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Growth performance of Red Sokoto bucks fed diets containing varying inclusion levels of irrigated gamba grass (*Andropogon gayanus*) forage in Zaria.

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Target Audience: Smallholder farmers, Livestock owners, Forage agronomists and Extension agents

Abstract

A study was carried out to evaluate the effect of feeding graded levels of Gamba grass (Andropogon gayanus) forage on the performance of Red Sokoto bucks. Twelve (12) Red Sokoto bucks were randomly allotted into four (4) treatment diets containing graded levels of Gamba grass forage (0, 25, 50, and 100%). Experimental animals were individually pen-fed at 3% body weight in a Completely Randomized Design (CBD) for a period of 3 months. Animals fed 50% inclusion level of gamba grass forage in the diet had higher (P < 0.05) final live weight gain (13.50kg), average daily weight gain (38.89g/day) and daily feed intake, (371.30g/day). The live weight gain of bucks in the supplemented diets (25, 50 and 75) were significantly (P < 0.05) higher (2.22, 3.50, 2.80 kg) respectively than the un-supplemented diet (2.73kg). Results indicated that digestibility of dry matter (93.84%), crude protein (95.76%), crude fiber (97.07%), nitrogen free extract, (92.26%) and ash (94.60%) increased (P < 0.05) with increasing level of gamba grass forage in the diet. Also, bucks fed dietary inclusion level of 50% Andropogon gayanus Forage had significantly higher (P < 0.05) nitrogen intake (47.33 g/day), although it was at par with the control (41.32g/day) diet. Total Nitrogen output was higher (P < 0.05) in bucks fed the control diet and 50% inclusion level of gamba grass (5.85 vs 6.38g/day). Nitrogen absorbed and retained were higher (P < 0.05) in bucks fed 50% inclusion levels of gamba grass. However, nitrogen retained as percentage of intake was not significant (P > 0.05) across the treatments. The pH and temperature of rumen fluid of bucks fed 75% inclusion level of gamba grass forage were higher (P < 0.05) than other treatments fed. Total Volatile Fatty Acid (TVFA) of bucks fed 75% inclusion level gamba grass was 18% lower (P < 0.05) than those control diet. It was therefore concluded, that supplementation of 50% gamba grass forage to Red Sokoto bucks improved the dry matter intake, nutrient digestibility and live weight gain compared to the un-supplemented diet. Therefore, it is recommended that gamba grass forage should be supplemented to Red Sokoto bucks up to 50% without any negative effect on their performance.

Keywords: Gamba grass, growth performance, nutrient utilization, red sokoto buck.

Description of Problem

The productivity of small ruminants in the tropics and subtropics is mainly based on feeds from native pastures, crop residues and edible parts of shrubs and trees, which are generally high in fiber and low in crude protein (CP) as well as in metabolizable energy (ME) (1;2). Feed intake and the nutrient absorption from such diets are insufficient to even meet the maintenance requirements of the animals and thus they are prone to lose weight if not receiving additional nitrogen, energy and mineral supplements (3). Supplementation of low quality diets with forage legumes or grains has been reported to increase intake, digestion and growth performance (4; 5). Several studies have shown that adding an energy supplement to the protein supplement further improved dry matter (DM) intake and digestibility coefficients of low quality diets (1; 6). Despite the fact that there are potential economic benefits of using cereal grains for supplementation to ruminants, the availability, costs and value as food for humans limits their use under small farm conditions. Cultivation of *Andropogon gayanus* (Gamba) to supplement foliage feed for growing small ruminants under smallholder farms in the tropical regions is important. Gamba grass has soft leaves, stays green for long into the dry season, and provides palatable forage when young but feeding value declines rapidly with age and decreasing leaf/stem ratio. Even in rainy season, they can only serve as maintenance requirements (7). Has a low mineral content i.e 0.08% P and 0.27% Ca on dry matter basis (8). Improvement in ruminant production will therefore require increased effort at investigating the different possible ways and means of upgrading poor roughages through increasing their digestibility and voluntary intake (9). The use of appropriate supplements and basal diets is a fundamental component of the feeding strategy in order to balance nutrients for improved performance (10). The main objective of this study was to determine the growth performance, nutrient digestibility and nitrogen retention in Red Sokoto bucks fed varying inclusions of irrigated Gamba grass (*Andropogon gayanus)* forage in Zaria, Nigeria.

