

Adewuyi et al

Growth, Nutrient Digestibility and Nitrogen Retention of Growing Bucks Fed Gamba Grass Supplemented with Acacia Leaf Meal-Based Concentrates

Adewuyi, F.A., Adamu, S.B., Asheikh, L.G., Munza, B.M., Girgiri, A.Y., Abbator, F.I. and Alade, N.K.

Department of Animal Science, Faculty of Agriculture, University of Maiduguri, Maiduguri, Nigeria

Corresponding author: bellomunza@gmail.com, +2347038737250

Abstract

The study was conducted to evaluate the performance of growing bucks fed Gamba grass supplemented with different Acacia leaf meal-based concentrate in the semi-arid zone of Nigeria. Twenty (20) growing bucks with an average weight of 11.50 kg were assigned to four (4) dietary treatments (*Acacia nolitica*, *Acacia albida*, *Acacia senegal* and *Acacia sieberina*) in a completely randomized design. The results for chemical composition of different Acacia species revealed the dry matter (94.84 – 95.80 %), crude protein (12.42 – 17.78 %), ether extract (2.08 – 3.58 %), ash content (7.58 – 9.52 %), NFE (43.43 – 51.69 %), ADF (20.64 – 25.11 %), NDF (24.89 – 30.68 %) and lignin (7.36 – 9.14 %) while Gamba grass recorded dry matter (91.24%), crude protein (9.89%), ether extract (2.09%), ash (7.31%), NFE (37.41%), ADF (35.64%), NDF (43.17%) and lignin (12.71%). The chemical composition of the experimental diets had dry matter (89.25 – 94.74 %), crude protein (10.88 – 15.82 %), ether extract (2.73 – 2.99 %), ash (7.72 – 8.55 %), NFE (38.41 – 46.39 %), ADF (22.73 – 28.01 %), NDF (27.60 – 34.44 %) and lignin (8.13 – 10.10 %), respectively. There was significant ($P < 0.05$) effect of different Acacia species on total feed intake, daily feed intake, weight gain and daily weight gain. While non-significant ($P > 0.05$) effect was observed for initial weight, final weight and feed conversion ratio (FCR). The following ranges for initial weight (11.50 – 11.63 kg/buck), final weight (13.28 – 13.70 kg/buck) and FCR (12.26 – 14.26) were observed. Higher ($P < 0.05$) total feed intake (23217.00 g/buck) and daily feed intake (331.68 g/buck/day) were recorded for bucks fed *A. sieberina* based diet while lower ($P < 0.05$) total feed intake (20972.00 g/buck) and daily feed intake (299.60 g/buck/day) were recorded for bucks fed *A. senegal* based diet. Higher ($P < 0.05$) weight gain (2.20 kg/buck) and daily weight gain (31.46 g/buck/day) were obtained for bucks fed *A. nolitica* based diet while lower ($P < 0.05$) weight gain (1.78 kg/buck) and daily weight gain (25.36 g/buck/day) were recorded for bucks fed *A. senegal* and *A. sieberina* based diets, respectively. For apparent nutrient digestibility, higher ($P < 0.05$) dry matter (60.70%), ADF (54.22%) and NDF (55.45%) digestibilities were recorded by bucks fed *A. nolitica* based diet while lower ($P < 0.05$) dry matter (54.43%), ADF (52.10%) and NDF (52.00%) digestibilities were recorded by bucks fed *A. sieberina* based diet. Higher ($P < 0.05$) crude protein (64.08%) digestibility was obtained by bucks fed *A. senegal* based diet while lower ($P < 0.05$) crude protein (58.74%) digestibility was recorded by bucks fed *A. nolitica* based diet. Significant ($P < 0.05$) effect of different Acacia species was obtained for nitrogen retention parameters except nitrogen intake which ranged from 51.26 to 53.38 g/buck/day. Faecal nitrogen (15.43 g/buck/day) and urinary nitrogen (11.99 g/buck/day) were higher ($P < 0.05$) in bucks fed *A. senegal* based diets while lower ($P < 0.05$) faecal nitrogen (14.31 g/buck/day) and urinary nitrogen (10.16 g/buck/day) were recorded in bucks fed *A. nolitica* based diet. Higher ($P < 0.05$) nitrogen

Adewuyi et al

retained (26.79 g/buck/day) and nitrogen retained as % intake (52.26%) were recorded in bucks fed *A. nolitica* based diet while lower ($P < 0.05$) nitrogen retained (25.96 g/buck/day) and nitrogen retained as % intake (48.63%) were recorded in bucks fed *A. senegal* based diet. In conclusion, the supplementation of Gamba grass with *Acacia* species not only promotes enhanced growth performance in bucks but also offers a cost-effective feeding solution for small ruminant production in Nigeria's semi-arid regions. Based on these results, all the *Acacia* species can be recommended to farmers when they are well formulated in a balanced proportion.

