Intake, performance and digestibility of West African dwarf goats supplemented with graded levels of *Grewia pubescens* and *Panicum maximum*

O. M. Arigbede*¹, J.A. Olanite¹ and M.A. Bamikole²

¹Department of Pasture and Range Management, University of Agriculture, Abeokuta, Nigeria.

²Department of Animal Science, University of Benin, Benin city, Nigeria.

*Corresponding author

Abstract

A trial was carried out with 16 female West African Dwarf (WAD) goats to assess their dry matter intake, digestibility and liveweight gain when fed *Grewia pubescens* as supplement to *Panicum maximum*. The levels of inclusion of *G. pubescens* were 0, 25, 50 and 75%. The highest nutrient intakes occur at 50% level of supplementation being 61.01, 54.40, 8.44, 26.07, 19.29 and 6.57 g d⁻¹ W^{0.75} for DM, OM, CP, NDF, ADF and Lignin respectively. These were significantly ($P < 0.05$) higher than other levels of intake. The dry matter digestibility (DMD) coefficients increased significantly ($P < 0.01$) with increased inclusion levels of *G. pubescens* supplementation. It increased from 52.24% at 0%, which is the control or unsupplemented diet to the highest of 80.42% at 50% level of supplementation. Thereafter, the DMD decreased to 79.06% at 75% level of inclusion though the decrease was not significant ($P > 0.05$). The digestibility coefficients of OM and CP at 50% level of supplementation were also highest being 81.86% and 84.23% respectively. Digestibility of other nutrients followed the same trend as for DM, OM and CP digestibility. The liveweight gain of the animals ranged from 8.81 g d⁻¹ for unsupplemented to 10.95, 18.33 and 20.71 g d⁻¹ for 25, 50, and 75% levels of inclusion respectively. The differences were significant ($P < 0.05$) between supplemented and unsupplemented animals though, not significant ($P > 0.05$) between 50% and 75% levels of inclusion. The nutritive value index was highest (61.33) for 50% level of inclusion and significant ($P < 0.05$) from other levels of supplementation which, were in turn, higher ($P < 0.05$) than that of unsupplemented animals.

Key Words: *Grewia pubescens*, West African Dwarf goats, dry matter intake, digestibility coefficients, weight gain, nutritive value index.

Introduction

Tree-crop-livestock interaction research activities by the International Livestock Research Institute (ILRI) that started two decades ago

identified *Leucaena leucocephala* and *Gliricidia sepium* as suitable tree species that could be included in arable lands with food crops (Atta-Krah and Sumberg, 1988). The foliage from these

tree species was also used to feed ruminants with positive results (Adejumo, 1987; Jones, 1979).

Meanwhile, the adoption of this technology by local farmers was not encouraging due to the exotic nature of the trees. The trees exhibited adaptation problems to the acid soils of tropical Africa resulting in generally poor establishment and poor foliage productivity (AFNETA, 1996). In addition, the foliage of *L. leucocephala* was observed to be toxic to animals due to its high mimosine content (Jones, 1979) while *G. sepium* was poorly consumed as a result of the repulsive odour caused by coumarin present in its foliage (Atta-Krah and Sumberg, 1988).

These problems were compounded by the observation of foliar disease infestation caused by *Heteropsylla cubana* and *Cercosporidium gliridiasis* on *L. leucocephala* and *G. sepium*, respectively (Lenne, 1990). Consequently, the challenge of identifying well-known indigenous multipurpose tree species (MPTS) that are well adapted to the acidic soils of Nigeria and as a substitute become imperative. Some indigenous MPTS have been identified through the research efforts by ILRI to have potentials for animal utilization. The trees were observed to have high biomass productivity, good adaptation to acid soils and high green leaf retention in the dry season (Ladipo, 1994; AFNETA, 1996).

One of such MPTS is *Grewia pubescens* (GP) which is a non-leguminous shrub belonging to the family Tiliaceae. The tree species is noted to be tolerant of soil acidity. Its leaves are used as forage while its bark is good for cordage. It coppices vigorously producing small dimension wood and controls weed efficiently (Ladipo, 1994). Its leaves, roots, flowers and fruits are edible and its ash is a vegetable salt source (HTS, 1968). This study further explores the potential of this tree with a view to determining the dry

matter intake, apparent digestibility coefficients, and weight gain of West African Dwarf (WAD) goats fed graded levels of its forage as a supplement to *Panicum maximum*.

