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Intake, Nutrient Digestibility and Nitrogen Balance of *Acacia auriculate, Gmelina arborea, Albizia lebbeck* and *Butryospermum parkii* by Yankasa Bucks

Research Article

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ABSTRACT

The study was conducted to compare the effects of feeding *Acacia auriculata (AA), Gmelina arborea* (GA), *Albizia lebbeck* (AL) and *Butryospermum parkii* (BP) tree forages as a sole feed for Nigerian goats. Four goats (Yankasa) averaging one year and weighing 11.7±1.8 kg were used to measure the feed intake, digestibility and nitrogen balance. The leaves were offered *ad libitum*. Dry matter (DM) intakes were significantly different (P<0.05), with the highest on AL and GA (456.72 and 478.79 g/d respectively) and lowest on AA (155.01 g/d) with intermediate values for BP (207.65 g/d). Total intakes of N were significantly different among the browse plants (P<0.05). Significantly higher intake was observed on BP (125.41 g/d), while statistically similar intake was recorded on AL and GA and least on AA. The lower N intake of 31.54 g/d was observed in AA. The result of the nutrients digestibility showed a significant difference in the nutrients digestibility (P<0.05). BP, GA and AL (80.56, 86.67 and 89.70 respectively) had significantly high digestibility, while AA had significantly lower DM digestibility (75.76). Also, the digestibility of organic matter (OM), crude protein (CP) and crude fiber (CF) followed similar pattern. Nitrogen balance showed significant difference (P<0.05) in fecal N output, AA had higher fecal N (16.76), followed by BP (12.42) and AL and GA had 9.95 and 7.70, respectively. *Gmelina arborea*, *Albizia lebbeck* and *Butryospermum parkii* have potential as protein supplement for Yankasa goats.

KEY WORDS *Acacia auriculata, Albizia lebbeck, Butryospermum parkii*, digestibility, *Gmelina arborea,* Yankasa goat.

INTRODUCTION

Small ruminants are almost as ubiquitous as poultry, though not so numerous. In Nigeria, Adu and Ngere (1979) estimated a population of 7.2 to 8.2 millions sheep. ILCA (1979) gives a figure of 7.6 million sheep and 22 million goats. Reported about 29 million goats and that the number of sheep, i.e. approximately 9 millions, which was equal to the number of cattle. National survey estimated a total of 56.6 million heads throughout the country (34500000 goats and 22100000 sheep), with goats outnumbering sheep by three to two. Although, some seasonal movement of pastoral sheep does take place, the great majority of small ruminants are sedentary village livestock and their patterns of distribution mirror those of human settlement (FDLPCS, 1992).

The major constraint to small ruminant production is that of availability and quality of the natural pastures and crop residues, which become very low in nutritive value particularly during the dry season in the Sahelian Regions of Africa (Njoya *et al.* 2005; Savadogo, 2000).

Foliage from fodder trees, legumes and shrubs have high protein content, ranging from 14% to 25%. The protein content in fodder trees and legumes consists of both soluble and insoluble components, which are used both as an important source of nitrogen to increase rumen microbial activity and as by-pass protein for supplying amino acids to the lower gut of the host animal (Leng, 1997; Wanapat, 2003).

The presence of anti-nutritional substances, in particular condensed tannins, in fodder of some trees and shrubs can limit animal performance, especially when tree/shrub foliages are fed in large quantities. The objectives of the present study were to evaluate the chemical composition of *Acacia auriculata* (AA) *Gmelina arborea* (GA), *Albizia lebbeck* (AL) *and Butryospermum parkii* (BP) and to evaluate intake, nitrogen balance and retention and nutrient digestibility of these browse plants.

MATERIALS AND METHODS

Location of study

The experiment was conducted in the Animal Science Departmental Farm, on the Samaru campus of Ahmadu Bello University, Zaria. The site is in the northern Guinea Savanna ecological zone of Nigeria and receives an annual rainfall of about 1100 mm, spread from April to October. The temperature ranges from 12-28 ^{o}C during the cold (harmattan) season (December to February) and 20-30 ^{o}C in hot seasons (March to April). The relative humidity of the area is 75% and 21% for both rainy and dry seasons, respectively (Osinowo *et al.* 1991).

