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Effects of Feeding Graded Levels of Desert Date (*Balanites aegyptiaca*) Leaves as Supplement to Urea Treated Maize Stover on the Performance of Red Sokoto Goats

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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ABSTRACT

The study was conducted to evaluate the effect of feeding graded levels of Desert date (*Balanites aegyptiaca*) leaf forage as supplement to urea treated maize stover on nutrient intake, weight gain, nitrogen retention and rumen parameters of Red Sokoto goats. Sixteen (16) Red Sokoto goats weighing 9.36±0.67 Kg on average were randomly grouped into four and exposed to four dietary treatments: A (control), B (100 g *Balanites aegyptiaca*), C (200 g *Balanites aegyptiaca*) and D (300 g *Balanites aegyptiaca*), with each treatment group having four goats and a goat formed a replicate in a completely randomized design (CRD). The experiment lasted for ten (10) weeks in which there was 2 weeks adaptation period and 8 weeks collection period. $p<0.05$ was considered as level of significance. Total dry matter (DM) intake increased from 346.53 g/day (control) to 546.87 g/day (treatment D). Supplementation significantly ($p<0.05$) increased daily weight gains. Treatment D had the highest average daily weight gain (54.29 g/day). Supplementation significantly increased ($p<0.05$) total nutrient intake for all parameters recorded with treatment D having the highest

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values. Nitrogen utilization, rumen ammonia concentration and rumen pH significantly increased ($p<0.05$) with supplementation. According to the finding of this study, supplementing urea treated maize stover with *Balanites aegyptiaca* greatly improved the performance of the animals and thus, *Balanites aegyptiaca* is a good protein supplement and should be utilized when feeding goats with low quality basal diets.

Keywords: Balanites aegyptiaca; maize stover; goats; nutrient intake; nitrogen utilization; ammonia concentration; pH.

1. INTRODUCTION

Livestock production is an important tool in the economy of developing countries. Goats particularly play an important role in the livelihood of small scale farmers as a major component of livestock mixed farming systems, which produce meat, milk, skin, fibre, and manure to large number of low income earners [1]. The Sokoto Red, Kano Brown or Maradi goat is probably the most widespread and well-known type in Nigeria [2]. It is the usual village goat in the northern two-thirds of the country although it is less common with transhumant pastoralists. Livestock farmers in developing countries are faced with various challenges that have led to a considerable fall in the production of certain livestock species like goats, cattle, swine and poultry. The major problem is the high cost of production due to increased prices of locally available feed ingredients [3]. The systems of small ruminant production (sheep and goats) in Nigeria are usually characterised by limitations poised by non-availability of year round feed resources due to prolonged dry season especially in the Northern part of Nigeria [4].

Crop residues from maize, sorghum, millet, cowpea and groundnut are important livestock feedstuffs in the West African savannah particularly during the long dry season [5]. As stated by Preston and Leng [6], crop residues especially cereal types are characterised by low nutrient content and digestibility, and poor voluntary consumption by ruminant animals. Ruminant feeding systems based on poor quality tropical foliages, crop residues or agro-industrial by-products, in which protein is one of the first limiting factors, may require additional protein and roughage to maintain an efficient rumen ecosystem that will stimulate nutrient intake and improve animal performance [7].

Supplementation of straw based diets is often necessary as these are low in protein and energy so as to meet the nutrient requirements even for maintenance [8]. Tree fodders (browse plants) are important in providing nutrients to grazing ruminants in arid and semi-arid environments, where feed supply are a major constraint to livestock production [9].

Balanites aegyptiaca is a promising economic plant for both the arid and semi-arid regions of tropical Africa, the Middle East and India. It can be found in many kinds of habitat, tolerating a wide variety of soil types, from sand to heavy clay, and climatic moisture levels [10]. As a multipurpose tree, *Balanites aegyptiaca* offers food, medicines, cosmetics, fodder, fuel wood and pesticides valued for subsistence living in the arid and semi-arid areas where other options are few [11]. According to Hall [12], few African species are as widely distributed as *Balanites aegyptiaca*, which occurs in almost every African country north of the equator and several countries in the southern hemisphere. The leaves and fruits are widely consumed by animals. The green leaves, and particularly the green shoots, are commonly used as animal forage [11]. *Balanites aegyptiaca* could contribute up to 38% of the dry matter intake of goats in the dry season [13]. It is also a good source of degradable protein [14].

