

Utilization of Sorghum Stover (Jigari Vareity) With Raw and Differently Pocessed Mesquite (*Prosopis Africana*) Pods by Red Sokoto Bucks as Supplement

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Abstract

Sorghum stover was fed with differently processed mesquite (prosopis africana) pods as supplement to Red Sokoto bucks consisting of five diets (T1 –T5). Twenty Red Sokoto bucks were assigned to the five dietary treatments and replicated four times in a completely randomized design (CRD). The sorghum stover had 87.50, 8.15, 37.00 and 53.60% for dry matter, protein, crude fibre and neutral detergent fibre. Prosopis africana pods had 18.15, 18.57, 19.18 and 19.94% for protein, 25.00, 24.75, 23.32 and 22.18% crude fibre and 41.75, 40.62, 40.10 and 40.00% neutral detergent fibre for raw, soaked, boiled and toasted. Total feed intake was higher T1 (20.80kg) and least in T5 (18.74kg). Total body weight gain was higher in T5 (1.53kg) and least in T3 (0.58kg). Dry matter (61.66-75.45%), crude protein (64.14-77.80%), crude fibre (64.47-78.61%), and neutral detergent fibre (65.51-77.77%). PCV and white blood cell reduces but red blood cell increases and also glucose and creatinine with processing methods. Therefore, prosopis africana pods toasting showed to be the best processing method

Keyword: *Sorghum stover, Mesquite tree, Red Sokoto bucks, Digestibility, Blood profile*

Introduction

Crop residues are important feed resources in ruminant animal production and can be accomplished through improved utilization by supplementation (FAO, 2012). A crop residue such as sorghum stover is a vital conventional feedstuff for ruminants. Ruminants are usually faced with a scarcity of high-quality feedstuffs during the dry spell due to over-dependence on pasture materials of poor quality and quantity at this time of the year. Sorghum stover is the mature cured stalks from sorghum crop with the grain removed. The stovers are relatively poor in nutritive value but are often widely used for feeding ruminants when other feeds are inadequate or unavailable towards the end of the dry season (Bean, 2020). It is now used in most developing countries like Nigeria as livestock feed during the period of feed scarcity, but are characterized by their low crude protein, energy levels and high concentration of cell wall fractions (Aliyu *et al.*, 2012). Ruminants feeding on these poor-quality roughages exhibits decreased feed intake, weight loss and increased susceptibility to health risk and reduced production performance (Aliyu *et al.*, 2012). While, the small holder farmers cannot afford the cost of establishing a pasture as such depend solely on the natural pastures and agro-industrial

by-products to feed their animals. Mesquite (*Prosopis africana*) is a multipurpose tree which is a native to arid and semi-arid regions of the world. The *Prosopis africana* is indigenous to Africa and grows naturally in the forest of Nigeria. The value of mesquite as animal feed was reported from many regions in the world (Pasicznik, 2004). The pods have a crude protein level of 7-22% and a carbohydrate level of 30-75% based on the soil type and the process of extraction (Choge *et al.* 2007). This makes the pod a good feed resource and low-cost alternative feed stuff almost for all ruminant species (Abdullah *et al.* 2011). The leaves from mesquite trees are unpalatable (Bhatta *et al.*, 2002) where as pods and seeds are relish to ruminant animals. The *Prosopisa africana* pods which can serve as supplementary feed is therefore seen as a Panacea in bridging this nutritional gap for livestock production in the region. A challenge therefore, for animal nutritionists to introduce and promote alternative browse plant like *Prosopis africana* that have high nutritive value and are adapted to harsh environmental conditions and cost effective. The ongoing climatic change is also expected to create harsher conditions such as high temperatures, droughts, floods and drastic climatic variations, with the greatest impact to be felt among subsistence or small holder farmers in developing countries

Statement of the problem

Feeding constitutes about 80% of the total cost of animal production (Adeloye, 1994). Mgheni *et al.*, (2010) also reported that inadequate nutrition is a constraint to livestock production. The grazing areas are declining due to expansion of arable cropping, road and housing constructions which forces farmers to spend much on commercial feeds. The high cost of feed is also due to the fact that most of the ingredients used in formulating conventional feeds are needed by man. This competitive effect makes the feed ingredient expensive and beyond the reach of the local farmers and the finishing costs of products of these animals are expensive (Paul *et al.*, 2007). Therefore, It is necessary to find alternative sources of improving nutritional profile of these crop residues by using locally available feed materials like *prosopis africana* pods by differently processing methods with correct combinations in order to provide adequate quantities of the needed nutrients.

The objectives of this study are:

- i. to determine the effect of diets containing raw and differently processed *prosopis africana* pods on growth performance of Red Sokoto Bucks fed sorghum stover as basal diet
- ii. to determine the nutrient intake and digestibility of Red Sokoto Bucks fed sorghum stover with raw and differently processed *prosopis africana* pods as supplement
- iii. to determine the effect of diets containing raw and differently processed *prosopis africana* pods on haematology and biochemical indices of Red Sokoto Bucks fed sorghum stover as basal diet.

