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Effect of varied inclusion levels of *daniella oliveri* leaf meals in red Sokoto bucks on intake, digestibility and nitrogen utilisation

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Target Audience: Animal nutritionists, livestock farmers, Nomadic Fulani and Students

Abstract

The work was carried out to study the intake nutrient digestibility and nitrogen balance in Red Sokoto bucks fed varied grade levels of Daniella oliveri leaf meals (DOLM) in a complete diet. Four Red Sokoto bucks of average weight 12.5 ± 0.1kg were used in a 4 x 4 Latin Square Designs. Involving four dietary treatments (T_1, T_2, T_3 and T_4) containing 0, 10, 20 and 30% levels of inclusions of DOLM. The result of proximate composition showed that the DOLM had 32.04, 16.89 and 40.64% of CF, CP and NFE respectively. The result of the nutrients intake showed that animals fed 30% DOLM had highest ($P<0.05$) DM, CP and CF intake of 400.48, 70.82 and 44.26 g/day respectively. The result indicated that the apparent digestibility of almost all the nutrients was best in 30% inclusion level and was significantly ($P<0.05$) differed across the treatments. Animals fed 30% DOLM had highest nitrogen retention and was positive for all treatments .It can be concluded from the trial that DOLM leaves can be included in the diets of Red Sokoto buck up to 30% without adverse effect on intake and digestibility of nutrients.

Key words: Cottonseed cake. *Daniella oliveri* leaf, Red Sokoto bucks; Sorghum panicles;

Description of Problem

Increase in population growth will lead to increase in demand for animal products, hence the demand for food crops will also increase. The future hopes of feeding the millions and safe guarding their food security will depend on the demand and efficient utilization of unconventional feed resources which cannot be used as food for human but as feed for livestock [1] [2].

In Nigeria, ruminants are feed mainly on Agro-industrial by products containing large portion of ligno-cellulosic feeds such as cereals crop residues (straws and stovers), native pastures and other similar feeds. These feeds are usually poor in protein, energy, minerals and vitamins [3]. The problem of seasonal fluctuation in both quality and quantity of animal feed in the tropics calls for exploration of some these varieties of multipurpose trees and shrubs abundant all the year round in the region for their suitability as livestock feeding. Due to the non availability of pasture lands, more attention is now being given to trees, leaves and shrubs for feeding sheep and goats in most areas of the world.

Browses constitute an abundant biomass in farmlands in the tropical environment of northern Nigeria. They are commonly utilized in the wild by smallholder livestock for farmer feeding their ruminant animals. The potential of leaf meals from these tropical browse tree to yield relatively higher levels of crude protein, minerals and lower crude fiber levels than tropical grasses has also been recognized .Browses including young twigs, leaves and shoots of woody spices that are eaten by ruminants. The browses used often include Ficus species, Acacia species, *Spondias mombin*, *Daniella oliveri e.t.c.* They vary in quality and quantity from time to time and from place to place. The importance of browse plants in the survival and maintenance of ruminants cannot be overemphasized especially in the dry season as these trees and shrubs have on the average higher crude protein contents than grasses during the dry season4 [4;5]. It can be said that browse plants play important roles in bridging the forage-gap between the dry and wet seasons by playing a supplementary role in the dry matter intake of ruminants in the dry season.

Daniella oliveri is commonly known as copaiba balsam. It belongs to the family of *Fabaceae* (sub-family *caesalpinioideae*). It is an evergreen plant that grows abundantly in the bush fallows, secondary bushes and marginal lands in most of the savannah zones of Nigeria. Different parts of the plant are used for different purposes including mulching and fodder (leaves and twigs), firewood and ethno medicine (stems and root) [6].

It has received very little attention in Nigeria. Information on its nutritive value, digestibility and utilization by animal is scanty. This study was therefore designed to investigate the intake, digestibility and nitrogen utilization by bucks fed varying proportions of *Daniella oliveri leaf meal* and sorghum panicle in a complete diet.

