Short paper and poster abstracts: 38th Congress of the South African Society of Animal Science

The potential of legume pods as supplements to low quality roughages

A.T. Ngwa, I.V. Nsahlai and M.L.K. Bonsi
Animal and Poultry Science, School of Agricultural Sciences & Agribusiness,
University of Natal, P/Bag x 01, Scottsville, 3209

Introduction

Poor quality and the seasonal nature of forage supply, together with low intake and digestibility of forage are factors contributing to low productivity of ruminants in Africa. One way of reducing the problem of feed deficiency is through the judicious use of forage (foliage and pods) from tree legumes which could provide a good source of protein, vitamins and minerals to animals at critical periods of the year when pastures are deficient both in quantity and quality. The goal of this study was to evaluate the potential of legume pods as supplements to ruminants fed poor quality roughages.

Materials and Methods

In the first phase, the chemical composition and the degradabilities of dry matter (DM), nitrogen (N) and fibre fractions (NDF, ADF and Hemicellulose) of pods from six tree legumes (*Acacia erioloba, A. karoo, A. nilotica, A sieberiana, A. tortilis* and *Leucaena leucocephala*) were examined. Nylon bags containing 4g of pod sample were incubated in the rumen of two Jersey cows following the method described by Mehrez & Orskov (1977). The second phase was aimed at evaluating the effect of feeding *A.sieberiana, A. nilotica, L. leucocephala* or alfalfa in combination with veld hay (50:50) on the ruminal degradation of maize stover, alfalfa hay and their neutral detergent extracts in sheep. Each feed was given at the rate of 450 g/animal/day at three intervals. Five fistulated South African Merino rams were used for the incubation exercise in an incomplete (5 x 4) Latin square design. Diets were offered in four periods of 15 days each, comprising seven days of adaptation, followed by seven days of incubation and one day of rumen fluid collection. The degradation of dry matter, nitrogen and detergent fibre-fractions was estimated by fitting the degradation data of each component to the non-linear model proposed by McDonald (1981) and modified by Dhanoa (1988):

$$Y = w + b[1-e^{-c(t-tl)}]$$

Y = the disappearance of DM, N or fibre fraction at time t; w = washing loss or solubility; b = degradable part of the insoluble fraction; c = rate of degradation of 'b'; PD = (w + b), the potential degradability; tl = lag time.

$$ED = w + b \times c /(k+c)$$

k = passage rate = 0.03 (Nsahlai, 1998)

Results and Discussion

Table 1 Chemical composition of the pods of *Leucaena leucocephala, Acacia erioloba, A. karoo, A. nilotica, A. sieberiana, A. tortilis,* Alfalfa, Maize stover and veld hay.

Species	Plantpart	S:H Ratio	DM	Ash	OM	CP	NDF	ADF	HEM
L. leucocephala	pod	60:40	943	47.4	952.6	246.9	408.9	284.7	124.2
A. erioloba	pod	22:78	938	47.3	952.7	124.1	477	335.2	141.8
A. karoo	pod	53:47	935	63.7	936.3	193.2	459.7	384.2	75.5
A. nilotica	pod	31:69	936.5	54.3	955.7	149.1	224.7	180.8	43.9
A. sieberiana	pod	27:73	936.5	44.2	945.8	174.9	366.9	290.1	76.8
A. tortilis	pod	45:55	939.5	76.4	923.6	191.2	398.9	294.9	104
Alfalfa	hay		927	101.2	898.8	220	402.4	341.1	61.3
Maize stover	straw		943	71.2	928.8	53.5	522.8	360.3	161.5
Veld hay	hay		952	75.4	924.6	41.9	700.8	472.3	228.5

S:H – seed:husk; DM: dry matter; OM: organic matter; CP: crude protein; NDF: neutral detergent fibre; ADF: acid detergent fibre; HEM: hemicellulose