Keywords: Acacia leaf, Bucks, Growth, Nutrient Digestibility, Nitrogen retention

DESCRIPTION OF PROBLEM

One of the major limitations of small ruminant production in the tropics is poor nutrition, particularly during the dry season (1). During critical periods, forages are characterized by low nitrogen (protein) and high fibre (energy), which affects voluntary intake and digestibility, leading to loss of weight amongst animals (2). In addition, the high cost of conventional feedstuffs because of competition with monogastrics and man serves as a contributing factor to the successful small ruminant production (3).

The scarcity of livestock feed in the dry season, especially protein, is a major constraint to viable livestock production in many countries. The above circumstance justifies efforts towards sourcing for alternative and locally available means of feeding ruminants for increased productivity (4). In recent years, the attention of researchers has been shifted to locally available and cheaper alternative feedstuffs such as grasses, shrubs and some seasonal fodders, etc. which is nutritionally viable, non-toxic and of little or no dietary value in human diets (4).

In Nigeria, the browse grows in the range commonly around damp valleys bordering Niger Republic. Despite the usage of this browse by agro-pastoralists, scanty information is available on its nutritional value, intake and performance on livestock feeding on it. In Nigeria, *Acacia nilotica*, popularly known as Bagaruwa in Hausa is widely grown in Kano, Yobe, Borno, Kebbi, and Katsina states in the northern part of Nigeria, they cover large kilometers of land mass. Notwithstanding the availability of *A. nilotica* and its potentials for feeding livestock, its use in feeding livestock is still very limited. Its major use is for leather tanning, and to a lesser extent for treatment of some diseases and for control of erosion in the desert prone areas. A major limitation to the use of *Acacia* species is the presence of an anti-nutritional factor known as tannin which is why they are dried before feeding to livestock.

Gamba hay, presents a low-cost alternative as a basal diet. However, its low nutritional value, particularly protein content, limits its effectiveness in meeting the dietary needs of growing bucks. *Acacia* species abundant in the region offer a potential source of protein-

Adewuyi et al

rich supplements, but their effectiveness as feed additives, particularly when formulated into different concentrate forms, remains under-researched (6)

Inadequacy of livestock feeds in the dry season, particularly protein sources a major constraint to livestock production in the tropics as reported by (7). *Acacia* species, such as *A. nilotica*, *A. albida*, *A. Senegal*, *A. seyal* and *A. sieberina* are found in most tropical countries. They have a relatively high crude protein content ranging from 12 to 30% (8). Notwithstanding, their availability and potential as an alternative source of protein for livestock is highly feasible, they are also used for tanning leather, as medicine and for reclamation of degraded lands. Hence, need for a study on the performance of growing bucks fed Gamba grass supplemented with different *Acacia* species-based concentrates. The objective of the study was to evaluate the growth performance, nutrient digestibility and nitrogen retention of growing bucks fed *Andropogon gayanus* hay supplemented with the different *Acacia* leaf meal-based concentrate.

MATERIALS AND METHODS

Study Area

The experiment was conducted at the Small Ruminant Unit, Livestock Teaching and Research Farm of the Department of Animal Science, Faculty of Agriculture, University of Maiduguri. Maiduguri is situated between latitude 11° 49'10.3"North, longitude 13° 11'45.29" East and at an altitude of 354m above sea level. The area falls within the semi-arid

zone of West Africa, which is characterized by short duration of rainy season (3-4 months) per annum and very long dry season (8-9 months). The mean ambient temperature is low in December to January ranging from 15-19°C and high in March to June, ranging from 33-44°C and low relative humidity ranging from 30-45% in August which usually lowers to above 5% in December and January. Day length varies from 11-12 hours (9).

Preparation of Experimental Materials

Five (4) different browse plants (*Acacia nilotica*, *Acacia albida*, *Acacia Senegal*, and *Acacia sieberina*) leaves were used to formulate the concentrate, which was used to supplement *Andropogon gayanus* as a basal diet. All these browses were sourced within the Maiduguri metropolis. The browse plants were sun-dried under shade for seven (7) days before the commencement of the experiment. The Gamba grass was chopped into about 2 to 4cm pieces with the aid of a forage chopper. This was done to prevent wastage and preferential selection of the feed materials by the experimental animals. Other feed ingredients, such as maize offal, rice husk, cotton seed cake, bone meal and table salt, were sourced from the Cattle Market, Gamboru, Maiduguri, Borno State. The browse plant leaves (*A. nilotica*, *A. albida*, *A. Senegal*, *A. sieberina*) and the gamba grass were sourced within Maiduguri metropolis. It was mixed with the concentrate ingredients, with each representing a treatment. Thereafter, the hay and concentrate portions were thoroughly mixed at a ratio of 60% hay

and 40% concentrate in a total mixed ration. The composition of the experimental diets is given in Table 1.

