Asian Research Journal of Agriculture

6(2): 1-9, 2017; Article no.ARJA.36076
ISSN: 2456-561X

Growth Performance and Nutrient Digestibility of Red Sokoto Goats Fed Urea Treated Maize Stover Supplemented with Graded Levels of *Balanites aegyptiaca* Leaf Forage

A. J. Hyelda[1*], M. M. Yahya[1] and Z. A. Gworgwor[1]

[1]Department of Animal Science and Range Management, Modibbo Adama University of Technology, P.M.B. 2076, Yola, Adamawa State, Nigeria.

Authors' contributions

This work was carried out in collaboration between all authors. Author AJH designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors MMY and ZAG managed the analyses of the study. Author AJH managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/ARJA/2017/36076
Editor(s):
(1) Jose E. Celis, Department of Animal Science, Facultad de Ciencias Veterinarias, Universidad de Concepcion, Chile.
Reviewers:
(1) Marco Ferretti, University of Pisa, Italy.
(2) Arbab Sikandar, University of Veterinary and Animal Sciences, Lahore, Sub campus, Pakistan.
Complete Peer review History: http://www.sciencedomain.org/review-history/20785

Original Research Article

Received 11th August 2017
Accepted 30th August 2017
Published 2nd September 2017

ABSTRACT

Sixteen Red Sokoto male goats weighing on average 9.36±0.67 Kg were used for the experiment in a completely randomised design (CRD) for a duration of 12 weeks to determine the total feed intake, weight gain and apparent nutrient digestibility coefficients. The treatments were; A (control): the basal diet (maize stover treated with 4% urea) plus 100 g maize bran, B: control diet plus 100 g *Balanites aegyptiaca*, C: control diet plus 200 g *Balanites aegyptiaca* and D: control diet plus 300 g *Balanites aegyptiaca*. All animals were allowed ad libitum access to water and mineral lick. $p<0.05$ was considered as level of significance. Supplementing urea treated maize stover with *Balanites aegyptiaca* resulted in increased ($p<0.05$) total dry matter (DM) intake from 346.12 g/day (control), to 423.73 g/day (treatment B), 488.54 g/day (treatment C) and 536.81 g/day (treatment D). Supplementation increased ($p<0.05$) daily weight gain. Treatment D recorded the highest value of

**Corresponding author: E-mail: hyeldajohn@gmail.com;*

52.00 g/day. Apparent DM digestibility increased (p<0.05) with supplementation with treatment D having the highest value of 74.32%. Nutrient digestibility also increased (p<0.05) with treatment D supplemented group having the highest values for all the parameters recorded.

Keywords: Balanites aegyptiaca; weight gain; goats; intake; digestibility; basal diet.

1. INTRODUCTION

Crop residues represent a high proportion of total feed for herbivorous animals. They are characterised by high content of fibre usually above 40%, low content of nitrogen (0.3-1.0%) and low content of essential minerals such as sodium, phosphorus and calcium [1]. Preston and Leng [2] also observed that crop residues especially cereal types are characterised by low nutrient content and digestibility and poor voluntary consumption by ruminant animals. The consequences for ruminant animals are low feed intake (about 1.2 kg DM/100 kg live weight) and low performance [1]. Maize residues in particular is low in protein, that vary from 2.3% [3] to 7.1% [4] and, therefore, requires supplementation. Treatment of the stover before feeding may be necessary to improve stover utilisation by animals [4].

Tree legumes and shrubs that persist during the dry season when pasture is either scarce or of poor quality have been extensively used to provide protein rich forage for ruminant production in Asia, Africa and pacific Islands [5]. Tree fodders (browse plants) are important in providing nutrients to grazing ruminants in arid and semi-arid environments, where feed supply is a major constraint to livestock production [6]. They are less susceptible to climatic fluctuation since they are tree or perennial shrubs and they remain green all year round [7]. Browse plants maintain higher protein and mineral contents during growth than do grasses, which decline rapidly in quality with progress to maturity [8]. Also, browse plants tend to have low crude fibre than grasses harvested at the same time [9].