Materials and Methods

Experimental Site

The research was conducted at Teaching and Research Farm of the Department of Animal Science. Ahmadu Bello University, Zaria. Zaria is within the Northern Guinea Savannah Zone of Nigeria, Latitude 11^0 and 12^0N and between 7^0 and 8^0E, at an altitude of 610m above sea level with a mean annual rainfall of 1150mm falling between May and October. The maximum temperature varies from 26^0C to 35^0C depending on the season while the mean relative humidity during harmattan period and the wet season are 21% and 72%, respectively [7]

Experimental Animals and their management

Four Red Sokoto bucks of average initial weight range of 12.5 ± 0.1 kg were used for the experiment. The animals were purchased from Giwa market and quarantined for three weeks in the farm and dewormed with Albendazole, Amitic was sprayed against ecto_parasites. The animals were managed intensively before they were confined to individual metabolic crates.

Experimental Feed and Design

The diets consisted of *Daniella oliveri* leaf meal, sorghum panicle, wheat offal, cotton seed cake, bone meal and common salt. *Daniella oliveri* leaf meals were included at the levels of 0, 10, 20, and 30%. Digestibility and nitrogen balance studies were carried out in a 4×4 Latin Square arrangement with 4 periods each of 10 days of adjustment periods and 5 days for collection of sample. The animals were weighed and housed individually in clean disinfected metabolism cages ideal for collection of feaces and urine. The diets were offered to the animals daily at 3.5% of their body weight. Water was offered *ad libitum* and changed every morning.

Parameters taken

Animals were allowed 10 days to adjust to the new environment. Measurements were taken for a period of five consecutive days.

Left over was weighed and recorded daily before the morning feeding.

Total feacal output was collected daily in the morning, weighed and mixed thoroughly. The total feacal sample collected over the 5 days collection was bulked and sub-sampled. Twenty percent (20%) formaldehyde was added to prevent further bacterial activity and the feacal samples were stored at - 4^0C.

A total urine output for 24 hours was collected. Plastic containers containing 10mls 0.1N H_2SO_4, were placed under the metabolic crates. Ten percent (10%) of daily urine output was taken from each buck and stored in a refrigerator for analysis.

Laboratory Analyses

Feed samples were oven-dried at 70^0C for 48 hours and milled through a 2.5mm sieve. Dry matter content of the dried feed samples and feaces were determined by drying at 60^0C for 48 hours. Nitrogen content of the feed samples and urine were determined using Kjeldahl procedure [8] . The samples were ashed by charring in muffle furnace at 500^0C for about 3 hours. Ether extract and Crude fibre of the samples were analyzed according to [8] procedure . The Acid detergent fiber (ADF) and Neutral detergent fiber (NDF) of feed samples, and feaces were analyzed according to the procedure of [9] . The calculated metabolizable energy was determined using the formula as described by [10] ; ME (kcal/kg) = 37 x % Cp + 81.1 x % EE + 35.5 x % NFE,

Statistical Analysis

Data collected during the feeding and the digestibility were subjected to one-way analysis of variance (ANOVA) procedure [11] to evaluate for significant difference among treatment means. Duncan Multiple Range Test (DMRT) was used to compare treatment means [12].

Results and Discussion

The chemical composition of *Daniella oliveri* leaf is presented in Table1. The proximate composition of the *Daniella oliveri* leaf in this study showed that the *Daniella oliveri* leaf had 95.48, 9.56, 0.8, 32.04, 16.89 and 40.64% of DM, ASH, EE, CF, CP and NFE respectively. The reported nutrient levels of *Daniella oliveri* leaf in this study were comparable to those reported by[4] and [13] that most tree leaves contained between 8–33 per cent crude protein, 1–19 per cent ether extract, 11–50 per cent crude fibre and36–66 per cent nitrogen free extract.

The likely differences noticed in the chemical composition of the *Daniella Oliveri* leaf in this trial concurred with the reports of several authors on different forage legumes [14],[15] and [16] who reported that environmental differences, variation in relation to a stage of growth of the plants and type (i.e. twigs leaves or soft stem) of foliage sampled, site of sampling and/or proportion of foliage materials sampled and soil influence the chemical composition and digestibility of forages.

However, the *Daniella oliveri* leaf in the present study had CP contents above 8%, a minimum requirement for ruminants. According to [17] feed containing less than 8% CP cannot provide the minimum ammonia levels required by rumen micro organisms to support optimum activity. Thus, *Daniella oliveri* leaf is beneficial and therefore can be used for supplementing the low protein pastures and crop residues especially during the dry season.