Management of Experimental Animals

A total of sixteen (16) growing bucks with an average body weight of ± 11.5 kg were used for the experiment. The bucks were sourced from the Small Ruminant Unit of the Livestock Teaching and Research Farm, Department of Animal Science, University of Maiduguri. The bucks were weighed and randomly grouped into four (4) groups and were assigned to 4 dietary treatments (*A. nolitica*, *A. albida*, *A. Senegal*, *A. sieberina*) in a Completely Randomized Design (CRD). The animals were housed in individual pens on concrete floors with full shade. Before the experiment, the bucks were dewormed using *Abendazole*® suspension (4ml/100lb)

and sprayed with acaricide (*Amitix*® 1.5 – 2ml per litter) solution one week before the commencement of the feeding trial to control *endo* and *ectoparasites* (10). Feed was provided at 8.00hrs and 14.00hrs *ad libitum*, and the leftovers were weighed the following morning before any other subsequent feeding. Drinking water was provided *ad libitum*. The pens were cleaned daily to maintain sanitation. The bucks were weighed at the beginning of the feeding trial and then fortnightly, and the changes in weight were calculated. The animals were weighed in the morning before feeding using the digital livestock weighing balance, and the feed offered was adjusted, in line with the changes in their body weights. The growth trial lasted for ninety (90) days. Then followed by a metabolism trial which lasted for 7 days.

Table 1: Composition of the Experimental Diets

Ingredients	<i>A. nolitica</i>	<i>A. albida</i>	<i>A. senegal</i>	<i>A. Sieberina</i>
	T1	T2	T3	T4
Maize offal	33	33	33	33
Rice husk	33	33	33	33
Cotton seed cake	12	12	12	12
Acacia species	20	20	20	20
Bone meal	1.5	1.5	1.5	1.5
Salt	0.5	0.5	0.5	0.5
Total	100	100	100	100

Chemical Analysis of Feeding Materials

Gamba grass hay, concentrate, diets and faeces samples were analyzed for their proximate compositions: Dry matter, Crude protein, Crude fibre, Ether extract and Ash according to AOAC, (11). Neutral Detergent Fiber (NDF), Acid

Detergent Fiber (ADF) and Acid Detergent Lignin (ADL) were determined by the Method of (12). Cellulose and hemicellulose were calculated as the difference between NDF and ADF. Metabolisable energy of the diets was estimated using the Method of Alderman (13) as follows: ME (MJ/kg DM) 11.78 +

$0.00654CP + (0.000665EE) \times 2 - CF$
 $(0.00414EE) - 0.0118A$, Where DM= Dry Matter, CP = Crude Protein, EE = Ether Extract, CF = Crude fibre, A = Ash.

Growth Performance

Feed intake (kg): Feed intake was recorded daily, that is quantity of feed given (x) minus the quantity of feed refused (y) or left over. Feed intake = feed given (x) – leftover feed (y).

Body weight gain (kg): The body weight gain of the animal was taken at the beginning of the feeding trial as initial weight and subsequently every week using a weighing balance. Daily body weight gain was calculated by dividing the weekly gain by 7 days. The difference between the initial weight and the current weight now became the weekly body weight gain of the bucks.

Feed conversion ratio (FCR): This was obtained by dividing the feed intake by weight gain.

$$\text{Feed conversion ratio} = \frac{\text{The amount of feed consumed}}{\text{Per unit weight gain}}$$

Metabolism Studies

At the end of the growth trial, three (3) bucks from each of the treatment groups were randomly selected and housed in individual metabolism crates ideal for easy collection of urine and faeces as described by (14). The bucks were maintained on the same treatment diets in the feeding trial. The animals were allowed 7 days adjustment period to the feed and crates, while 7 days was used as collection period for urine and faeces. The leftovers of the previous day's feed

were collected and weighed each morning at 8:00 am.

The total faecal output from individual animal was collected daily in the morning, weighed, mixed thoroughly and a sub-sample was taken for dry matter determination. The total faecal sample was collected over the 7 days period, bulked and sub-samples were taken to the laboratory for analysis.

The total urine output for 24 hours was collected from individual animal for a period of 7 days. This was done using graduated plastic containers containing 10ml of 0.1M H₂SO₄, which was placed under the metabolism crates. An aliquot (10%) of the daily urine output was taken from each buck, bulked and stored in a freezer at (0 °C) until required for analyses as described by (14). Apparent nutrient digestibility was calculated using the formula:

$$\text{Digestibility} = \frac{\text{Nutrient intake} - \text{Nutrient in faeces}}{\text{Nutrient intake}} \times 100$$

Cost-Benefit Analysis

The market prices of various feed ingredients, as at the time of the study, including the cost of the *Acacia species* and *Andropogon gayanus* hay were used to compute the total cost of feed consumed within the feeding period and feed cost per kilogram weight gain. This was used to determine the profitability of feeding Gamba grass supplemented with different *Acacia species* leaves using the formula:

$$\text{Cost Benefit} = \frac{\text{Improved Performance Value}}{\text{Feed Ingredient Cost}}$$

Statistical Analysis

The data was analyzed using the General Linear Model Procedure of SAS (15). The mean significant difference was compared using the Duncan's Multiple Range Test (16).