Materials and Methods

The study was carried out at Wasimi village in southwestern part of Nigeria as part of an ongoing screening trial of some indigenous MPTS that commenced in 1994. The village is located about 50 km south-east of Ibadan and is an on-farm experimental station for Alley Farming Network for Tropical Africa (AFNETA). The area is in the humid rainforest zone receiving on the average 1200 mm rainfall per annum with a major dry season between November and March.

Fresh *P. maximum* were chopped and offered to female West African dwarf (WAD) goats along with weighted quantity of *Grewia pubescens*. Sixteen female WAD goats of about 12 months old weighing between 4.5 and 7.0 kg were used for the trial, which lasted for 12 weeks. The goats were randomly divided into 4 groups of 4 animals and allocated to *G. pubescens* and *P. maximum* at the ratio of 100:00, 75:25, 50:50 and 25:75. The total quantity of forage offered to the animals was calculated based on forage allowance of 50 g DMkg⁻¹d⁻¹ for each animal. The goats were dewormed, housed in individual pens and offered fresh water and salt licks *ad libitum*. Initial and weekly weights were recorded and used to calculate weight gain during the period of the study on metabolic body weight basis (LWkg^{0.75}).

A tray made of net was placed under each pen at the beginning of the sixth and twelfth weeks of the trial for collection of faeces over seven days period. This is possible because the animals were reared on a raised platform. Feed remnants and faeces were collected from the animals and dried in the oven at 65°C for 3 days to determine their dry matter (DM) contents. The dried samples

were then ground with laboratory hammer mill to pass through 1mm sieve and then preserved for chemical analysis. The proximate composition was determined according to AOAC (1995) procedure while the fibre parameters viz: Neutral detergent fibre (NDF), Acid Detergent Fibre (ADF) and Lignin were determined according to Goering and VanSoest (1970) procedure.

The data obtained were subjected to one-way analysis of variance (Steel and Torrie, 1980). Significant differences among treatment means were detected with Duncan's multiple range test (Duncan, 1955).

Results and Discussion

The dry matter (DM) content was higher for *G. pubescens* being 32.27% compared to 27.60% for *P. maximum* (Table 1). These values were comparable to 19.9, 32.7 and 27.6% for *G. sepium*, *Erythrina variegata* and *L. leucocephala*, respectively (Topps, 1992). Mecha and Adegbola (1980) reported a higher DM value of 36.7% for *Cajanus cajan*. The crude protein (CP) content was 17.0% for *G. pubescens* and 8.5% for *P. maximum*. Though a non-nodulator, the CP content of *G. pubescens* was much higher than for the grass and only slightly lower than for most leguminous browse plants (Asiegbu and Anugwa, 1988). The fibre components as determined in the forage samples showed that *G. pubescens* is richer in soluble carbohydrates than *P. maximum* (40.50 versus 46.50% NDF

respectively) and lower in insoluble fraction (ADF) than the grass. The same trend was observed for other fibre fractions. Akkasaeng *et al.* (1989) reported similar values of 42.10% NDF for *E. Cyclocarpum* during the dry season. The similar results obtained in this trial and the low CP content of *P. maximum* might be attributed to closeness of the trial to dry season.

Table 2 shows the DM and nutrient intakes of WAD goats fed *G. pubescens* as supplement to *Panicum maximum*. The DM intake of goats on supplementation were significantly higher ($P < 0.05$) than those fed grass alone. The DM intake however, increased up to 50% level of supplementation being $61.01 \text{ g kg}^{-1} \text{ W}^{0.75} \text{ d}^{-1}$ and thereafter decreased to $52.51 \text{ g kg}^{-1} \text{ W}^{0.75} \text{ d}^{-1}$ at 75% level of supplementation. A consistent decrease was noticed in the voluntary DM intake of *P. maximum* as the level of *G. pubescens* increased, which shows the potential of the tree to supplement grass in ruminant feeding systems. The intake of organic matter, crude protein and fibre increased and followed the same trend as the level of supplementation increases. This is as a result of higher DM intake and increased concentration of nutrients in the foliage of *G. pubescens* than in the grass. Increased DM intakes by animals on browse supplementation have also been reported by several authors (Adeneye and Oyenuga, 1976; Adejumo, 1987; Mtenga and Shoo, 1990; Ifut, 1992). *G. pubescens* was reported to be very low in tannin

Table 1: Chemical composition (%)¹ of *G. pubescens* and *P. maximum* fed to goats.