The Leucaena pods and seeds had higher ($P < 0.01$) crude protein (CP) contents than the Acacia pods. The NDF concentrations of the husks were higher than those of the pods and seeds with the pods of *A. erioloba* having the highest and those of *A. nilotica*, the lowest values respectively. The pods of *A. tortilis* and *A. karoo* were rich in macro and micro-minerals while the others contained quantities that could adequately fulfil the dietary

requirements of sheep if fed as supplement at the rate of 0.5 kg/day. Dry matter and nitrogen degradabilities were highest for pods of *A. nilotica* and *A. sieberiana* respectively and lowest for those of *A. karoo*. The detergent fibre-fractions of the pods of *A. tortilis* and *A. erioloba* were the most and the least susceptible to microbial degradation in the rumen respectively. The dry matter disappearance of alfalfa and maize stover was not affected by diet. The rate and effective degradability of dry matter was higher ($P < 0.0001$) for alfalfa than maize stover. The effective degradabilities of NDF, ADF and hemicellulose were similar ($P > 0.05$) for animals that were fed a mixture of hay and pods but higher ($P < 0.01$) for animals that ate hay alone or hay mixed with alfalfa. Lag time (LT) was similar ($P > 0.05$) for DM, NDF, ADF and hemicellulose disappearances of the two roughages. The slowly degradable fraction (B) and potential degradability (PD) of the NDF, ADF and hemicellulose of the maize stover were higher ($P < 0.01$) than those of alfalfa. The effective degradabilities (ED) and the rates of degradation (C) of NDF and ADF were higher ($P < 0.01$) for alfalfa than for maize stover.

Table 2 Dry matter degradation of the pods of *L. leucocephala, A. erioloba, A. karoo, A. nilotica, A. sieberiana* and *A. tortilis* incubated in the rumen of Jersey cows.

Parameter:	Degradation (g/kg)							
	L.leucocephala	A.erioloba	A. karoo	A. nilotica	A.sieberia	A. tortilis	SED	SIG
W	266.6	310.8	229.5	473.4	374.1	304.5	5.75	***
B	372.1	318.5	425.9	381.7	415.4	506.7	17.42	***
PD	638.7	629.3	655.4	855.1	789.5	811.2	13.99	***
ED	530.7	477.1	448.3	644.2	592.1	572.2	13.93	***
C/h	0.063	0.028	0.026	0.022	0.027	0.028	0.0042	***
LT (h)	0.306	1.783	-0.878	-2.668	1.161	0.948	1.285	NS

W is the wash value; B, degradable fraction; PD, potential degradability; ED, effective degradability; C, rate of degradation and LT, lag time.

Table 3 Effect of rumen ecology on the degradabilities of maize stover and alfalfa incubated in the rumen of South African Merino sheep

Parameter	Rumen Ecology										SED	RE	FINC
	Hay+ Alfalfa		Hay		Hay+ Leuc		Hay+Nilotica		Hay+Sieb				
	A	MS	A	MS	A	MS	A	MS	A	MS			
W	288	117	288	117	288	117	288	117	288	117			
B	432	613	426	642	432	780	403	442	428	555	60.7	NS	NS
PD	720	730	714	759	721	917	692	559	716	672	60.7	NS	NS
ED	565	329	578	336	548	299	545	294	540	330	8.2	NS	***
C	0.04	0.01	0.05	0.01	0.04	0.01	0.04	0.02	0.04	0.02	0.011	NS	***
LT	-2.9	- 5.4	-1.5	-2.9	-3.9	- 6.9	-2.6	-3.6	-4.6	-1.1	-1.29	NS	NS

A is Alfalfa; MS, maize stover; RE, rumen ecology; FINC, feed incubated.

The differences observed in the C and ED of MS and A are related to the fact that a very sizable proportion of alfalfa cell walls consists of rapidly degradable pectins found in non-lignified tissues whereas a large proportion of the potentially degradable cell walls of maize stover are composed of very thick secondary walls that are very slowly degraded (Jung et al., 2000). Maize stover also has high lignin content which is negatively correlated to hemicellulose degradability.

Conclusion

The results show that the pods can serve as a valuable source of N, and have effects comparable to alfalfa on dry matter degradability.

References

Dhanoa, M.S., 1988. Grass Forage Sci. 43, 441.
Jung, H.J.G. et al., 2000. J. Sci. Food Agric. 80, 419.
McDonald, I.M,. 1981. J. Agric. Sci., Camb. 96, 251.
Mehrez, N.P. & Orskov, E.R. 1977. J. Agric. Sci., Camb. 88, 645.
Nsahlai, I.V. et al., 1998. J. Appl. Anim. Res. 14, 33.