RESULTS AND DISCUSSION

Chemical composition of *Acacia* species and grass used in the experiment

The chemical composition of *Acacia* species and grass used in the experiment is presented in Table 2. The crude protein contents of *Acacia spp* leaves, 12.42 to 17.78% obtained in this study, were within the range of 12.00 to 30.00% reported by (17) and (18) for most tropical browse plants. Similar values for West African browse plants were also reported by (19) for some *Acacia* plant. In a previous study by (20), the minimum crude protein content for rumen function is 7.00 – 8.00%; while the findings of (21) reported that the minimum crude protein for maintenance is between 70.00 – 80.00 CP kg dry matter for ruminants. The fibrous fractions of different *Acacia spp* in the form of ADF (20.64 – 35.64%) and NDF (25.00 – 30.68%) were higher than 18.00% and 20.20% as reported by (22, 23 and 24). Acid detergent fibre (ADF), NDF and lignin are fibre fractions which helps in defining the feed value of forages. Lignin is the non-digestible component of a fibrous material. The

higher the lignin content of forage the lesser the quality of the forage. The chemical composition of different *Acacia spp* leaves in this study confirmed the findings of (25) that *Acacia spp* leaves are rich in nutrients.

The dry matter of Gamba hay was closed to the values (91.05% and 92.40%) obtained by (6 and 26). The CP (9.89%) obtained in this study was higher than the value (9.48%) reported by (6) but lower than the value (11.06%) recorded by (26). The value for NFE (37.41%) obtained for Gamba hay was higher than the value (25.10%) recorded by (6) but lower ($P < 0.05$) than the value (50.20%) reported by (27). The higher crude fibre and its fractions in the basal diet and its low content in the supplement are in consonance with the findings of (6 and 28). The author reported that the crude fibre and its fractions content of grasses are generally higher than those of browse plants even when harvested at the same time. The difference observed from the present study may be due to stage of plant growth and/or season of collection (29, 30), site of sampling (30, 31), and/or proportions of foliage materials sampled (29, 30). The high energy and protein values of the *Acacia spp* clearly show that it is a good supplement to a basal feed of gamba grass hay (6). These imply that various *Acacia spp* and Gamba hay will meet the nutrient composition of growing goats.

Table 2: Chemical composition of *Acacia* species and grass used in the experiment

Parameters	<i>Acacia nolitica</i> T1	<i>Acacia albida</i> T2	<i>Acacia senegal</i> T3	<i>Acacia sieberina</i> T4	Gamba
------------	------------------------------	----------------------------	-----------------------------	-------------------------------	-------

Adewuyi et al

Dry matter	94.90	94.84	95.03	95.80	91.24
Crude protein	12.42	14.91	17.78	14.06	9.89
Ether extract	3.58	3.08	2.08	3.03	2.09
Ash	7.71	9.52	7.61	7.58	7.31
Nitrogen free extract	51.69	43.43	46.39	51.13	37.41
Acid detergent fibre	20.64	25.11	21.95	20.64	35.64
Neutral detergent fibre	25.00	30.68	26.58	24.89	43.17
Lignin	7.36	9.14	7.69	7.36	12.71

Chemical composition of experimental diets fed to growing bucks

The chemical composition of experimental diets fed to the growing bucks is shown in Table 3. The results for chemical composition of the experimental diets fed to growing bucks were varied across treatments. The dry matter and crude protein contents of all the diets were above the levels considered as adequate to meet the nutritional

requirements for moderate weight gain in goats (32). According to (33), a diet with 8.00% CP was recommended for moderate live-weight gains in goats and compared to the result in this present study, all the diets had sufficient CP content. The chemical compositions of the diets were similar with the values reported by (34). These imply that the diets contained adequate dry matter and crude protein capable of supporting normal rumen functions (35).

Table 3: Chemical composition of experimental diets fed to growing bucks

Parameters (%)	<i>Acacia nolitica</i> T1	<i>Acacia albida</i> T2	<i>Acacia senegal</i> T3	<i>Acacia sieberina</i> T4
Dry matter	94.39	94.74	89.25	93.28
Crude protein	10.88	12.91	15.82	14.60
Ether extract	2.81	2.99	2.73	2.86
Ash	7.72	8.55	8.40	7.86
Nitrogen free extract	46.27	43.95	38.41	46.39
Acid detergent fibre	28.01	27.19	24.66	22.73
Neutral detergent fibre	34.44	32.93	29.25	27.60
Lignin	10.10	9.73	8.79	8.13

Growth performance of growing bucks fed Gamba grass supplemented with different *Acacia* leaf meal-based diets