The study was designed to determine the dry matter and nutrient intake, weight gain, nitrogen retention, rumen ammonia concentration and rumen pH in Red Sokoto goats when fed graded levels of *Balanites aegyptiaca* leaf forage as a supplement to urea treated maize stover.

2. MATERIALS AND METHODS

2.1 Study Area

The experiment was conducted at the Teaching and Research Farm of the Department of Animal Science and Range Management, Modibbo Adama University of Technology Yola, Adamawa state. Yola is located in the North Eastern part of Nigeria. It is situated within the Savannah region and lies between latitude 9° 14' North and longitude 12° 28' East and altitude of about 152 m above sea level. Yola has a tropical climate marked by rainy and dry seasons. Maximum temperature can reach 40°C particularly in April, while minimum temperature can be as low as 18°C. Annual rainfall is less than 1000 mm [15].

2.2 Source and Preparation of Feed

The leaves of *Balanites aegyptiaca* were collected around Rumde-Kila and Mayo-Ine villages of Yola South Local Government Area, Adamawa state. After collection, the leaves were shade-dried for 7-10 days and then stored in bags. Maize stover was obtained from farms around the university area. The maize stover was chopped using a cutlass to a size of 2-4 cm before treatment with 4% urea for three weeks (400 g of urea in 10 litres of water per 10 kg of stover). The treated stover was placed for 3 weeks in black polythene sheets and covered with sacks. The urea treated maize stover served as the basal diet and the browse leaves served as the supplement.

2.3 Experimental Animals and Their Management

Sixteen (16) Red Sokoto male goats weighing 9.36±0.67 Kg on average were used for the experiment. All the animals were treated against external and internal parasites, using ivermectin and albendozole respectively. Terramycin long acting (TLA) injection was used to take care of subclinical bacterial infections. The animals were confined in an individual, well ventilated raised pens within a common house. The roof of the house was relatively high so as to reduce heat. Proper hygiene of the house was ensured all through the period of the experiment.

2.4 Experimental Treatments and Design

Four (4) treatment diets were offered in a Completely Randomized Design (CRD) with four 4 animals per treatment. Urea treated maize stover, mineral salt lick and water were offered *ad-libitum*. The 4 treatments were;

A) Urea treated maize stover + mineral salt lick + 100 g maize bran (control)
B) Control diet +100 g of *Balanites aegyptiaca*
C) Control diet + 200 g of *Balanites aegyptiaca*
D) Control diet + 300 g of *Balanites aegyptiaca*.

2.5 Experimental Procedure

The live weight of each animal was obtained before the commencement of the experiment. The supplement was first offered before the basal diet was offered every morning. Feed refusals were collected and weighed in the morning before fresh diet was offered. Mineral salt lick and fresh water were provided *ad libitum*. The goats were weighed weekly to determine the weight gain. The experiment lasted for ten weeks, with 2 weeks of adaptation period and 8 weeks collection period.

2.6 Data Collection

2.6.1 Feed intake

Feed intake was determined by collecting and weighing the amount of leftover every morning before feeding, and subtracting the refusal from the total amount of feed offered to the animals.

2.6.2 Weight gain

Weight gain of each animal was determined by subtracting the initial weight from the final weight of the animal. Daily weight gain was obtained by dividing total weight gain by fifty six (56) days of the collection period.

2.6.3 Rumen liquor collection

Rumen liquor was collected in the last week of the experiment by restraining the animals' fore and rear legs on the ground in a standing position and the fluid was collected using a suction tube. The fluid was collected before feeding and 4 hours after feeding. About 20 ml of the fluid was drawn from the animals and transferred into the sample bottles. The pH was taken using a pocket size pH indicator strips (non-bleeding). The samples were immediately taken to the laboratory for pH confirmatory test and rumen ammonia concentration analysis.

2.7 Chemical Analysis

The proximate composition of the experimental feeds and faeces were determined following standard methods A.O.A.C [16]. Neutral detergent fibre (NDF) and acid detergent fibre (ADF) were determined by the method of Van Soest et al. [17].

2.8 Statistical Analysis

All data generated from the experiment were subjected to one way analysis of variance

(ANOVA) in a completely randomized design (CRD) according to Steel and Torrie [18]. Treatment means were separated using Duncan's multiple range test (DMRT) [19].