Experimental design

Four Yankasa bucks with an average body weight of 11.7 kg were used to study the feed intake, total tract digestibility and N-retention of four browse plants (*Acacia auriculata, Gmelina arborea, Albizia lebbeck, Butryospermum parkii*).

The experiment was carried out in a completely randomized design in a 4×4 Latin square. Each feeding period lasted 17 days, in which 10 days were for adaptation and 7 days for data collection. The animals were kept in digestibility cages ideal for the collection of urine and fecal samples, as described by Osuji *et al.* (1993).

Feeding management

The leaves of the browse plants of *Acacia auriculata* (AA), *Gmelina arborea* (GA), *Albizia lebbeck* (AL), and *Butryospermum parkii* (BP) were harvested daily from plots in the Livestock Research Centre.

They were offered fresh as the sole feed, immediately after harvesting. Fresh quantities of foliage were given two times per day (8:00 AM and 4:00 PM) in amounts nearly 20% above observed intakes. Water and salt were freely available for all animals.

Chemical analysis

Feed and fecal samples were dried in an oven at 105 ^{o}C for the determination of dry matter. Total N of feed, feces and urine were measured by the Kjeldahl procedure as outlined by the AOAC (2005). The ash contents of feed and feces were determined by combustion in a furnace at 500 ^{o}C, following the procedure of AOAC (2005). Organic matter was assumed to be the result of subtracting the percentage of ash from 100. Tannin content was analyzed by the methods of Wheeler *et al.* (1994).

Statistical analysis

All data collected on feed intake, nutrient digestibility and nitrogen balance were calculated and subjected to statistical analysis of variance using GLM procedure of SAS (2001). When treatment means were significant, Duncan Multiple Range Test (Duncan, 1955) was used to compare the treatment means.

RESULTS AND DISCUSSION

Chemical compositions

The result of the chemical compositions of the browse leaves fed is presented in Table 1.

Table 1 Percentage of chemical composition of the four browse plant leaves fed to Yankasa goats in this experiment

	AA	GA	AL	BP
Dry matter (DM)	59.62	78.49	77.74	65.40
Organic matter (OM)	52.21	68.59	70.81	58.61
Crude protein (CP)	12.13	16.18	18.06	39.56
Crude fiber (CF)	25.49	11.90	14.49	20.83
Ash	6.79	9.90	6.93	6.79
NFE	53.97	59.38	68.39	31.11
Tannin g/100mg	4.06	1.88	1.84	1.84

AA: *Acacia auriculata*; GA: *Gmelina aborea*; AL: *Albizia lebbeck*; BP: *Butryospermum parkii* and NFE: nitrogen free extract.

The result of the chemical composition shows that BP had the highest crude protein CP (39.56), while AA having the lowest (12.13%) and GA and AL having 16.18 and 18.06 %, respectively. These results are within the range of CP s reported by Abdu *et al.* (2007) for *Balanyte eagyptiaca* leaf meal and also for most browse plants in West African sub-region (Le Houérou, 1980; Rubanza *et al.* 2003). The differences observed in this study on same browse plants are consistent with Ibrahim *et al.* (1988), who reported that environmental and soil differences influence the chemical composition and digestibility of forages grown in different areas even if they are harvested at the same age. The CP of these browse plants are higher than the CP of tropical grasses (Minson, 1980).

The high ash content in leaves of GA, AL and BP (9.90, 6.93 and 6.79, respectively) was similar to that in *Morus* *alba* (Nguyen and Ngoan, 2003). This is probably an indication of high concentrations of minerals as reported by Kwabiah *et al.* (2003).