Materials and Methods

3.1 Experimental Site

The study was conducted at the Small Ruminant Unit of the Taraba State University, Jalingo, Ardo-Kola Local Government Area, Taraba State. It is located within the Guinea Savannah Zone. It lies between latitude $8^{\circ} 11'$ to $8^{\circ} 50'$ and longitude $11^{\circ} 05'$ to $11^{\circ} 25'$ East in Guinea Savannah Zone of Northern Nigeria (Taraba State Diary, 2008). The State is characterized by tropical climate marked by dry and rainy season usually commences in the month of March and ends up in October. The dry season starts in the late October and ends in March. The annual

rainfall is between 1000-1500mm with an average minimum Temperature of 30⁰c and maximum temperature of 38⁰c depending on the season. It has undulating topography with complex groups of mountains and hills. The soil type ranges from sandy to loamy which makes the rural inhabitants mostly farmers (arable and livestock), (Taraba State. Diary, 2008).

3.2 Sources and Processing of *Prosopis africana* Pods

The *prosopis africana* pods were sourced from the forest of Ardo kola and Lau local Government Areas of Taraba State. The pods after collection were sun dried as described by Pamphona-Rogers (2004). The dried pods were subsequently pulverized, where the pulverized pods were subjected to four processing methods; raw *prosopis africana* pods meal, soaked *prosopis africana* pods meal, boiled *prosopis africana* pods meal and toasted *prosopis africana* pods meal and after properly dried then stored in sacks for subsequent use in the feeding trial.

- i. **Raw:** One hundred (100) kg of pulverized *prosopis africana* pods were processed as raw *prosopis africana* pods meal and stored in sack for subsequent use during the feeding trial.
- ii. **Soaked:** One hundred (100) kg of raw *prosopis africana* pods were soaked in a large plastic basin containing 75 litre of clean water for 24 hours. The water was decanted and the soaked *prosopis africana* pods were sun-dried for 4 days (Amaefule and Nwagbara (2004). The processed *prosopis africana* pods were put in sacks and tagged as soaked *prosopis africana* pods for subsequent use.
- iii. **Boiled:** A modified Amaefule and Nwagbara (2004) method of boiling was adopted. A raw *prosopis africana* pods were shared in 35kg batches and boiled. After boiling, the water was decanted and sun dried to constant weight. The dried *prosopis africana* pods were then kept in sacks for subsequent use.
- iv. **Toasted:** Raw *prosopis africana* pods (100kg) were toasted in a local oven like constructed 12m high and 0.90m wide, with firmly placed frying pan on top, one person on either side toasting at a time, using fire wood as source of energy. The *prosopis africana* pods were stirred constantly in the frying pan to ensure the toasting was uniformly done. The toasting continued until a change in colour from red to a dark brown with a pleasant aroma was achieved. The *prosopis africana* pods were poured on the cement floor to cool as described by Amaefule and Nwagbara (2004) and subsequently kept in sacks for later use.

3.3 Experimental Bucks and Management

Twenty (20) Red Sokoto Bucks within age range of 9-10 months with average weight of 6-9kg were purchased at Iware sheep and goats' market of Taraba State. The animals were individually housed in pens measuring about 1.5m² with concrete floors. The top is roofed with Zinc insulated with ceiling and sufficiently ventilated. The animals were treated against both internal and external parasites using injectable ivermectin prior to start of the work. The animals were placed on the experimental diet for two weeks for adaptation period. All routine management practices were carried out include: deworming against intestinal parasites using Albendazole administered in drinking water once in every three months during the experimental period. Proper hygiene of the house was carried out to ensure sanity all through the period of the experiment.

3.4 Experimental Diets and Design

Sorghum stover (freshly harvested Jigari variety) was fed to the bucks in form of hay as basal

diet while the *prosopis africana* pods as supplement. The twenty Red Sokoto Bucks were randomly allotted to the five dietary treatments and replicated four times in completely randomized design (CRD). Treatment T1(control) contain 0g *prosopis africana* pods, while treatments 2, 3, 4, and 5 contain 650g each of raw, soaked, boiled and toasted *prosopis africana* pods, respectively. The treatment combinations are shown below:

T₁ = Sole Sorghum Stover

T₂ = Sorghum Stover + 650g Raw *Prosopis africana* pods

T₃ = Sorghum Stover + 650g Soaked *Prosopis africana* pods

T₄ = Sorghum Stover + 650g Boiled *prosopis africana* pods

T₅ = Sorghum Stover + 650g Toasted *Prosopis africana* pods

3.5 Experimental Procedure

The live weight of each animal was obtained before the commencement of the experiment. Feeds were offered simultaneously using feeding troughs twice daily in the morning and evening (8:00am and 4:00pm). The feed left over were collected and weighed in the morning before the next feeding. The bucks were weighed weekly so as to determine the weight gain and the experiment last for 15 weeks.

3.5.1 Data Collection

3.5.2 Daily Feed Intake

Every morning before the next feeding each leftover diet was collected and weighed before the next feeding and subtracting the refusal from the total amount of feed offered to the animals.

3.5.3 Weight Gain

The Bucks were weighed at the beginning of the experiment and every successive seven days thereafter. Average daily live weight changes were calculated as difference between final and initial body weights divided by number of days of feeding.

3.5.4 Feed Conversion Ratio

Feed conversion ratio is the feed consumed per unit weight. It is therefore the measure of the ability of the animal to convert feed to meat. Feed conversion ratio was determined by dividing daily feed intake by average daily weight gain.

$$FCR = \frac{\text{Average daily feed intake}}{\text{Average daily weight gain}}$$

3.5.5 Digestibility Study

Digestibility study was conducted immediately after the feeding trial. Three (3) bucks from each treatment were selected and faeces collected from them for five days. The feeding regime during the digestibility study were the same as in the feeding trial. The total faecal outputs were measured daily using a weighing scale and 10% sub-sample taken, dried and stored in polythene bags for chemical analysis.