The growth performance of growing bucks fed Gamba grass supplemented

with different *Acacia* leaf meal meal-based diets is presented in Table 4. Improved feed intake was observed in bucks fed diets containing *A. sieberina*, *A. nolitica* and *A. albida* compared to *A.*

senegal. The improved feed intake for these species of Acacia meal may be ascribed to palatability and acceptability of the feeds. This result was higher to the result of (36) and (34) who reported feed intake of 278 – 289 g/d and 237.79 – 330.17 g/d, respectively when Moringa leaves and Gmelina leaves were fed as sole forage or combined with legume tree leaves to growing goats. Abdu *et al.* (37) however, reported higher intake of 498.28 to 562.89 g/d when they fed complete diets with varying levels of Gmelina leaf meal. The overall result showed that different Acacia leaf meal inclusion improved performance in terms of body

weight gain and daily body weight gain. This may be attributed to higher nutrient intake, digestibility and nitrogen balance in bucks fed different Acacia spp. This finding concurred with the works of (34, 38 and 39) that reported improved body weight gain and daily weight gain when goats were supplemented with browse leaves. Although, (40) and (41) reported negative effect of high level of browse leaves in goats' diets. The authors suggested that it will be more profitable to feed browse leaves as supplements at a reduced level of inclusion in small ruminants' diets.

Table 4: Growth performance of growing bucks fed Gamba grass supplemented with different *Acacia* leaf meal-based diets

Parameters	<i>Acacia nolitica</i> T1	<i>Acacia albida</i> T2	<i>Acacia senegal</i> T3	<i>Acacia sieberina</i> T4	SEM
Initial weight (kg/b)	11.50	11.63	11.50	11.63	-
Final weight (kg/b)	13.70	13.53	13.28	13.40	0.33 ^{NS}
Total feed intake (g/b)	23131.00 ^a	23137.00 ^a	20972.00 ^b	23217.00 ^a	976.12*
Daily feed intake (g/b/d)	330.44 ^a	330.52 ^a	299.60 ^b	331.68 ^a	13.94*
Weight gain (kg/b)	2.20 ^a	1.90 ^{ab}	1.78 ^b	1.78 ^b	0.15*
Daily weight gain (g/b/d)	31.46 ^a	27.18 ^{ab}	25.36 ^b	25.36 ^b	2.15*
FCR	10.50	12.16	11.81	13.08	1.30 ^{NS}

^{ab}Means with different superscripts within row differed significantly (P<0.05), SEM = Standard error of mean, NS = Not significant, FCR = Feed conversion ratio

Apparent nutrient digestibility and nitrogen retention of Gamba grass supplemented with different *Acacia* leaf meal-based diets by growing bucks

There was significant (P<0.05) effect of different *Acacia* leaf meal-based diets on the apparent nutrient digestibility (Table 5). The observed significant (P<0.05) effect of different *Acacia* species on dry matter, acid detergent fibre and neutral detergent fibre digestibilities may be as a

result of variation in the cell wall components, stage of harvest and age of the browse leaves. The observed decreased in NDF digestibilities affirm the assertion that the escape of potentially degradable fibre substrate from the rumen, possibly resulted in a depression in NDF digestibility (42). However, Pereira *et al.* (43) found no effect of concentrate supplementation on ruminal apparent digestibility of nutrients. It is

well accepted that forage degradation in the rumen is mainly affected by the cell wall content and its degree of lignification. Lignin is indigestible and acts as a barrier limiting the access of microbial enzymes to the structural polysaccharide of the cell wall. The crude protein digestibility recorded in this study was lower than values reported by (36) and (37) who fed complete diets to Red Sokoto goats. Reduction in digestibility agreed with the report of (44) that high supplementation of tree fodder levels reduced nutrient digestibility due to increased passage rate.

There was significant ($P < 0.05$) effect of different *Acacia* species on faecal nitrogen, urinary nitrogen, nitrogen retained and nitrogen retained as % intake except nitrogen intake (Table 5). The observed result on faecal and urinary

nitrogen does agree with the findings of (45) who reported that the nitrogen concentration of faeces strongly depends on the N concentration of the diet. The reduced N retention in animals fed the different *Acacia* species may suggest that probably much of the protein is unavailable for digestion owing to formation of tannin-protein complexes. Elseed (46) however observed that supplementation of protein sources improved microbial N yield and N retention. Nitrogen intake observed in this work was not significant across treatment. It has been reported that dietary nitrogen intake influenced nitrogen losses through urine and feces (47). Positive nitrogen balance by the bucks was an indication that the nitrogen in the diets was adequate and well utilized.

