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Intake and Nutrient Utilization of West African Dwarf Goats Fed Mango (*Mangifera indica),* Ficus *(Ficus thionningii),* Gliricidia *(Gliricidia sepium)* Foliages and Concentrates as Supplements to Basal Diet of Guinea Grass (*Panicum maximum*)

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Abstract: Twelve West African dwarf goats balanced for sex and weight were fed *Mangifera indica* (MI), *Gliricidia sepium* (GS), *Ficus thionningii* (FT) foliages and concentrate as supplement to basal diet of *Panicum maximum* (PM) to evaluate their intake, growth rate, digestibility and nitrogen balance. Goats were assigned to dietary treatments in a completely randomized design with four animals per treatment. The dietary treatments were as follows; mango, panicum and concentrate (T_1), Ficus, panicum and concentrate (T_2) and gliricidia, panicum and concentrate (T_3). The legumes, grass and concentrate (13.30% CP) were fed in ratio 1:1:3 for 105 days. Diets supplemented with mango leaves (T_1) had the best dry matter (DM) intake (98.12 g/kgW0.75) and was significantly ($p<0.05$) different when compared to T_2 and T_3. The liveweight gain (g/day) was highest in diet supplemented with mango leaves and significantly differ from the other treatments. Significant differences did not occur in the nutrient digestibility among dietary treatments. The nitrogen retention in goats was best in the gliricidia supplemented diets , T_3 (57.24%) and was followed by mango leaves, T_1 (42.95%), the least was in *Ficus thionningii* leaves, T_2 (14.87%). The results showed that mango leaves are palatable and acceptable to goats. When fed in addition to concentrate as supplement to guinea grass (*Panicum maximum*) leads to increase dry matter intake, liveweight gain and nitrogen utilization.

Key words: *Mangifera indica* · *Ficus thionningii* · *Gliricidia sepium* · nutrient digestibility · WAD goats

INTRODUCTION

A major constraint to livestock production in developing countries is the scarcity and fluctuating quantity and quality of year round forage supply. Dixon *et al.*, [1] reported that during the dry season the natural pastures and crop residues available for animals after crop harvest are usually fibrous and devoid of most essential nutrients which are required for improved microbial fermentation and improved performance of host animal. This manifest in loss of weight and condition, reduced reproduction capacity and increase mortality rate.

With increasing demand for livestock products as a result of rapid growth in the world economies and shrinking land area, future hope of feeding the millions of people and safeguarding their food security will depend on the better utilization of non-conventional feed resources [2].

The inclusion of multipurpose tree legumes like *Gliricidia sepium*, *Ficus thionningii* among others is one of the ways of improving the utilization of low quality roughages. Ficus plants are emerging as common domestic trees as they are raised in traditional home gardens in many parts of Nigeria. They are ever green and could be used as potential source of forage for ruminant livestock year round. Ficus species belong to the family Moracea and are often distinguished by their characteristic root growing from the branches [3]. *Ficus thionningii* contain 14.75-20.50% CP [4].

Mango is native to South Asia. In south-western Nigeria, apart from the usefulness of the fruits, the foliage has medicinal importance to humans. It could be used as potential source of forage to ruminant since they are ever green all year round.

Gliricidia sepium foliage has been identified as one of the fodder legumes that promote rumen ammonia production and liveweight gain of animals.

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The objective of present study is to evaluate the feed intake, weight gain, nutrient digestibility and nitrogen utilization in goats fed with the foliages of *Gliricidia sepium*, *Mangifera indica*, *Ficus thionningii* and concentrate as supplement to basal diets of *Panicum maximum*.

MATERIALS AND METHODS

Housing management: The present study was carried out at the dairy unit of the Teaching and Research farm, University of Ibadan. The goats were housed in open sided, well-lighted and adequately ventilated building with slightly sloppy concrete floor. The house was demarcated into twelve individual pens and disinfected with Izal solutions before the animals arrived. The concrete floor was covered with 5 cm layers of wood shavings to absorb urine and for easy removal of faeces.

