KENAF SEEDS (*HIBISCUS CANNABINUS* L.) AS A PROTEIN SUPPLEMENT TO SHEEP

T. S. Sgwane[ab] *E. Teleni*[b] *C. P. Gardiner*[b]

[a] Department of Animal Production and Health, University of Swaziland, P O Luyengo, Swaziland.

[b] School of Tropical Veterinary and Biomedical Sciences, James Cook University, Townsville, Australia

Email: tsgwane@agric.uniswa.sz

INTRODUCTION

Kenaf, *Hibiscus cannabinus* L. is traditionally known as a fibre crop but it also produces seeds which may be a valuable protein supplement to livestock in rangelands. This study investigated the potential of kenaf seeds (KS) as a protein supplement to ruminants. Twelve merino wethers were assigned to two diets in a randomised complete block design forming two groups of six wethers each. The dietary treatments allocated to animals were mixed summer grass hay of low quality (LQH) and LQH supplemented with KS (LQHKS). Addition of KS to grass hay increased dietary dry matter intake (DMI) and organic matter intake (OMI). However, there were no differences in DM or organic matter (OM) digestibilities between dietary treatments (P>0.05). In contrast, nitrogen (N) digestibility of the LQHKS was almost twice that of LQH. There was inefficient use of N by the LQHKS animals and this was evidenced by high N excretion in urine. Even though LQHKS animals had high N excretion in urine, they retained 0.36 g/d of N compared to the LQH (–0.91 g/d). The excretion of N in faeces as a percent of N intake was significantly reduced in the LQHKS group compared to the LQH. The increased N digestion observed in LQHKS group implies that KS can be a good source of protein for ruminants but should be fed with an energy source.

Key words: *Kenaf seeds; Protein supplement; Ruminants*

INTRODUCTION

Ruminant animals are capable of converting vast renewable resources from rangeland pasture into food for humans. However, some of the feed resources tend to be poor in quality (low protein) and inadequate for satisfactory support of ruminant animal production, especially in the dry seasons and drought (Gutteridge and Shelton, 1994). Leguminous plants have become the centre of attention as cheap sources of protein, however, high levels of antinutritive chemical in some, makes them inferior for livestock production (Norton, 1994). Other plants also high in protein content do exist, one such plant is kenaf (*Hibiscus cannabinus* L.). Kenaf is traditionally known as a fibre crop (Webber *et al*. 2002), but research has highlighted the potential of the seeds as a protein supplement (Arora *et al.* 1983; Rajashekher *et al.* 1993). The crude protein (CP) content of kenaf seeds (KS) ranges from 24 to 35% on DM (Rajashekher *et al.* 1993). The role which KS can play in the nutrition of ruminants has not yet been realised. The aim of this study was to evaluate the effect of supplementing low quality grass hay with KS in the diet of sheep.

MATERIALS AND METHODS

The experiment was conducted at the School of Veterinary and Biomedical Sciences, James Cook University (JCU), Townsville, Australia. The research experiment was approved by the Experimental Animal Ethics Committee of JCU.

Animals and housing

Twelve merino wethers, twelve months old were used in randomized complete block design with liveweight stratified across two dietary treatments. The two dietary treatments used in this study were mixed summer grasses of low quality hay (LQH = Diet 1) and LQH supplemented with KS (LQHKS = Diet 2). Two groups of six animals per group with liveweight of 25.52± 1.5 kg and 25.58±1.4 kg were respectively assigned to the LQH and LQHKS diets. Live weights of individual animals were measured in the beginning and end of the experimental period. Animals had a ten day adaptation period.

Feeds and feeding

The grass hay was a mixture of the summer grasses; Sabi grass (*Urochloa sp.*) (30 – 60 %), barnyard grass (*Echinochloa colona*) (15 – 35 %), summer grass (*Digitaria sp.*) (15 – 35 %), stink grass (*Eragrostis cilianensis*) (0 – 5 %), Indian couch (*Bothriochloa pertusa* (0 – 5 %) and nut grass (*Cyperus rotundus*) (0 – 5 %). Kenaf seeds were ground using a hammer mill to pass through a 1.5 mm sieve then stored in a cold room at 10^0C. A mineralised Forsfolic block was provided as mineral supplement. Animals were offered their diets DM equivalent to 2.5 % of their individual liveweight at 0900 hours. The LQH to KS ratio was 70:30 on a DM basis. Animals had unlimited access to mineralised block and clean drinking water.

Feeds, faeces and urine

Feeds, refusals and faecal sub-samples were collected daily at 0840 hours and dried at 100^0C for 24 hours for DM determination. Daily total urine volume of individual animal was measured, and then daily aliquots of 20% were pooled and stored at $–20^0$C pending laboratory analysis. At the end of collection period, samples were ground to pass through a 1 mm sieve and then analysed for N, OM and DM. Ether extract was obtained using ultrasonic bath and solvent was evaporated for one hour using a freeze drier. Fatty acids were analysed using a gas chromatography with helium as a carrier gas and a flame ionisation detector. Independent Sample T-test was used to determine differences between the treatments means using SPSS® Version 11 for Windows ™.