3. RESULTS AND DISCUSSION

3.1 Proximate Composition of Experimental Feeds

The result of the proximate composition of the experimental diets is shown in Table 1. The DM content obtained for urea treated maize stover (91.0%) is higher than 65.47% reported by Tesfaye et al. [20] but lower than 95.6% reported by Hirut et al. [21]. The DM content recorded for *Balanites aegyptiaca* (92.5%) is lower than 955.00 g/KgDM (95.5%) reported by Njidda and Ikhimioya [22]. Maize bran DM obtained is higher than 91.5% reported by Mlay et al. [23]. CP content for urea treated maize stover (9.7%) is higher than 5.09% reported by Wambui et al. [8]. *Balanites aegyptiaca* had a CP content of 11.9%, which is lower than 15.0% reported by Abbator and Kibon [24]. Generally, the crude protein content in browses has been shown to be above the minimum level (7%) required for microbial activities in the rumen [25]. The CP content of maize bran (10.3%) is similar to 10.9% reported by Mlay et al. [23]. Egbu [26] reported a CF content of 27.03%, which is similar in value (28.0%) to the CF obtained for urea treated maize stover. Kamal and Nour [27] reported 17.33% as CF for *Balanites aegyptiaca*, which is lower than 20.0% obtained. Yahaya and Kibon [28] reported a CF content of 31.21% for maize bran, which is much higher than 7.5% obtained. The CF obtained for maize bran falls within the minimum and maximum values (4.8% and 20.7%) compiled by Heuzé et al. [29].

Ash content obtained for urea treated maize sover (8.1%) is similar to 7.92% reported by Tesfaye et al. [20]. The ash content for *Balanites aegyptiaca* (10.4%) is lower than 15.0% reported by Kamal and Nour [27]. Bello and Tsado [30] reported an ash content of 5.50% for maize bran, which is lower than 8.1% obtained. 3.6% EE content obtained for urea treated maize stover is higher than 2.15% reported by Wambui et al. [8]. Kamal and Nour [27] reported an EE content of 6.15% for *Balanites aegyptiaca*, which is higher than 3.3% obtained. Lepanga et al. [31] reported 82.0 g/KgDM (8.2%) as EE content for maize bran, which is lower than 9.6% obtained. The NFE obtained for urea treated maize stover (41.6%) is lower than 58.69% reported by Yahaya and Kibon [28]. Njidda and Ikhimioya [22] reported an NFE of 581.80 g/KgDM (58.18%) for *Balanites aegyptiaca*, which is higher than 46.9% obtained. Yahaya and Kibon [28] reported an NFE of 44.30% for maize bran which is lower than 61.8% obtained.

NDF, ADF and OM contents for urea treated maize stover obtained are comparable to 76.15%, 53.6% and 93.72% reported by Tesfaye et al. [20], Hirut et al. [21] and Wambui et al. [8] respectively. Ondiek et al. [32], Elseed et al. [14] and Lepanga et al. [31] reported 349 g/KgDM (34.9%), 257 g/KgDM (25.7%) and 103.9 g/KgDM (10.39%) for NDF, ADF and OM respectively for *Balanites aegyptiaca*, which are all comparable to the values obtained. Lepanga et al. [31] reported 189.1 g/KgDM (18.91%) NDF for maize bran which is lower than 28.6% obtained and 103.9 g/KgDM (10.39%) ADF, which is higher than 9.2% obtained. Mlay et al. [23] reported an OM of 94.9% for maize bran which is similar to 95.2% obtained.

Table 1. Chemical composition of feeds used in the experiment (% DM)

Parameters	Urea treated Maize stover	*Balanites aegyptiaca*	Maize bran
Dry matter	91.0	92.5	94.0
Crude protein	9.7	11.9	10.3
Crude fibre	28.0	20.0	7.5
Ash	8.1	10.4	4.8
Ether extract	3.6	3.3	9.6
Nitrogen free extract	41.6	46.9	61.8
Organic matter	91.9	89.6	95.2
Neutral detergent fibre	74.4	33.8	28.6
Acid detergent fibre	52.5	26.4	9.2

Table 2. Dry matter intake and nutrient intake (DM basis) of red sokoto goats offered urea treated maize stover and graded levels of *Balanites aegyptiaca*