Table 5: Apparent nutrient digestibility and nitrogen retention of Gamba grass supplemented with different *Acacia* leaf meal-based diets by growing bucks

Parameters	<i>Acacia</i>	<i>Acacia</i>	<i>Acacia</i>	<i>Acacia</i>	SEM
	<i>nolitica</i>	<i>albida</i>	<i>senegal</i>	<i>sieberina</i>	
	T1	T2	T3	T4	
<i>Digestibility (%)</i>					
Dry matter	60.70 ^a	56.83 ^b	55.14 ^c	54.43 ^c	0.82*
Crude protein	58.74 ^b	60.40 ^b	64.08 ^a	62.80 ^a	0.92*
Acid detergent fibre	54.22 ^a	53.15 ^{ab}	52.75 ^b	52.10 ^b	0.70*
Neutral detergent fibre	55.45 ^a	54.32 ^{ab}	52.78 ^b	52.00 ^b	0.79*
<i>Nitrogen retention (g/buck/d)</i>					
Nitrogen intake	51.26	52.59	53.38	53.35	1.38 ^{NS}
Faecal Nitrogen	14.31 ^c	14.65 ^{bc}	15.43 ^a	15.05 ^{ab}	0.23*
Urinary Nitrogen	10.16 ^c	11.12 ^b	11.99 ^a	11.98 ^a	0.20*
Nitrogen retained	26.79 ^a	26.82 ^a	25.96 ^b	26.32 ^{ab}	0.30*
Nitrogen retained as % intake (%)	52.26 ^a	50.99 ^{ab}	48.63 ^c	49.33 ^{bc}	1.01*

^{ab}Means with different superscripts within row differed significantly ($P < 0.05$), SEM = Standard error of mean, NS = Not significant

Cost-benefit of feeding growing bucks with Gamba grass supplemented with different *Acacia* species-based diets

The cost benefit of feeding growing bucks with gamba grass supplemented with different *Acacia* leaf meal-based diets is shown in Table 6. The cost-benefit of feeding growing bucks with gamba grass supplemented with different *Acacia* species-based diets is shown in Table 9. The cheapest feed cost per buck recorded for bucks *A. senegal* and cost per kg gain for bucks fed *A. nolitica* is attributed to the quantity of feed consumed and the

weight gained by the bucks fed different acacia species.

Conclusion and Application

In conclusion, the supplementation of Gamba grass with *Acacia* species not only promotes enhanced growth performance in bucks but also offers a cost-effective feeding solution for small ruminant production in Nigeria's semi-arid regions. Based on these results, all the *Acacia* species can be recommended to farmers when they are well formulated in a balanced proportion.

Table 6: Cost-benefit of feeding growing bucks with Gamba grass supplemented with different *Acacia* leaf meal-based diets

Ingredients	<i>A. nolitica</i>	<i>A. albida</i>	<i>A. senegal</i>	<i>A. sieberina</i>
Cost of feed/ kg (₦)	124.60	124.60	124.60	124.60
Total feed intake (kg)	23.13 ^a	23.14 ^a	20.97 ^b	23.22 ^a
Total feed cost/ buck (₦)	2881.20	2881.90	2612.30	2891.90
Weight gain (kg)	2.20 ^a	1.90 ^{ab}	1.78 ^b	1.78 ^b
Cost/ kg gain (₦)	1527.40	1566.10	1581.70	1775.90

REFERENCES

1. Olafadehan, O.A., Olafadehan, O.O., Obun, C.O, Yusuf, A.M., Adeniji, A., Olayinka, O.O., and Abdullahi, B. (2009). Global Economic Recession and the Challenges to Livestock Production in Nigeria. Proc. of the 14th Annual Conf. of Animal Science of Nigeria held at Ladoke Akintola University of Technology, Ogbomosho. Pp. 572-574.
2. Balewu M. A. and Bananolola F. T. (2009). Nutrient enrichment of waste agricultural residues after solid state fermentation using *Rhazopusolkjoporos*. *Journal of Applied Sciences*, 13: 695-699.
3. Njoya, A., Awa, D.N. and Chupamom, J. (2005). The Effect of a Strategic Supplement and Prophylaxis on the Reproductive Performance of Primiparous Fulbe ewes in the Semi-Arid Zone of Cameroun. *Small Ruminant Research*, 56 (1-3): 21-29.
4. Babayemi, O. J. (2007). *In- vitro* fermentation characteristics and acceptability of West African Dwarf Goats on some dry season forages. *African Journal of Biotechnology*, 10: 1260-1265.

