Livestock Research for Rural Development 23 (12) 2011 | Guide for preparation of papers | LRRD Newsletter | Citation of this paper

Chemical composition of selected browse plants and their acceptability by West African Dwarf sheep

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Abstract

Eight WAD sheep with average initial weight of 14.8 kg were used in a completely randomized design experiment to determine the acceptability of *Moringa oleifera* and seven selected browse plants. Proximate composition of the selected browse plants varied widely.

Crude protein content was highest for *L. leucocephala* (31.2%) followed by *M. oleifera* (29.7%) and was least in *Spondia mombin* and *Aspilia africana* (17.1%). Tannin content was lowest for *A. africana* (0.84 %) closely followed by *M. oleifera* (1.02 %) which also had the least phytate content (2.6 %). *M. oleifera* was ranked first in relative preference by WAD sheep followed by *A. africana, G. sepium and L. leucocephala* in that order. *C. siamea* was least preferred by the animals. DM and phytate contents had significant negative correlations with preference.

Keywords: Nutrient composition, preference, ruminants, shrubs, trees

Introduction

The potentials of trees and shrubs as alternative fodder resources in ruminant nutrition have attracted the attention of researchers worldwide. Several indigenous and exotic browse species have been investigated and evaluated for inclusion in ruminant feeding systems in Nigeria. Unfortunately, the adoption of most of these species by farmers has been faced with several challenges such as pests and diseases attack and presence of anti-nutritional factors. There is therefore the need for continuous screening of browse plants to identify those with good potentials as livestock fodder and which could serve as alternatives to those species which have already being evaluated.

According to Mtengeti and Mhelela (2006), any method used to screen potential browse species must take into consideration both the preference of browsing animals and laboratory analyses to verify the nutritional quality of the browse plants. D'Mello (1992) stated that results of proximate analyses are extensively employed in research and industry for quick estimation of nutrient potentials of feedstuffs; although such results may not give a true indication of the nutritive value of a feed, they supply clues in research to plants of potential value for further *in vitro* or *in vivo* studies. Buttressing this assertion, Okoli et al (2003) stated that proximate analysis is specifically useful in screening the array of tropical browse plants utilized by indigenous farmers for ruminant feeding.

Thus, the objectives of this study were to determine the proximate and anti-nutritional compositions of eight browse plants as well as their relative preference by West African Dwarf sheep. It also examined the relationship between preference and chemical compositions.

Materials and Methods

The experiment was carried out at the Teaching and Research Farm of Federal College of Agriculture, Akure (7°16´N, 5°12´E) located in the rain forest ecological zone of Nigeria. Eight browse species namely *Leucaena leucocephala, Gliricidia sepium, Ficus thonningii, Ficus exasperata, Aspilia africana, Cassia siamea, Spondia mombin and Moringa oleifera* were used in this study. *G. sepium* and *M. oleifera* were obtained from cultivated pastures while the remaining species were sourced from the bush and fallow lands within the premises of the College.

Samples of leaves and tender stems of the browse species were collected and divided into two portions. One part was weighed and oven-dried at 60° C for 48 hours, ground through a 1 mm screen and analyzed for proximate composition according to AOAC (1995). Organic matter (OM) content was obtained by subtracting ash from 100 %. The second portion was air-dried, ground and analyzed for the anti-nutritional factors: tannin (Makkar and Goodchild 1996), phytate (Maga 1982) and oxalate (AOAC 1995).

The cafeteria technique described by Larbi et al (1993) was used for the preference trial. Eight growing West African dwarf (WAD) sheep averagely weighing 14.8 kg were housed in a pen measuring about 20 m^2. The experiment lasted for twenty days comprising fourteen day adjustment and six day collection periods. Daily relative preference index (RPI) was calculated for each species by dividing its intake values with that of the species having the highest intake for that day and multiplying by 100. The species were ranked on the basis of their mean RPI.

Relative preference index data were subjected to analysis of variance as a completely randomized design using collection days as replicates according to the general linear model procedure of MINITAB (2000). Correlation and regression analyses to determine the relationship between RPI *(Y)* and each of % DM, OM, CP, CF, tannin, phytate and oxalate contents of the browse species *(X)* were performed using a scientific calculator (Casio *fx*-7400G PLUS POWER GRAPHIC model).

Results and Discussion

Table 1 shows the proximate composition of the browse plants under investigation. The lower dry matter (DM) value obtained for *A. africana* is probably because it is an herbaceous annual plant unlike the other species and it was therefore harvested at a relatively younger age and at higher moisture contents. The content of organic matter (OM) which varied from 83.3 – 94.0 % could be attributed to anatomical differences between plant species which according to Phuc (2006) depends on effect of plant development and on leaf: stem ratio. Crude protein (CP) content for *L. leucocephala* was the highest in this study and compares favorably with the value obtained for *M. oleifera*. This indicates that both plants had comparable potentials as protein supplements in ruminant diets. Also comparable were CP values for *F. exasperata* and *G. sepium* on one hand and *C. siamea, F. thonnningi, S. mombin* and *A. Africana* on the other hand. Similarities in nutrient (especially CP) contents may be used as the basis for selecting browse plants for comparative studies aimed at assessing their relative potentials as fodder resources in ruminant nutrition.

