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Nutrient Intake and Digestibility of Red Sokoto Bucks Fed Varying Levels of Gmelina (*Gmelina arborea)* Leaf Meal.

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Target audience: Farmers, nutritionist, extension agents

Abstract

An experiment was conducted to evaluate dry matter intake, total tract digestibility and nitrogen balance by red Sokoto bucks fed varying levels of Gmelina arborea leaf meal (GLM). Diet 1 devoid of GLM served as the control. Diets 2, 3 and 4 had GLM supplemented at 10, 20, 30% levels, respectively. A 4X4 Latin square design arrangement was employed for the study that lasted for 21 days. Animals fed 10 and 20% Gmelina arborea diets had statistically (P>0.05) similar dry matter intake (442.20 and 427.80g/day, respectively) and were significantly higher (P>0.05) than values obtained for animals fed 30% level of GLM inclusion. Organic matter intake (OMI) were statistically similar and higher (P<0.05) at 0 and 10% inclusion levels of GLM, while 20 and 30% inclusion level had the lowest (389.71 and 388.52g/d). Crude protein intake (CPI) at 10 and 20% GLM inclusion levels were similar and significantly (P<0.05) higher, followed by control and the least was observed in 30% GLM inclusion level. Dry matter digestibility (DMD) was significantly (P<0.05) different across the dietary treatments, with 10% inclusion level being higher, followed by 20, and 30%. N retention differ (P<0.05) significantly, at 10% GLM inclusion had (22.93 g/day), followed by the control (18.88g/day), which significantly declined with increasing level of GLM (18.74, 12.12 g/day) at 20 and 30 % inclusion level, respectively. N observed was significantly (P<0.05) different, diet with 10% GLM had high observed N (39.97g/day) and decreasing at 20 and 30% GLM (36.86 and 37.96g/day). N retention as percent of intake followed similar pattern. From the result of this study, it can be concluded that inclusion of GLM at 10% had no adverse effect on intake and nutrient digestibility in goats

Keywords: Buck, digestibility, *Gmelina arborea*, maize cobs, red Sokoto bucks

Description of Problem

Feed scarcity especially during the dry season has always been a serious problem to ruminant livestock production in Nigeria (1). It was reported by (2) that during the dry season the quality and quantity of natural range and crop residues resources are greatly reduced due to termites attack and widespread bush fires.

The decrease in the nutritional quality of natural forages during the dry season underscores the importance of supplementary feeding for animals raised

under the extensive system of management. Various studies have been conducted on the need for feed supplementation during the dry season (3, 4, 5). Supplementary feeding with concentrate mixture rich in protein helps to maintain live weight gain at the end of the rains especially during the dry season (6).

Supplementation helps in improving the animal's body weight. The use of oil seed cakes such as cotton seed cake and groundnut cake as supplement are expensive to purchase by small holder farmers. This situation is well summarized by (7) who reported that the basic problem concerning any livestock improvement in Nigeria is not one of the first instances for geneticists, but for the animal nutritionists. As such, the evaluation of the feeds used for the nutrition of our domestic animals is a matter of very great importance this problem is therefore given much emphasis.

The foliage from browse trees and shrubs in the semi-arid and sub humid zone are important source of feed for both domestic and wild ruminant animals (8). Tree leaves have a high protein content (18-26%), and some of them have low rates of degradability in the rumen (9). *Gmelina arborea* a tropical flowering deciduous tree is one of these browse plants. Osakwe and Udeogu (10) reported that *G. arborea* had CP of 10.05%. While Akinjagunla *et al.* (11) also reported that *Gmelina* leaves have higher nutrient composition (80.58% dry matter, 12.59% crude protein and 0.45% Ca). *Gmelina* fruits have 78.49 % DM, 5.51 % CP, and 0.29 % Ca. (12). According to Little (13), the leaves are harvested as fodder for animals.

Feeding of complete diets ensures mixing of the required proportions of roughages to concentrate into a uniform blend to supply adequate and balanced nutrients and avoid individual preferences. The use of crop residues, agro-industrial by-products in formulating complete diet for ruminants were seen to improve feed intake, nitrogen balance and live weight gain (14). Experiments conducted by Prakash *et al*., (15) to determine the performances of animals fed complete diets and conventional feed separately, showed significantly higher feed intake, nutrient digestibility and body weight gain in animals fed complete diet as compared to conventional feeds. Therefore the objectives of this study are to assess the effect of varied inclusion levels of *Gmelina arborea* leaf meal in complete diet on intake, digestibility and nitrogen balance in Red Sokoto bucks.

Materials and methods

Location of study

The experiment was conducted in Animal Science Departmental Teaching and Research Farm, Ahmadu Bello University, Zaria. The site is located in the Northern Guinea savanna ecological zone of Nigeria and receives an annual rainfall of about 1100mm, spread from April to October and the temperature range from 12-28^0 C during cold (harmattan) season and 20-30^0 C in hot

seasons. The relative humidity of 75% during the raining season and 21% during the dry season (16)

Processing of G. arborea leaf meal

Gmelina arborea leaves were harvested in March, 2011. Branches of *Gmelina* tree were harvested manually and placed in a shed with concrete floor. Leaves were allowed to air-dry on the branches and then removed by carefully beating the branches with sticks. The leaves were then ground and kept in bags until when required for the feed formulation.