Animal management: Twelve growing West African dwarf (WAD) goats with average initial body weight (BW) of 6.50±0.18 kg comprising of six bucks and six does were used. The were purchased at a local market in Saki about 150 km from Ibadan. On arrival, the goats were given prophylactic treatments. Ivermectin, Oxytetracycline and vitamins were given at the rate of 1 mL per 10 kg body weight by intramuscular route. Goats were drenched with Albendazole at the rate of 1 bolus/40 kg BW. Prophylactic treatment lasted 21 days. The pens were cleaned daily and wood shavings was changed fortnightly. Goats were fed *Panicum maximum* and maize crop residue during the 21-day adjustment period.

Experimental feed: The foliages of *Gliricidia sepium*, *Ficus thionningii* and *Mangifera indica* were harvested from mature trees around the Teaching and Research farm of the University of Ibadan. The *Panicum maximum* was harvested at the pre-anthesis stage and manually chopped into small sizes of 3 cm before to the animals. The composition of the concentrate feeds are as followed; maize 10, wheat bran 30, palm kennel cake 20, corn bran 30, ground nut cake 5, bone 4, premix 0.5 and salt 0.5%, respectively.

Feed intake and weight gain: The goats were weighed before the commencement of the study. They were balanced for weight and sex and randomly allocated to the three dietary treatments in a Completely Randomized Design. Each treatment was replicated with four animals. Forage and concentrate were fed at 1 and 4% BW, respectively. *Panicum maximum*, fodder legume and concentrate were fed at proportions of 20:20:60. Forage and concentrates were fed to goats at 09:00 h and 16:00 h, respectively. Provisions were made for daily feed allowance of 10% above previous day's intake. Clean drinking water was given daily. The daily feed intake was determined by the difference in weight in the quantity of feed provided and the residue of the previous day's feed or leftovers. Weighing of the goats was carried out weekly before the morning feed was offered. Sub-samples of feed offered were oven dried at 65°C to constant weight for dry matter determination. They were milled using the Christy Norris hammer mill fitted with a 2 mm sieve. Dried samples were stored in air-tight bottles for analysis.

Digestibility and nitrogen balance: Three goats were used for digestibility and nitrogen balance per treatment. The goats were transferred to metabolic cages with facilities for separate collection of urine and faeces. After a week adjustment period, quantities of feed offered and refusals as well as that of the faeces and the volume of urine voided were determined daily for 7 days. Ten percent of faecal sample were taken and oven dried at 65°C for three days for dry matter determination. Volatization of nitrogen from urine was prevented by introducing 10 mL of 10% H_2SO_4 into the urine collection container. 10% of daily urine voided was taken and stored in a deep freezer.

Blood collection: Blood samples were collected at the end of the feeding trial through jugular vein puncture into EDTA (Ethylene Diaminetetra Acetate Acid) bottle. This was to determine the packed cell volume (PCV), red blood cell (RBC), white blood cell (WBC) and their differential counts as described by Wintrobe [5].

Chemical analysis: The dry matter, crude protein and ash content of feeds were analysed according to the official method of analysis [6]. The Neutral detergent fiber, acid detergent fibre and lignin were determined by method of Van Soest *et al*., [7].

Statistical analysis: Data from parameters collected were analysed in a Completely Randomized Design using the procedure of SAS [8]. Significant treatment means were compared using the Duncan Multiple Range F-Test [9].

