



**NUTRIENT DIGESTIBILITY AND BLOOD PROFILE OF UDA RAMS FED GRADED LEVELS OF DESERT DATE (*Balanites aegyptiaca*) LEAVES SUPPLEMENTED TO SORGHUM STOVER**

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**ABSTRACT**

The study examined the effect of varying levels of *Balanites aegyptiaca* leaf meal (BLM) inclusion on nutrient digestibility and blood profile of Uda rams at the Department of Animal Science, Teaching and Research Farm, Federal University Gashua, Yobe State. Sixteen Uda rams with an average weight of  $15 \pm 0.15$  kg were randomly allocated to four dietary treatments containing graded levels of BLM at 0%, 5%, 10%, and 15%, with four rams per treatment. The rams were individually fed the supplemental diet at 3% of their body weight, while the sorghum stover basal diet was offered ad libitum daily for twelve weeks in a Completely Randomized Design (CRD). Each ram served as a replicate. Results from the feeding trials indicated that, the apparent digestibility of crude protein (83.91%), crude fibre (74.82%), and nitrogen-free extract (60.19%) were significantly ( $P < 0.05$ ) higher in rams fed 15% BLM. The results of the haematological analysis revealed a significant ( $P < 0.05$ ) difference in all parameters analysed, except for haemoglobin, PCV, and MCV. It was concluded that incorporating BLM at 15% in the diet of growing Uda rams enhanced their growth performance without adversely affecting haematological and serum chemistry parameters.

**Keywords:** Haematology, Performance, Supplementation, Sheep, Serum, Biochemical

**INTRODUCTION**

Ruminant animals have great potential to improve the world's food supply, human health, and poverty alleviation (Tella and Chineke, 2022). Small ruminants are produced to get meat, milk, wool and skin. The four products assumed varying degrees of importance in different countries depending on the existing agroecological conditions (Hassan *et al.*, 2016). Among these four products, meat is the most important product, especially in Nigeria, where there is no taboo against consuming small ruminant animal meat (Alikwe *et al.*, 2011). Feed quality and availability are significant constraints in increasing ruminant animal productivity under tropical conditions. Basal feed often provides inadequate protein, minerals and vitamins to support optimum animal productivity during the dry season. Supplementary feeds are used as a source of protein and energy. The oilseed cakes, cereal bran and brewer's grains, often used to alleviate the effect of the long dry season, are scarce, costly and sometimes adulterated (Adediran, 2002).

The long dry season in the northern part of Nigeria causes severe limitations in grazing and pasture production. The dry season, therefore, predisposes ruminants fed standing hay and low-protein roughages to consistent weight loss (Babayemi and Bamikole, 2006). There is a sporadic year-round shortage of pasture, both in quantity and quality, despite the abundant availability of feed during the late rainy season (Muhammad *et al.*, 2009).

*Balanites aegyptiaca* is among the most abundant browse trees found in Gashua; it is less susceptible to climatic fluctuation and remains green all year round. *Balanites aegyptiaca*, being a browse plant, has been reported to improve the feeding potential of ruminant animals in the tropics



(Njidda and Ikhimioya, 2010). Additionally, the report of Njidda and Ikhimioya (2010) revealed that *Balanites aegyptiaca* had no deleterious effects on the haematological and biochemical parameters of the animals and can, therefore, be utilized for feeding small ruminants with low-quality basal feeds to upgrade their blood profile. However, there is a paucity of information on the effective utilization of graded levels of *Balanites aegyptiaca* leaf meal in the feeding management of Uda rams. Therefore, the objective of the current study is to evaluate the potential of *Balanites aegyptiaca* leaf meal as a supplement to sorghum stover on the performance indices of Uda rams

## MATERIALS AND METHODS

### Experimental Site

The research was conducted at the Teaching and Research Farm, Federal University, Gashua, Yobe State, Nigeria. The vegetation characteristic of the area is Sahel Savannah. It consists of an open Thorny savanna with short trees and grasses. Gashua is located between Longitude 10° 02' and 11° 11'E and Latitude 12° 48' and 12° 88'N. It is situated in the Sudan Savanna ecological zone of Nigeria. The climate is characterized by high temperatures and seasonal rainfall. The mean minimum temperature ranges between 10-12°C in December to January, while the mean maximum temperature is about 34-40°C in March-May. The mean rainfall is between 300-500 mm per annum, is unimodal, and lasts mainly from June to September, while the dry season lasts from October to May (NEAZDP, 2022).