Table 1. Proximate and anti-nutritional factors composition (%) of selected browse plants

Browse Plants	DM*	OM	CP	CF	Tannin	Phytate	Oxalate
M. oleifera	21.5	92.5	29.7	17.0	1.02	2.60	3.85
L. leucocephala	26.1	91.0	31.2	17.0	2.74	8.45	4.90
S. mombin	28.0	94.0	17.1	19.6	7.71	9.21	5.79
F. thonningi	28.2	83.6	17.6	17.2	1.22	12.3	3.60
F. exasperata	35.1	83.3	26.2	12.8	1.17	5.74	1.70
C. siamea	35.9	91.0	19.7	16.4	1.07	7.54	3.91
G. sepium	31.6	91.0	24.4	14.0	2.52	7.21	7.01
A. africana	14.9	88.9	17.1	7.08	0.84	2.64	3.74

Mean	27.7	89.4	22.9	15.1	2.29	6.96	4.31
S.E.M.	6.53	3.70	5.39	3.61	2.16	3.07	1.49

** DM = % fresh sample, others = % DM; S.E.M. = Standard error of means*

Table 1 also depicts tannin, phytate and oxalate compositions of the browse plants under study. Average tannin content was lower than 4.0 % for cassava leaves, 4.3 % for *Daniellia oliveri* and 5.1 % for forage legumes reported by Ravindran (1993), Osakwe et al (2004) and Ologhobo (1989) respectively. According to Diagayette and Huss (1981), the level of tannin which adversely affect digestibility in sheep and cattle is between 2 – 5 % whereas goats have a threshold capacity of about 9 % dietary tannin (Nastis and Malachek 1981). Therefore, except for *S. mombin* in which tannin content is beyond the ideal level for sheep, all the plants investigated in this study contain tannin at levels tolerable to ruminants. The average phytate content is similar to that reported by Ologhobo (1989) for forage legumes but higher than observed by Okoli et al (2003) for selected browse plants. Compared with tannin and phytate, oxalate contents were less varied in the species investigated in this study.

Table 2 shows the relative preference index (RPI) of the selected browse plants under study and their preference ranking. According to Semenye (1991), knowledge of the relative palatability of plants fed to sheep and goats may be used as a tool to increase DM intake of the animals by offering the least palatable first and the most palatable last. The pattern of intake of the species investigated in this study shows that *M. oleifera* was the most preferred while *C. siamea* was totally rejected by the experimental animals probably due to the hard physical structure of the leaves which according to Daovy et al (2008) was responsible for the low preference for mango leaves. Freer (1981) reported that the intake of browse plants is affected both by their physical structures and chemical compositions. The table also shows that *Gliricidia and Aspilia* had 100% average RPI in the first two days of collection compared with 95% for *Moringa* which ultimately ranked first in preference. This suggests that the animals were more familiar with *Gliricidia* and *Aspilia* at the beginning of the experiment than *Moringa* and that the animals needed a few days to get accustomed to the latter when it was introduced to them for the first time. This is in agreement with Grovum (1988) that animals need some time to get used to a new feed.

Table 2. Daily relative preference index (RPI, %) and preference ranking of selected browse plants

SPECIES	COLLECTION DAYS						MEAN	S.E.M.	PROB.	RANK
	1	2	3	4	5	6				
M. oleifera	90.0	100	100	100	100	100	98.3^{a}	3.73	0.46	1
A. africana	100	100	73.7	40.0	100	66.7	80.1^{a}	22.4	0.50	2
G. sepium	100	100	31.6	46.7	73.3	73.3	70.8^{a}	25.3	0.49	3
L.leucocephala	26.7	86.7	42.1	20.0	53.3	46.7	45.9^{b}	21.5	0.48	4
S. mombin	66.7	60.0	0.00	26.7	20.0	66.7	40.0^{b}	25.8	0.50	5
F. thonningii	26.7	53.3	0.00	0.00	13.3	13.3	17.8^{cd}	18.3	0.48	7
F. exasperata	20.0	66.7	52.6	26.7	6.67	0.00	28.8^{c}	23.8	0.49	6
C. siamea	0.01	0.02	0.01	0.00	0.00	0.01	0.01^{d}	0.01	0.60	8

S.E.M. = Standard error of means

Table 3 shows the relationship between RPI and the nutritive and anti-nutritive compositions. Except for DM, all the proximate components had weak correlation with preference for the selected browse plants by WAD sheep. The significant negative correlation between RPI and DM confirm earlier findings that high forage DM may impair feed intake (Phuc 2006; Daovy et al 2008). The table also show that phytate content significantly affected palatability while tannin and oxalate contents were weakly correlated with animal preference. This is probably because average tannin and oxalate contents in this study (2.3% and 4.3% respectively) are much lower than mean phytate content (7.0 %) and tannin content in particular is within the range (2 – 5 %) reported to be beneficial to ruminant animals for optimum intake and utilization of fodder trees and shrubs (Barry 1987).

Table 3: Correlation and regression analyses between chemical compositions of selected browse plants (X) and RPI (Y)

CORRELATED PAIRS	CORRELATION	REGRESSION EQUATION
RPI versus DM	-0.73*	$Y = 143.67\text{-}3.47X$
RPI versus OM	+0.38 NS	$Y = 240.21+3.22X$

RPI versus CP	+0.35 NS	$Y = 1.77+2.01X$
RPI versus CF	-0.34 NS	$Y = 92.62-2.97X$
RPI versus tannin	-0.07 NS	$Y = 49.98-0.99X$
RPI versus phytate	-0.71*	$Y = 97.48-7.15X$
RPI versus oxalate	+0.26 NS	$Y = 24.03+5.49X$

**Significant (P<0.05); NS = Not significant*

Conclusion

- This study revealed that *M. oleifera* was the most preferred by WAD sheep out of eight selected browse plants despite the fact that it was newly introduced to the animals. This is probably a reflection of the higher relative palatability of *M. oleifera,* its better nutrient profile and lower anti-nutritional factors content.

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Received 5 September 2011; Accepted 27 November 2011; Published 1 December 2011

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