RESULTS AND DISCUSSION

Table 1 shows the proximate composition of the forages and concentrate. The composition of the *Panicum maximum* in the present study corresponds with reported

Table 1: Proximate composition of *Panicum maximum*, concentrate and foliages of *Mango indica*, *Ficus thionningii* and *Gliricidia sepium*

Constituent (% DM)	Guinea grass	Mango leaves	*Ficus thionningii* leaves	*Giliricidia sepium* Leaves	Concentrate
Dry matter	12.87	20.44	14.93	19.58	89.00
Crude protein	8.00	20.38	24.88	29.31	23.40
Neutral detergent fibre	42.70	43.14	30.40	31.45	26.10
Acid detergent fibre	50.20	51.48	38.45	35.14	31.40
Acid detergent lignin	2.97	2.47	2.38	2.43	2.83
Organic matter	12.80	9.28	15.79	13.60	37.44
Ether extract	1.59	0.48	3.30	3.00	2.58
Ash	15.00	10.00	17.31	6.67	3.92
Nitrogen free extract	13.69	57.69	44.23	49.02	66.70

Table 2: Performance characteristics of WAD goats fed *M. indica*, *F. thionningii* and *G. sepium* leaves and concentrate as supplements to *P. maximum*

Variables	Mango leaves + *P. maximum* + concentrate (T_1)	*F. thionningii* leaves + *P. maximum* + concentrate (T_2)	*G. sepium* leaves + *P. maximum* + concentrate (T_3)	SE
DM intake (g/day)	78.44 (15.3%)	75.52 (16.9%)	73.70 (17.3%)	
P. maximum	127.60 (25.0%)	-	-	
Mango leaves	-	-		
G. sepium leaves	-		68.82 (16.1%)	
F. thionningii leaves		73.34 (16.5%)		
Concentrate	305.08 (59.7%)	296.64^b (66.6%)	284.52^c (66.6%)	
Total DMI (% live weight)	511.18^a (100%)	445.50^b (100%)	427.04^c (100%)	
DMI (% Live weight)	7.13^a	6.75^b	6.47^c	
Nutrient intake g/$W_{kg}^{0.75}$/day				
Dry matter	98.12^a	93.59^b	93.24^b	2.09
Crude protein	23.67^a	26.84^a	22.49^a	0.22
Neutral Detergent Fibre	38.40^a	31.00	30.92^b	2.50
Acid Detergent Fibre	45.87^a	37.43^b	36.53^b	6.87
Acid Detergent Lignin	3.23^a	2.93^a	2.89^a	0.39
Initial weight (kg)	5.30	5.20	5.60	
Final weight (kg)	9.05	8.00	7.60	
Live weight gain (g/day)	44.64^a	33.33^b	23.81^c	7.14
Metabolic weight ($W_{kg}^{0.75}$)	4.38^a	4.12^a	4.12^a	0.09

a, b, c = means on the same row with different superscripts are significantly different ($p>0.05$)

values of FAO [10] and Bamikole *et al*., [11]. These authors reported crude protein (7.20-8.25%) and dry matter (17.89-71.29%).The values of proximate composition obtained for mango corresponds to the earlier report of Mecha and Adegbola [12], who reported that mango leaves contained 19.2 % dry matter and 10.1% crude protein. The crude protein (20.38%) obtained is above the value sufficient to serve as nutritious browse leaves for ruminants [13]. The composition of *F. thionningii* used in the present research was similar to values reported Bamikole *et al.,* [4, 11]. The authors showed that *F. thionningii* contained 17.01 to 30.64% dry matter and crude protein. The values of proximate composition for Gliricidia sepium obtained in the present study is in agreement with earlier report Aye [14] and Folayan [15].

Significant ($p<0.05$) differences occurred among the treatment means. The value of dry matter intake and crude protein (g/kgW0.75) reported in present research were higher than values reported bye Omojola *et al*., [16] and Bamikole and Babayemi, [17]. 25% DMI of animals fed T_1 was obtained from mango leaves compared with approximately 16 intake from either the *Ficus thionningii* or *Gliricidia sepium* leaves. This suggested that the mango leaves were probably more palatable and more acceptable to goats than the other two browse leaves.