RESULTS AND DISCUSSION

Chemical composition of feeds

The chemical composition of KS is shown in Table 1. The CP content of KS was more than threefold (31%) that of the grass hay (8%). Kenaf seeds had high EE (19%) and the fatty acid composition was predominantly oleic (31%), linoleic (31%) and palmitic (33%). Stearic was the lowest fatty acid, 5%.

Table 1. Mean values for the chemical composition (% dry matter basis) of kenaf seeds

Component	**Kenaf seeds**
Crude protein	30.88
Organic matter	95.15
Ether extract	18.55
Fatty acids composition (% of total fatty acids)	
Palmitic	33.21
Stearic	5.02
Oleic	31.26
Linoleic	30.51

Dry matter intake, in vivo digestibility and N balance

The KS increased dry matter intake (DMI) of LQHKS diet (620 g/d) compared to LQH diet, 586 g/d (Table 2). Similarly, the organic matter intake (OMI) of animals supplemented with KS was significantly higher ($P < 0.05$). The high DMI observed in animals fed the LQHKS diet in this study was not a result of improved digestibility from additional N provided by KS. However, increased DMI due to grinding of feeds has been found in ruminants (Ørskov, 1998). There were no differences ($P>0.05$) on DM and OM digestibilities between groups (Table 2).

Table 2. Mean dry matter (DM), organic matter (OM) and nitrogen (N) intake, digestibilities, rumen ammonia and volatile fatty acids (VFA)

	Diets			
	LQH	**LQHKS**	**SEM**	**P**
Intake (g/d)				
DM	586	620	14	0.037
OM	525	566	13	0.012
N balance (g/day)				
N intake	7.45	14.82	0.39	0.001
N faeces	4.72	4.86	0.15	0.380
N urine	3.75	9.59	0.46	0.001
N retained	–0.91	0.36	0.33	0.004
Digestibilities (%)				
DM	47.6	49.0	1.3	0.337
OM	50.8	51.3	1.2	0.687
N	37	68	2	0.001
Rumen fluid (mg/L)				
Ammonia	162	244	9	0.206

SEM – Standard error of treatments mean

In other studies which supplemented oilseeds to low quality roughages, depressed DM and OM digestibilities have been observed (O'Kelly and Spiers, 1993; Wachira *et al.* 2000). This study suggested that there might have been no synchrony between the N released from the KS and energy substrates from grass hay for microbial activity. This might have caused the lack of improvement in the DM and OM digestibilities of the LQHKS diet. Low levels of fermentable carbohydrates, starch and glucose have been found in KS (Rajashekher *et al.* 1993).

Despite similarities in DM and OM digestibilities between dietary treatments, N digestibility of LQHKS diet (68%) was significantly increased ($P<0.001$) compared to LQH diet (37%). The amount of N excreted in urine of animals supplemented with KS was almost three times that of animals on the LQH diet (Table 2). Animals fed LQHKS diet excreted an average of 10 g N/d while those on LQH diet excreted 4 g N/d in urine. Increased ruminal protein degradation has been found when canola meal was supplemented to low quality grass hay at 8% (Leupp *et al.* 2006). Rumen fluid indicated that KS had influence on the amount of rumen ammonia (Table 2). Animal supplemented with KS had higher rumen ammonia levels, 244 mg/L compared to those on LQH diet, 162 mg/L ($P<0.05$). This is attributed to the high degradation and high CP content of KS. Animals on LQHKS diet had higher water intake (2095 mL/d) than animals on LQH, 1574 mL/d ($P < 0.01$). Similarly, the urine output of animals on LQHKS diet was significantly increased compared to animals on the LQH diet ($P < 0.01$). Increased intake of soluble protein results in high urinary N excretion since urine is the primary route of N excretion (Haig *et al.* 2002). Even though animals on the LQHKS diet excreted more N in urine, N retention was significantly higher than LQH group ($P < 0.01$). The low N retention in LQHKS animals may have been due to losses of N in the rumen due to insufficient readily fermentable energy substrates for microbial growth. Kenaf seeds proteins which escaped rumen degradation may have increased amino acid absorption in the small intestine resulting in positive N retention.

CONCLUSIONS

It was concluded in this study that KS can improve N retention and DMI by sheep. The protein in KS seemed to be highly degradable in the rumen. In situations where rumen degradable protein is limiting, like in rangeland feeds, the provision of KS proteins with readily degradable energy sources such molasses may improve the utilisation of these proteins.

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