3.5.6 Evaluation of Blood Profile

At the end of the experiment, blood samples were collected from three bucks per treatment for the determination of hematological and Biochemical parameters. The bucks were randomly selected and fasted over night before they were bled early in the morning to avoid temporary

elevation of blood metabolites by feeding.

3.5.7 Chemical Analysis

Proximate analysis of the feeds and faecal samples were carried out to determine the dry matter (DM), crude protein (CP), crude fibre (CF), ether extract (EE), nitrogen free extract (NFE) and total ash content using the procedure according to AOAC (2005) method.

3.5.8 Statistical Analysis

Data generated from this study were subjected to One-way Analysis of Variance (ANOVA) in a Completely Randomized Design (CRD) using SAS (2003). Where significant difference exists among means, Duncan's Multiple Range Test (DMRT) will be used to separate the means.

Results

4.1. Chemical Composition of Sorghum Stover (Jigari) and Raw and Differently Processed *Prosopis africana* Pods as Supplement.

The proximate composition of experimental diets is presented in Table 1. The sorghum stover contains 87.50% dry matter, 8.15% crude protein, 37.00% crude fibre, 3.01 ether extract, 8.40% ash, 53.20% nitrogen free extract, 38.10% acid detergent fibre and 53.60% neutral detergent fibre. The raw *prosopis africana* pods contains 96.25% dry matter, 18.15% crude protein, 25.00% crude fibre, 4.10% EE, 3.20% ash, 49.00% nitrogen free extract, 31.20% acid detergent fibre and 41.75% neutral detergent fibre. Soaked *prosopis africana* pods contains 95.69% dry matter, 18.57% crude protein, 24.75% crude fibre, 4.04% ether extract, 3.05% ash, 48.70% nitrogen free extract, 29.31% acid detergent fibre and 40.62% neutral detergent fibre. The boiled *prosopis africana* pods contains 94.25% dry matter, 19.18% crude protein, 23.32% crude fibre, 4.10% ether extract, 3.07% ash, 49.00% nitrogen free extra, 29.205 acid detergent fibre and 40.10% neutral detergent fibre and the toasted *prosopis africana* pods contains 92.80% dry matter, 19.94% crude protein, 22.18% crude fibre, 5.00% ether extract, 2.85% ash, 46.50% nitrogen free extract, 28.70% acid detergent fibre and 40.00% neutral detergent fibre, respectively.

Table1. Chemical Composition of Sorghum Stover (Jigari variety) and Raw and Differently Processed *Prosopis africana* Pods as Supplement

Parameters	DM	CP	CF	EE	ASh	NFE	ADF	NDF
Sorghum Stover	87.50	8.15	37.00	3.01	8.40	53.20	38.10	53.60
Raw <i>Prosopis africana</i> Pods	96.25	18.15	25.00	4.10	3.20	49.00	31.20	41.75
Soaked <i>Prosopis africana</i> Pods	95.69	18.57	24.75	4.04	3.05	48.70	29.31	40.62
Boiled <i>Prosopis africana</i> Pods	94.25	19.18	23.32	4.10	3.07	48.00	29.20	40.10
Toasted <i>Prosopis africana</i> Pods	92.80	19.94	22.18	5.00	2.85	46.50	28.70	40.00

4.2 Growth Performace of Red Sokoto Bucks Fed Sorghum Stover (jigari variety) with Raw and Differently Processed *Prosopis africana* Pods as Supplement

The growth performance of Red Sokoto bucks with sorghum stover with raw and differently

processed *prosopis africana* pods as supplement is presented in Table 2. The average daily feed intake was significantly ($P<0.05$) differently across the treatment groups with highest value of 330.19g/day was obtained in T1 and least value of 297.48g/day in T5. The total feed intake showed significant difference ($P<0.05$) across the treatment groups with higher value of 20.80kg was obtained in T1 and least value of 18.74kg was obtained in T5. Final body weight gain showed significant difference with highest value of 9.04kg in T5 and least value of 7.36kg was obtained in T1, while the total weight gain also showed significant difference with higher value of 1.53kg was obtained in T5 and 0.58kg was obtained in T3, respectively.

Table2. Growth Performance of Red Sokoto Bucks Fed Sorghum Stover (jigari variety) with Raw and Differently Processed *Prosopis africana* Pods as Supplement

Parameters	T1	T2	T3	T4	T5	SEM	P-value
Initial Body Weight (kg)	6.59	7.01	7.58	6.87	7.51	0.22	0.0256
Final body Weight (kg)	7.36ab	7.99ab	8.16ab	7.92ab	9.04a	0.27	0.010
Total Body Weight Gain (kg)	0.77bc	0.98b	0.58c	1.05b	1.53a	0.08	<0.0001
Average Daily Gain (g/day)	12.26bc	15.56b	9.25c	16.59b	24.29a	1.30	<0.0001
Total Feed Intake (kg)	20.80a	20.18ab	19.80bc	19.04cd	18.74d	0.18	<0.0001
Average Daily Feed Intake (g/day)	330.19a	320.32ab	314.27bc	302.26cd	297.48d	2.90	<0.0001

4.3 Nutrient Digestibility of Red Sokoto Bucks Fed Sorghum Stover (jigari variety) with Raw and Differently Processed *Prosopis africana* Pods as Supplement.

