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Response of growing Yankasa rams to stover-based diets containing different nitrogen sources with *Balanites aegyptiaca* (Desert Date) leaf powder as rumen buffer

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Target Audience: *Animal nutritionists, extension agents, ruminant animal farmers*

Abstract

The study was conducted to evaluate the response of growing Yankasa rams to complete sorghum stover-based diets containing varying levels of different nitrogen sources with Balanites aegyptiaca leaf powder as rumen buffer, on nutrient intake, growth performance and economics of production. Twenty growing Yankasa rams used for the experiment were randomly allocated to five treatment groups of four rams each in a completely randomized designed. Complete diets containing 16% CP were prepared for the experiment. Urea was incorporated into the respective diets at 0, 0.5, 1, 1.5 and 2% vis-à-vis cottonseed cake at 20, 15, 10, 5 and 0% and designated as diet 1, 2, 3, 4, and 5, respectively. Rams were fed experimental diets and water ad-libitum. The result of the experiment revealed significantly (P<0.05) higher dry matter intake in rams fed diets 2 and 3 (1097.55 and 1090.78 g/day), while diet 4 rams had the least (902.56 g/day). Higher daily weight gain 155.57 g/day and better feed conversion ratio of 7.01 were obtained in rams fed diets 3 while the least (81.43 g/day and 11.08) in those fed diet 4, respectively. Rams fed diet 3 had the lowest cost ₦ 572.22 per kg live-weight gain and highest feed cost savings of ₦467.05. Conclusively, rams fed diet 3, containing urea at 1% and cottonseed cake 10% levels of inclusion, gave the best growth performance, better feed conversion ratio and economics of production in the study. Therefore, this diet can be recommended for growing Yankasa sheep.

Key Words: *Sorghum stover, rumen buffer, Yankasa ram, digestibility*

Description of the Problem

Ruminants are distinguished from the rest of the animals by the morpho-physiological adaptation of the upper part of their stomach. This peculiarity allows them to turn roughages and low-quality proteins, even non-protein nitrogen (NPN), into quality nutrients for themselves such as the microbial protein and the volatile fatty acids (1). Urea can be converted via ammonia into microbial protein, thereby supplying additional protein to the host animal (2). The utilization efficiency of urea-N by ruminants may vary with different levels and methods of urea supplementation. (3) implied that low-level direct substitution of urea for degradable protein in concentrate supplements is feasible without negative repercussions on intake and digestion of low-quality forage. Molasses is used basically as source of energy; it is free of fat and fibre with a low nitrogen content.

Most agricultural and agro-industrial by-products such as sorghum stover are low in protein content (4). The protein content was reported to be within the range of 1.6 -

7.5% (4, 5). Animals fed exclusively on stover are in negative energy balance and supplementary feeding with energy and nitrogen has been used for improving their nutritional status (6, 7). The nutritive value of these low-quality roughages must therefore be enriched by supplements to improve their feeding value.

It was reported (8) that an established rumen is affected by types of feeds and roughage to concentrate ratios and these consequently influenced the population of microorganisms and the fermentation patterns. (9) concluded that feeding complete diets to animals provide scopes for incorporation of nutritious non-conventional feed resources in concentrate or roughage component by avoiding selective eating of palatable components by animals. This study was therefore designed to determine the nutrient intake, growth performance and economics of production of Yankasa rams fed sorghum stover based diets containing graded levels of different nitrogen sources

Materials and methods

Description of the study area

The research was conducted at the Livestock Teaching and Research Farm, University of Maiduguri, Borno State. Maiduguri lies between Latitude $11^0 51^{'}$ and 12^0N and longitude $13^0 05^{'}$ and 14^0E It falls within the Sahel savannah zone of West Africa, which is characterized by 4-5 month of rainfall with an average of 500-600mm. The ambient temperature ranges between 27-45^0C, while the Relative humidity varies between 19 to 78% and remains at 45% during the wet season (10).