Experimental diets

The experimental diets were 40% maize cobs base complete diets with 0, 10, 20 and 30% inclusion levels of *G. arborea* leaf meal. Other ingredients in the complete diet were maize offal, cotton seed cake, salt and bone meal. The ingredient composition of the experimental diets is presented in Table 1.

Table 1. Percent composition of feed ingredients

	Inclusion levels of *G. arborea* leaf meal (%)			
Parameter	0	10	20	30
Maize offal	25.8	25.7	19	15.7
Cotton seed cake	32.24	22.3	19	12.3
Gmelina leaf meal	0	10	20	30
Maize cob	40	40	40	40
Salt	0.5	0.5	0.5	0.5
Bone meal	1.5	1.5	1.5	1.5
Total	100	100	100	100

Experimental design and animals

Four Yankasa bucks with average body weight of 13.4 kg were used to study the feed intake, total tract digestibility and N-retention of four complete maize cob base diets with varied level of *Gmelina arborea* leaf meal. The experiment was complete randomized design in a 4x4 Latin square design. The experiment was conducted in four periods of 21 days each. In each experimental period, animal in each treatment were allotted to individual metabolism cages for 14-days adaptation period followed by 7-days nutrient intake.

Feeding and management of experimental animals

The complete diets were offered twice a day at 08:00hrs and 16:00hrs. Water and mineral salt licks were made available to all animals. Before the commencement of the experiment, the animals were treated with Ivomec (Ivomectin®) against both internal and external parasites.

Chemical analysis

Feed and fecal samples were dried in an oven at 105°C for the determination of dry matter. Total N of feed, feces and

urine was analysed by the Kjeldahl Procedure as outlined by (7). The ash content of feed and feces was determined by combustion in a furnace at 500°C, following the Procedure of (17). Organic matter was assumed to be the result of subtracting the percentage of ash from 100.

Statistical analysis

All data collected on feed intake, nutrient digestibility and nitrogen balance were calculated and subjected to statistical analysis of variance ANOVA using (18) Procedure. Treatment means that were significant, Duncan Multiple Range Test (19) was used to compare the treatment means.

Results and discussion

Experimental diets

The results of the chemical composition of complete diets, *G. arborea* leaf meal and maize cobs are presented in Table 2. The crude protein (CP) of GLM (10.25%) reported in this study is however lower than the 34% CP reported by (20), but similar to 11.5% reported by (21). The variation in the CP values for the GLM observed could be due to the stage of harvest. This agreed with (22) who reported that environmental differences influence the chemical composition and digestibility of forages grown in different areas and harvested at the same age of maturity. The crude fiber content is lower than 30.46% CF reported by (10), but in agreement with (23), who reported that most browse leaves have high CF content, due to its high cell-wall constituents. For the maize cob, the CP level (8.38%) was higher than 2.2% CP reported by (24). The difference could be attributed to the varietal differences.

Table 2. Chemical composition of experimental diets, Gmelina arborea leaf meal and maize cob

Parameter	Inclusion levels of *G. arborea* leaf meal (%)				GLM	Maize cob
	0	10	20	30		
Dry matter	93.20	93.51	93.64	93.41	92.74	93.00
Organic matter	86.13	85.62	84.91	81.13	81.44	88.46
Crude protein	13.06	13.13	13.94	13.38	10.25	8.38
Crude fiber	29.90	23.00	24.00	29.37	13.33	34.45
Ash	7.07	7.89	8.73	12.28	11.30	4.54
NFE	52.00	58.65	50.01	55.69	61.79	49.69

The proximate composition of the experimental diets is presented in Table 2. The 13% CP content of the complete diets in this study were above the requirements level for moderate weight gain in goats (25). The higher crude fiber obtained from the control treatment could be attributed to the high inclusion levels of cotton seed cake in the control diet. The crude fiber level increased with increased in the level of GLM inclusion. This could be attributed to high cell-wall

constituents of browse leaves, as reported by (23).

Nutrient intake

The result of nutrient intake is presented in Table 3. There was no significant (P>0.05) difference in total dry matter (DM) intake with increase in the level of GLM inclusion. This observation is in tandem with the report of (26). *Gmelina* leaves appeared to increase the goats appetite at 25 % level of inclusion. However, there was a depression in DM intake at 50 % level of inclusion. The high daily dry matter intake observed in this study is in agreement with the report of (27). It therefore showed that *Gmelina* leaves used in feeding the animals were probably more palatable and acceptable to the animals.