### Sources of Experimental Materials

The leaves of *Balanites aegyptiaca* were collected on the university premises. Leaves from the browse plant were collected by lopping the branches. The pruned branches were sun-dried for two days and then shaken to remove the leaves. The leaves were shade-dried for eight days and then stored in bags (Abakura *et al.*, 2017). Sorghum stover was sourced from farms around Gashua, Bade local government, Yobe State, Nigeria. The sorghum stover was chopped to 2 cm with a machete, allowed to air-dry in the shade, and stored in bags. The cured materials were chopped with a forage chopper at the Teaching and Research Farm Department of Animal Science, Federal University Gashua and used for the trial with the growing Uda rams.

### Experimental Animals and Their Management

Sixteen (16) Uda Rams, aged between 8 and 12 months, with an average initial weight of 15.15 kg, were sourced from the open market, quarantined for two weeks, and used for the study. The animals were given prophylactic treatment against internal and external parasites immediately after arrival. All animals received 0.1ml/10kg body weight of Ivermectin (10ml) injection and 0.1mg/kg body weight of *Tetranor* (Oxytetracycline Dehydrate, 20 per cent weight/volume injectable solution) and tagged for easy identification. They were housed in individual pens, which were cleaned and disinfected before their arrival. They were balanced for their weights and allotted 4 dietary treatments containing graded levels of *Balanite aegyptiaca* leaves at 0%, 5%, 10% and 15% inclusions, respectively, with 4 rams per treatment. The rams were fed an experimental diet at 3 % of their body weight at 8 am, while Sorghum stover was fed *ad lib*. Clean, fresh water and mineral salt were also offered at free choice daily. Daily feed offered (concentrate and hay) and ort (leftover) were weighed and recorded. Voluntary feed intake was determined by subtracting the ort from the feed offered. The rams were weighed weekly to determine their live weight changes and adjust for the feed offered.

### Experimental Design.

The experiment consisted of 4 treatments with 4 Uda Ram per treatment in a completely Randomized Design. Each ram served as a replicate.

### Digestibility Trial

Three Rams of equal weight were randomly selected from each group and kept in individual metabolic cages. They are allowed a 14-day adjustment period to the feed and a 7-day collection period for faeces. The faecal sample was oven-dried at 70 °C for 6 hours, bulked and stored in polythene bags until ready for use (Hassan *et al.*, 2016).



### **Chemical Analyses of the Experimental Diets**

Samples from the experimental diets offered were analyzed for dry matter (DM), crude protein (CP), ether extract (EE), crude fibre (CF), and ash according to the procedure of AOAC (2000). Neutral Detergent Fibre (NDF), Acid Detergent Fibre (ADF) and Acid Detergent Lignin (ADL) were determined using the Van Soest (1991) method.

### **Blood Test**

Blood samples (5 ml) were collected from the jugular vein of each experimental animal in the morning prior to feeding on the first day and last day of the trial using hypodermic syringes into sample bottles containing anticoagulant, ethylenediaminetetraacetic acid (EDTA), for the determination of haematological parameters which include: red blood cell (RBC), lymphocyte, neutrophil, monocyte, eosinophil, mean corpuscular haemoglobin (MCH), and mean cell volume (MCV). Another 5 mL was emptied into plain bottles without an anticoagulant for serum analysis, specifically for total protein, albumin, and urea.

### **Statistical Analysis**

The data collected was subjected to analysis of variance (ANOVA) using the general linear model (GLM) procedure of SAS (2005). Significant differences among means were compared using Duncan's Multiple Range Test (DMRT) of the SAS package (2005).

## **RESULTS AND DISCUSSION**

### **Proximate Composition**

Table 1 shows the results of the proximate composition and fibre fraction of the experimental diet. It was observed that the dry matter content of the concentrate diets ranged between 90.61 and 88.90% while the crude protein varied from 13.86 % in treatment T4 to 14.05% in T1. Ether extract ranged from 1.45 % in T4 to 2.05% in T2, while the highest value (30.35 %) for crude fibre was recorded in T4, and the lowest value of 28.90 % was observed in T3. Treatment 3 (T3) contained the highest ash content of 6.05 % while T1 had the lowest value of 4.96 %. The highest nitrogen-free extract content of 50.34 % was recorded in T1, and the least (48.94 %) was observed in T2.