Collection and preparation of experimental feed materials

Sorghum stover was collected from harvested sorghum farms within Maiduguri and its environs after harvest and removal of the seeds. The stover was milled to about 3 - 5cm using stover milling machine which are then bagged and stored before usage. Leaves of *Balanites aegyptiaca* (Desert date) were obtained by pruning branches of the trees. The pruned materials were sun-dried for 2-3 days before collecting the leaves. The leaves' powder was produced by grinding using mortar and pistil. The powder was packed in polythene bags before usage. Other feed ingredients; urea graded fertilizer, cottonseed cake, wheat offal, sorghum panicle, molasses, bone meal and salt were purchased from Gamboru Cattle market at Maiduguri.

Experimental animals and their management

Twenty growing Yankasa rams were used for the experiment. The animals were purchased from Kasuwan Shanu at Maiduguri with an average weight of 18.23 kg. The animals were quarantined for 14 days during which they were tagged, vaccinated against *pestes despetit ruminant*, dewormed with Albendazole at 12.5mmg/kg1 body weight for internal parasites and injected intramuscularly with antibiotic i.e Oxytetracycline L.A (Alfasan ®) 20%, at 1ml per 10kg body weight. During this period the animals were fed with groundnut haulms and maize offal for adaptation. The animals were divided randomly into five dietary groups of four animals each in a completely randomized design and allocated to their respective diets. All the animals were housed in well-ventilated pens (2 m × 2 m) pens that were disinfected using Dettol at the rate of 10mls/4litres of water as a fumigant before the arrival of the experimental animals to maintained healthy surroundings and proper cleanliness during the experimental period.

Experimental diets

Complete diets containing 16% crude protein (CP) were formulated for the

experiment. Urea was incorporated into the diets at 0, 0.5, 1, 1.5 and 2% alongside with cottonseed cake at 20, 15, 10, 5 and 0% and designated as diet 1, 2, 3, 4, and 5 respectively. Ingredient and compositions of the experimental diets are presented in Table 1.

Table 1: Ingredients and chemical composition (%) of experimental diets

Ingredients	**Diets**				
	1	**2**	**3**	**4**	**5**
Wheat offal	26.93	32.73	38.52	44.32	50.11
Sorghum panicle	27.32	26.02	24.73	23.43	22.14
Urea	0.00	0.50	1.00	1.50	2.00
Cotton seed cake	20.00	15.00	10.00	5.00	0.00
Milled sorghum stover	20.00	20.00	20.00	20.00	20.00
Molasses	3.00	3.00	3.00	3.00	3.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Salt	0.50	0.50	0.50	0.50	0.50
B. aegyptiaca leaf powder	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Parameters					
Dry matter	93.01	93.2	92.33	93.87	93.07
Organic matter	86.32	88.13	90.08	88.32	89.06
Crude protein	16.04	16.13	16.02	16.18	15.95
Ash	6.69	5.07	2.25	5.55	4.01
Neutral detergent fibre	37.34	35.41	36.54	33.87	36.39
Acid detergent fibre	28.43	25.42	22.16	24.52	23.98
Hemicellulose	8.91	9.99	14.38	9.35	12.41

Diet 1 = 0% with cottonseed cake (CSC) at 20%, Urea, Diet 2 = 0.5% Urea with CSC at 15%, Diet 3= 1.0% Urea with CSC at 10%, Diet 4 = 1.5% Urea with CSC at 5%, Diet 5 = 2.0% Urea with CSC at 0%

The respective diets were offered at 7.00 hr and 14.00 hr daily for 90 days. During the feeding trial, animals were offered weighed quantities of respective complete diets *ad libitum*. Residues, if any, were weighed on the next day morning before offering of feed in order to calculate daily feed intake of animals. Fresh clean drinking water was provided to the animals and daily water intake, recorded. Initial body weight, weekly weights and final body weights of the animals were measured in order to ascertain the growth performance. Feed conversion ratio (FCR) was calculated from feed intake and weight gain. The experimental period lasted for 84 days (including 14 days adaptation period)

Economics of production

Cost of diet/kg in each treatment, total cost of feed intake in naira and cost of feed per kg weight gain were calculated based on the prevailing market price of feed ingredients in the study (11).