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 [10]. According to Hall [11], 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 [10]. *Balanites aegyptiaca* could contribute up to 38% of the dry matter intake of goats in the dry season [12]. It is also a good source of degradable protein though it needs mineral supplementation [13] since it is poor in phosphorus and copper [14].

The study was designed to determine the dry matter intake, weight gain and apparent nutrient digestibility coefficients 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℃ particularly in April, while minimum temperature can be as low as 18℃. Annual rainfall is less than 1000 mm [15].

2.2 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. The leaves from the browse plant were collected by lopping the branches. The lopped branches were sun-dried for 2 days. The branches were then shaken to remove the leaves. 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 2-4cm before treatment with 4% urea (purchased from the market) 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 (in order to absorb more heat) 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 on average 9.36±0.67 Kg 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 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 offered in the morning before the basal diet was offered. Feed refusals were collected and weighed in the morning before fresh diet was offered. Salt licks and fresh water were provided *ad libitum*. The goats were weighed weekly so as to determine the weight gain. The experiment lasted for 12 weeks in which there was 2 weeks of adaptation period and 2 weeks of digestibility experiment.

2.6 Data Collection

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.

Weight gain of each animal was determined by subtracting the initial weight of the animal from the final weight of the animal. Daily weight gain was obtained by dividing total weight gain by the number of days of the collection period.

Feed conversion ratio was obtained by dividing daily dry matter intake by daily weight gain.

2.7 Digestibility Experiment

The digestibility study was conducted during the last 14 days of the feeding trial. Two animals from each treatment were confined in separate pens for the 14 days period. Adaptation period lasted for seven days and collection period for seven days. Daily feed intake and faecal output for each animal were collected, weighed and recorded.

2.8 Chemical Analysis

The proximate composition of the experimental feeds and faeces were determined following standard methods [16]. Neutral detergent fibre (NDF) and acid detergent fibre (ADF) were determined by the method of [17]. Data collected were used to compute the apparent digestibility coefficients, using the formula: (nutrient in feed - nutrient in faeces/nutrient in feed x 100).

2.9 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 [18]. Treatment means were separated using Duncan's multiple range test (DMRT) [19].

3. RESULTS AND DISCUSSION

3.1 Proximate Composition of Experimental Diets

The proximate composition of the experimental diets is shown in Table 1. The dry matter content obtained for urea treated maize stover (91.0%) is comparably higher than 65.47% reported by [20] but lower than 95.6% reported by [21]. Wambui et al. [22] reported a dry matter value of 45.68% for urea sprayed maize stover, which is also lower than the value obtained in this study. The dry matter content recorded for *Balanites aegyptiaca* (92.5%) is lower than the value 955.00 g/KgDM (95.5%) reported by [23]. Heuzé and Tran [24] compiled a dry matter content of 94.0% on average for *Balanites aegyptiaca*, which is similar to the value obtained. Maize bran had a dry matter content of 94.0%, which is higher than the value (91.5%) reported by [25]. The crude protein content for urea treated maize stover (9.7%) is higher than the value (5.09%) reported by [22] but lower than 15.40% reported by [20]. [21] reported a crude protein value of 7.67% for urea treated maize stover, which is lower than the value obtained in this study. *Balanites aegyptiaca* had a crude protein content of 11.9%, which is lower than 15.0% reported by [26]. LeHouerou [27] reported a mean crude protein value of 12.5% in West African browse species, which is relatively higher than the value obtained in this study. Generally, the crude protein content in browses has been shown to be above the minimum level (7%) required for microbial activities in the rumen [28]. The crude protein content of maize bran obtained in this study (10.3%) is similar to 10.9% reported by [25] and relatively higher than 9.6% reported by [29].