The DM content recorded for *Balanites aegyptiaca* (88.70%) was lower than the 92.5% and 95.5% reported by Hyelda (2017) and Njidda and Ikhimiya (2010), respectively. *Balanites aegyptiaca* had a CP content of 14.06%, which is higher than 11.9% reported by Hyelda (2017). Generally, the crude protein content in browses is above the minimum level (7%) required for microbial activities in the rumen (Assefa *et al.*, 2024). The crude fibre content (33.75%) obtained in this study was higher than the 20.0% reported by Hyelda (2017). Ondiek *et al.* (2010); Elseed *et al.* (2002); and Lepanga *et al.* (2009) reported 349 g/KgDM (34.9%), 257 g/KgDM (25.7%) and 103.9 g/KgDM (10.39%) for NDF and ADF, respectively, for *Balanites aegyptiaca*, which were all lower than the values obtained in this work. This variation in the chemical composition of the test material, *Balanites aegyptiaca*, might be due to differences in the location of collection.

The crude protein, neutral detergent fibre and acid detergent fibre values (%) for sorghum stover were 5.48, 65.13 and 38.67. The values for CP and NDF were slightly lower than the 5.83% (CP) and 49.39% (NDF) reported by Hyelda (2017). However, the ADF content (42.21%) recorded in his report was lower than the value obtained in this study. The differences in the proximate composition of sorghum stover might be due to variation in the location where the crops were grown.

**Table 1:** Proximate Composition of the Experimental Diet

Parameters	Treatments				Balanites leaf meal	Sorghum stover
	T1	T2	T3	T4		
Dry matter (%)	90.61	88.90	90.14	89.54	88.70	91.65
Crude protein (%)	14.05	14.03	13.97	13.86	14.06	5.48
Ether extract (%)	1.54	2.05	1.76	1.45	1.53	1.02
Crude fibre (%)	30.11	29.80	28.90	30.35	33.75	35.86
Ash (%)	4.96	5.18	6.05	5.13	3.10	7.14
Nitrogen free extract (%)	50.34	48.94	50.72	49.87	47.56	50.50
Acid detergent fibre (%)	32.65	33.49	27.84	30.29	35.60	38.67
Neutral detergent fibre (%)	56.68	58.90	59.43	60.66	60.15	65.13

T1 = 0% BLM (Balanites Leaf Meal), T2 = 5% BLM, T3 = 10% BLM and T4 = 15% BLM

### Nutrient Digestibility of the Experimental Diets Fed to Growing Uda Rams

The results, as presented in Table 2, indicated that increased consumption of BLM resulted in improvements in the apparent digestibility of dry matter, crude protein, neutral detergent fibre, and acid detergent fibre. Fasae *et al.* (2014) observed a similar improvement in apparent digestibility when West African dwarf sheep were fed forage legume supplemented with maize cobs. The work also aligns with that of Njidda and Titus (2023), who observed higher nutrient digestibility values for all treatments that included BLM. Inclusion of BLM significantly increased ( $P < 0.05$ ) apparent nutrient digestibility except for ether extract. Dry matter digestibility (%) was higher among rams fed diet containing BLM, T4 (75.48%), T3 (73.74%) and T2 (67.93%) than the control diet, T1 (65.51%), which indicated that combining browse fodder like balanites with low quality basal diet promotes dry matter digestibility. The values obtained for CP digestibility were significantly ( $P < 0.05$ ) higher in rams fed diets containing graded BLM than the control diet. This may be attributed to the ability of *Balanites aegyptiaca* to supply more digestible CP in the diet; this supports the fact that digestion of feed in ruminant animals is highly influenced by the level of protein and fibre in the diet (Bakare *et al.*, 2019).

Digestibility of nitrogen-free extract was higher in the diets containing graded levels of BLM than in the control with 0% BLM. The values obtained were T1 (43.10%), T2 (42.26%), T3 (54.08%) and T4 (60.19%). Also, the increased fibre digestion of the diet containing graded levels of BLM compared to the control diet may be due to the possibility of lactic acidosis, which reduces the cellulolytic bacteria's activities in the rumen of the animals on the control diet (Njidda & Titus, 2023). The enhanced neutral detergent fibre and acid detergent fibre digestibility of T4 suggests the supply of degradable cellulose essential for increased activities of fibrolytic bacteria and the rumen ecosystem. Feeding sorghum stover alone would not support adequate nutrient intake and digestibility, but supplementing low-quality sorghum stover with BLM at the appropriate ratio will improve nutrient utilization for overall productivity of the animal.

