Intake and rumen degradation in cattle fed napier grass (*Pennisetum purpureum*) supplemented with various levels of *Desmodium intortum* and *Ipomoea batatus* vines

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Abstract

This study was conducted to assess the effect of greenleaf desmodium (*Desmodium intortum*) and sweet potato vine (*Ipomoea batatus*) supplementation of napier grass on dry matter intake, degradation and rumen fermentation in Friesian steers. Four fistulated steers were offered napier grass diets containing 0, 10, 20 or 30% desmodium or sweet potato vine in two 4 x 4 latin squares. Organic matter intake per kg metabolic body weight increased linearly with increasing inclusion level of desmodium (74-90 g/ $kg^{0.75}$) and sweet potato vine (78-94 g/$kg^{0.75}$). Crude protein intake also increased linearly with the increase in inclusion level of desmodium (7.6-13.0 g/$kg^{0.75}$) and sweet potato vine (7.9-12.9 g/$kg^{0.75}$). Supplementation improved DM degradation but did not change rumen pH. Rumen fermentable organic matter increased by up to 52% and 43% for desmodium and sweet potato vine respectively at the highest levels of supplementation. Ammonia nitrogen concentrations increased with increasing level of desmodium (130-214 mg/l) and sweet potato vine (139-235 mg/l). Inclusion of desmodium and sweet potato vine led to small increases in concentrations of total and individual volatile fatty acids. It was concluded that the two forage supplements could play an important role in improving animal performance when napier grass is fed as the basal diet.

Key words: Napier, desmodium, sweet potato vine, intake, degradation, fermentation**,** rumen, nutrition, cattle
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Introduction

The low protein content of tropical grasses and crop residues has been cited as a major constraint to animal production (Egan, 1997; Minson, 1990). Napier grass (*Pennisetum purpureum*), the main fodder used by smallholder dairy farmers in Kenya, has a mean crude protein (CP) content of less than 80 g kg^{-1} DM (Wouters, 1987). This is lower than the minimum dietary CP concentration required for milk production from dairy cows (Muia *et al*., 1999). However, napier grass appears to meet the energy requirements of cattle reared by smallholder dairy farmers (Muinga *et al.*, 1993; Muia *et al.*, 2000). Since the majority of smallholder farmers cannot afford commercial fertilisers, and little or no manure is used on napier grass fields, soil fertility deteriorates (Delve *et al.*, 2001) leading to low plant productivity and poor quality fodder (Muia *et al*., 1999; Wouters, 1987). Forages such as *Desmodium intortum* (Boonman, 1997; Kariuki *et al.*, 1999a, b) and sweet potato vines (*Ipomoea batatus*; Karachi, 1982) have a high protein content and are used as supplements to napier grass. Although greater quantities of these supplements are fed in the wet season than in the dry season (Mureithi *et al.*, 1998), optimum inclusion levels have not been established. The objective of this study was to determine the effect of supplementing a napier grass basal diet with different levels of desmodium and sweet potato vines on the intake, rumen dry matter degradation and rumen fermentation of Friesian steers.

Materials and methods

The study was conducted at the National Animal Husbandry Research Centre, Naivasha, in the Kenyan rift valley (0° 40' S, 36° 26' E, 1900 m above sea level) between December 1996 and June 1997. The mean annual rainfall for the study site is 620 mm and the mean annual temperature is 18° C (Jaetzold & Schimdt, 1983).

Napier grass (*Pennisetum purpureum*, variety Bana), green-leaf desmodium (*Desmodium intortum*) and sweet potato vine (*Ipomoea batatus*, variety Musinya) were grown using the recommended cultural practices (MLD, 1991). The forages were irrigated to allow continuous growth. Napier grass was harvested after eight weeks growth (1.0 m in height), and desmodium and sweet potato vine were harvested after 12

weeks growth. Clearing cuts were planned and executed sequentially to ensure consistency of forage maturity (56 days regrowth for napier grass and 84 days for desmodium and sweet potato vine; Kariuki *et al.*, 1999b).