The nutrient digestibility of Red Sokoto Bucks Fed Sorghum Stover (jigari) with Raw and Differently Processed *Prosopis africana* Pods as supplement is presented in Table3. Significant difference ($P<0.05$) occur across the treatment groups for dry matter digestibility with higher value of 76.15% in T4 and least value of 69.54% in T1. Significant differences also occur for crude protein digestibility with higher value of 77.80% in T5 and least value of 70.18% in T1. Digestibility of crude fibre was significant across the treatment groups with values of 78.61% in T5 and least in T3 (64.47%). Ash digestibility was significantly different ($P<0.05$) across treatment groups with higher value of 77.65% in T5 and lower in T1 (72.33%). Ether extract digestibility was significantly different ($P<0.05$) across the treatment groups with higher value of 86.71% in T5 and least value of 60.13% in T1. Nitrogen free extract digestibility was also significantly different ($P<0.05$) across the treatment groups with higher value of 81.75% in T4 and least value of 71.65% in T3. While, acid detergent fibre digestibility was also significantly ($P<0.05$) different with higher value of 75.32% in T4 and least value of 61.03% in T3 and that neutral detergent fibre was also higher in T4 (77.77%) and least in T3 (65.51%), respectively.

Table3. Nutrient Digestibility of Red Sokoto Bucks Fed Sorghum Stover (jigari variety) with Raw and Differently Processed *Prosopis africana* Pods as Supplement.

Parameters	T1	T2	T3	T4	T5	SEM	P-value
Dry matter	69.54b	71.28	61.66c	76.15a	75.45a	0.84	<0.0001
Crude protein	70.18b	74.34a	64.14c	76.87a	77.80a	0.87	<0.0001
Crude fibre	70.83c	74.23bc	64.47d	77.70ab	78.61a	0.84	<0.0001

Ash	72.33c	73.50bc	62.34d	76.75ab	77.65a	0.87	<0.0001
Ether extract	60.13c	75.67b	71.49b	85.46a	86.71a	1.10	<0.0001
Nitrogen Free Extract	77.15b	79.77ab	71.65c	81.75a	81.13a	0.74	<0.0001
Acid Detergent Fibre	71.13a	72.69a	61.03b	75.32a	74.38a	0.92	<0.0001
Neutral Detergent Fibre	76.51a	74.49a	65.51b	77.77a	77.18a	0.84	<0.0001

4 Haematological Indices of Red Sokoto Bucks Fed Sorghum Stover (jigari variety) with Raw and Differently Processed *Prosopis africana* Pods as Supplement

The haematological indices of Red Sokoto bucks fed sorghum stover with *prosopis africana* pods is presented in Table 4. The Pack Cell Volume showed significant difference ($P<0.05$) across the treatment groups with higher value of 2.55% was obtained in T1 and least value of 2.10% in T5. Haemoglobin was significantly different ($P<0.05$) across the treatment groups with higher value of 8.15g/dl were obtained in T3 and T4 respectively, and lower value of 7.50g/dl in T2. Red blood cell count also were significantly different ($P<0.05$) across the treatment groups with higher value of $2.95 \times 10^{12}/l$ was obtained in T5 and least value of $2.55 \times 10^{12}/l$ in T2. White blood cell count showed significant difference ($P<0.05$) across the treatment groups with higher value of $4.70 \times 10^9/l$ in T1 and lowest value of $2.65 \times 10^9/l$ in T4. Mean corpuscular HC was significantly different ($P<0.05$) across the treatment groups with higher value of 34.90pg in T4 and least value of 33.20pg in T1. MCH was also significantly different ($P<0.05$) across the treatment groups with higher value of 31.25pg in T2 and lowest value of 28.90pg in T5, while MCV was not significantly different ($P>0.05$) across the treatment groups with the highest value of 89.90fl in T2 and least in T5 (86.70fl), respectively.

Table4. 4 Haematological Indices of Red Sokoto Bucks Fed Sorghum Stover (jigari variety) with Raw and Differently Processed *Prosopis africana* Pods as Supplement

Parameters	T1	T2	T3	T4	T5	SEM	P-value
Packed cell volume (%)	2.55a	2.50ab	2.45ab	2.30b	2.10c	0.043	<0.0002
Haemoglobin (g/dL)	7.80bc	7.50c	8.15b	8.15b	8.75a	0.092	<0.0001
Red blood cell count($\times 10^{12}/L$)	2.65bc	2.55c	2.70b	2.75b	2.95a	0.026	<0.0001
White blood cell count($\times 10^9/L$)	4.70a	3.85a	3.90a	2.65b	4.60a	0.214	0.0003
Mean corpuscular HC	33.20b	34.55a	34.40a	34.90a	34.65a	0.152	0.0001
MCH(pg)	30.25ab	31.25a	30.60a	30.40a	28.90b	0.313	0.0045
MCV(fl)	89.30	89.90	89.30	88.20	86.70	0.969	0.2245

4.5 Serum Biochemical Characteristics of Red Sokoto Bucks Fed Sorghum Stover (jigari variety) with Raw and Differently Processed *Prosopis africana* Pods as Supplement

The serum biochemical indices of Red Sokoto Bucks Fed Sorghum Stover (jigari variety) with Raw and Differently Processed *Prosopis africana* Pods as Supplement is presented in Table 5. Significant difference exist ($P<0.05$) across treatment groups for glucose with higher value in T2 (4.75g/l) and least in T4 (3.50g/l), urea was significantly different ($P<0.05$) across the treatment groups with higher value of 4.95mmol/l (T5) and least value of 3.30mmol/l in T1, also creatinine was significantly different ($P<0.05$) across the treatment groups with higher value of 77.55mmol/l in T5 and least value of 36.30mmol/l in T3. While total protein was not significantly different ($P>0.05$) across the treatment groups with higher value of 67.65mmol/l in

T1 and least value of 59.75mmol/l in T3. Albumin also was not significantly different ($P>0.05$) across the treatment groups with higher value of 33.75mmol/l in T1 and least value of 29.70mmol/l in T3. Globulin was also not significantly different ($P>0.05$) across the treatment groups with higher value of 33.85mmol/l in T1 and least in T3 (29.85mmol/l), while cholestoral was not significantly different ($P>0.05$) across the treatment groups with higher value of 1.90mmol/l in T4 and least value of 1.50mmol/l in T1, respectively.