**Table 2:** Digestibility of Diet Containing Graded Levels of BLM

Parameters	Treatments				SEM	P-value
	T1	T2	T3	T4		
Dry matter (%)	65.51 <sup>c</sup>	67.93 <sup>bc</sup>	73.74 <sup>ab</sup>	75.48 <sup>a</sup>	2.56*	0.032
Crude mrotein (%)	78.14 <sup>b</sup>	80.07 <sup>b</sup>	81.12 <sup>ab</sup>	83.91 <sup>a</sup>	1.65*	0.033
Ether extract (%)	71.96	72.92	72.51	73.16	0.67 <sup>NS</sup>	0.711
Crude fibre (%)	72.52 <sup>b</sup>	71.54 <sup>b</sup>	74.16 <sup>a</sup>	74.82 <sup>a</sup>	0.59*	0.033
Nitrogen free extract (%)	43.10 <sup>b</sup>	42.26 <sup>b</sup>	54.08 <sup>a</sup>	60.19 <sup>a</sup>	4.11*	0.019
Acid detergent fibre (%)	75.65 <sup>b</sup>	74.83 <sup>b</sup>	77.59 <sup>ab</sup>	81.41 <sup>a</sup>	1.96*	0.031
Neutral detergent fibre (%)	70.15 <sup>b</sup>	70.74 <sup>b</sup>	74.60 <sup>ab</sup>	77.95 <sup>a</sup>	2.31*	0.050

SEM = Standard error of mean, T1 = 0% BLM (Balanites Leaf Meal), T2 = 5% BLM, T3 = 10% BLM and T4 = 15% BLM

<sup>a,b,c</sup>Means in the same row with different superscripts differ significantly.





### **Haematological Parameters of Uda Rams Fed a Diet Containing Graded Levels of Balanites Leaf Meal**

Table 3 shows the haematological parameters of growing Uda rams fed a sorghum stover basal diet supplemented with concentrate containing graded levels of BLM. There were significant differences ( $P < 0.05$ ) in some of the parameters measured. The packed cell volume (PCV) ranged from 33.4% in T1 to 28.03% in T3, and haemoglobin (Hb) values ranged from 10.87g/dl in T4 to 10.27g/dl in T1. The values recorded for PCV and Hb were within the ranges of 24-45% and 8-16g/dl, respectively reported for growing sheep by Pampori (2003) and 24-45% (PCV) and 8-16g/dl (Hb) of growing sheep reported by Aruwayo *et al.* (2011) thus, indicated that the diets had no adverse effects on the cells. Haemoglobin functions as a carrier of oxygen to target organs by forming oxyhaemoglobin; hence, animals on all the treatment diets were well nourished (Adebisi *et al.*, 2019). The observed red blood cell (RBC) values for the rams on the diet containing BLM were similar to  $8.23-9.42 \times 10^6$  g/mL reported by Daramola *et al.* (2005) for sheep. The values recorded in this study were within the normal range of  $5.00 - 11.00 \times 10^6$  /mL for sheep observed by Pampori (2003). This observation was in line with the report of Adeyemi *et al.* (2008), who reported that red blood cells and haemoglobin are positively correlated with protein quality and protein level in the diet and that any decrease in the red blood cell counts could be associated with protein deficiency in the diet. This showed that animals fed diets containing graded levels of BLM could maintain an active immune system that defends their body against infection, allergic reactions, and parasites. WBC counts obtained in the study indicated that BLM in animal feed can be tolerated at a 15% inclusion level.

Neutrophil and eosinophil counts recorded across dietary treatments in this study were within the range obtained by Maigandi *et al.* (2003) and Taiwo and Ogunsanmi (2003). The neutrophil values recorded were within the range of values (30.00 – 65.00 %) obtained for West African dwarf rams reported by Bakare *et al.* (2019). Lymphocytes are known to play key roles in the immune defence system of both humans and animals (Ameen *et al.*, 2007). The lymphocyte count observed for uda rams in this work was within the range recommended for healthy sheep reported in Bakare *et al.* (2019). The lymphocyte values observed were also similar to the range of 40–70 per cent reported by NseAbasi *et al.* (2014). The values for MCH and MCV recorded were within the normal range for healthy sheep. The presence of basophils in the blood is an indication of a disease condition (Aruwayo *et al.*, 2011). The level obtained indicated that the rams did not harbor any disease infection, as it was still within the reported range of 0-3% (Coles, 1986). Eosinophils were also reported to be an indication of parasitic infestation; their low level in the blood, which fell within the reported range of 1-8% (Bakare *et al.*, 2019), indicated that the animals were healthy.

