with different superscript on the same row differ significantly (p<0.05) WBb-15 (15 % inclusion of water fermented baobab seed meal), PBb-15 (15 % inclusion of palm wine fermented baobab seed meal).

Result of cost of feeding WAD goats with baobab seed meal is shown in table 4. Cost of concentrate intake was highest (₦ 627.21) in WBb-15 group while the least cost (₦ 372.52) was observed in the control group. The feed cost/kg weight gain was significantly ($p<0.05$) different across the treatment groups. The highest cost/kg weight gain (₦ 914.48) was observed in the control group while ₦ 651.88 which is least cost/kg weight gain found in WBb-15 group. Cost of forage intake and total feed intake was not significantly ($p>0.05$) different across the treatment groups.

Discussion

Significantly ($p<0.05$) higher concentrate intake in treatment groups may be an indication of the palatability of the concentrate with fermented baobab inclusion and this is consistent with report of Belewu *et al*. (2007) that young goats fed diet containing 40 % baobab leaf meal had higher dry matter intake when compared to other leaves as Blighia sapida ,Entada africana and Gliricidia sepium. Non significant ($p>0.05$) daily weight change reported in this study is in contracts with Idayat (2012) which reported a significant difference in the daily gain in WAD rams fed 25% baobab bark inclusion in diet. The difference in the daily weight change between this report and that of Idayat (2012) could be adjured to be the specie difference and the kind of baobab component used. Daily weight change in the present report numerically increased with inclusion of fermented baobab seed meal. Result of FCR is consistent with that of Idayat (2012) who did not observe a significant difference when WAD rams were fed up to 25 % baobab bark in their diet.

Oyawoye and Ogunkunle (2004) has reported that Haematological parameters are valuable in monitoring feed toxicity especially with feed constituents that affect the blood as well as the health status of farm animals . Fermented baobab seed meal increased Packed Cell Volume (PCV) which is the percentage (%) of red blood cells in blood (Purves, *et al*., 2003). According to Isaac *et al*. (2013) Packed Cell Volume is involved in the transport of oxygen and absorbed nutrients. The increase in PCV in the present study could mean that fermented baobab seed meal improved transport of oxygen and absorbed nutrients thus resulting in an increased primary and secondary polycythemia. This increase ($p<0.05$) in PCV could have been responsible for the slightly better feed conversion ratio in this study observed in fermented baobab seed meal groups. Result of other haematological parameters measured which did not indicate a significant ($p>0.05$) difference in supplemented groups is indication that fermented baobab seed meal did not have any toxic effect on the health of the animals. Result of this study is consistent with reports of Okunlola et al. (2015) which fed Red Sokoto goats with baobab fruit meal and Belewu and Ojo-Alokomaro (2007) which fed baobab leaf to WADgoats.

Table5. *Cost analysis of feeding baobab seed meal to WAD goats*

Item	Control	WFBSM-15	PFBSM-15	SEM
Total Weight gain (kg)	2.09	3.26	2.27	0.29
Total forage intake (kg)	24.88	25.10	28.46	1.08
Total concentrate intake (kg)	5.59^{b}	9.99^{a}	7.34^{ab}	0.80
Cost of forage intake (₦)	1244.13	1255.13	1423.13	54.08
Cost of Concentrate intake (₦)	372.52^{b}	627.21^{a}	472.12^{ab}	50.21
Cost of total feed intake (₦)	1616.65	1882.34	1895.25	80.18
Feed cost/kg weight gain(₦/kg)	914.48^{a}	651.88^{b}	885.50^{ab}	101.29

^{ab}Means with different superscript on the same row differ significantly ($p<0.05$) WBb-15 (15 % inclusion of water fermented baobab seed meal), PBb-15 (15 % inclusion of palm wine fermented baobab seed meal).

The significant ($p<0.05$) decrease in total protein in the blood could be as a result of decrease in crude protein in fermented baobab seed. Fermentation of baobab decreased protein and carbohydrate but increased fat levels (Nnam and Obiakor, 2003). The marginal lower blood urea in WBb-15 is indication of a superior protein quality when compared to control and PBb-15 groups. It has been reported Okah and Ibeawuchi (2011) that significant differences in the blood urea of treatments groups could have been as a result of quality of protein in the various diets. The non significance ($p<0.05$) of some other parameters measured is consistent with the serum parameters reported by Okunlola *et al*. (2015).

Significantly higher ($p<0.05$) concentrate intake in baobab groups accounted for the higher ($p<0.05$) cost of concentrate intake in the experimental groups. Although WAD goats fed palm wine fermented baobab seed had statistically similar cost of concentrate intake with the control group. Feed cost/kg weight gain was higher (p<0.05) in the control group when compared to the groups fed fermented baobab seed meal. Even though cost of concentrate intake was higher in the treatment groups, the lesser feed cost/kg weight gain is attributed to the fact that groups fed fermented baobab seed had a better feed conversion when compared to control group.

Conclusion

Result in this present study has shown that even though cost of concentrate intake increased with baobab seed inclusion due to increase in concentrate intake, inclusion of water fermented baobab seed meal up to 15 % in diet of WAD goats gave optimum cost/kg weight gain even in dry season feeding, hence helping to improve profitability of WAD goat production.

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