Table5. Serum Biochemical Characteristics of Red Sokoto Bucks Fed Sorghum Stover (jigari variety) with Raw and Differently Processed *Prosopis africana* Pods as Supplement

Parameters	T1	T2	T3	T4	T5	SEM	P-value
Total protein (g/L)	67.65	62.05	59.75	62.30	61.00	2.429	0.261
Albumin (g/L)	33.75	31.75	29.70	30.40	30.05	1.119	0.1433
Globulin(g/L)	33.85	31.05	29.85	32.05	32.25	1.383	0.3668
Glucose (mmol/L)	3.70bc	4.75a	4.55ab	3.50c	3.85abc	0.219	0.0085
Urea (mmol/L)	3.30c	3.45c	4.25ab	3.50bc	4.95a	0.163	0.0001
Creatinine (mmol/L)	49.10b	47.70b	36.30b	43.35b	77.55a	3.484	<0.0001
Cholesterol(mmol/L)	1.50	1.75	1.70	1.90	1.60	0.119	0.2432

Discussion

Chemical Composition of Sorghum Stover (Jigari variety) and Raw and Differently Processed *Prosopis africana* Pods as Supplement as Supplement

The dry matter content of sorghum stover (Jigari variety) used in the study was 87.50% and higher than the range values of 94.61% to 96.29% reported by Tikabo and Shumuye, 2021 and 85.00% to 92.00% reported by VanSoest, 1994 with different varieties. Onaleye *et al.*, 2012 reported 95.29% which is higher than in this study and 82.0% reported Mbahi *et al.*, 2006 which is lower than in this study, but with different variety. The difference could be due to variety, stage of harvest or method of processing. Crude protein content of the sorghum stover was 8.15% and similar to 8.495% reported by Onaleye,2012 but higher than 6.00% reported by Mbahi *et al.*, 2006 but higher than range values of 2.76 -4.91% and 3 -7% reported by Tikabo and Shumuye (2021) and VanSoest, 2014. The differences could be due to soil or stage of harvest. Crude fibre content of 37.00% in the study was similar to 36.00% reported by Helen *et al.*, 2026, but higher than 18.645% reported by Onaleye, 2012. Ash content of 8.405% was also similar to 8.30% reported by Helen *et al.*, 2026 and 8.85% reported by Onaleye *et al.*, 2012, but higher than 4.15% reported by Tikabo and Shumuye, 2021. Ether extract content 3.01% was similar to 3.005% reported by Helen *et al.*, 2026, but higher than 0.90% and 2.04% reported by Mbahi *et al.*, 2006 and Onaleye *et al.*, 2012. Nitrogen free extract content of 53.20% was also similar to 53.15% reported by Helen *et al.*, 2026 but lower than 57.27% reported by Onaleye *et al.*, 2012. Acid detergent fibre content of 38.10% was similar to 38.16% reported by Helen *et al.*, 2026 which is higher than 27.78% reported by Onaleye *et al.*, 2012 but lower than 45.74% reported by Tikabo and Shimuye, 2021. While the neutral detergent fibre content of 53.60% was similar to 54.60% and 53.38% reported by Helen *et al.*, 2026 and Onaleye *et al.*, 2012, but lower than 75.06% reported by Tikabo and Shumuye, 2012. The dry matter content values ranged from 92.80-96.24% for raw add differently treated *prosopis africana* pods in this study were higher than the range values of 85.20 -86.70% reported by Shina *et al.*, 2019, while Mbahi *et al.*, 2023 reported a higher value of 96.50% and 96.00% by Rotemo *et al.*, 2024 which is similar to this

value obtained in study for raw *prosopis africana* pods. Crude content of range values of 18.15 - 19.945% is similar to report by Helen *et al.*, 2025, while Mbahi *et al.*, 2023 reported lower protein content of 17.00% for raw *prosopis africana* pods, and Rotemo *et al.*, 2024 reported 10.80% for *prosopis africana* pods meal, while Shina *et al.*, 2019 reported much higher values of 35.10% and 37.89% for raw and toasted *prosopis africana* pods meals. The differences could be due to soil, stage of harvest or processing methods. Ether extract content range values of 3.01- 5.00% is within the range values of 3.00-5.06% reported by Helen *et al.*, 2025 for differently treated *prosopis africana* pods. Also, Roemo *et al.*, 2024 and Mbahi *et al.*, 2023 both reported 3.50% ether extract which falls within the range values obtained in this study. Nitrogen free extract content range values of 46.50-53.20% obtained is similar to the range values of 46.62- 53.15% reported by Helen *et al.*, 2025, while Shina *et al.*, 2019 reported much lower values of 34.295 and 35.44% for raw and toasted *prosopis africana* pods, while Mbahi *et al.*, 2023 reported 50.00% for raw *prosopis africana* pods. Acid detergent fibre content range values of 28.70-38.10% obtained is similar to range values of 28.65- 38.15% reported by Helen *et al.*, 2025 and Rotemo *et al.*, 2024 also reported 30.10% *prosopis africana* pods meal which falls within the range values in this study. And the neutral detergent fibre content range values of 40.00-53.60% obtained is also similar to the range values of 40.10-54.60% reported by Helen *et al.*, 2025, and Rotemo *et al.*, 2024 reported 43.10% neutral detergent fibre which is within the range values obtained in this study.