There was higher dry matter intake (g/day) as percent body weight ranged between 6.47-7.13. Lower percentages (1.82-4.29%) have been reported by Omojola *et al.*, [16]; Devendra [18] and Morand-Fehr [19], while higher values of dry matter intake of 9% body weight were obtained for Red Sokoto goats [20]. Neutral detergent fibre obtained (38.40%) was in agreement with values reported by Bamikole and Babayemi [17]. The liveweight gain of animals fed mango leaves was the highest (44.64 g/day) when compared to other treatments. The lowest value (23.81 g/day) was observed in diet supplemented with Gliricidia leaves, this was due to the poor acceptability of the forage (Table 2).

Table 3: Digestibility of WAD goats fed *M. indica*, *F. thionningii* and *G. sepium* leaves and concentrate as supplements to *P. maximum*

Variables	Mango leaves + *P. maximum* + concentrate (T_1)	*F. thionningii* leaves + *P. maximum* + concentrate (T_2)	*G. sepium* leaves + *P. maximum* + concentrate (T_3)	SE
Dry matter	78.00[a]	80.63[a]	75.83[a]	1.87
Crude protein	47.84[a]	52.70[a]	38.87[a]	7.31
Crude fibre	68.13[a]	72.46[a]	70.79[a]	2.49
Ash	68.62[a]	75.82[a]	60.34[a]	4.50
Ether extract	61.05[a]	73.92[a]	64.80[a]	3.82

a,b,c = means on the same row with different superscripts are significantly different (p>0.05)

Table 4: Mean nitrogen utilization of WAD goats fed *M. indica*, *F. thionningii* and *G. sepium* leaves and concentrate as supplements to *P. maximum*

Variables	Mango leaves + *P. maximum* + concentrate (T_1)	*F. thionningii* leaves + *P. maximum* + concentrate (T_2)	*G. sepium* leaves + *P. maximum* + concentrate (T_3)	SE
Nitrogen intake (g/day)*	3.19[a]	3.16[a]	3.04[a]	0.06
Nitrogen excretion (g/day) faecal	1.30[b]	1.87[a]	1.02[b]	0.02
Urinary	0.52[b]	0.82[a]	0.28[c]	0.01
Total	1.82[a]	2.69[a]	1.30[c]	0.05
Nitrogen loss (%N_2 intake)				
Faecal	40.75[b]	59.18[a]	33.55[c]	0.18
Urinary	16.30[b]	25.95[a]	9.12[c]	0.12
Total	57.05[b]	85.13[a]	42.76[c]	0.34
Nitrogen (g/day)	1.37[b]	0.47[c]	1.74[a]	0.04
Nitrogen retention (%)	42.95[b]	14.87[c]	57.24[a]	0.19

a,b,c = means on the same row with different superscripts are significantly different (p>0.05),

* Nitrogen intake measurement during metabolic experiment only

Table 3 shows the mean digestibility by goats fed *M. indica*, *F. thionningii* and *G. sepium* leaves and concentrate as supplements to *P. maximum*.

Digestibility values of dry matter, crude protein, crude fibre, ash and ether extract were not significant (p>0.05) among the three dietary treatments. However, diet supplemented with *F. thionningii* however showed higher digestibility values.

The dry matter digestibility values obtained in present reseach, 75.83-80.63% agreed with the earlier report of 78-80% [21]. The CP digestibility values correspond with 26.52-64.3% reported by Ogunmoye [22] and Omojola [23]. The crude fibre digestibility values 68.13-72.46% were higher than the values of 7.52-59.2% reported by Ogunmoye [22]; Omojola [23] and Richard *et al*., [24] and. Omojola [23] reported ash digestibility range of 31.96-54.43%, which was lower than the recorded values in the present study. The digestibility Values obtained for ether extract in this study agreed with values reported in earlier studies [22, 23].

Nitrogen utilization of goats: Table 4 shows the nitrogen utilization of WAD goats fed *M. indica*, *F. thionningii* and *G. sepium* leaves and concentrate as supplements to *P. maximum* Nitrogen intake did not differ significantly (p>0.05) across the treatments. There was however, a gradual decrease from Treatment 1 to Treatment 3. Nitrogen intake in the present study agreed with earlier report by Bamikole and Babayemi [17].