Experimental design

The experiment was conducted in a Completely Randomized Design (CRD) with five treatments of four animals each according to the procedure of (12).

Chemical analysis

Dry matter (DM), ash, crude protein (CP), Crude Fiber (CF) and Ether Extract (EE) of the diets were determined according to (13) procedure. The fiber fractions neutral and Acid detergent fibre were determined according to procedure described by (14).

Statistical Analysis

Data generated were subjected to analysis of variance (ANOVA) in a completely randomized design using (15). Where analysis of variance indicates a significant difference, means were separated using Duncan's new multiple range test (DMRT).

Results and discussion

Feed and nutrient intake of growing Yankasa rams fed diets containing different nitrogen sources with *Balanites aegyptiaca* as rumen buffer are presented in Table 2. The total feed intake (TFI) compared between the dietary groups in this study indicated a significant difference (P.<0.05). The feed intake figure of 1177.63 and 1181.39g/day obtained in this study was below the value of 1255.51 g/day documented by (16) for Yankasa rams fed graded levels of urea to replace cotton seed cake in diets as a source of Nitrogen. Higher feed intake observed in this study was higher than 1110.90 g/day reported by (17) which fed complete diet with untreated groundnut shell with high level of CSC to Yankasa sheep. The TFI value recorded in this study was higher than 907.70g/day reported by (18) in a feeding trial conducted to assess the performance of Yankasa sheep fed ensiled sugarcane waste (ESCW) enhanced with non-protein nitrogen (urea and poultry litter) sources and soybean meal. The figures of TFI in this study were higher than 819.42 g/day reported by (19) for Yankasa rams fed concentrate and basal diets of maize husk. (20) recorded an average daily feed intake range of 900 to 1000 g/day in Yankasa rams fed diets with graded levels of sesame residues and CSC as source of protein nitrogen which is lower than the higher values recorded in this study, but slightly higher than 886.30 g/day recorded in animals fed diet 4 in this study.

The DMI recorded in this study differs significantly across the dietary treatments with higher figure of 1097.55 and 1090.78 g/day. (21) recorded a mean DMI of 1154.17 g/day when fed lambs with different dietary protein source which was higher than the value recorded in this study. The DMI values in this study were higher than that reported by (22) for Yankasa rams fed cotton seed cake (CSC) which was partially or completely replaced by urea and / or sun-dried broilers litter (SDBL) (484-543g/day respectively). The DMI of1178.67 g/day reported by (16) was higher than the values reported in this study. The figure recorded in this study was within the range of1055 to 1100 g/day reported by (23) who fed diet containing different levels of urea. (24) reported mean values of 1011.20, 1008.10 and 972.50 g/day for fattening lambs fed diets with incremental urea supplementation at 1, 2 and 3% which were slightly lower than the figures recorded in this study. Dry matter intake of 978.10 g/day was reported by (25) for ruminant fed diet of urea treated maize-stover and supplemented with different levels of concentrate mix during growing period which is lower than those recorded in the present work. The figures of DMI in this study was above the range of 853.00 to 949.90 g/day reported by (26) in a study conducted with Yankasa rams fed diets with treated rice husk at 0, 1, 1.5 and 2% respectively. (27) reported DMI of 1035.98 g/day of Yankasa rams fed urea treated rice straw and Gamba hay in the ratio of 40:00 supplemented with 14% CP concentrate

mixture containing CSC which is slightly lower than that of this study.

The values for DMI as % of BW were significantly different across the dietary treatment. Animals fed diet with 20% inclusion level of CSC had the highest figure of 4.25% DMI as % of BW in this study. The figure was not in consistent with range (2.37 to 2.51 %) and (5.03 to 5.24. %) reported by (18) and (16) respectively. It also disagreed with the findings of (19) who recorded DMI as % of BW range (3.06 to 3.30%). This may be as the result of the palatability of diets in form of complete ration which resulted in high DMI in this study which was in conformity with that reported by (9) that ruminant species on complete feeding system usually records increased intake of DM and nutrients as compared to conventional feeding system.