The average daily feed intake in this study reduces with processing method and is similar to the report by Mbahi *et al.*, 2023 who fed Red Sokoto bucks with *panicum maximum* with raw *prosopis africana* pods as supplement, and Abdullah and Abdel Hefes (2000) who also reported reduced average feed intake but contrary to the report by Helen *et al.*, 2025 and Teklead *et al.*, 2025 who fed similar diets to Red Sokoto bucks and obtained increased intake to maximum values in T5 with increasing level of supplement. Total feed intake also reduces with processing method from T1 to T5 and is similar to Mbahi *et al.*, 2023, Mahgoub *et al.*, 2005, Babayemi and Banikole (2009) and FAO (2003) but contrary to the report by Helen *et al.*, 2025 and Teklead *et al.*, 2025 who reported increase in total feed intake and the differences could be due stage of harvest, soil or processing methods. The average body weight gain increases with supplement processing method from T1 to T5 and this is similar to the report by Helen *et al.*, 2025, Mbahi *et al.*, 2023, Shua, 2026, Obieidat *et al.*, 2008, Rotemo *et al.*, 2024 who obtained increase in body weight gain, but differ with report by Teklead *et al.*, 2025 who use alfalfa and elephant grasses as supplements to sorghum stover based diets fed to dairy goats and reported weight decline with level of intake. Total weight gain followed same trend and increases with processing methods of *prosopis africana* pods meals, and this agrees with earlier report by Mbahi *et al.*, 2023, Helen *et al.*, 2025 and Teklead *et al.*, 2025 and also showed increase as the level of supplementation. While all the authors reported reduced performance when the animals were fed raw *prosopis africana* pods without treatment. Nutrient digestibility was all significantly different for all the treatment groups and increases from raw to toasted with all animals. The results obtained were similar to the earlier reports by Mbahi *et al.*, 2023, Ansarinik *et al.*, 2013, Teklead *et al.*, 2025 and Helen *et al.*, 2025 who reported increase in digestibility with processing method and level of supplementation. Also, VanSoest (2014) reported that toasting help reduces the anti nutritional factors which enable the accessibility to microbial activities and utilization of the nutrients. Ansarinik *et al.*, 2023 and Andrade *et al.*, 2009, reported enhanced utilization of low-quality roughages when supplemented with treated pods. Haematological indices from PCV to MCH were significantly significant except MCV which were not significantly different across the

treatment groups. Feeding *prosopis africana* pods to Red Sokoto bucks for the period of the study did not affect their health or growth. This agrees with the report by Mahgoub *et al.*, 2007, but contrary to health problem encountered at Dubti Pastoral and Agro Pastoral Research Centre (Tabosa *et al.*, 2000). While range values obtained in this study falls within the range values reported by Tibbo *et al.*, 2004 for PCV, HB, WBC and MCHC (27.77-29.77%, 7.2-8.6G/dl for Hb, $9.66-10.88 \times 10^{12}/L$ for WBC and 30.7-34.4g/100ml for MCHC. The serum biochemical indices obtained in this study were not significantly different ($P>0.05$) across treatment groups with Total protein, Albumin, Globulin, and Cholesterol, but significantly ($P<0.05$) different with Glucose, Urea and Creatinine, but these are contrary to the earlier report by Mbahi *et al.*, 2023, Shaker *et al.*, 2014 and Mahgoub *et al.*, 2005. But agrees with Zubcic, 2001 and Al-Soqeer and Fahmy, 2014 who reported nutrient adequacy with the *prosopis africana* pods the differences could be due variety, soil, stage of harvest or processing method. The low cholesterol levels in this study is similar to the report by Waziri *et al.* (2010) but are lower than the Physiological range values of 2.30-250mmol/L with Sahel goats reported by Zubcic, 2001, while Shaker *et al.*, 2014 obtained similarly low values with goats fed *prosopis africana* pods as supplements. And the overall value of the serum biochemical indices agrees with earlier report by Al-Soqeer and Fahmy, 2014 and this confirms the nutritional adequacy of the experimental diets.

Conclusion

From the results obtained in this study, it could be concluded that *prosopis africana* pods when subjected to different processing methods could help improve the nutritive values and reducing the anti-nutritional factors which are the major problem when fed raw. The treated *prosopis africana* pods could be a good supplement for the utilization of cereal residues like sorghum stover during the period scarcity especially months of March to May during the dry season when it used to be the sole available feed for the animals.