Table 2 shows the nutrient composition of the experimental diets. The levels of Crude Fibre (CF) and Crude protein (CP) increased linearly with increasing level of *Daniella oliveri*. leaves In contrast, the levels of NFE decreased with increasing levels of *Daniella oliveri* leaves in the diets. The concentration of CF increased with increasing levels of

Daniella oliveri leaves in the diets. This could be attributed to the high cell wall constituents usually present in leaf meals . Results on proximate composition showed that crude protein content (15.38-15.70% CP) of the experimental diets were within the values of 15-18% CP recommended by [18] for growing small ruminants.

Table 3 shows the result of the nutrient intake. The inclusion of *Daniella oliveri*_dry leaves showed that the bucks in T_4 had the highest (P<0.05) dry matter (400.84g/day) intake which significantly differed compared to others. The bucks in T_1 had the least dry matter intake (361.10g/day). There was no significant difference (P>0.05) between T_1 and T_2 (361.10 and363.55 g/day respectively) in dry matter intake. The increase in nutrients intake from T_1 to T_4, may be as a result of an increase in the level of *Daniella oliveri leaves* in the feed which may lead to the increase in the CP contents of the diets, This apparent effect of increased dietary Crude protein agreed with the reports of [16] who demonstrated the influence of dietary crude protein or nitrogen level as well as palatability of the *Daniella oliveri*_which is in agreement with the report of [15] who stated that it was accepted to goat.

The results of nutrient digestibility coefficient are presented in Table 4. The results Showed that the diets containing 30% inclusion level of *Daniella oliveri leaf* had highest (P<0.05) crude protein and crude fibre of 82.66% and 81.26% respectively and were statistically different (P<0.05). Bucks in control diet had the least of almost all the nutrients digested. The most probable explanation for this phenomenon is in the fact that bucks in the diet contained a highest percentage of *Daniella oliveri* leaves which might result in high palatability and better utilization of the nutrients by the bucks.

The crude protein digestibility (CPD) was significantly (P<0.05) different across the treatments.T_4 recorded highest crude protein (82.66%), followed by T_3 (81.85%) and the least were obtained in T_2 and T_1 (69.17 and 60.07% respectively). it is generally expected for supplementations to increase digestibility of DM and nutrients. The significant (p<0.05) increase in the protein digestibility of diets containing 30% inclusion of *Daniella oliveri* dry leaves as observed , may be attributed to the Palatabilty of The Plant which perhaps had low amount of tannins.. Tannins are complex phenolic polymers, which can affect the voluntary intake of a plant and bind to proteins and carbohydrates resulting in reduction in digestibility of these macromolecules when are taken much and thus inhibition of microbial growth [15]. Tannins have been known to cause decreased feed consumption in animals, bind dietary protein and digestive enzymes to form complexes that are not readily digestible [19]; [15]). They also cause decreased palatability and reduced growth rate.

The results of nitrogen intake are presented in Table 5. The results showed a significant (P<0.05) increase in nitrogen intake across the treatments. The increase in nitrogen intake may be as a result of increasing level of *Daniella oliveri* dry leaves. The result of the faecal nitrogen was significant (P<0.05) across the treatments. The significant high urinary N observed in T_4 (2.96g/day) can be explained by the fact that excess ruminal ammonia was absorbed and excreted in the urine in the form of urea [20]. Bucks FED 30% level of inclusion of *Daniella oliveri* had the highest nitrogen balance (55.86g/d) and absorption (67.85g/day) compared with other treatments. This is in agreement with the report of [15] that nitrogen retention depends on good digestibility of nutrients and / or utilization. In some cases this effect is sufficient to maintain an adequate N balance [21].

Conclusion and Application

This study revealed that inclusion of

1. 30 % *Daniella oliveri* dry leaves in complete diet could successfully improve the performance of goat. At this level feed intake crude, protein digestibility and nitrogen retention values observed were better than those of control and other treatment diets. It was therefore concluded that
2. 30% *Daniella oliveri* dry leaves inclusion in complete diet for goat can increase daily feed intake (400.84g/day)crude protein and crude fibre of digestibility coefficients of 82.66% and 81.26% respectively and Nitrogen balance 55.86g/day.