The OMI values differed significantly across the diets in this study with higher value 967.27 g/day recorded in animal fed diet 2. The OMI in this study was higher than the range of 909.00 to 945.00 g/day reported by (23), but lower than 998.80 g/day documented by (16). (20) recorded OMI of 959.88 g/day in Yankasa rams fed diets with 5% inclusion level of CSC as source of protein nitrogen which was below the reported value in this study. The OMI reported was higher than 520.00 to 760.00 g/day reported by (25). (24) in a finding reported OMI range of 884.10 to 919.70 g/day which fell with the range reported in this study.

Crude protein intake of 177.04 and 174.74 g/day were recorded in in this study were higher than the range of 154 to 162 g/day reported by (23) and lower than 184.14 to 189.46 g/day reported by (16). The CPI values were also higher than 127.79 g/day reported by (20). In a study by (24), CPI of 174.00 g/day was reported which was closely related to the value reported in this study. (26) reported CPI of 129.80 g/day when fed diet with rice husk treated with 2% urea which was contrary to the findings in this study. (27) reported CPI of 135.21 g/day which is lower than the reported of this study.

The neutral detergent fibre intake (NDFI) values differed significantly across the diets in this study. The NDFI figure of 388.64, 398.57 and 387.96 g/day in this study was above the range of 291.90 to 322.00 g/day reported by (24), but lower than 441.06 g/day reported by (16). (26) reported NDFI of 589.00 g/day for animal fed diet with urea-treated rice husk at 2% which is contrary with this study. The NDF values were lower than the range of 616.79 to 656.33 g/day reported by (27) when Yankasa rams were fed with diets containing different proportions of urea treated rice straw with gamba grass

The ADFI values were significantly ($P<0.05$) different across the diets. The ADFI figures of 284.55 and 279.00 g/day recorded in this study were lower than the range of 325.00 to 342.00 g /day reported by (23). The ADFI in this study fell within the range of 239.69 to 324.25 g/day reported by (16). (24) reported range value of 182.20 to 209.70 g/day than the present study. The figure of ADFI of up to 399.80 g/day was reported by (26) which was higher than the figure recorded in this study.

Water intake figures of 4.60 and 4.78 l/day recorded in this study were contrary to the range of 1.46 to 1.60 l/day and 2.56 to 3.09 l/day reported (19) and (28).

The mean water intake recorded in this study was higher than the range (2.10 to 2.60 l/day) reported by (29) for sheep fed diets containing corn meal with dry brewer's yeast, but fell within the range (4.65 to 5.06 l/day) describe by (16).

Table 2: Dry matter and nutrient intake of Yankasa rams fed diets containing different nitrogen sources with *Balanites aegyptiaca* leaf powder as rumen buffer

Parameters	Diets					SEM
	1	2	3	4	5	
Total feed intake (g/day)	1076.10[b]	1177.63[a]	1181.39[a]	961.50[c]	1144.71[ab]	31.93*
DMI (g/day)	1000.88[b]	1097.55[a]	1090.78[a]	902.56[c]	1065.38[ab]	29.28*
DMI as % of body weight	3.91[b]	3.98[b]	3.75[b]	3.82[b]	4.25[a]	0.10*
OMI (g/day)	863.96[b]	967.27[a]	982.57[a]	797.14[c]	948.83[a]	26.68*
CPI (g/day)	160.54[b]	177.04[a]	174.74[a]	146.03[c]	169.93[ab]	4.67*
NDFI (g/day)	373.73[b]	388.64[a]	398.57[a]	305.70[c]	387.69[a]	11.39*
ADFI (g/day)	284.55[a]	279.00[a]	241.72[ab]	221.31[b]	255.48[ab]	8.05*
Water intake l/day	4.60[a]	4.01[c]	4.39[b]	3.89[c]	4.78[a]	0.17*