The results of the Serum biochemistry of Uda rams fed the experimental diet are presented in Table 3. The results showed no significant effects of the treatments ( $P < 0.05$ ) on the serum parameter values studied, except for albumin. Total protein values recorded in this study agreed with those reported by Aruwayo *et al.* (2011) for uda rams. The observed total protein values agreed with the report of Adebisi *et al.* (2019), who stated that the total protein in an animal is a reflection of the level of dietary protein and the state of health of the animals. The range of values (2.70-3.30 g/dL) obtained for albumin was similar to those reported by Bakare *et al.* (2019). The higher the value of albumin, the higher the clotting ability of blood; hence, it prevents haemorrhage. Albumin is the most abundant protein in the blood and accounts for 50 to 60 per cent of the total blood protein content (Contreras *et al.*, 2000). It is also an essential constituent of protein metabolism and a relevant indicator of the protein nutritional status (Agenas *et al.*, 2006). The urea levels observed in this study (both in the control and test diets) were not significantly ( $P < 0.05$ ) different from each other and were all within the normal range reported for Uda rams by Aruwayo *et al.* (2011). The normal values obtained in the study indicated that the test diet provided adequate protein for the animals. This agrees with Aliyu *et al.* (2012), who suggest that low dietary protein may result in a decrease in urea nitrogen. This showed that BLM, up to a 15% level of inclusion, did not interfere with renal function. The urea levels observed indicate a normal liver.

**Table 3:** Haematology and Serum Biochemistry of Rams Fed Diet Containing Graded Levels of BLM

Parameters	Treatments				SEM	P-value	*Reference value
	T1	T2	T3	T4			
<b>Haematology</b>							
White blood cells (x 10 <sup>9</sup> /L)	5.87 <sup>c</sup>	7.67 <sup>a</sup>	8.07 <sup>a</sup>	6.37 <sup>b</sup>	0.24*	0.0001	4-12
Lymphocyte (%)	54.83 <sup>a</sup>	40.13 <sup>b</sup>	39.86 <sup>b</sup>	55.50 <sup>a</sup>	3.91*	0.0149	20-90
Monocyte (%)	2.43 <sup>c</sup>	5.03 <sup>b</sup>	2.77 <sup>c</sup>	9.03 <sup>a</sup>	0.32*	0.0129	0-8
Neutrophils (%)	42.17 <sup>b</sup>	57.13 <sup>a</sup>	59.30 <sup>a</sup>	40.90 <sup>b</sup>	4.06*	0.0446	
Eusophill (%)	0.13 <sup>c</sup>	0.17 <sup>c</sup>	1.07 <sup>b</sup>	1.60 <sup>a</sup>	0.09*	0.0293	0-1.0
Basophil (%)	0.43 <sup>b</sup>	1.50 <sup>a</sup>	0.80 <sup>b</sup>	1.97 <sup>a</sup>	0.25*	0.0292	
Red blood cells (×10 <sup>6</sup> /mL)	9.98 <sup>a</sup>	8.15 <sup>b</sup>	10.80 <sup>a</sup>	10.37 <sup>a</sup>	0.85*	0.039	9-15
Haemoglobin (g/dL)	10.27	10.43	10.80	10.87	0.53 <sup>NS</sup>	0.930	9-15
Packed cell volumes (%)	33.40	30.50	28.33	29.77	2.60 <sup>NS</sup>	0.659	27-45
MCV (fl)	47.83	47.80	49.90	47.80	0.83 <sup>NS</sup>	0.368	28-40
MCH (pg)	6.77	7.40	7.16	7.73	0.30 <sup>NS</sup>	0.092	8-12
<b>Serum Biochemical</b>							
Total protein(g/dl)	5.87	6.10	5.93	5.97	0.23 <sup>NS</sup>	0.228	6-7.9
Albumin ((g/dl))	2.93 <sup>b</sup>	3.57 <sup>a</sup>	3.47 <sup>ab</sup>	3.70 <sup>a</sup>	0.28*	0.010	2.4-3
Urea (Mmol/L)	7.03	5.57	5.73	6.47	0.92 <sup>NS</sup>	0.187	3-10

SEM = Standard error of mean, MCV= Mean corpuscular volume, MCH = Mean corpuscular haemoglobin, a,b,c Means in the same row with different superscripts differ significantly, T1 = 0% BLM (Balanites Leaf Meal), T2 = 5% BLM, T3 = 10% BLM and T4 = 15% BLM

\*Source: Abdulkarim and Aljameel, (2021)

## CONCLUSION AND RECOMMENDATION

Based on the findings of this study, it can be concluded that growing Uda rams can be fed sorghum stover basal diets supplemented with concentrate containing graded levels of *Balanites aegyptiaca* leaf meal at 15%, which enhances nutrient digestibility. Based on the haematological and serum biochemical parameters, it was found that feeding graded levels of BLM had no harmful effects on the health of the growing Uda rams.

## ACKNOWLEDGEMENT

This research was funded by the Tertiary Education Trust Fund (TETFUND), grant number FUGA/REG/SSP-192.

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