Nitrogen retention was best in animals fed *G. sepium* leaves supplements possibly because of high CP content of *G. sepium* leaves. Nitrogen retention obtained was highest in Treatment 3, diet supplemented with Gliricidia leaves (57.24%) this was followed by Treatment 1, diet supplemented with mango leaves (42.95%), the least was observed in Treatment 2, diet supplemented with ficus leaves (14.87%). The results obtained in Treatment 1 and Treatment 2 are in agreement with 40.48-51.20% reported by Bamikole and Babayemi [17]. The high nitrogen retention observed in Treatment 3 may be as a result as the high crude protein content.

Table 5 shows the heamatological indices of WAD goats before and after feeding of *M. indica*, *F. thionningii* and *G. sepium* leaves and concentrate as supplements to *P. maximum*.

The mean values obtained for the heamatology correspond to the values reported earlier [15, 25 - 28] and showed no significant (p>0.05) differences among the values of each haematological parameters across treatments. The mean value of PCV increased from 28.00% in treatment supplemented with mango leaves to 31.33% in *G. sepium* leaves supplement. Diet supplemented with gliricidia leaves had the highest heamoglobin values (10.45 g dL^{-1}), the lowest was in the mango leave

Table 5: Mean haematological indices of WAD goats fed *M. indica*, *F. thionningii* and *G. sepium* leaves and concentrate as supplements to *P. maximum*

Mean variables	Before feeding / Control (C)	Mango leaves + *P. maximum* + concentrate (T_1)	*F. thionningii* leaves + *P. maximum* + concentrate (T_2)	*G. sepium* leaves + *P. maximum* + concentrate (T_3)	SE
Mean packed cell volume (%)	30.50	28.00	30.33	31.33	1.05
Mean haemoglobin (g dL^{-1})	9.85	9.13	10.00	10.45	0.34
Mean red blood cells (X 10^6 mm^{-3})	11.36	11.71	11.64	11.81	0.14
Mean cell volume (μm^3)	26.43	24.09	26.18	26.44	0.89
Mean cell haemoglobin ($\mu\mu g$)	8.61	7.88	8.59	8.80	0.28
Mean cell haemoglobin concentration (%)	32.94	32.61	32.99	33.26	0.33
Mean white blood cells (X $10^3 mm^3$)	8.01	11.25	9.40	9.03	0.89
Mean platelets (X $10^3 mm^3$)	195.17	151.00	146.67	185.00	114.85
Mean lymphocytes (%)	69.25	60.50	58.00	59.33	1.58
Mean neutrophils (%)	27.25	37.25	40.67	39.00	1.74
Mean eosinophils (%)	3.50	1.50	2.00	2.00	0.36
Mean monocytes (%)	0.00	0.50	0.00	0.33	0.11

a,b,c = means on the same row with different superscripts are significantly different (p>0.05)

supplement (9.13 g dL^{-1}). The red blood cell indices; MCV; MCH and MCHC values increased from Treatment 1 to Treatment 3.

The white blood cells values was highest in the mango leave supplement (11.25 x 10^3). The value decreased slightly from 11.25 x 10^3 mm^{-3} to 9.03 x 10^3 mm^{-3} in diet with gliricidia leaves.

Lymphocytes decreased from 69.25% in the control to 58.00% in ficus supplemented diet. There was an increase in the mean value of the neutrophils from 27.25% in control to 37.25% in mango leave supplement.

CONCLUSIONS

When Mango leaves and concentrate are fed as supplement to *Panicum maximum* based diet, increased dry matter and crude protein intake as well as daily liveweight gain. The heamatology findings revealed that mango leaves are safe and could not be detrimental to animals. The high nutrient value of the leaves coupled with it's palatability and acceptability to animals showed that it can be used as a browse plant.

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