[a, b, c,d]Means within each row with different superscripts are significantly different *(P<0.05), Diet 1 = 0% with CSC at 20%, Urea, Diet 2 = 0.5% Urea with CSC at 15%, Diet 3= 1.0% Urea with CSC at 10%, Diet 4 = 1.5% Urea with CSC at 5%, Diet 5 = 2.0% Urea with CSC at 0%, DMI=dry matter intake, OMI= Organic Matter Intake CPI= Crude Protein Intake, ADFI= Acid Detergent Fibre Intake, NDFI= Neutral Detergent Fibre Intake SEM= standard error mean, NS= Not significant

The growth performance and feed utilization of growing Yankasa rams fed diets containing different nitrogen sources with *Balanites aegyptiaca* as rumen buffer were presented in Table 3. Performance increased with decrease in sorghum panicle inclusion this may be as the result of the palatability of sorghum stover in diets with other feed ingredients. Significant differences were recorded in final body weight (FBW) of rams fed experimental diets in this study. The highest FBW of 29.05 kg recorded in this study was higher than 23.88 kg reported by (28) in feeding trail of Yankasa rams fed diets with urea treated groundnut shell with higher level of CSC inclusion in diet which was not similar to the FBW recorded in this study.

Total weight gain (TWG) of 10.89 kg was recorded in this study with average daily weight gain (ADG) of 155.57 g/day which was contrary to the TWG of 2.75 kg reported by (28). Total weight change of 5.90 to 10.20 kg was documented by (30) fell within the range of reported values in this study. It was documented by (19) TWG of 4.37 to 6.22 kg in Yankasa rams fed diet containing *Acacia sayal* leaf meal as a replacement for CSC which was lower than the value reported in this study. (20) reported TBW change of 3.08 to 6.00 kg with ADG range 48.89 to 95.24 g/day which was not consistent with the value recorded in this study. Figures of TBW change of 3.02 to 3.12 kg were reported by (19) which is lower than the figures obtained in this study but better feed utilization was recorded in animals fed diets with 10% inclusion of CSC which is in lined with this study. Complete feed with the use of fibrous crop residue is a noble way to increase the intake and to improve feed utilization and animal production performance (9). The highest daily weight gain in this study was higher than the value 78.89g/day reported by (31) for performance of West African Dwarf sheep fed cassava peel with varying inclusion levels of palm kernel cake. (32) reported higher FBW change of 5.66 kg with ADG of 67.38 g/day for Yankasa rams supplemented with 14% CP diet containing Ziziphus leaf meal and CSC at 31% level of inclusion which was lower than the values recorded in this study. (27) documented

higher TBW change of 8.46 kg which was lower than the figure reported in this study. (18) in a study conducted on growth performance of Yankasa ram fed diet with sugar cane wastes ensiled with urea, soybean meal and poultry litter recorded higher TBW change of 8.50 kg and ADG of 101.19 g/day which was contrary to the higher value reported in this study. It was reported by (16) TBW change of 31.25 to 37.03 kg which was higher than the value in this study and ADG of 110.12 to 161.07 g/day which fell within the range. (24) reported TBW change of 9.50 to11.20 kg with ADG of 167.20 to 199.90 g/day for sheep fed diets with urea supplementation which was in lined with range of TBW and ADG documented in this study. Average daily weight gains of 147.14 g/day in this study was higher than the 131.43 g/day reported by (33) who fed complete diets with 15% dry poultry litter to sheep. Better feed utilization was observed in animal fed diets 3 in this study. Better ADG and nutrient utilization efficiency in lambs fed ground paddy straw-based complete diets compared to those fed conventional diet was reported by (34).