Parameters	Treatments				
	A	B	C	D	SEM
DMI (g/day)					
UTMS	252.53^{a}	234.33^{b}	216.13^{c}	191.10^{d}	3.01*
B. aegyptiaca	-	92.04^{c}	180.84^{b}	261.77^{a}	0.65*
Maize bran	94	94	94	94	
Total	346.53^{d}	420.37^{c}	490.97^{b}	546.87^{a}	2.70*
CPI (g/day)					
UTMS	24.50^{a}	22.73^{b}	20.96^{c}	18.54^{d}	0.29*
B. aegyptiaca	-	10.96^{c}	21.52^{b}	31.15^{a}	0.08*
Maize bran	9.68	9.68	9.68	9.68	
Total	34.18^{d}	43.37^{c}	52.16^{b}	59.37^{a}	0.26*
CFI (g/day)					
UTMS	70.71^{a}	65.61^{b}	60.52^{c}	53.51^{d}	0.84*
B. aegyptiaca	-	18.41^{c}	36.17^{b}	52.36^{a}	0.13*
Maize bran	7.05	7.05	7.05	7.05	
Total	77.76^{d}	91.07^{c}	103.74^{b}	112.92^{a}	0.78*
Ash (g/day)					
UTMS	20.46^{a}	18.98^{b}	17.51^{c}	15.48^{d}	0.24*
B. aegyptiaca	-	9.57^{c}	18.81^{b}	27.23^{a}	0.07*
Maize bran	4.51	4.51	4.51	4.51	
Total	24.97^{d}	33.06^{c}	40.83^{b}	47.22^{a}	0.21*
EEI (g/day)					
UTMS	9.09^{a}	8.44^{b}	7.78^{c}	6.88^{d}	0.11*
B. aegyptiaca	-	3.04^{c}	5.97^{b}	8.64^{a}	0.02*
Maize bran	9.02	9.02	9.02	9.02	
Total	18.11^{d}	20.50^{c}	22.77^{b}	24.54^{a}	0.10*
OMI (g/day)					
UTMS	232.07^{a}	215.35^{b}	198.62^{c}	175.62^{d}	2.77*
B. aegyptiaca	-	82.47^{c}	162.03^{b}	234.55^{a}	0.58*
Maize bran	89.49	89.49	89.49	89.49	
Total	321.56^{d}	387.31^{c}	450.14^{b}	499.66^{a}	2.48*
NDFI (g/day)					
UTMS	187.88^{a}	174.34^{b}	160.80^{c}	142.18^{d}	2.24*
B. aegyptiaca	-	31.11^{c}	61.13^{b}	88.48^{a}	0.22*
Maize bran	26.88	26.88	26.88	26.88	
Total	214.76^{d}	232.33^{c}	248.80^{b}	257.54^{a}	2.13*
ADFI (g/day)					
UTMS	132.57^{a}	123.03^{b}	113.47^{c}	100.33^{d}	1.58*
B. aegyptiaca	-	24.30^{c}	47.74^{b}	69.11^{a}	0.17*
Maize bran	8.65	8.65	8.65	8.65	
Total	141.22^{d}	155.98^{c}	169.86^{a}	178.09^{a}	1.49*

Means with different superscript in the same row differ significantly (p<0.05)
*SEM = Standard error of mean, * = Significant at (p<0.05), UTMS = Urea treated maize stover, B. aegyptiaca = Balanites aegyptiaca, DMI = Dry matter intake, CPI = Crude protein intake, CFI = Crude fibre intake, EEI = Ether extract intake, OMI = Organic matter intake, NDFI = Neutral detergent fibre intake, ADFI = Acid detergent fibre intake*

3.2 Dry Matter and Nutrient Intake (DM Basis)

The stover DM intake ranged from 191.10 to 252.53 g/day. There were significant differences (P<0.05) between the treatments. Hirut et al. [21] stated that the lower basal diet DM intake in high level of supplementation could be attributed to the high intake of the supplement DM as a proportion of total dry matter intake, thus preventing maximum intake of the basal feed. The total DM intake for treatments A, B, C and D were 346.53, 420.37, 490.97 and 546.87 g/day respectively. The treatments were significantly different (P<0.05) from each other. The progressive increase in the value of the total DM intake from treatment A-D can be attributed to the increase in the amount of the supplement consumed. Wambui et al. [33] reported DM intake of 582.0 g/day for goats fed urea treated maize stover supplement with Tithonia foliage and 360 g/day for the control (urea treated maize stover), which are relatively higher than the values obtained.