Materials and methods

Experimental site, Animals and management

The feeding trial and nutrient digestibility study were conducted at the Department of Animal Science, Teaching and Research Farm, Faculty of Agriculture Ahmadu Bello University, Zaria, Kaduna State. The farm is located at an elevation of 676m and North latitude of 11^{0}2'N and longitude of 007^{0}.6'E (11). The composition of the experimental diets containing varying levels of inclusion of gamba grass forage (0, 25, 50, and 75%)presented in table 1. Twelve (12) Red sokoto bucks goats of average initial weight range of 10-11kg were used. The animals were subjected to prophylactic treatment against internal and external parasites on arrival. All animals received 0.1ml/10Kg body weight of ivermectin (10ml) injection and 0.1mg/Kg body weight of Tetranor (Oxytetracycline Dehydrate, 20% weight/volume injectable solution). Albendazole 10% solutions were administered in drinking water for the control of intestinal parasites. Amitics solutions were spread on the animals using Knapsack sprayer against external parasites prior to the commencement of the study. The animals were allowed 14 days to adjust to the feed and confinement before the commencement of the experiment.

Feeding trial, design and treatment

The animals were randomly allotted to 4 treatment diets containing varying inclusion levels of gamba grass forage (0, 25, 50, and 75 %,). The lush gamba grass forage was used to replace cotton seed cake in the diet. The supplemented concentrate also consist of other ingredients such as maize bran, rice offal, bone meal and salt which was fed at 3% body weight without any basal diet with 3 bucks per treatment in a Complete Randomize Design (CRD) for a period of 3 months (Table 1). Each buck served as a replicate. Water was provided ad-*libitum.* Each buck received the treatment diet at 8:00a.m and 4:00p.m, respectively. The orts were collected the following morning and weighed before fresh feed were offered to determine the voluntary feed intake. All animals were weighed at the beginning of the experiment and forth nightly thereafter to adjust the quantity of diet fed.

Measurement of growth performance

Weekly feed intake, weight gain and feed conversion ratio were determined. Feed intake was calculated by the difference between feed offered and feed left over in each pen. Weight gain was determined as the difference between the final weight of the animals at the end of the experiment and their initial weights, respectively. Feed conversion ratio was calculated as the ratio of feed intake and weight gain for each pen treatment.

Digestibility study

At the end of the feeding trial, two animals were randomly selected from each treatment and housed in metabolic creates for total faecal and urine collection. The animals were allowed 7days adjustment period in the metabolic creates before the commencement of the collection period, which lasted for another 7days. The animals were fed experimental diets daily in a single meal at8:00am. The urine was collected daily in plastic containers containing 10ml of 0.1M H_2SO_4 to prevent nitrogen loss by volatilization, which was placed under the metabolic, creates. The collected urine per treatment was strained through a layer of glass wool to remove contaminants. About 10% of the daily urine output were taken from each animal and stored in the refrigerator pending nitrogen determination (12), while the total faecal output was also collected daily, weighed and sub-sampled for chemical analysis. Proximate composition: Crude protein (CP), crude fibre (CF), ether extract (EE) and ash of feed samples were carried out using the method of A.O.A.C (13).

Measurement of rumen metabolites

Samples of rumen fluid samples were collected at the end of the feeding trial from two animals in each treatment at 0, 3hrs, 6hrs and 9hrs post feeding. Temperature and pH of the rumen fluid were measured immediately using a laboratory digital thermometer and Philips digital pH, respectively. The rumen fluids were collected by aspiration method using stomach tube. The fluid were then strained through cheese cloth and about 20mls of the filtrate were collected into plastic containers containing equal quantity of 0.1M H_2SO_4 to trap ammonia and lower the bacterial activity. The mixtures were centrifuged at 3000rpm for 10 minutes. About 20mls of the supernatant were decanted into plastic bottles and kept in a deep freezer (1 - 20^0C) until when required for analysis of Total Volatile Fatty Acids (TVFAs) and rumen ammonia nitrogen (NH_3-N). The Total Volatile Fatty Acids (TVFAs) and ammonia nitrogen (NH_3-N) of the rumen fluid were determined by steam distillation method following the procedure of (14).

Chemical analysis

The proximate analysis for the nutrients composition of experimental diets and feces were done in the Biochemistry Laboratory of the Department of Animal Science, Ahmadu Bello University, and Zaria. Using the method described by Association of Analytical Chemist-A.O.A.C (13), the samples were analyzed for Dry matter, Crude protein, Nitrogen free extract and Ash content, respectively. Samples were oven-dried to a constant weight at 65^0C to determine the dry matter and thereafter the sample were ground to pass through 1-mm sieve for later use. The crude protein was calculated and the crude fibre components were determined by the method of A.O.A.C (13). Acid detergent fibre (ADF) and Neutral Detergent fibre (NDF) were determined according to van Soest (14). Metabolizable Energy (ME) will be estimated by the equation of (15).