5. Uguru, C. (2014). Nutritional potential of *Acacia (Acacia nilotica (L.) del.)* pods for growing Red Sokoto goats. PhD Dissertation submitted to Department of Animal Science, Ahmadu Bello University Zaria. Pp. 1-120.
6. Ajiji, I., Nyako, H.D. and Ashom, S.A. (2013). Performance of Yankasa rams fed *Andropogon gayanus*(gamba grass) hay supplemented with *Faidherbia albida* (Acacia) pods. *Journal of Biology, Agriculture and Healthcare*, 3(13): 137-141.
7. Ibeawuchi, J. and Tula, A. (1991). The digestibility and intake of sodium hydroxide or local alkali-treated straw by goats. *Nigerian Journal of Animal Production*, 18 (1): 101-107.
8. Jamal, S. (2007). Fancy eating mutton? It is not goat meat <http://bernama.com.my/bernama/v3>
9. NiMet (2024). Nigerian Meteorological Agency, Maiduguri.
10. Amadou, H., Dossa, L. H., Lompo, D. J., Abdulkadir, A. and Schlech, E. (2012). A comparison between urban livestock production strategies in Burkina Faso, Mali and Nigeria in West Africa. *Tropical Animal Health and Production*, 44(7): 1631–1642.
11. AOAC (2005). *Official Method of Analysis*. International, Association of Official Analytical Chemists, 24th Edition Washington D.C. USA. Pp. 200-210.
12. Van Soest, P. J., Robertson, J. B. and Lewis, B. A. (1991). Method for directory Neutral detergent fibre and Non-starch polysaccharides in relation to Animal Nutrition. *Journal of Dairy Science*, 74: 3583-3597.
13. Alderman, G. (1985). Prediction of the energy value of compound feeds. In Recent Advances in Animal Nutrition, (eds Haresign, W. and Cole, D.J.A.), Butterworth, London, England, Pp. 1-52.
14. Osuji, P. U., Nsahlai, I. V. and Khalili, H. (1993). *Feeds Evaluation*. ILCA Manual 5:ILCA, Adis Ababa, Ethiopia. Pp. 1-40.
15. SAS. (2002). Statistical Analysis Software (CD-ROM), Version 8.1, SAS Institute Inc., Cary, N.C., USA.
16. Duncan, D. B. (1955). Multiple range and multiple F-test. *Biometrics*, 11: 1-42.
17. Norton, B.W. (1998). The nutritive value of tree legumes. In: Gutteridge, R.C. Shelton, H. M. (eds). *Forage Trees legumes in Tropical Agriculture*. Tropical Grassland Society of Australia Inc., St. Lucia, Queensland.
18. Jokthan, G. E., Braimah, Y., Muhammad, I. R., Abdu, S. B. and Mohammed, R. H. (2012). Evaluating the performance of Yankasa rams fed *Acacia sayel del* (Chenchilo) leaf meal as a replacement for cotton seed cake. *Nigerian Journal of Animal Science*, 14:121-133.
19. Abdulrazak, S.A. (1995). The effects of supplementing roughage diets with leguminous tree forages on intake, digestion, and performance of crossbred cattle in Coastal lowland Kenya. Ph.D Thesis, University of Aberdeen, Australia.

Adewuyi et al

20. Leng, R.A. (1990). Factors affecting the utilization of poor-quality forages by ruminants particularly under tropical conditions. *Nutrition Research Review*,3: 277-303.
21. Meissner, H.H. (1997). Recent research on forage utilization by ruminant livestock in South Africa. *Animal and Feed Science Technology*,69: 103-119.
22. Reed, J.D., Soller, H. and Woodward, A. (1990). Fodder tree and straw diets for sheep: intake, growth, digestibility and the effect of phenolics on nitrogen utilization. *Animal Feed Science and Technology*, 30: 39-50.
23. Abdulrazak, S. A., Fujihara, T., Ondiek, J.K. and Orskov, E.R. (2000). Nutritive evaluation of some *Acacia* tree leaves from Kenya. *Animal Feed Science and Technology*, 85: 89-95.
24. Elseed, A.M.A., Amin, A.E., Khadiga, A., Abdel, A.T.I., Sekine, J. Hishinuma, M. and Hamana, K. (2002). Nutritive evaluation of some fodder tree species during the dry season in Central Sudan. United Graduate School of Veterinary Science, Yamaguchi University, Yamaguchishi 753 – 851, Japan.
25. Raimi, C.O. and Adeloje, A.A. (2022). Growth of West African dwarf goats fed *Acacia* leaves and increasing proportions of cassava pulp replacing cocoa pods. *Livestock Research for Rural Development*, 34(01):
26. Ibrahim, B.G. (2007). Supplementary feeding of cowpea vines to Yankasa sheep offered a based diet of guinea grass. Unpublished M.Tech Thesis, submitted to the Department of Animal Science and Range Management, MAUTECH, Yola. Pp 67.
27. Nyako, H.D. (2010). Utilization of Local Feed Resources for Improved Small Ruminant Production in Adamawa State. Unpublished Ph.D Thesis, submitted to the Department of Animal Science and Range Management, MAUTECH, Yola. 174p.
28. Mohammed, A.I. (2006). Performance of Yankasa Rams Feed on *Ficus sycomorus* Fodder supplemented with Different levels of maize Bran. M.Tech. Thesis, Department of Animal Science and Range Management, MAUTECH, Yola. 42pp.
29. Ben Salem, H., Abidi, S., Makkar, H.P.S. and Nefzaoui, A. (2005). Wood ash treatment, is a cost-effective way to deactivate tannins in *Acacia cyanophylla* Lindl foliage and to improve digestion by Barbarine sheep. *Animal Feed Science and Technology*, 123: 93-108.
30. Yashim, S.M. (2014). Effect of inclusion levels of fig (*Ficus sycomorus*) leaf meal in concentrate diets on the performance of Yankasa rams fed *Digitaria smutsii* hay. PhD Dissertation, Department of Animal Science, Ahmadu Bello University, Zaria, Nigeria. Pp. 1-46.
31. Makkar, H.P.S. and Becker, K. (1998). Do tannins in leaves of trees and shrubs from African and Himalayan regions differ in level and activity? *Agroforestry Systems*, 40: 59-68.
32. NRC (2007).