References

- Abdullah, A. Y. and Abdel Hafes, B. Y. (2004). Inclusion of *Prosopis juliflora* pods in finishing Awassi lamb diets. Proc. 11th AAAP Animal Science Congress, vol. 2, pp.373-375..
- Abdullah, A.Y., Mahmoud, K.Z., Nusairat, B.M., & Qudsieh, R.I. (2011). Small ruminant feed supplementation with *Prosopis juliflora* pods and sesame hulls to replace soybean meal and barley. *Livestock Science*, 142(1-3), 11-17.
- Adeloye A.A (1994). The influence of varying ratio of Cowpea husk and maize milling waste on feed intake, protein and energy utilization by the goat. *Nigerian journal of Animal production* 21, (1, 2): 23-25
- Aliyu, I.D., Maigandi, S.A., Muhammad, I.R. and Y. Garba (2012). Haematological Indices and Blood Urea Nitrogen of Yankasa Ram Lambs Fed Urea, Poultry Droppings and or Urea treated *Pennisetum pedicellatum* (kyasuwa) (2012). *Nigerian Journal of Basic and Applied Science*, 2012,20(1):23-28.
- Ansarinik, H., Saberi, M., Jahantigh, M. and Ebrahimzadeh, A. (2013). The evaluation of chemical composition and dry matter degradability of *Prosopis farcta* fruit using in situ nylon bag technique. *International Journal of AgricultureCrop Science* 5 (9): 972-975. Available online at www.ijagcs.com
- Al-Soqeer, A. and Fahmy, O. (2014). Mesquite (*Prosopis juliflora*) pods as a local alternative
- Amaefule, K. U. and Nwagbara, N. N. (2004). The effects of processing on nutrient utilization of pigeon pea (*cajanus cajanus*) seed meal-based diets by pullets. *International Journal of Poultry science*. 3(8):543-564.
- Andrade, H. M., Alegria-Rios, F. S., Pacheco-Lopez, M., Aguilar-Borja, J. H., Villegas- Diaz., J. L. O. and Basurto-Gutierrez, R. (2009). Effect of dry roasting composition, digestibility and degradability of fiber fractions of mesquite pods (*Prosopis laevigata*) as feed supplement in goats. *Tropical Sub- tropical Agro-ecosystem.*, 11: 237-243.
- Ansarinik, H., Saberi, M., Jahantigh, M. and Ebrahimzadeh, A. (2013). The evaluation of chemical composition and dry matter degradability of *Prosopis farcta* fruit using in situ nylon bag technique. *International Journal of AgricultureCrop Science* 5 (9): 972-975. Available online at www.ijagcs.com
- AOAC, (2005). Association of Official Analytical Chemists. Official Methods of Analysis, 13th edition, AOAC, International, Maryland, USA.]
- Babayemi, O. J. and Banikole, M. A. (2009). Silage quality, dry matter intake and digestibility of west African dwarf sheep of Guinea grass (*Panicum maximum* cv Ntchis) harvested at 4 and 12 week regrowth. *African Journal of Biotechnology.*, 8(16):3983-3988.
- Bhatta, R., Shinde, A. K., Vaithyanathan, S., Sankhyani, S. K. and Verma, D. L. (2002). Effect of polyethylene glycol-6000 on nutrient intake, digestion and growth of kids browsing *Prosopis cineraria*. *Animal Feed Science and Technology* 101: 45-5
- Bruce P. and Frank P. (1993). Feeding program for meat goats (<http://www.clemmson.edu/agronomy/Goatshandbook>) 17/8/2007.
- Chopra, D. and Hooda, M. S. (2002). Variability in mineral content of *Prosopis juliflora* seeds collected from different places. *Indian Journal Animal Nutrition* 19(2):162-165
- Choge, S. K., Pasiecznik, N. M., Harvey, M., Wright, J., Awan, S. Z. and Harris, P. J. C. (2007). *Prosopis* pods as human food, with special reference to , Kenya,. *Water Sa*, 33(3).
- Devendra, C. and M. Burns. (1995). Goat production in a tropics. Commonwealth Agricultural Bureau, Fanham house, United Kingdom. Pp 95-105.
- FAO (2012). Crop residue-based densified total mixed ration: A user-friendly approach to utilize