ME (MJ/kg DM) = 11.78 + 0.0064CP + $(0.000665EE)^2$- CF (0.004EE) - 0.0118A

Cost benefit analysis

The cost- benefit analysis was carried out to determine the profitability of substituting Gamba grass forage for whole cotton seed in maize offal based complete diet of Goats. The cost of Gamba grass forage per kilogram were estimated based on the total expenditure used in the production of the grass, including fertilizer and labour cost, while other calculations of feed cost and output were based on averages per head and at prevailing market prices.

Statistical analysis

Data collected were analyzed using Analysis of Variance (ANOVA) by General Linear Model (GLM) of SAS Statistical analysis system,version 9 (16).Treatment means were separated and compared using Dunnet's Test.

The model of the experiment is given as;

$X_{ijk}= \mu + T_i + e_{ijk}$

Where X_{ijk}= Any observation.

μ= Population mean,

T_i= Treatment effect,

e_{ijk}= Random error

Result and Discussion

Table 1: Ingredient composition of the diet containing various levels of Gamba grass.

Feed components	Percentage of Inclusion levels.			
	0	25	50	75
Andropogon gayanus	**0**	5.5	11	16.5
Maize bran	38	38	38	38
Cotton seed cake (g)	22.0	16.5	11	5.3
Rice offal (g)	38	38	38	38
Bone meal(g)	1.5	1.5	1.5	1.5
Common salt	0.5	0.5	0.5	0.5
Total	100	100	100	100
Calculated analysis				
Cost/kg feed (₦)	24.00	19.15	15.44	11.19
M/E	3344	3314	3289	3301
Crude Protein (%)	12.56	12.11	11.85	11.89

M.E = Metabolisable Energy

Table 2 shows the chemical composition of the diets used in the experiment. The dry matter, crude protein and either extract of the diets were similar across the treatments. Also, the highest value of Crude fibre (11.56%) was observed in treatment with 25% Gamba grass forage. NFE content ranged from 66.98% in treatment (75%) to 68.22% in treatment (0%). The Ash content of the experimental diet ranged from 5.26 in treatment with 0% Gamba grass forage to 6.30% in treatment (50%).

Table 2: Proximate composition of gamba grass, cotton seed cake and experimental diets with varying inclusion levels of gamba grass.

Parameters (%)	Inclusion level of *Andropogon gayanus* (%)				Gamba grass	Cotton seed cake
Nutrient	0	25	50	75		
Dry matter	97.76	92.89	93.33	93.66	78.00	87.00
Crude protein	13.24	14.81	13.68	13.77	7.90	36.00
Ether extract	2.06	2.85	3.77	2.19	1.70	1.60
Crude fibre	11.22	11.56	10.78	11.08	36.80	10.3
Nitrogenfree extract	68.22	64.58	65.47	66.98	33.50	42.70
Ash	5.26	6.20	6.30	5.98	8.1	6.40

Table 3 shows the effect of varying inclusion level of Gamba grass forage on the growth performance in Red Sokoto Goat. The live weight gain of bucks in the supplemented diets (25, 50 and 75%) differed significantly (P<0.05) with a value range of 11.72kg (25% inclusion) to 13.50% (50% inclusion). The study clearly demonstrated that supplementation of cotton seed cake to gamba grass forage to Red Sokoto bucks has an advantage in weight gain of the bucks over feeding cotton seed cake alone. This finding is in agreement with (17) in an investigation on the effect of level of cowpea vines supplementation to Yankasa sheep fed a basal diet of gamba grass. The author observed that rams fed supplemented diets had significantly (P<0.05) higher daily weight gain than rams fed only gamba grass, which recorded the least daily weight gain. Animals fed 50% inclusion level of gamba grass forage in the diet had higher (P< 0.05) final live weight gain (13.50kg), average daily weight gain (38.89g) and daily feed intake (371.30g), respectively. The high significant daily live weight gain observed in this study might be related to palatability and acceptability of the diet by the bucks, since it contained equal proportions of gamba grass forage and cotton seed cake. An increase in the weight of the goats indicated that nutrients in the diets were adequate for growth performance. The results of this experiment agreed with the report of (18), who observed that nitrogen source supplements increased growth rate. The feed conversion ratio was similar (P > 0.05) across the treatments.

Table 3: Effect of varying level of Gamba grass on the performance in Red Sokotobucks.