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Table 1: Chemical composition of *Daniella 0liveri* dry leaves

Nutrients	Percentage
Dry matter	95.48
Organic Matter	85.92
Crude protein	16.89
Crude fibre	32.04
Ether extracts	0.87
Ash	9.56
Nitrogen free extracts	40.64
ME (Kcal/kg)	2118

Table 2: Chemical composition of the experimental diets

	Inclusion levels of *Daniella oliveri* dry leaves			
Parameters	T1 (0%)	T2 (10%)	T3 (20%)	T4 (30%)
Dry matter	94.60	94.28	94.13	94.42
Crude protein	15.38	15.66	15.67	15.69
Crude fibre	8.20	8.94	9.16	10.43
Ether extract	3.85	3.51	3.45	3.64
Ash	9.17	9.60	9.68	9.02
Nitrogen free extract	64.40	62.89	62	60.22
ME(Kcal/kg)	3100	3045	3033	3022

Table 3: Nutrient intake of Red Sokoto Bucks fed graded levels of *Daniella oliveri dry leaves*

Parameter (g/d)	Percent levels of *Daniella oliveri* leaf inclusion				
	0%	10%	20%	30%	SEM
Dry matter intake	361.10[c]	363.55[c]	382.99[b]	400.84[a]	4.33
Crude protein intake	54.92[d]	58.07[c]	63.83[b]	70.82[a]	0.70
Crude fibre intake	31.31[a]	34.46[ab]	37.26[ab]	44.26[a]	0.41
Ether extract intake	13.85[c]	13.53[c]	14.03[b]	15.44[a]	0.14
Ash intake	35.01[c]	37.01[b]	39.38[a]	38.27[b]	0.43
Nitrogen free extract intake	245.93[c]	242.51[c]	252.32[a]	247.72[b]	3.04
Organic matter intake	326.06[c]	326.53[c]	343.60[a]	332.90[b]	4.70

[abc] Mean values with different superscripts within a row differed significantly ($P<0.05$)
SEM = Standard Error of Mean,

Table 4: Nutrient digestibility of Red Sokoto Bucks fed graded levels of *Daniella oliveri dry leaves*

	Percent level of *Daniella oliveri l*eaves inclusion				
Parameters (%)	0%	10%	20%	30%	SEM
Dry matter	54.07[c]	50.38[d]	64.58[a]	63.60[b]	0.85
Crude protein	76.52[c]	72.45[d]	81.85[b]	82.66[a]	0.43
Crude fibre	69.01[c]	69.17[c]	79.30[b]	81.26[a]	0.50
Ether extract	85.49[c]	81.42[d]	88.34[a]	86.37[b]	0.5
Nitrogen free extract	46.49[ab]	40.16[b]	54.09[a]	48.95[ab]	1.14
Organic matter	51.89[c]	43.16[d]	62.91[b]	63.19[a]	1.03

[abcd] Mean values with different superscripts within a row differed significantly ($P<0.05$)
SEM = Standard Error of Mean.

Table 5: Nutrient balance of Red Sokoto Bucks fed graded levels of *Daniella oliveri* dry leaves

	Percent level of *Daniella oliveri leaves* inclusion				
Parameters	0%	10%	20%	30%	SEM
Nitrogen intake	54.80[c]	58.07[c]	63.83[b]	70.82[a]	0.69
N losses in feaces	13.74[b]	15.21[a]	11.42[c]	11.99[c]	0.22
N losses in urine	2.28[d]	2.42[c]	2.92[b]	2.96[a]	0.09
Total N losses	16.03[b]	17.63[a]	14.36[d]	14.96[c]	0.21
N balance	38.76[d]	40.43[c]	49.47[b]	55.86[a]	0.72
N absorbed	52.51[c]	55.64[c]	60.91[b]	67.85[a]	0.80
N retained as % of intake	70.03[c]	67.74[d]	77.06[b]	78.50[a]	0.58

[abc] Mean values with different superscripts within a row differed significantly ($P<0.05$)
SEM = Standard Error of Mean.