Nutrient intake (DM basis) for the different treatments vary significantly (P<0.05). For stover nutrient intake, treatment A had the highest intake (obviously due to the high amount of the stover consumed). Treatment D had the highest *Balanites aegyptiaca* nutrient intake because it was offered the highest level of the supplement. For all parameters measured, the total nutrient intake increased with increase in the level of supplementation. Thus, treatment D had the highest total nutrient intake and treatment A had the lowest. Wambui et al. [8] reported 14.49 g/day as CP intake for goats fed urea sprayed maize stover, which is lower than 24.50 g/day obtained.

3.3 Nitrogen Utilization

Nitrogen intake increased as *Balanites aegyptiaca* level increased. There were no significant differences (P>0.05) between the treatments for nitrogen intake. Treatment D had the highest nitrogen intake of 13.70 g/day which is attributed to high total dry matter and crude protein intake. Abbator et al. [34] reported a range of 10.87-13.85 g/day for nitrogen intake in goats fed bovine rumen content and wheat offal as supplement to groundnut haulms, which is comparable to the range of 12.25 - 13.70 g/day obtained. Nitrogen in faeces (1.28 - 1.36 g/day) is similar to 1.42 - 1.56 g/day reported by Olomola et al. [35] in pregnant West African dwarf goats fed groundnut cake, urea and rumen epithelial wastes in cassava flour and citrus pulp–based diets. Treatment A had the lowest nitrogen excreted in faeces (1.28 g/day) which is attributed to the low amount of total nitrogen ingested when compared to other treatments. Ajibola [36] reported mean values of 1.73±0.78 and 1.74±0.72 g/day for urinary nitrogen in goats fed medium protein diet amidst limited water supply (70 and 50% reduction in water supply respectively) which is comparable to the values for nitrogen in urine obtained. There was an increase in nitrogen balance from treatment A (9.26 g/day) to treatment D (11.10 g/day) due to an increase in total nitrogen intake and utilization. Nitrogen balance is in agreement with the statement reported by Wambui et al. [33] that nitrogen retention increases if protein-tannin complexes are protected from rumen degradation but released further down the digestive tract and digested. Wambui et al. [33] reported a nitrogen balance of 4.44, 1.10 and 4.98 g/day for goat offered urea treated maize stover supplemented with Tithonia, Calliandra and Sesbania foliage respectively, which are lower to the values obtained. The nitrogen balance obtained (9.26 - 11.10 g/day) is relatively higher than 7.45 - 10.70 g/day [34] but lower than 15.01-15.84 g/day [35]. Treatment D had the highest nitrogen balance value (11.10 g/day).

3.4 Growth Performance

The average daily weight gain for treatments A, B, C and D were 23.75, 36.07, 46.43 and 54.29g respectively. There were significant differences (P<0.05) between treatments. Wambui et al. [8] reported an average daily weight gain of 20.9 g/day for animals in the control (4% urea treated maize stover), which is lower than 23.75 g/day obtained for the control in this study. For feed conversion ratio, treatment D was had the best ratio and treatment A had the least which is attributed to the absence of supplement.

3.5 Rumen Ammonia Concentration and pH

The rumen ammonia concentration levels obtained (2.41 - 5.78 and 3.87 - 6.96 mg/100 ml) before and after feeding respectively are similar to 2.6-7.96 mg/100 ml reported by Lindela and Lewis [37]. A minimum ammonia-nitrogen level of 2 - 5 mg/100 ml rumen fluid has been suggested to maximize rumen microbial synthesis [38], which fell in the range of values obtained. As the level of the supplement was increased, the level of rumen ammonia increased. Higher rumen ammonia levels were obtained after the animals were fed. There were significant differences (P<0.05) between the treatments for rumen ammonia concentration both before and after feeding. Treatment D had the highest values for rumen ammonia concentration both before and after feeding.

