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VOLUNTARY INTAKE, APPARENT DIGESTIBILITY AND PERFORMANCE OF WEST AFRICAN DWARF GOATS FED WITH LEAVES OF SOME MULTI-PURPOSE TREE SPECIES

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Target Audience: Ruminant nutritionists, Local Farmers, Researchers

ABSTRACT

The Multi- purpose tree species (MPTS) were sole fed to 16 West African Dwarf (WAD) goats to investigate their optimum DMI and performance. The DMI of 57.40g.kg^{-1} W$^{0.75}$d^{-1} recorded for *Pterocarpus santalinoides* (PS) was the highest followed by 56.13, 46.27 and 14.76g.kg^{-1}W$^{0.75}$d^{-1} for *Leucaena leucocephala* (LL), *Grewia pubescens* (GP) and *Enterolobium cyclocarpum* (EC) respectively. The differences were significantly different (P<0.05). The OMI followed the same trend as DMI. The CPI was highest (12.06g.kg^{-1}W$^{0.75}$d^{-1}) for LL and lowest (3.84g.kg^{-1}W$^{0.75}$d^{-1}) for EC. Also, NDF, ADF and Lignin intakes ranged from 5.96 – 27.84, 4.42 – 19.46 and 1.63 – 8.90 g.kg^{-1}W$^{0.75}$d^{-1} for EC and PS. Similarly, the digestibility coefficients (%) were significant (P<0.05) between the MPTS. DMD ranged from 66.54 in GP to 76.47 in EC. OM, CP, NDF, ADF and Lignin digestibility varied between 62.46-78.03, 70.75-79.64, 65.06-74.34, 56.59-76.45 and 61.33 – 78.10 for LL and EC. The best growth performance was recorded for goats on PS being 24.49g.d^{-1} while goats on EC lost 5.27g.d^{-1}. The nitrogen utilization of all the goats on the MPTS ranged between 65.76-70.92% which reflected no significant difference (P>0.05) between the forage species.

Key words: MPTS, Nutrient intake, digestibility, nitrogen retention, performance.

DESCRIPTION OF PROBLEM

The need to increase feed resources for livestock feeding emanated from increased requirement for livestock protein. This is as a result of population explosion and escalating cost of conventional feed ingredients. Among the potential feed resources commonly used for ruminant animals were browse trees known as Multi- purpose tree

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Species (MPTS). They are more persistent and productive than the herbacious legumes and grasses (3).

The dry matter intakes of ruminant animals on feedlots are at least 3-3.5% of their body weight (4, 14). Thus a good MPTS should be able to supply about 3% DM to ruminant animals when they are solely fed or in combination with other feeds. They should also be harmless to the animals and their nutrient digestibility should be high i.e. at least 65% (9). Evaluation of the nutritive value of lesser known trees other than *Leucaena leucocephala*(LL) and *Gliricidia sepium*(GS) will shift the focus from exotic to indigenous species which are better known to the farmers and well adapted to the prevailing tropical soil and climatic condition. This study therefore, investigated the DM intake, digestibility and performance of West African Dwarf (WAD) goats when they were sole fed with foliage of indigenous MPTS using LL as control.

MATERIALS AND METHODS

Three indigenous MPTS namely *Pterocarpus santalinoides* (PS), *Grewia pubescens* (GP) *Enterolobium cylcocarpum* (EC) and the control *Leucaena leucocephala* (LL) represented the 4 treatments in this trial. They were sole fed in order to establish their effect on the animals with regards to the optimum DM intake of animals from the plants, digestibility of each species and the extent to which they could contribute to the growth of the animals.

The trial was carried out over a 12 week period to assess weight gain or loss, DM intake and apparent digestibility coefficients of major nutrients. Sixteen young WAD goats aged between 8-12 months with mean live - weight of 6.0± 2kg were used for the trial. They were de-wormed with citarin and dipped in asuntol solution against ectoparasites prior to the commencement of the trial. They were then randomly divided into four groups consisting of four goats per treatment. The goats were allowed 14 days adjustment to the cage during which they were gradually introduced to the MPTS foliage. The animals were weighed at the beginning of the trial and subsequently weekly till the end of the trial. The averages of the initial and final live-weights were used to obtain the metabolic body weight ($Kg.LW^{0.75}$) for each animal. Each MPTS was offered to the goats in their individual pens with water and salt licks provided *ad libitum*. The leaves were offered such that there would always be at least 10% remnants. Daily feed offered and remnant were recorded to calculate the DM intake. Total faeces, urine and feed refusals were weighed and collected during the 8^{th} week of the trial over 7 days. The samples were pooled together at the end of the collection period. DM content of the feaces and MPTS samples were determined by drying in the oven at 65°C for three days. They were later ground in a 1mm diameter screen and preserved for proximate (5) and Fibre (6) analysis.