Egbu [30] reported a crude fibre content of 27.03% for a 50:50 mixture of *Centrocema pubescens* and urea treated maize stover, which is similar in value (28.0%) to the crude fibre content for urea treated maize stover obtained in this study. Similarly, Yahaya and Kibon [31] reported a crude fibre content of 14.00%, which is very low when compared to the value obtained. Kamal and Nour [32] reported 17.33% as crude fibre content for *Balanites aegyptiaca*, which is lower than 20.0% obtained in this study. Yahaya and Kibon [31] reported a crude fibre content of 31.21% for maize bran, which is much higher than 7.5% obtained in this study.

Ash content obtained for urea treated maize sover (8.1%) is similar to 7.92% reported by [20] but lower than 11.35% reported by [31]. The ash content obtained for *Balanites aegyptiaca* (10.4%) is lower than 15.0% reported by [32] but higher than 65.00 g/KgDM (6.5%) reported by [23]. Bello and Tsado [33] reported an ash content of 5.50% for maize bran, which is lower than 8.1% obtained. 3.6% ether extract content obtained for urea treated maize stover is lower than 5.00% reported by [33] but higher than 2.15% reported by [22]. Yahaya and Kibon [31] also reported a higher ether extract content of 7.13% for 4% urea treated maize stover. Kamal and Nour [32] reported an ether extract content of 6.15% for *Balanites aegyptiaca*, which is higher than 3.3% obtained. Similarly, the ether extract content obtained fell in the range of 2 - 5% reported by [34] for different browse plants. Lepanga et al. [35] reported 82.0 g/KgDM (8.2%) as ether extract content for maize bran, which is lower than 9.6% obtained. The nitrogen free extract obtained for urea treated maize stover (41.6%) is lower than 58.69% reported by [31]. Njidda and Ikhimioya [23] reported a nitrogen free extract content of 581.80 g/KgDM (58.18%), which is higher than the content (46.9%) obtained. Yahaya and Kibon [31] reported a nitrogen free extract content of 44.30% for maize bran which is lower than 61.8% obtained.

Tesfaye et al. [20] reported a neutral detergent fibre content of 76.15% for urea treated maize stover, which is comparable to the value 74.4% obtained. The neutral detergent fibre obtained for *Balanites aegyptiaca* (33.8%) is lower than 44.6% reported by [36], similar to 349 g/KgDM (34.9%) reported by [37] and higher than 222 g/KgDM (22.2%) reported by [13] for leaves collected in early dry season. [35] reported a neutral detergent fibre of 189.1 g/KgDM (18.91%) for maize bran, which is lower when compared to the value (28.6%) obtained. Acid detergent fibre content obtained for urea treated maize stover (52.5%) is higher than 44.58% reported by [22], similar to 53.6% reported by [21] and lower than 69.10% reported by [38]. Acid detergent fibre obtained for *Balanites aegyptiaca* (26.4%) is lower than 401.10 g/KgDM (40.11%) reported by [23] but similar to 257 g/KgDM (25.7%) reported by [13] for leaves collected in late dry season. Lepanga et al. [35] reported 103.9 g/KgDM (10.39%) as acid detergent fibre content for maize bran, which is relatively higher than 9.2% obtained. The organic matter content for urea treated maize stover obtained in this study (91.9%) is comparable to 93.72% reported by [22]. 89.6% organic matter content obtained for *Balanites aegyptiaca* is relatively higher than 867 g/KgDM (86.7%) reported by [37] but similar to 903 g/KgDM (90.3%) and 897 g/KgDM (89.7%) reported by [13] for leaves collected in early and late dry season respectively. Mlay et al. [25] reported a similar organic matter content (94.9%) for maize bran when compared to 95.2% obtained in this study.