Rumen pH was within the optimal range of 6.0 - 7.0 for cellulolytic bacterial activity as reported by Hespell and Bryant [39]. The rumen pH was slightly affected by supplementation and it was maintained within a narrower range both before and after feeding (6.14 - 6.78 and 7.05 - 7.52 respectively). The values were in the range of 6.14 and 7.52, which is considered optimal for microbial activity and growth as observed by Muia [40], who reported an overall pH mean of 6.7 in steers fed different crude protein content of napier-based diets. Lindela and Lewis [37] reported a rumen pH of 6.41-6.73 for goats fed mature veld hay ground with deep litter poultry manure and supplemented with graded levels of poorly managed groundnut hay, which is similar to the range of 6.14 - 6.78 obtained before the animals were fed. pH levels obtained before feeding are also similar to 6.45±0.34 and 6.13±0.36 reported by Darlis et al. [41] for goats fed rice straw supplemented with soybean meal and soybean meal+sago meal respectively. The pH values obtained before (6.14 - 6.78) and after (7.05 - 7.52) feeding are comparable to 6.69 - 6.89 (before feeding) and 7.04 - 7.19 (after feeding) reported by Wambui et al. [33]. There were significant differences (P<0.05) between the treatments for rumen pH before feeding but no significant difference (P>0.05) was observed for rumen pH after feeding. Treatment D had the highest values for rumen pH both before and after feeding, which is attributed to greater microbial activity.

Table 3. Nitrogen utilization of red sokoto goats offered graded levels of *Balanites aegyptiaca* and urea treated maize stover

Parameters	Treatments				
	A	**B**	**C**	**D**	**SEM**
Nitrogen intake (g/day)	12.25^{a}	12.97^{a}	13.43^{a}	13.70^{a}	0.51^{NS}
Nitrogen in faeces (g/day)	1.28^{a}	1.31^{a}	1.34^{a}	1.36^{a}	0.14^{NS}
Nitrogen in urine (g/day)	1.71^{a}	1.60^{a}	1.53^{a}	1.24^{a}	0.16^{NS}
Nitrogen balance (g/day)	9.26^{c}	10.06^{bc}	10.56^{ab}	11.10^{a}	0.14*

Means with different superscript in the same row differ significantly (p<0.05)
SEM = Standard error of mean
*^{NS} = Not Significant; * = Significant at (p<0.05)*

Table 4. Growth performance of red sokoto goats offered graded levels of *Balanites* aegyptiaca and urea treated maize stover

Parameters	Treatments				
	A	**B**	**C**	**D**	**SEM**
Initial live weight (Kg)	10.10	9.68	9.10	8.56	0.46
Final live weight (Kg)	11.43	11.70	11.70	11.60	0.48
Total weight gain (Kg)	1.33^{b}	2.02^{ab}	2.60^{a}	3.04^{a}	0.21*
Daily weight gain (g)	23.75^{c}	36.07^{b}	46.43^{ab}	54.29^{a}	3.73*
Feed conversion ratio	14.59^{c}	11.65^{b}	10.57^{a}	10.07^{a}	1.94*

Means with different superscript in the same row differ significantly (p<0.05)
SEM = Standard error of mean
*^{NS} = Not Significant; * = Significant at (p<0.05)*

Table 5. Effect of feeding graded levels of *Balanites aegyptiaca* and urea treated maize stover on rumen ammonia concentration and rumen pH in red sokoto goats

Parameters		Treatments				
		A	**B**	**C**	**D**	**SEM**
Rumen ammonia (mg/100 ml)	BF	2.41^{c}	4.13^{b}	5.02^{a}	5.78^{a}	0.15*
Rumen ammonia (mg/100 ml)	AF	3.87^{c}	5.54^{b}	6.03^{b}	6.96^{a}	0.11*
Rumen pH	BF	6.14^{b}	6.35^{ab}	6.51^{ab}	6.78^{b}	0.15*
Rumen pH	AF	7.05^{a}	7.40^{a}	7.43^{a}	7.52^{a}	0.08^{NS}

Means with different superscript in the same row differ significantly (p<0.05)
SEM = Standard error of mean
*^{NS} = Not Significant; * = Significant at (p<0.05);*
BF = Before feeding; AF = (4 hours) After feeding

4. CONCLUSION

The use of *Balanites aegyptiaca* as a supplement for urea treated maize stover greatly improve the total dry and nutrients intake, average daily gains, nitrogen utilization rumen ammonia concentration and rumen pH. *Balanites aegyptiaca* has the potential to be used as a protein supplement and could be utilized for supplementing cereal crop residues and low quality roughages.

COMPETING INTERESTS

Author has declared that no competing interests exist.