Data collected were analyzed with one-way ANOVA using Completely Randomized Design. Significant means were separated with Duncan's (7) multiple range test.

RESULTS AND DISCUSSION

The nutrient intake of WAD goats is shown in Table 1. The DM intake ranged between 14.76 to 57.40 g.kg^{-1}W$^{0.75}$d^{-1} , this represented 3.65, 2.93, 0.97 and 3.46% of the animals body weight for PS, GP, EC and LL respectively. Except for the 0.97% recorded for EC, the DMI of the other MPTS were comparable to a value of 3% recommended by (4) and

Table 1 : Proximate and fibre composition of four MPTS

	MPTS			
DM	30.60 ±2.06	27.72 ±0.96	29.92 ±1.59	26.70 ±0.39
ASH	6.66 ±0.36	8.83 ±0.27	5.90 ±0.31	6.42 ±0.87
CP	19.70 ±1.05	11.26 ±0.31	26.85 ±1.09	22.07 ±0.97
NDF	39.95 ±1.17	33.62 ±0.78	29.67 ±2.88	31.62 ±1.21
ADF	33.94 ±1.97	29.32 ±1.04	22.12 ±3.51	26.67 ±0.66
Lignin	17.98 ±1.06	9.92 ±0.36	10.12 ±0.40	20.17 ±1.69
Cellulose	15.96 ±2.00	19.40 ±1.11	12.08 ±3.52	16.49 ±2.35
Hemicellulose	6.01 ±1.44	6.30 ±1.71	7.55 ±0.63	9.95 ±2.56

Mean of three replicates.
PS = *Pterocarpus santalinoides*
GP = *Grewia pubescens*
EC= *Enterolobium cyclocarpum*
LL = *Leucaena leucocephala*

3 to 3.5 % by (14). The DMI were significantly different (P<0.05) except between PS and LL. The low DMI from EC could be attributed to a repulsive odour and bitter taste of its foliage when tasted probably due to the presence of saponin. The OM intake followed a similar trend as the DMI. The least OMI of 13.92g.kg^{-1}W$^{0.75}$d^{-1} was recorded for EC while the highest of 53.01 g.kg^{-1}W$^{0.75}$d^{-1} was recorded for PS. There was no significant difference in the DMI of PS and LL (P<0.05). Similar results of low DMI and OMI have been reported during sole feeding of forages. For instance, (15) reported a DMI of 45.7g. kg^{-1} W$^{0.75}$ d^{-1} when dried *Caliandra calothrysus* was fed *ad libitum* while (16) obtained mean DMI of 48.6g. kg^{-1} W$^{0.75}$ d^{-1} for the same plant. These authors reported higher DMI when the browse was supplemented and concluded that sole feeding of browse resulted in lowered DMI due to the animal acceptance problems. Apart from this reason, it was found in this study that animals retain browse in their stomach for a long time before digestion is completed and since

this affects subsequent DMI, stomach fill is therefore implicated. This is in agreement with the view of (10) that increased DMI of low quality forage can only be achieved when the high protein supplement is itself very degradable in the rumen.

The CP intakes were significant ($P<0.05$) among the MPTS being highest in LL (12.06g. $kg^{-1}W^{0.75}d^{-1}$) and lowest for EC (3.84 g. kg^{-1} $W^{0.75}$ d^{-1}). The minimum CP requirement for growing WAD goats is $5g.d^{-1}$ (12) and this was supplied by these MPTS except EC. The MPTS could therefore, be said to have potentials to act as nitrogen supplements in livestock feeding. NDF, ADF and Lignin intakes followed the same pattern ranging from 1.63g. kg^{-1} $W^{0.75}$ d^{-1} to 27.84g. $kg^{-1}W^{0.75}d^{-1}$ and significantly different ($P<0.05$) except between PS and LL. Though, most of the reported fiber intake values were on crude fiber, the general trend is low fiber intakes from forage plants. This might be due to low fiber contents of green leaves compared with dried forages and crop residues. Cellulose and Hemicellulose intakes were dependent on the ADF, NDF and Lignin intakes. Thus, any factor that affects the level of fiber intake is expected to have a corresponding influence on cellulose and hemicellulose intakes.