Forage	DM	OM	CP	IE	Ash	NDF	ADF	Lignin	² Cellulose	cellulose
Hemi-										
<i>G. pubescens</i>	32.37	88.40	17.0	2.55	11.60	40.50	30.50	11.50	10.0	19.0
<i>P. maximum</i>		27.60	90.30	8.50	2.80	9.70	46.50	33.50	9.50	13.0
24.0										

¹Mean of duplicate samples; ²Cellulose = ADF-Lignin; ³Hemicellulose = NDF-ADF

Table 2: Nutrients intake of WAD goats fed graded levels of *G. pubescens* and *P. maximum* ($\text{g} \cdot \text{kg}^{-1} \text{W}^{0.75} \text{d}^{-1}$).

Nutrients	% levels of inclusion of <i>G. pubescens</i>				SEM
	0	25	50	75	
Dry Matter	52.11 ^a	57.11 ^{ab}	61.01 ^a	52.51 ^b	1.61
Organic Matter	47.06 ^b	51.22 ^{ab}	54.40 ^a	46.76 ^b	1.44
Crude Protein	4.43 ^d	6.49 ^c	8.44 ^a	7.59 ^b	0.20
NDF	24.23 ^{ab}	25.41 ^a	26.07 ^a	22.20 ^b	0.71
ADF	17.46 ^{bc}	18.46 ^{ab}	19.29 ^a	16.49 ^c	0.52
Lignin	5.36 ^b	5.81 ^{ab}	6.57 ^a	5.72 ^b	0.26

^{a, b, c, d} Means along the same row with different superscripts are significantly different ($P < 0.05$).

Table 3: Digestibility coefficients (%) of nutrients by WAD goats fed graded levels of *G. pubescens* and *P. maximum*.

Nutrients	% levels of inclusion of <i>G. pubescens</i>				SEM
	0	25	50	75	
Dry Matter	52.24 ^c	70.59 ^b	80.42 ^a	79.06 ^a	0.57
Organic Matter	55.38 ^c	72.31 ^b	81.86 ^a	80.27 ^a	0.54
Crude Protein	41.55 ^c	75.23 ^c	84.23 ^a	82.25 ^b	0.56
NDF	39.39 ^a	63.33 ^b	74.07 ^a	72.19 ^a	0.74
ADF	36.69 ^d	59.73 ^a	72.37 ^a	69.25 ^b	0.69
Lignin	25.13 ^b	61.72 ^b	71.29 ^a	71.56 ^a	0.84

^{a, b, c, d} Means along the same row with different superscripts are significantly different ($P < 0.05$).

and phytic acid (Arigbede, 1998). Decreased intake of this plant above 50% could therefore, not be attributed to these anti-nutrient factors but rather to other intrinsic factors such as the coarseness of its foliage which could have affected its palatability.

As shown in Table 3, DM digestibility coefficients significantly increased ($P < 0.01$) with increased inclusion of *G. pubescens* from 52.24% at 0% (grass only) to 70.59% and 80.42% at 25% and 50% levels of supplementation respectively. Thereafter, the DM digestibility decreased to

79.06% at 75% level of inclusion although the decrease was not significant ($P>0.05$). Similar reports of between 50.8% and 70.3% were obtained by Adejumo (1987) when fed *L. leucocephala* at graded levels up to 80% to WAD goats. However, unlike the reported decreased DM intake as the levels of *L. leucocephala* increased, there was increased DM intake with increasing *G. pubescens* inclusion. High digestibility coefficients of DM in this study could therefore be associated with rapid rate of degradation of nutrients in *G. pubescens* which decreased retention time in the rumen.