Also, AA had the highest crude fiber (CF) value of 25.49%, followed by BP with 20.83%, while AL and GA had 14.49 and 11.90%, respectively. This finding agrees with the report of Anbarasu *et al.* (2004), who reported that browse leaves have a high CF value, which could be attributed to the high cell-wall constituents usually present in leaf meal. The tannin levels in the browse leaves studied are presented in Table 1 and shows that AA had 4.06%, which is higher than that in GA, AL and BP leaves (1.84, 1.84 and 1.88%, respectively).

Voluntary feed intake

The results of nutrient intakes are presented in Table 2.

Table 2 Feed intake of Yankasa bucks fed *Acacia auriculata, Gmelina arborea, Albizia lebbeck* and *Butryospermum parkii* leaves

	Treatments				
Parameters	AA	GA	AL	BP	SEM
DM intake g/d	155.01[c]	478.79[a]	456.72[a]	207.65[b]	31.44
OM intake g/d	135.75[c]	418.40[a]	416.01[a]	186.09[b]	27.73
CP intake g/d	31.54[c]	102.54[b]	106.10[b]	125.41[a]	7.23
CF intake g/d	66.27[c]	72.59[b]	85.13[a]	66.14[c]	5.86

a, b, c: means with different superscript within a row differ significantly (P<0.05).
AA: *Acacia auriculata*; GA: *Gmelina aborea*; AL: *Albizia lebbeck*; BP: *Butryospermum parkii*; DM: dry matter; OM: organic matter; CP: crude protein; CF: crude fiber and SEM: standard error of means.

Dry matter intake was significantly different among some of the plants (P<0.05), with the highest on AL and GA (456.72 and 478.79 g/d, respectively) and lowest on AA (155.01 g/d) with intermediate values for BP (207.65 g/d) (Figure 1).

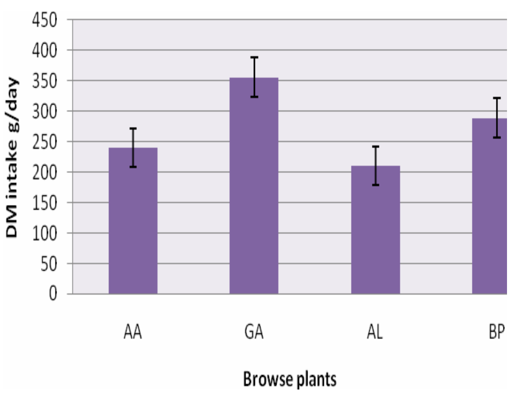

Figure 1 Feed intake of Yankasa bucks fed some browse leaves

Organic matter (OM) intake followed similar pattern. The reason for the low intakes of AA foliage is apparently the result of the concentrations of anti-nutritional factors such as cyanogenic glucosides and tannins, which have been reported widely to affect on intake. The differences in feed intake can be due to other factors, e.g., structure of the leaves, soft versus hard, and smooth versus waxy or hairy, content of substances causing the foliages to smell or taste distinctly, or morphology of the plants resulting in different bite sizes (Van, 2006). Total intakes of CP were significantly (P<0.05) different among some of the browse plants. Significantly higher intake was observed on BP (125.41 g/d) and the lowest CP intake of 31.54 g/d was observed in AA, while statistically similar intake was recorded on AL and GA. This may be related to the high tannin content of AA as it was reported elsewhere (Chang *et al.* 1998; Al-Mamary *et al.* 2001) that high tannin levels have a negative effect on feed intake by causing astringency. Further evidence is provided by Downs *et al.* (2003) who reported that tree rats avoid high tannin diets, even to the extent that they lose body mass by only targeting alternative diets.

Nutrient digestibility

Nutrients digestibility showed significant differences (P<0.05) in different plants (Table 3).

Table 3 Nutrient digestibility in Yankasa bucks fed *Acacia auriculata, Gmelina arborea, Albizia lebbeck* and *Butryospermum parkii* leaves

	Apparent digestibility (%)				
	AA	GA	AL	BP	SEM
Dry matter	75.76[d]	86.67[b]	89.70[a]	80.56[c]	1.85
Organic matter	82.05[c]	88.59[b]	93.09[a]	85.69[c]	1.84
Nitrogen	76.83[c]	81.20[b]	87.01[a]	81.95[b]	2.91
Crude fiber	38.26[b]	72.56[a]	61.44[b]	47.13[b]	8.95

a, b, c: means with different superscript within a row differ significantly (P<0.05).
AA: *Acacia auriculata*; GA: *Gmelina aborea*; AL: *Albizia lebbeck*; BP: *Butryospermum parkii* and SEM: standard error of means.