33. Norton, B.W. (1994). Tree legumes as dietary supplements for ruminants. In: Gutteridge, R.C. and Shelton, H.M. (editors), *Forage tree legumes in Tropical Agriculture*, CAB International Wallingford, UK.
34. Okafor, E. C. (2017). Performance of Red Sokoto goats fed inclusion levels of mixed *Gmelina* (*Gmelina arborea*) and *Moringa* (*Moringa oleifera*) leaf meal in *Digitariasmutsihay*-based diets. PhD. Thesis, Department of Animal Science, Ahmadu Bello University Zaria, Nigeria. Pp. 1-149.
35. Ahamefule, F.O., Ibeawuchi, J. A. and Agu, C. I. (2006). Comparative evaluation of some forages offered to goats in Umudike, Southeastern Nigeria. *Journal of Sustainable Tropical Agricultural Research*, 18: 79 – 86.
36. Asaolu, V.O., Binuomote, R., Akinlade, J.A., Oyelami, O.S. and Kolapo, K.O. (2011). Utilization of *Moringa oliefera* fodder combinations with *Leucaena leucocephala*, and *Gliricidia sepium* fodders by West African Dwarf Goats. *International Journal of Agricultural Research*, ISSN 1816- 4897/ DOI:IO. 3923/ ijar.2011.
37. Abdu, S.B., Hassan, M.R., Jokthan, G.E., Adamu, H.Y., Yashim, S.M. and Yusuf, K. (2012). Effect of varied inclusion levels of *gmelia* (*Gmelina arborea*) leaf meal on intake, digestibility and nitrogen in Red Sokoto bucks fed sorghum glum based complete diets. *Advances in Agriculture, Sciences and Engineering Research* 2 (2): 79–84. <http://www.ejournal.sedinst.com>
38. Fasae, O.A., Sowande, O.S. and Popoola, A.A. (2010). Evaluation of selected leaves of trees and foliage of shrubs as fodder in ruminant production. *Journal of Agricultural Science and Environment*, 10(2):36-44.
39. Fasae, O.A., Adesope, A.I. and Ojo, V.O.A. (2011). The effect of *Leuaena* leaf supplementation to maize residues on village goats" performance. *Journal of Animal and Plant Science*, 10 (2): 1276-1282.
40. Bamikole, M.A. and Babayemi, O.J. (2004). Feeding goats with Guinea grass-*veranostylo* and nitrogen - fertilized grass with energy concentrate. *Archivos de Zootecnea*, 53:13-23.
41. Okpara, O., Akporhwarho, P.O. and Okagbare, G.O. (2014). Determination of browse intake and nutrient digestibility of grazing West African Dwarf (WAD) goats fed varying levels of *Gmelina arborea* leaves as supplements in Delta state Nigeria. *International Journal of Animal and Veterinary Advances*, 6 (2): 52-57.
42. Robbles, V., Gonzalez, L.A., Ferret, A., Manteca, X. and Calsamiglia, S., (2007). Effects of feeding frequency on intake, ruminant fermentation and feeding behaviour in heifers fed high concentrate diets. *Journal of Animal Science*. Vol 85:10 2538-2547.
43. Pereira, D.H., Pereira, O.G., Dasilva, B.C., Leao, M.I., Valadares Filho, SC., Chizzotti, F.H.M. and Garcia, R. (2007). Intake and partial and total digestibility of nutrients, ruminal pH and ammonia concentration and microbial efficiency in beef cattle fed with diets containing sorghum (*Sorghum bicolor* (L.) Moench) hay

Adewuyi et al

- and concentrate in different ratios. *Livestock Science*, 107: 53-61.
44. Melaku, S., Peters, K.J. and Tegegne, A. (2004). Microbial nitrogen supply, nitrogen retention and rumen function in Menz sheep supplemented with dried leaves of multipurpose trees, their mixtures or wheat bran. *Small Ruminant Research*, 52: 25-36.
45. AL-Asfoor, H., (2010). Effects of different feeding regimes on the digestibility and faecal excretion of nitrogen, soluble carbohydrate and fibre fractions in water buffaloes kept under subtropical conditions. Dissertation presented to the Faculty of Agricultural Science, Animal Husbandry in the tropics and subtropics, University of Kassel. Accessed from http://www.uni-kassel.de/fb11/dec/research-training-group-397_en.html on 12th February, 2013.
46. Elseed, F. A. (2005). Effect of supplemental protein feeding frequency on ruminal characteristics and microbial N production in sheep fed treated rice straw. *Small Ruminant Research*, 57:11-17.
47. Badamana, M.S. and Sutton, J.D. (1992). Hay intake, milk production and rumen fermentation in British Sannen goats given concentrates varying widely in protein concentration. *Animal Production*, 54(3): 395-403.