The nutrient digestibility coefficients of the MPTS are presented in Table 2. The general high values reported might be as a result of low DMI from the plants probably due to sole feeding. It could therefore, be said that the little intakes were fully utilised within the animals body system. This was evidenced by the small quantities of faeces and urine output by the animals. The differences in the digestibility coefficient were significant ($P< 0.05$) for all the nutrients except cellulose. The values were higher than those obtained by (8) for *Gliricidia sepium* : 54.2, 56.8, 42.9, 48.2 and 56.5% for DM, OM, ADF, NDF and CP respectively. (11) also obtained 66.1, 62.3, 54.7 and 66.6% for DM, CP, CF and OM.

Table 2 :Nutrient intake of WAD goats fed with four MPTS

	MPTS				
Nutrients Intakes ($g.d^{-1}W^{0.75}d^{-1}$)	PS	GP	EC	LL	SE_m
DM	57.40^a	46.27^b	14.76^c	56.13^a	1.04
OM	53.01^a	41.11^b	13.92^c	50.70^a	1.42
CP	10.91^b	7.87^c	3.84^d	12.06^a	0.26
NDF	27.84^a	15.57^b	5.96^c	27.74^a	0.56
ADF	19.46^a	13.56^c	4.42^d	14.63^b	0.35
Lignin	8.90^a	5.32^c	1.63^d	7.13^b	0.16
Cellulose	9.19^a	9.25a	1.85^b	9.32^b	0.20
Hemicellulose	4.31^b	4.12^b	1.36^c	5.76^a	0.12

Means along the same row having different superscripts are significantly different ($P<0.05$).

PS = *Pterocarpus santalinoides* EC= *Enterolobium cyclocarpum*

GP = *Grewia pubescens* LL = *Leucaena leucocephala*.

These results demonstrated the ability of ruminant animals to process structural carbohydrates of plant origin to products utilizable by man, such as meat, milk, wool or hides and skin. The digestibility values of 96.84, 70.08, 76.08 and 67.18, 62.46, 70.75% reported for DM, OM, and CP in PS and LL demonstrated the ability of WAD goats to tolerate browse plants with high tannin contents. This is in agreement with the findings of (13) which was attributed to the ability of WAD goats to inactivate tannin with their saliva and rumen microbes. The level of tannin obtained for the MPTS used in this study and those reported in the literature will therefore, pose no threat to livestock especially when the plants are used as supplements.

As shown in Table 3, there was no significant difference ($P<0.05$) between the nitrogen retention of WAD goats on the MPTS. The values of 68.22, 69.80, 70.92 and 65.76% nitrogen retention for PS, GS, EC and LL respectively were high compared with similar studies previously reported. (7) reported a lower value of 56.5% for *G. sepium* while (11) reported 57.5% and 65.5% for LL from two separate trials. The low DMI coupled with high nutrient digestibility might have resulted in maximal utilization of nutrients particularly nitrogen from the MPTS which resulted in high nitrogen retention and utilization. Nitrogen could not be stored within the body system of animals. Thus, high levels of N intakes via high DMI will result in wastage of N consumed by the animals through belching or eructation while low N intakes will ensure optimum utilization of the N present in the feed. For economic reasons, N intake should always be closely monitored to meet just the production requirements of animals without leaving any room for wastage.