Table 3. Nutrient intake of Red Sokoto bucks fed Inclusion levels of *Gmelina arborea* leaf meal in Maize cobs based complete diets

Parameters	Inclusion levels of *G. arborea* leaf meal (%)				SEM
	0	10	20	30	
Dry matter	442.70	442.30	427.80	421.85	32.34
Organic matter	409.12	404.98	389.71	3882.52	29.61
Crude protein	62.80	62.10	62.04	61.55	4.65^{NS}
Crude fiber	108.12^{b}	108.79^{b}	135.10^{a}	142.03^{a}	9.33*

^{a,b,c} Mean values with different superscripts within a row differ significantly (P<0.05) SEM standard error of mean * significant at 0.05

Animals fed diets 3 and 4 were significantly (P<0.05) higher in CPI 135.10 and 142.03g/day, respectively, than animals fed diet 1 and 2 (108.12 and 108.79g/day), respectively. The higher CFI observed with an increase in GLM inclusion level may be attributed to the high CF content of the complete diets (Table 2).

Nutrient digestibility

Nutrients digestibility of the various diets fed to red Sokoto goats are presented in Table 4. Dry matter digestibility (DMD) and Organic matter digestibility (OMD) were not significantly (P>0.05) different across dietary treatments. However, there was significant (P<0.05) difference in the digestibility of CP. The result obtained showed that with an increase in level of G. *arborea* there is a decrease in CP content of the diet.

Table 4. Nutrient digestibility by Red Sokoto bucks fed Inclusion levels of Gmelina aborrea leaf meal in Maize cobs based complete diets

Parameters	Inclusion levels of *Gmelina abore*a *leaf meal*				SEM
	0	10	20	30	
Dry matter	47.64	46.92	43.35	42.17	3.66^{NS}
Organic matter	53.27	52.72	49.85	47.62	3.38^{NS}
Crude protein	62.89^{a}	64.15^{a}	58.31^{b}	58.06^{b}	2.56*
Crude fiber	72.79^{a}	70.09^{a}	62.40^{b}	61.27^{b}	2.14*

[a,b,c] Mean values with different superscripts within a row differ significantly (P<0.05) SEM standard error of mean * significant at 0.05

Animals fed diets 1 and2 had significantly (P<0.05) better crude protein digestibility (CPD) of 62.89 and 64.15%, respectively, while animals fed diets 3 and 4 had significantly (P<0.05) lower CFD 58.31 and 58.06%, respectively. The reduction in the CP and CF digestibility with increase in GLM inclusion may be attributed to the increase in crude fiber in the diets. Lascano and Palacios (28) observed that intake and digestibility of tropical dry season grasses by goats and sheep tend to be low due to high fibre.

Nitrogen balance

The result of nitrogen balance showed no significant (P>0.05) difference in total N intake across dietary treatments, (Table 5). Animals fed the control diet had a significantly (P<0.05) higher N intake of 62.80g/day, followed by those on diets 4, 2 and 3 with 61.55, 62.10 and 62.04 g/day, respectively. The lower N intake observed on animals fed diet 3 compared to those on diet 4 could be due to increase in the level of *Gmelina arborea*.

The result of the fecal N and urinary N output showed a significant (P<0.05) decrease with an increase in the level of G. *arborea* inclusion in the diets. Nitrogen retention is considered as the most common index of the protein nutrition status of ruminants. The N retention obtained in this study showed a significant (P<0.05) difference across the dietary treatments. Animals fed diet 1 had the highest N retention (37.81g/day), followed by those on diet 2 (33.17g/day), while those on diets 3 and 4 were statistically similar and lower with 31.63 and 31.1g/day, respectively.

Table 5. Nitrogen balance in Red Sokoto bucks fed Inclusion levels of *G. arborea* leaf meal in Maize cobs base diets

Parameters	Inclusion levels of *G. arborea*				SEM
	T1(0)	T2(10)	T3(20)	T4(30)	
Nitrogen intake	62.80	62.10	62.04	61.55	6.65^{NS}
Fecal nitrogen	25.59^{a}	25.18^{a}	22.74^{a}	20.70^{b}	1.54*
Urinary nitrogen	6.19^{a}	5.25^{b}	4.35^{c}	4.28^{c}	0.33*
Nitrogen observed	42.10	39.37	36.86	35.96	3.81
Nitrogen retention	37.81^{a}	33.17^{b}	31.63^{c}	31.61^{c}	3.73*
N retention as % of intake	56.16^{a}	52.99^{a}	51.26^{a}	48.89^{b}	3.18*

^{a,b,c} Mean values with different superscripts within a row differ significantly (P<0.05) SEM standard error of mean * significant at 0.05

Conclusion and recommendations

1 *Gmelina arborea* leaf meal (GLM) can be included in maize cob based complete diet for small ruminants.

2 Dry matter and organic matter digestibility were not significantly affected by GLM inclusion, while crude protein and crude fiber digestibility were improved up to 10% GLM.

3 Up to 10% level of GLM can be included in maize cob based complete diet for the Red Sokoto bucks.

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