The digestibility coefficients of OM, CP, NDF, ADF and Lignin followed the same trend as DM digestibility. The values for these parameters were higher for goats on the supplemented diets than those on unsupplemented diets and tended to decrease for all the nutrients above 50% inclusion level. The digestibility coefficients were however, generally, higher than earlier reported values (Adejumo, 1987; Mtenga and Shoo, 1990; Ifut, 1992) especially for the fibre components. This could be attributed to the

young and tender age of *G. pubescens* used (less than 3 years old) in this study. Thus, lower digestibility values could be expected as the plant becomes older. Since there was decreased DM intake and digestibility of nutrients at above 50% inclusion level, the suggested optimum level of inclusion of *G. pubescens* foliage in the feed of ruminant animals should be about half of their basal feed.

The liveweight gain values of the animals ranged from 8.81 g d⁻¹ for unsupplemented animals to 10.95, 18.33 and 20.71 g d⁻¹ for 25, 50 and 75 % levels of supplementation respectively (Table 4). The values were generally lower than those reported from similar trials elsewhere. For instance, Mtenga and Shoo (1990) reported daily gains of 20 g d⁻¹ for small East African goats fed with hay alone and 23, 29 and 30g d⁻¹ for those fed hay supplemented with 100 g, 200 g and *ad libitum* levels of *L. leucocephala*. Similarly, Adejumo (1987) reported values of 24.36, 28.62, 30.76, 33.13 and 25.32 g.d⁻¹ for 0, 20, 40, 60 and 80% levels of *L. leucocephala* supplementation to *Pennisetum purpureum*.

Table 4: Weight gain of WAD goats fed graded levels of *G. pubescens* and *P.maximum*.

Parameters	% levels of inclusion of <i>G. pubescens</i>				
	0	25	50	75	SEM
Initial weight (kg)	5.56	5.16	5.44	5.49	0.39
Final weight (kg)	5.93	5.62	6.21	6.36	0.39
Average weight (kg)	5.75	5.39	5.83	5.93	0.39
Metabolic weight (LW ^{0.75})	3.71 ^a	3.53 ^a 3.75 ^a	3.79 ^a		0.19
Total weight gain(kg)	0.37 ^b	0.46 ^b 0.77 ^a	0.87 ^a		0.24
Daily weight gain (g.d ⁻¹)	8.81 ^b	10.95 ^b	18.33 ^a	20.71 ^a	3.72
Nutritive Value Index	34.03 ^c	50.39 ^b	61.33 ^a	51.89 ^b	5.56

^{a,b,c} Means along the same row with different superscripts are significantly different ($P<0.05$)

Many factors have been found to be responsible for varied live weight gain of animals on different dietary regimes. Apart from effects of inherent anti-nutritive factors, palatability of the feed, weather condition and physiological state of the animal are also critical. The low weight gain of WAD goats on *G. pubescens* foliage supplementation in this study could be attributed to the low nitrogen content in its foliage compared to its leguminous counterparts as well as the age of the goats used, which might not be in the active growth phase.

The nutritive value index calculated for the plant showed that the best combination of *G. pubescens* and *P. maximum* is 50:50 at which point a value of 61.33 was obtained. This is higher than the nutritive value index range of 25.12 to 29.02 reported for *L. leucocephala* by Adejumo (1987). This connotes that *G. pubescens* could be more nutritive than *L. leucocephala* if properly integrated into ruminant feeding system. Though, animals on 50:50 combination of *G. pubescens* and *P. maximum* gained 18.33 g.d⁻¹ as against 20.71 g.d⁻¹ reported for goats on 75:25, the difference was not significant ($P < 0.05$). This trend implies that higher nutritive value index may not necessarily translate to optimum performance of animals on a diet. Other conditions that favour livestock performance such as high nutrient intake and digestibility must be adequately satisfied.

Conclusion

It was observed from this study that supplementation of grass (*P. maximum*) with *G. pubescens* resulted in significant increase in DM intake, digestibility and liveweight gain. Though, a non-nodule forming species, the foliage was rich in crude protein (17%) and low in fiber (NDF, ADF and Lignin). Like other browse plants,

G. pubescens retained most of its nutrients throughout the period of this study. Including this plant in the feeding system will no doubt increase the feed resource base of ruminants especially during the dry season.

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