Table 3: Digestibility coefficients (%) of major nutrients in foliage of four MPTS fed to WAD goats

	MPTS				
Digestibility Coefficients(%)	PS	GS	EC	LL	SE_M
Dry Matter	69.84^b	66.54^b	76.47^a	67.18^c	1.14
Organic Matter	70.08^b	70.34^b	78.03^a	62.46^c	0.91
Crude Protein	76.08^b	75.72^b	79.64^a	70.75^c	0.98
NDF	65.06^b	61.58^c	74.34^a	67.56^d	0.91
ADF	68.93^b	61.05^c	76.45^a	56.59^d	0.80
Lignin	71.43^b	67.26^c	78.10^a	61.33^d	1.01
Cellulose	77.29^a	77.41^a	76.79^a	73.46^b	0.88
Hemicellulose	45.04^c	45.22	64.23^a	56.24^b	1.35

Means along the same row having different superscripts are significantly different ($P<0.05$)

Table 4 shows the growth performance of WAD goats fed the 4 MPTS foliage. The highest growth rate of 24.49 $g.d^{-1}$ was recorded for PS, 19.97 $g.d^{-1}$ for LL and 19.64 $g.d^{-1}$ for GP. Animals on EC lost weight (-5.27g. d^{-1}) because of their DMI this implies that the amount of nutrients derived by the animals from the MPTS could not support their body

Table 4. Nitrogen Utilization by WAD goats fed with four MPTS

	MPTS				
Parameters	PS	GS	EC	LL	SE_m
N-intake ($g.kg^{-1}W^{0.75}d^{-1}$)	1.75^{a}	1.26^{b}	0.05^{c}	1.93^{a}	0.07
Faecal N-Output($g.d^{-1}$)	1.60^{b}	1.12^{c}	0.43^{d}	2.24^{a}	0.09
Urinary N-Output($g.d^{-1}$)	0.52^{a}	$0.32^{a\,b}$	0.19^{b}	$0.37^{a\,b}$	0.07
Total N-Output($g.d^{-1}$)	2.12^{b}	1.44^{c}	0.62^{d}	2.61^{a}	0.12
N- Retained ($g.d^{-1}$)	4.59^{a}	3.37^{b}	1.51^{c}	4.99^{a}	0.12
N-Retention (%)	68.22^{a}	69.80^{a}	70.92^{a}	65.76^{a}	1.78

Means along the same row having different superscripts are significantly different ($P<0.05$)

Table 5. Growth Performance of WAD goats fed with four MPTS foliage

	MPTS				
Parameters	PS	GP	EC	LL	SE_m
Number of animals/treatment	4	4	4	4	-
Initial live weight of Animals (kg)	5.01	5.14	5.49	5.39	0.32
Final live weight of Animals (kg)	7.07^{a}	6.79^{a}	5.05^{b}	7.07^{a}	0.31
Average live weight of Animals	6.05	5.97	5.27	6.23	0.31
Metabolic weight gain (kg)	3.85	3.81	3.48	3.94	0.15
Total weight gain (kg)	2.06^{a}	1.65^{b}	-0.44^{c}	1.68^{b}	0.11
Growth rate $g.d^{-1}$	24.49^{a}	19.64^{b}	-5.27^{c}	19.97^{b}	1.33

Means along the same row having different superscripts are significantly different ($P<0.05$)

metabolic functions. In fact, animals on this treatment were withdrawn from the trial during the 8th week immediately after the metabolic trial due to emaciation, loss of appetite and gait. Surprisingly, the animals recovered within two days after they were transferred to a concentrate diet. This shows that EC is not toxic to livestock. In fact, no toxic sign was noticed throughout the trial period. Further investigation might be necessary to verify the degree of toxicity or otherwise when the plant is fed for a long time in a compounded ration. The weight gains reported in this study fell below those reported for WAD goats on different feeding regimes. for instance (2) reported gains of between 70.46 – 134.76 g. d^{-1} for young male WAD goats fed concentrate diets. Similarly, (1) reported daily gains of between 24.36 - 33.13$g.d^{-1}$ for WAD goats fed graded levels of LL as supplements to *Panicum maximum*. A range of between 25.7 to 66.3 g. d^{-1} has also been reported for WAD goats fed cassava peels mixtures (8). These reported values were higher than values observed in this study because

the tree foliage were used as supplements in those studies and this enhanced the DMI unlike in this trial where the tree foliage were sole fed to the animals.

CONCLUSION AND APPLICATIONS

1 It could be concluded that none of the MPTS may be able to support a profitable goat production enterprise when used as sole feed though PS showed some potentials.

2 They may be more profitably utilized as supplements to other feeds in a compounded ration for ruminants. A feeding system whereby forage plants are used as supplements to other feeds rather than as sole feed is therefore, recommended.

3 Since the foliage is non-toxic and palatable, they could be utilized for small ruminants to reduce cost of feeding.

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