REFERENCES

1. Acharya SN, Iwaasa AD, McAllister TA, Wang Y, Thomas J. Animal performance and incidence of bloat in mixed Affalfa/sanifoin grazing; Plant Canada 2011, saint Mary' suniversity, Halfax NS, Canada. July 17; 2011.
2. Haumesser JB. Some aspects of reproduction in the Red Sokoto goat. Comparison with other tropical and subtropical breeds. REMVT. 1975;28:225–233.
3. Tona GO, Ogunbosoye DO, Bakare BA. Growth performance and nutrient digestibility of West African Dwarf goats fed graded levels of *Moringa oleifera* leaf meal. International Journal of Current Microbiology and Applied Sciences. 2014; 3(8):99-106.
4. Aina AB, Yusuf AO, Sogbade LA, Sowande OS. Evaluation of different combination of palm kernel cake and cotton seed cake based diet on the performance of WAD goats. Nigerian Journal Animal Production. 2002;29(2): 189-194.
5. Ajeigbe HA, Singh BB, Musa A, Tarawali SA. Effect of feeding crop residues of different cereals and legumes on weight gain of Yankasa rams. International Journal of Livestock Production. 2011;2(2): 17-23.
6. Preston TR, Leng RA. Matching ruminant production systems with available resources in the Tropics and Sub-tropics. Penambul Books, Armidale. 1987;245.
7. Oni AO, Arigbede OM, Oni OO, Onwuka CFI, Anele UY, Oduguwa BO, Yusuf KO. Effects of feeding different levels of dried cassava leaves (*Manihot esculenta*, Crantz) based concentrates with *Panicum maximum* basal on the performance of growing West African Dwarf goats. Livestock Science. 2010;129(2010):24–30.
8. Wambui CC, Abdulrazak SA, Noordin Q. Performance of growing goats fed urea sprayed maize stover and supplemented with graded levels of *Tithonia diversifolia*. Asian-Australian Journal of Animal Science. 2006;19(7):992-996.
9. Aganga AA, Tshwenyane SO. Feeding values and Anti-nutritive factors of forage tree legumes. Pakistan Journal of Nutrition. 2003;2(3):170-177.
10. Mbah JM, Retallick SJ. Vegetative propagation of *Balanites aegyptiaca* (L.) Del. Commonwealth Forestry Review. 1992;71(1)52-56.
11. Nuclear Regulatory Commission [NRC]. Lost crops of Africa: Volume III: Fruits. Development, security and cooperation policy & global affairs. National academies press, Washington, DC. 2008;380.
12. Hall JB. Ecology of a key African multipurpose tree species *Balanites aegyptiaca*: (Balanitaceae): The state-of-knowledge. Forest ecology and management. 1992;50:1-30.
13. Orwa C, Mutua A, Kindt R, Jamnadass R, Anthony S. Agro-forestry database: A tree reference and selection guide version 4.0. World Agroforestry Centre, Kenya; 2009.
14. Elseed AMAF, Amin AE, Khadiga, Ati AA, Sekine J, Hishinuma M, Hamana K. Nutritive evaluation of some fodder trees during the dry season in Central Sudan. Asian-Australian Journal of Animal Science. 2002;15(6):844-850.
15. Adebayo AA, Tukur AL. Mean annual rainfall: Adamawa state in maps. 1st Edition. Paraclete publishers, Yola. Nigeria. 1999;23-25.
16. Association of Official Analytical Chemists [AOAC]. Official methods of analysis of AOAC International. 18th Edition, AOAC International, Gaitherburg. 2011;2590.
17. Van Soest PJ, Robertson JB, Lewis BA. Methods of dietary fibre, neutral detergent fibre and non-starch polysaccharides in relation to animal nutrition. Journal of Dairy Science. 1991;74:3583-3597.
18. Steel RGD, Torrie JH. Principles and procedures of statistics: A biometrical approach, 2nd Edn. McGraw-Hill, New York, NY. 1980;633.