3.2 Feed Intake and Growth Performance

Table 2 shows the feed intake and growth performance of Red Sokoto goats fed the different experimental diets. The stover intake was different (P<0.05) between the treatments. Animals on treatment A had relatively higher Stover intake (252.12 g/day) than the rest of the treatments (238.88, 216.09 and 185.89 g/day for treatments B, C and D respectively). Supplementation with *Balanites aegyptiaca* increased (P<0.05) the total feed intake. For treatments A, B, C and D; 346.12, 423.73, 488.54 and 536.81 g/day were obtained respectively for total feed intake. The grading of the supplement offered influenced the total feed intake and thus, treatment A that was not offered supplement recorded the lowest total feed intake (346.12 g/day) and treatment D that was offered the highest level of the supplement (300 g) recorded the highest total feed intake (536.81 g/day). Wambui et al. [22] reported 286.7 g/day as stover intake for animals in the control diet (urea sprayed maize stover), which is relatively higher than the value for the control (treatment A) in this study.

Total weight gain, average daily weight gain and feed conversion ratio were positively affected by supplementation. The average daily weight gain for treatments A, B, C and D were 26.14, 36.29, 44.88 and 52.00 g respectively. There were significant differences (P<0.05) between treatments. Wambui et al. [22] reported an average daily weight gain of 20.9 g/day for animals in the control (4% urea treated maize stover), which is lower when compared to the value for the control. The control group (treatment A) was the least in feed conversion ratio when compared to other treatments which can be attributed to the absence of supplement.

Table 1. Chemical composition of experimental diets (%DM)

Samples	UMS	UTMS	*B. aegyptiaca*	Maize bran
Dry matter	94.5	91.0	92.5	94.0
Crude protein	3.5	9.7	11.9	10.3
Crude fibre	36.0	28.0	20.0	7.5
Ash	6.6	8.1	10.4	4.8
Ether extract	3.2	3.6	3.3	9.6
Nitrogen free extract	45.2	41.6	46.9	61.8
Organic matter	93.4	91.9	89.6	95.2
Neutral detergent fibre	77.3	74.4	33.8	28.6
Acid detergent fibre	39.2	52.5	26.4	9.2

UMS = untreated maize stover; UTMS = Urea treated maize stover
B. aegyptiaca = Balanites aegyptiaca

Table 2. Performance characteristics of Red Sokoto goats fed graded levels of *Balanites aegyptiaca* leaf forage (BAL) and urea treated maize stover

Parameters	Treatments				
	A (0 g BAL)	B (100 g BAL)	C (200 g BAL)	D (300 g BAL)	SEM
Dry matter (DM) intake (g/day)					
Urea treated maize stover	252.12^{a}	238.88^{a}	216.09^{b}	185.89^{c}	4.73*
Balanites aegyptiaca	-	90.85^{c}	178.45^{b}	256.92^{a}	0.97*
Maize bran	94	94	94	94	
Total DM intake (g/day)	346.12^{d}	423.73^{c}	488.54^{b}	536.81^{a}	4.95*
Growth performance					
Initial live weight (Kg)	10.10	9.68	9.10	8.56	0.46
Final live weight (Kg)	11.93	12.22	12.24	12.20	0.49
Total weight gain (Kg)	1.83^{b}	2.54^{ab}	3.14^{a}	3.64^{a}	0.23*
Daily weight gain (g)	26.14^{c}	36.29^{b}	44.88^{ab}	52.00^{a}	3.74*
Feed conversion ratio	13.24^{c}	11.67^{b}	10.89^{a}	10.32^{a}	1.84*

Means with different superscript in the same row differ significantly (p<0.05)
*SEM = Standard error of mean; * = Significant at (p<0.05)*

Table 3. Apparent nutrient digestibility of Red Sokoto goats fed urea treated maize stover and graded levels of *Balanites aegyptiaca* leaf forage (BAL)

Digestibility (%)	Treatments				
	A (0 g BAL)	B (100 g BAL)	C (200 g BAL)	D (300 g BAL)	SEM
Dry matter	58.67^d	67.19^c	71.90^b	74.32^a	0.07*
Crude protein	76.59^d	81.09^c	83.90^b	85.68^a	0.11*
Crude fibre	87.14^d	89.02^c	89.88^b	90.70^a	0.09*
Ash	75.97^d	81.85^c	85.30^b	88.35^a	0.18*
Ether extract	66.32^c	73.16^b	73.65^b	75.14^a	0.12*
Organic matter	70.77^d	75.73^c	79.12^b	81.89^a	0.15*
Neutral detergent fibre	85.85^b	86.01^b	86.90^a	87.15^a	0.19*
Acid detergent fibre	86.90^d	87.69^c	88.70^b	89.33^a	0.11*