Table 3: Growth performance and feed utilization of growing Yankasa rams fed diets containing different nitrogen sources with *Balanites aegyptiaca* leaf powder as rumen buffer

Parameters	Diets					SEM
	1	2	3	4	5	
Initial body weight (kg)	18.10	18.35	18.16	17.92	18.17	0.12^{NS}
Final body weight (kg)	25.58^{b}	27.59^{ab}	29.05^{a}	23.62^{c}	25.04^{b}	0.53*
Total weight gain (kg)	7.48^{b}	9.24^{ab}	10.89^{a}	5.70^{c}	6.87^{b}	0.51*
DMI (g/day)	1000.88^{b}	1097.55^{a}	1090.78^{a}	902.56^{c}	1065.38^{ab}	29.28*
ADG	106.86^{b}	132.00^{ab}	155.57^{a}	81.43^{c}	98.14^{b}	9.86*
Feed conversion ratio	9.37^{c}	8.31^{b}	7.01^{a}	11.08^{e}	10.86^{d}	0.47*

$^{a, b,c}$Means within each row with different superscripts are significantly different* ($P<0.05$), Diet 1 = 0% with CSC at 20%, Urea, Diet 2 = 0.5% Urea with CSC at 15%, Diet 3= 1.0% Urea with CSC at 10%, Diet 4 = 1.5% Urea with CSC at 5%, Diet 5 = 2.0% Urea with CSC at 0%, DMI=dry matter intakes, ADG=Average daily weight gain, SEM= standard error mean

Table 4: Economics of production of growing Yankasa rams fed diets containing different nitrogen sources with *Balanites aegyptiaca* leaf powder as rumen buffer

Parameters	Diets				
	1	2	3	4	5
Total feed consumed (kg)	75.33	82.43	82.70	67.31	80.13
Cost of diets (₦ /kg)	70.82	71.04	71.27	71.49	71.72
Total feed cost (₦)	5334.87	5856.00	5893.85	4811.81	5746.92
Weight gain (kg)	6.33	8.58	10.30	4.63	5.88
Feed Cost/kg gain (₦)	842.79	682.52	572.22	1039.27	977.37
Feed Cost Savings(₦)	196.48	356.75	467.05	-	61.90

Diet 1 = 0% with CSC at 20%, Urea, Diet 2 = 0.5% Urea with CSC at 15%, Diet 3= 1.0% Urea with CSC at 10%, Diet 4 = 1.5% Urea with CSC at 5%, Diet 5 = 2.0% Urea with CSC at 0%

The highest feed cost per kg ₦ 71.72 in this study range from was lower than lower than ₦107.55 reported by (35) for West African Dwarf Sheep fed *Moringa oleifera* and cotton seed cake as protein supplement. (30) reported highest cost of feed/kg ₦100.86 for supplement and basal fed to sheep which is higher than that reported in this study. it was also lower than 179.35 ₦/kg reported by (36) when evaluating the economics of sheep production with varying levels of rice milling waste. Highest total feed cost (₦ 5893.85) in this study was higher than that obtained ₦3256.37 to 3515.26 by (30). It was also higher than the value ₦2584.3 to 3959.2 reported by (37) for sheep fed varying levels of cotton seed cake as replacement for groundnut cake. The feed cost in this study was lower than 6355.45 reported by (16). Lowest feed cost of ₦ 572.22 per kg live-weight gain in this study was lower than that ₦433.63 and ₦ 433.63 reported by (16) and (11). Feed cost/kg gain of ₦ 428.40 was reported by (30). The feed cost per kg gain in this study has the highest savings cost of ₦467.05. Complete feed system improves nutrient utilization that supports higher growth performance and reduces the cost/ kg live weight gain, thus is economical in comparison to conventional feeding system (9).

Conclusion and Applications

1. Growing Yankasa rams could be fed sorghum stover based diets containing varying levels of different nitrogen source with *Balanites aegyptiaca* leaf powder as rumen buffer without any deleterious effects on the feed intake, fed conversion ratio, growth performance and with concomitant reduction in feed cost per kg gain.
2. From the results of the current study, diet 3 with urea at 1% and cottonseed cake at 10% inclusion levels with *Balanites aegyptiaca* leaf powder had the best average daily weight gain (ADG) 164.29g/day, feed conversion ratio (FCR) 6.76, lowest cost ₦ 522.23 in feed per weight gain and highest cost ₦ 208.12 of saving in diets. Therefore, this diet can be recommended for growing Yankasa rams

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