BP, GA and AL (80.56, 86.67 and 89.70% respectively), had significantly high digestibility, while AA had significantly lower DM digestibility (75.76%). Also, the digestibility of OM, CP and CF followed a similar pattern. The dry matter digestibility values obtained for GA, AL and BP leaves were considerably higher than those reported by Norton (1994) for Leucaena in goats (68%) and *Sesbania grandiflora* in sheep (63%).

The lower apparent nutrients digestibility of AA measured in this experiment was as a result of low intake since in this case the feces of metabolic origin account for a greater proportion of the total fecal output. In addition, the high CF content and tannins levels of AA are associated with its ability to bind proteins, structural carbohydrate polymers and minerals with an overall effect of lowering the bioavailability of the nutrients at specific sites in the gastro-intestinal tract (Chang *et al.* 1998; Al-Mamary *et al.* 2001).

Nitrogen balance

The results on nitrogen balance showed significant differences in fecal N output (P<0.05); AA had higher fecal

N (16.76), followed by BP (12.42) and AL and GA which had 9.95 and 7.70, respectively (Table 4). The very high fecal N in AA indicates very strong tannin activity resulting in dietary N being excreted in the feces as tannin-protein complexes. The reduced N retention in animals fed AA was associated with its high tannin levels.

Similar results have been reported elsewhere in *A. saligna* (Ben Salem *et al.* 1997), *A. seyal* (Ebong, 1995) and *A. brevispica* (Woodward and Reed, 1997). Total N output was significantly higher in AA (20.65 g/d), followed by BP (18,67 g/d), while the lowest was recorded in GA and AL, which were statistically similar.

Table 4 Nitrogen balance in Yankasa bucks fed some browse plants

	N balance g/d				
	AA	GA	AL	BP	SEM
N intake (g)	31.54[c]	102.54[b]	106.10[b]	125.41[a]	7.23
Fecal N output (g)	16.76[a]	7.70[c]	9.95[c]	12.42[b]	1.45
Urinary N output (g)	3.89[c]	4.47[b]	4.99[b]	6.25[a]	0.33
Total N out put	20.65[a]	12.17[c]	14.94[c]	18.67[b]	0.54
Nitrogen retention	14.89[c]	90.37[b]	91.16[b]	106.74[a]	2.22
Ash % of intake	34.53	88.13	85.92	85.11	

a, b, c: means with different superscript within a row differ significantly (P<0.05).
AA: *Acacia auriculata*; GA: *Gmelina aborea*; AL: *Albizia lebbeck*; BP: *Butryospermum parkii* and SEM: standard error of means.

The increased total N output observed in animals fed AA in this study is a necessary consequence of decreased N absorption caused by high tannin contents of feed, as reported in the work of Harrison *et al.* (1973), Fassler and Lascano (1995), Reed and Soller (1987) and Woodward and Reed (1997).

The result of N retention showed BP to be significantly (P<0.05) higher, followed by GA and AL, which were statistically similar, while AA had the lowest N retention. This is in line with the findings of Reed *et al.* (1990), who reported nitrogen retention to vary according to the inclusion of tannins in the diet.

CONCLUSION

The experimental protocol followed here allows us to extract the following relevant conclusions:

A: Chemical analysis showed that the browse plants investigated had high crude protein content, in levels that are higher than tropical grasses and crop residues.

B: AA had the highest level of tannins. This relates with low N uptake, which seems to explain why goats favored the other leaves studied.

C: Goats fed with leaf with higher digestibility and nitrogen balance will eat more and thus are expected to produce more benefits to the community. Results here will help to choose the best diet for goats, considering the availability and nutritional value of different plants.

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