Means with different superscript in the same row differ significantly (p<0.05)
*SEM = Standard error of mean; * = Significant at (p<0.05)*

3.3 Apparent Nutrient Digestibility

The results of the apparent nutrient digestibility coefficient in Table 3 above showed significant differences (P<0.05) between the treatments. Treatment D had the highest values for all the parameters observed. Digestibility for dry matter ranged from 58.67 to 74.32%. [39] reported a mean dry matter digestibility of 63.94±10.33 and 62.14±11.27% for Nubian and Desert goats respectively fed different energy/protein levels, which fell within the range obtained. The values obtained for crude protein digestibility are higher than 60.4-77.4% reported by [20]. Tona et al. [40] reported a crude fibre digestibility which ranged from 66.13 to 74.80% for West African dwarf goats fed graded levels of *Moringa oleifera* leaf meal, which is comparably lower to the range 87.14 to 90.70% obtained. Ash digestibility (75.97-88.35%) is comparable to 67.0-87.8% reported by [33] for Yankasa rams fed sorghum stover supplemented with graded levels of dried poultry droppings based diet. Tona et al. [40] also reported similar values of 79.53-90.80% for ash digestibility. When compared to 66.32-75.14% obtained in this study, [41] reported a similar ether extract digestibility of 63.70-78.80% for West African dwarf goats fed foliage combinations of *Moringa oleifera* and *Gliricidia sepium* with equal proportions of a low-cost concentrate. Organic matter digestibility obtained (70.77- 81.89%) is similar to 78.07-80.47% reported by [40]. Values obtained for neutral detergent fibre and acid detergent fibre digestibility (85.85-87.15% and 86.90-89.33% respectively) are higher when compared to 56.6-64.3% and 39.2-56.5% reported by [42] for neutral detergent fibre and acid detergent fibre respectively. Tona et al. [40] reported 26.27-34.12% neutral detergent fibre digestibility and 15.38-24.11% acid detergent fibre digestibility, which are lower to the values obtained. Nutrient digestibility in animals is the classical and direct method for estimating feed digestion by ruminants; hence studies on digestibility of ruminant feeds are very important as they allow for the estimation of nutrients actually available for ruminant nutrition [43].

4. CONCLUSION

The use of *Balanites aegyptiaca* as a supplement for urea treated maize stover greatly improve the total intake, apparent nutrient digestibility and average daily weight gain of goats. Therefore, *Balanites aegyptiaca* has potential as a protein supplement and could be utilized when feeding goats with low quality basal diets. Supplementation of urea treated maize stover with 300 g of the *Balanites aegyptiaca* gave the best output.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Adegbola TA. Sustainable ruminant production for human nutrition and national development. Inaugural lecture series No.7. University inaugural lecture delivered on 21st January, at A.T.B.U Bauchi, Nigeria; 1998.
2. Preston TR, Leng RA. Matching ruminant production systems with available resources in the tropics and sub-tropics. Penambul Books, Armidale. 1987;245.