19. Duncan DB. Multiple biometrics. 1955;1:1-42.
20. Tesfaye A, Pornsri C, Pravee V, Sayan T. The potential of urea treated maize stover for growth performance of weaned crossbred calves. Kasetsart Journal of National Science. 2005;39(2005):638-646.
21. Hirut Y, Solomon M, Mengistu U. Effect of concentrate supplementation on live weight change and carcass characteristics of Hararghe Highland sheep fed a basal diet of urea-treated maize stover. Livestock Research for Rural Development. 2011; 23(12).
22. Njidda AA, Ikhimioya I. Nutritional evaluation of some semi-arid browse forages leaves as feed for goats. European Journal of Applied Sciences. 2010;2(3): 108-115.
23. Mlay PS, Pereka AE, Balthazary ST, Phiri ECJ, Hvel plund T, Weisbjerg, MR, Madsen J. The effect of maize bran or maize bran mixed with sunflower cake on the performance of smallholder dairy cows in urban and peri-urban area in Morogoro, Tanzania. Livestock Research for Rural Development. 2005;17(1).
24. Abbator FI, Kibon A. Digestibility and voluntary intake of some browse plants fed to sheep in semi-arid region of Nigeria. Journal of Arid Agriculture. 1999;9:115-119.
25. Norton BW. The nutritive value of tree legumes. In: Gutteridge RC, Shelton HM. (Eds.), Forage trees legumes in Tropical Agriculture. Tropical Grassland Society of Australia Inc., St Lucia Queensland; 1998.
26. Egbu CF. Effect of feeding urea treated maize stover and *centrosema pubescens* on grazing N'dama calves. Msc thesis, A project submitted to the Department of Animal Science, Faculty of Agriculture, University of Nigeria, Nsukka. 2014;43-46.
27. Kamal AN, Nour A. Nutritive value and dry matter disappearance of Sudanese Acacia browse leaves in goat nutrition. World's Veterinary Journal. 2016;6(2):46-52.
28. Yahaya MB, Kibon A. Effect of supplementation and voluntary feed intake in Red Sokoto goats offered a basal diet of treated maize stover. International Journal of Agriculture and Bioscience. 2013;2(1): 30-34.
29. Heuzé V, Tran G, Sauvant D, Lebas F. Maize bran and hominy feed. Feedipedia, a programme by INRA, CIRAD, AFZ and FAO; 2016. Available:http://www.feedipedia.org/node/712
30. Bello AA, Tsado DN. Feed intake and nutrient digestibility of Yankasa rams fed sorghum stover supplemented with graded levels of dried poultry droppings based diet. Asian Journal of Animal Sciences. 2013;7(2):56-63.
31. Lepanga KO, Ebong C, Opuda-Asibo J. Growth performance and feed utilization by intact male Mubende goats fed various supplements with elephant grass (*Pennisetum purpureum*) as basal diet in Uganda. Journal of Animal and Veterinary Advances. 2009;8(10):1999-2003.
32. Ondiek JO, Abdulrazak SA, Njoka, EN. Chemical and mineral composition, in-vitro gas production, in-sacco degradation of selected indigenous Kenyan browses. Livestock Research for Rural Development. 2010;22(2).
33. Wambui CC, Abdulrazak SA, Noordin Q. The effect of supplementing urea treated maize stover with Tithonia, Calliandra and Sesbania to growing goats. Livestock Research for Rural Development. 2006; 18(5).
34. Abbator FI, Kolo UM, Taimako ARM, Kwaghe AL. Performance of goats fed bovine rumen content and wheat offal as supplement to groundnut haulms. Global Journal of Agricultural Research. 2016; 4(1):9-16.
35. Olomola OO, Babayemi OJ, Akinsoyinu AO. Performance characteristics and nitrogen utilization of pregnant West African dwarf goats fed groundnut cake, urea and rumen epithelial wastes in cassava flour and citrus pulp-based diets. Tropical and Subtropical Agroecosystems. 2008;8(1):61-67.
36. Ajibola A. Nitrogen retention and water balance in animals fed medium protein diet amidst limited water supply. African Journal of Biomedical Research. 2006;9: 225-228.
37. Lindela RN, Lewis H. Intake, digestion and rumen parameters of goats fed mature veld hay ground with deep litter poultry manure and supplemented with graded levels of poorly managed groundnut hay. Livestock Research for Rural Development. 1995;6(3).
38. Salter LD, Syltter LL. Effect of ammonia concentration on rumen microbial protein production *in vitro*. British Journal of Nutrition. 1974;32:199-208.

39. Hespell RB, Bryant MP. Efficiency of rumen microbial growth: Influence of some theoretical and experimental factors of YATP. Journal of Animal Science. 1979; 49(6):1640–1659.
40. Muia JMK. Use of napier grass to improve small holder milk production in Kenya. Ph.D. Thesis, Wageningen Agricultural University. 2000;17-56.
41. Darlis D, Abdullahi N, Halim RA, Jalaludin S, Ho YW. Rumen parameters and urea kenetics in goats and sheep. Asian Australian Journal of Animal Sciences. 2000;13(7)922-928.

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