Parameter	Inclusion level of *Andropogon gayanus* (%)					
	0	25	50	75	SEM	LOS
Initial live weight (kg)	10.00	9.50	10.00	9.50	1.82	NS
Final live weight (kg)	12.73^{b}	11.72^{d}	13.50^{a}	12.30^{c}	0.11	*
Live weight gain (kg)	2.73^{b}	2.22^{c}	3.50^{a}	2.80^{b}	0.06	*
Ave daily weight gain (g)	30.33^{c}	24.67^{d}	38.89^{a}	31.11^{b}	0.26	*
Daily feed intake (g)	328.90^{a}	264.12^{b}	371.30^{a}	266.56^{b}	16.34	*
Feed conversion ratio	7.06	11.07	7.18	16.24	5.02	*

^{abc}= Means with different superscript along row differed significantly (P<0.05);
SEM = Standard Error of Means; LOS = Level of Significance

Table 4 shows the nutrient digestibility of Red Sokoto bucks fed varying inclusion levels of gamba grass forage. Digestibility of dry matter, crude protein, crude fiber, nitrogen free extract and ash increased (P <0.05) with increasing level of gamba grass forage inclusion in the diet. The digestibility values showed that bucks fed supplemented diets (25, 50 and 75%) had better digestibility than bucks on the control diet. Supplementation increases the digestibility of feeds which is in agreement with (19), who reported an increase in digestibility of dry matter, organic matter and crude fibre, respectively. The digestibility result obtained for ether extract in bucks fed 50% gamba grass forage was higher (P<0.05) across all the treatments. However, animals fed the control diet had the least digestibility (P <0.05) in all parameters compared to those on other levels.

Table 4: Effect of varying levels of Gamba grass on nutrient digestibility in Red Sokoto bucks.

	Inclusion level of *Andropogon gayanus*(%)					
Parameter	0	25	50	75	SEM	LOS
Dry matter	87.09^{c}	85.45^{d}	91.91^{b}	93.84^{a}	0.41	*
Crude protein	90.89^{c}	91.16^{c}	94.21^{b}	95.76^{a}	0.44	*
Ether extract	95.22^{c}	95.50^{c}	99.13^{a}	97.73^{b}	0.81	*
Crude fibre	93.45^{c}	93.19^{c}	96.11^{b}	97.07^{a}	0.49	*
Nitrogen free extract	84.02^{c}	81.18^{d}	89.68^{b}	92.26^{a}	0.65	*
Ash	88.24^{c}	88.27^{c}	92.65^{b}	94.60^{a}	1.01	*

^{abc}= Means with different superscripts along rows differed significantly (P<0.05);
SEM = Standard Error of Means; LOS = Level of Significantly

Table 5 illustrates the nitrogen balance of Red Sokoto bucks fed varying inclusion levels of *Andropogon gayanus* forage. The dietary inclusion level of 50% *Andropogon gayanus* had significantly higher (P < 0.05) nitrogen intake (47.33 g/day), although it was at par with the control (41.32g/day). Total Nitrogen output was higher (P < 0.05) in bucks fed the control diet (5.85%) and 50% (6.38%) inclusion level of gamba grass. Nitrogen absorbed and retained were higher (P >0.05) in bucks fed 50% inclusion levels of gamba grass. However, nitrogen retained as percentage of intake was not significant (P > 0.05) across the treatments. N retention is considered as the most common index of the protein nutrition status of ruminants. N retention was significantly (P < 0.05) different across the treatments. As level the *increased* from 50-75%, N retention decreased by 31%. This is in agreement with (20) and (21) as cited by(22), all of whom suggested that Nitrogen retention decreases with inclusion level of gamba grass forage.

Table 5: Effect of varying levels of Gamba grass *on* nitrogen balance in Red Sokoto Goats.

	Inclusion level of *Andropogon gayanus.* (%)					
Nitrogen balance (g/day)	0	25	50	75	SEM	LOS
Nitrogen intake	41.32[a]	35.10[b]	47.33[a]	36.99[b]	2.73	*
Urinary Nitrogen	2.14[a]	1.34[c]	1.82[b]	1.15[d]	0.03	*
Faecal Nitrogen	3.71[b]	3.30[c]	4.57[a]	4.50[a]	0.12	*
Total Nitrogen Output	5.85[a]	4.65[c]	6.38[a]	5.64[b]	0.11	*
Nitrogen absorbed	37.61[a]	31.80[b]	42.76[a]	32.49[a]	2.71	*
Nitrogen retained	35.47[a]	30.45[b]	40.95[a]	31.35[b]	2.71	*
Nitrogen retained (%N-intake)	85.83	86.74	86.52	86.67	1.09	NS