3. Kabatange MA, Shayo CM. Rumen degradation of maize stover as influenced by Leucaena hay supplementation. Livestock Research and Rural Development. 1991;3(2).
4. Woyengo TA, Gachuiri CK, Wahome RG, Mbugua PN. Effect of supplementation and urea treatment on utilization of maize stover by Red Maasai sheep. South African Journal of Animal Science. 2004;34(1):23-30.
5. Norton BW. Tree legumes as dietary supplements for ruminants. In: Tropical Tree Legumes in Tropical Agriculture (Ed. R. C. Gutteridge and H. M. Shelton). CAB International, UK. 994;177-201.
6. Aganga AA, Tshwenyane SO. Feeding values and anti-nutritive factors of forage tree legumes. Pakistan Journal of Nutrition. 2003;2(3):170-177.
7. Dzowela BH, Hove I, Topps SH, Matongoya PL. Nutritional and anti-nutritional characters and rumen degradability of dry matter and nitrogen for some multipurpose tree species with potential for agro-forestry in Zimbabwe. Animal Feed Science and Technology. 1995;55:207-215.
8. Shelton HM. The importance of silvopastroal systems in rural livelihoods to provide ecosystem services. Proc. of the 12th International Symposium on Silvopastoral Systems. In: Marnietje L, Ramirez L, Ibrahim M, Sandoval C, Ojeda N, Ku J, (eds). Universidad Antronoma de Yucatan, Merida, Yucatan, Mexico. 2004;158-174.
9. Mecha I, Adegbola TA. Chemical composition of some southern Nigeria forage eaten by goats, In: Le Houerou HN, (eds). Browse in Africa, the current state of knowledge. ILCA, Addis Ababa. 1985;261-289.
10. 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.
11. 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.
12. 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.
13. 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.
14. Mtui DJ, Lekule FP, Shem MN, Hayashida M, Fujihara T. Mineral concentrations in leaves of nine browse species collected from Mvomero, Morogoro, Tanzania. Journal of Food and Agricultural Environment. 2008;6(3-4):226-230.
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. 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.
23. 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.
24. Heuzé V, Tran G. Desert date (*Balanites aegyptiacus*). Feedipedia, a Programme by INRA, CIRAD, AFZ and FAO; 2015. Available:http://feedipedia.org/node/181
25. 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).
26. 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.
27. Le Houerou HN. Chemical composition and nutritive value of browse in West Africa. In: Browse in Africa, the Current State of Knowledge. International Livestock Centre for Africa, Addis Ababa. 1980;261-289.
28. 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.
29. Munthali JTK, Jayasuriya CN, Bhattachrya AN. Effects of urea treatment of maize stover and supplementation with maize bran or urea molasses block on the performance of growing steers and heifers. The complimentarity of feed resources for animal production in Africa. Proceedings of the Joint Feed Resources Networks Workshop, Gaborone, Botswana, 4-8 March 1991. (Stares JES, Said AN, Kategile, JA. Eds.), ILCA, Addis Ababa. 1992;279-286.
30. 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.
31. 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.
32. 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.
33. 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.
34. Njidda AA. Chemical composition, fibre fraction and anti-nutritional substances of semi-arid browse forages of North-Eastern Nigeria. Nigerian Journal of Basic and Applied Science. 2010;18(2):181-188.
35. 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.
36. Belete S, Hassen A, Assafa T, Amen N, Ebro A. Identification and nutritive value of potential fodder trees and shrubs in the mid rift valley of Ethiopia. Journal of Animal and Plant Sciences. 2012;22(4): 1126-1132.
37. 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).
38. 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).
39. Elamin KM, Tameem Eldar AA, Amin AE, Abdalla FS, Hassan HE. Digestibility and nitrogen balance of Sudan goat ecotypes fed different energy/protein levels. Asian Journal of Animal Sciences. 2012;6:230-239.
40. 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.
41. Olusegun JO, Vincent OA, Simisola MO. Nutrient digestibility and growth performance of West African Dwarf (WAD) goats fed foliage combinations of *Moringa oleifera* and *Gliricidia sepium* with equal

proportions of a low-cost concentrate. Journal of Natural Sciences Research. 2016;6(18).

42. 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;129:24–30.

43. Okoruwa MI, Igene FU, Isika MA. Replacement value of cassava peels with rice husk for guinea grass in the diet of West African dwarf sheep. Journal of Agricultural Science. 2012;4(7):254–261.

Peer-review history:
The peer review history for this paper can be accessed here:
http://sciencedomain.org/review-history/20785