- food crop by-products for ruminant production. FAO Animal Production and Health Paper No. 172. FAO, Rome, Italy.
- Helen, I. D., Mbahi, T. F., Tirmidhi, A. B. and Ishaya. W.W. (2026). Growth response and digestibility of Red Sokoto Bucks fed sorghum stover with raw and differently treated iron tree (*Prosopis africana*) pods as supplement. *International Journal of Agriculture and Earth Science*. E-ISSN 2489-0081 P-ISSN 2695-1894. Vol 12. No. 2 2026 www.iiardjournals.org online version
- Koech *et al.*, 2011
- Mahgoub, O., Kadim, I. T., Al-Ajmi, D. S., Al-Saqry, N. M., Al-Abri, A. S., Ritchie, A. R., Annamalai, K. and Forberg, N. E. (2004). The effects of replacing Rhodes grass (*Chloris gayana*) hay in Ghaf (*Prosopis cineraria*) pods on the performance of Omani native sheep. *Tropical Animal Health Production*. , 36: 281-294.
- Mahgoub, O., Kadim, I. T., Al-Busaidi, M. H., Annamalai, K., Al-Sagri, N. M. (2007). Effects of feeding ensiled palm fronds a by-products concentrate on performance and meat quality of Omani sheep. *Animal Feed Science Technology*. 135(3):210- 221
- Makkar, H. P. S. (2003). Recent advances in the *in vitro* gas method for evaluation of nutritional quality of feed resources. In: *Assessing Quality and Safety of Animal Feeds*. FAO Animal Production and Health Series 160 FAO, Rome. pp55-88.
- Mbahi, T. F., Kibon, A., Akosim, C. and Gworgwor, Z. A. (2006). Effects of different legume species on nutritive value and biomass yield of sorghum stover at different growth stages. *Nigeria Journal of Tropical Agriculture*. Vol.8 (130-135). ISSN 1595-5559 (Nigeria)
- Mbahi, T. F., Ubua, J., Vincent, A. and Ardo, A. (2023). Performance of Red Sokoto Bucks fed Guinea Grass (*Panicum maximum*) with iron tree (*Prosopis Africana*) pods as supplement in Taraba State, Nigeria. *Nigeria Journal of Animal Science and Technology*. Vol. 6(3)
- Mgheni, D.M., Hvelplund, T. and M.R. Weisbjerg (2010). Rumen Degradability of Dry matter and protein Tropical grass and Legume forages and their Protein values expressed in the AAT-PBV protein Evaluation Systems. (<http://www.ilri.org/info/serve/webpub/fulldocs/AFRNET/TOC.htm>). 15/10/2013.
- Obeidat, B.S., Abdullah, A.Y., & Al-Lataifeh, F.A. (2008). The effect of partial replacement of barley grains by *Prosopis juliflora* pods on growth performance, nutrient intake, digestibility, and carcass characteristics of Awassi lambs fed finishing diets. *Animal Feed Science and Technology*, 146(1-2), 42-54.
- Ogundipe S.O (2002). Ration formulation and least cost rations for small ruminants. A paper presented at *The Small Ruminant Workshop* held at NAPRI ABU Zaria. 13-18th Jan. 2002. Production Training
- Onaleye, K. J. Kibon, A. Mbahi, T. F. Mufwa, B. J. Gawi, G. O. and H. A. Labaran, H. A. (2012). Evaluation of five crop residues for degradability potentials in goats at Jalingo, Taraba State. *Journal of Science and Multidisciplinary Research*. Vol. 4 (59-67) ISSN 2277-0135 (Nigeria)
- Pamplona-Rogers (2004). *Encyclopedia of Medicinal plants* Pamplona-Rogers (Ed) Editorial Safeliz Spain. pp 15-443.
- Paul M.J, Mathew H.P, Jean M.L and James T.G(2007). Forages for goats: In marching forages to the Nutrient needs of meats goats. *Department of Animal Science, National researchcouncil USA*. (<http://www.cals.ncsu.edu>) 20/4/2017.

- Pasiecznik, N. M., Harris, P. J. C. and Smith, S. J. (2004). Identifying Tropical *Prosopis* Species: A Field Guide. Henry Doubleday Research Association (HDRA), Coventry
- Ratemo, H. M., Gachuri, C. K. Maina, J. G. and Onyango, C. M. (2024). Effects of *Prosopis juliflora* pods meal supplementation on feed utilization, body weight and digestibility in weaner galla goats. *Livestock Research for Rural Development*. 36(5). 2024.
- Sawal, R. K., Ram Ratan and Yadav, S. B. S. (2004). Mesquite (*Prosopis juliflora*) pods as a feed for livestock- A review. *Asian- Australia Journal Animal Science.*, 17: 719-725
- SAS. 2003. SAS, Institute Inc. SAS/STAT User's Guide: Version 9.0.
- Shaker, Y. M., Ibrahim, N. H. I., Younis, F. E. I. and E. I. Shaer, H. M. (2014). Effect of feedingsome salt tolerant fodder shrubs mixture on physiological performance of Shami goats in Southern Sinai, Egypt. *Journal of Animal Science*, 10 (2):66-77
- Shina, A. A., Wilfred O. A., Olubnmi T. A. and Adeyemi M. B. (2019). Effects of toasting value of mesquite (*Prosopis africana*) seeds and its utilization by *Oreochromis niloticus* Fingerlings
- Shua, J. N. (2026). Effect of raising West African Dwarf goats with graded levels of *prosopis africana* pods meal in Mubi, Adamawa State. *International Journal of Agricultural Technology*. Published by Cambridge Research and publications. Vol.11, No1. <https://doi.org/10.70382/caijaat.v11i1.013>.
- Steve, H. (2002). Introduction to goat nutrition, goat research. Langstone University USA. <http://www2.lursect.edu/goats/training/index.htm>) 15/8/2007
- Tabosa, I.M., Souza, J.C., Graca, D.L., Barbosa-Filho, J.M., Almeida, R.N., & Riet-Correa, F. (2000). Neuronal vacuolation of the trigeminal nuclei in goats caused by ingestion of *Prosopis juliflora* pods (mesquite beans). *Veterinary and Human Toxicology*, 42(3), 155-158.
- Taraba State Diary (2008). Taraba State Diar
- Tikabo, G. and Shumuye, B. (2021). Chemical composition and digestibility of major feed resources in Tanqua- Abergelle district of central Tigray, northern Ethiopia. *Hindawi, The Scientific World Journal*. Vol.2021, Article ID 5234831, 8Pages. <https://doi.org/10.1155/2021/5234831>
- Teklead, K. G., Vincent, M., Getachew, G. T., M, R. A, Mathew, G. and Isaac, M. O. (2025). Improvement of feed intake, digestibility and lactation performance of Hassan dairy goats by supplementing sorghum stover- based diets with alfalfa and elephant grass. *Journal of Agriculture Science*, Vol. 17, No 11:2025 E-ISSN 9760
- Van Soest, P.J. (1994). *Nutritional Ecology of the Ruminant* (2nd ed.). Cornell University Press.
- Waziri, M. and Agbugba, I. (2010). Agricultural production, population growth and poverty alleviation in Nigeria: A review of some theoretical issues. *Continental Journal of Agricultural Economics*, 4, 96-105.
- Zubcic, D. (2002). Some biochemical parameters in the blood of grazing German improved fawn goats from Istria, Croatia. *Veterinarski Arhiv*, 71(5), 237-244.