[abc]= Means with different superscript along row differed significantly (P<0.05);
SEM = Standard Error of Means; LOS = Level of Significance

Table 6 shows the effect of varying inclusion levels of gamba grass forage on rumen variables in Red Sokoto goats. The pH and temperature of rumen fluid of bucks fed 75% inclusion level of gamba grass forage were higher (P<0.05) than other treatments. The pH values obtained in this study are within the normal range of 6.0-7.0 for effective cellulolytic bacterial activity in the rumen, which is similar to reports by (23). The significantly higher pH values observed in this study indicates that gamba grass forage does not contain antinutritional factors, which hinder the activities of microbes (cellulolytic bacterial) by lowering the pH (24, 25). Previous studies have found forage to be efficient maintenance of rumen environment without deleterious effect on rumen pH (26). However, the total volatile fatty acid (TVFA) of bucks fed 75% inclusion level gamba grass was 18% lower (P<0.05) than the control. The normal physiological range of total volatile fatty acids (TVFAS) in high producing ruminant livestock has been reported to be 31-75mg/L (23). The TVFAS observed in this study was however low when compared to the value reported. This may probably be related to low rumen activities of microbes and low fermentation of microbial cells. Strong competition between the rumen microbes especially fungi and bacteria could result in low TVFAS and reduced growth performance. It has been established that anaerobic fungi in the rumen could result in disruption of feed structure through their strong activities and plant cell wall degrading activities (27). Therefore, increased level of gamba grass forage may have stimulated the existing competition between the rumen which resulted in very low rumen ammonia nitrogen NH_3-N (mg/l), with increased levels of gamba grass forage in the diet. Similar findings have been reported under in-vitro condition (28).

Table 6: Effect of varying levels of Gamba grass on rumen variables in Red Sokoto Goats.

	Inclusion level of *Andropogon gayanus*(%)					
Rumen variable	0	25	50	75	SEM	LOS
pH	6.28[c]	6.23[c]	6.43[b]	6.53[a]	0.04	*
TVFA (mm/l)	13.19[a]	11.48[c]	11.61[b]	10.77[d]	3.61	*
NH_3-N (mg/l)	30.12[b]	30.48[a]	28.88[d]	29.70[c]	1.64	*
Temperature (^{0}c)	33.60[b]	32.25[c]	34.25[b]	36.30[a]	0.50	*

[abc]= Means with different superscripts along row differed significantly (P<0.05).SEM = Standard Error of Means; LOS = Level of Significance; TVFA = Total Volatile Fatty Acids NH_3-N=Ammonia nitrogen

Table 7 shows the cost of feeding per animal in the various treatment groups during the experimental period. The cost of feeding an animal differed (P<0.05) significantly across the treatments, with (0%) group having the highest cost (₦552.5k) which was followed by (50%) group (₦401.30k) and lowest for animals on (75%) supplement (₦208.86k). The highest cost of feeding per animal for the period of the research in animals fed with cotton seed cake supplement can be attributed to the high cost per kilogram of the supplement compared to the price of the other with various inclusion levels of Gamba grass and also the amount of feed consumed.

Table 7: Economic analysis of varying levels of Gamba grassdiet fed to Red Sokotobucks.

	Inclusion level of *Andropogongayanus* (%)					
Parameter	0	25	50	75	SEM	LOS
Daily feed intake (g)	328.9[a]	264.12[d]	371.30[a]	266.56[c]	0.27	*
Total feed intake (kg)	2.73[b]	2.22[c]	3.50[a]	2.8[b]	0.12	*
Daily live weight gain (g)	30.33[b]	24.67[c]	38.89[a]	31.11[b]	2.4	*
Cost/kg feed (₦)	24.00	19.13	15.44	11.19	40.8	*
Cost of feeding/Animal/ day	552.5[a]	353.6[b]	401.30[a]	208.86[c]	20.4	*
Cost of feeding/ kg gain	202.38[c]	159.27[b]	114.65[b]	74.59[a]	2.53	*

SEM = ***S***tandard Error of Means LOS=Level of Significantly

Conclusion and Applications

1. Gamba grass forage at 50% inclusion level gave the highest weight gain and nitrogen retained in Red Sokoto bucks with a better nutrient digestibility as the inclusion levels increases.
2. Gamba grass forage can be included in the diet of Red Sokoto bucks up to 50% to enhance growth performance and profit gained

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