Four Friesian steers (body weight: 411 ± 18 kg; age 22 ± 2 months) fitted with large rumen fistulas (10 cm diameter) were used in two 4 x 4 latin squares. The two feeding experiments were designated A (desmodium supplement) and B (sweet potato vine supplement). The steers were drenched with an anti-helminthic at the start of the experiment and were treated weekly with an acaricide to control ticks.

In experiment A, the four steers were randomly allocated to the following diets: napier alone (D0), napier plus 10% desmodium (D1), napier plus 20% desmodium (D2), napier plus 30% desmodium (D3). Each feeding period lasted for 21 days. Intake was measured over eight days after an initial adaptation period of ten days. Rumen fluid was sampled on days 19, 20 and 21. In experiment B, sweet potato vines were substituted for desmodium and the new diets similarly designated as S0, S1, S2 and S3. The procedure for experiment A was then repeated. The forages were harvested each morning, chopped into 2.5 cm pieces and the diets constituted by thorough mixing. The diet*s* were offered ad *libitum* (110% of the previous day's intake) in two equal daily portions. The steers were housed and fed individually, and clean water and a mineral supplement were made available. Daily samples of the diet were collected before the morning feeding and were bulked on a weekly basis. Feed refusals were removed from the troughs and weighed before the morning ration was fed. These samples were oven-dried at 105^{o}C for 24 hours on a daily basis to determine DM content.

Rumen fluid was collected from the rumen every three hours for 24 h on days 19, 20 and 21. A plastic pipe (50 cm in length, inner diameter 15 mm) that was closed with a cork at one end and perforated with approximately 120 holes of 2.5 mm diameter was inserted through the fistula until the perforated end reached the liquor phase in the ventral sac of the rumen. Rumen liquor (200 ml) was aspirated using the vacuum created by a corked plastic container connected to the pipe. A portion of the rumen sample was acidified (1 ml 20% H_2SO_4 per 5 ml rumen fluid) and kept frozen in tightly capped containers until analysis for ammonia nitrogen (AOAC, 1990). A second portion was acidified with 5% metaphosphoric acid (1 ml per 5 ml rumen fluid), centrifuged and refrigerated at 4^{o}C in tightly capped containers until analysis for volatile fatty acid concentrations using gas-liquid chromatography. A third portion was used for pH determination.

Rumen degradation of the diets was estimated by incubation of a single dried composite sample of the diets. These samples were ground to pass through a 3 mm sieve and 5 g was placed in nylon bags (Nybold Switzerland; polyamide, porosity 26%, mesh size 40 ì m, size 6 cm x 12 cm). The bags were incubated for 0, 3, 6, 12 (in duplicate), 24, 48, and 96 hours (in triplicate) in each steer. All steers received a diet consisting of napier grass, desmodium and sweet potato vine in the ratio of 8:1:1 on an *ad libitum* basis. After incubation, the nylon bags were washed in tap water for five minutes and oven-dried at 70^{o}C for 48 h. A zero hour residue was obtained by soaking the bags in a water-bath at 38^{o}C for five minutes followed by oven-drying. DM disappearance was expressed as a proportion of amount incubated, and the data was fitted to the exponential model of Ørskov & McDonald (1979):

$$P = a + b\,(1 - e^{-ct})$$

where P = the DM disappearance at time t, a = the zero time intercept, b = the slowly degradable fraction and c = the rate of degradation. Potential degradability (PD) was estimated as (a+b), and effective degradability (ED) was calculated using the following equation (Ørskov & McDonald, 1979):

$$ED = a+bc/(k+c)$$

where an outflow rate (k) of 0.04 hour^{-1} (Lechner-Doll *et al.*, 1990) was used. The organic matter fermented in the rumen (DOMR) was subsequently determined as:

$$DOMR = ED*OM\ intake.$$

Diet samples for chemical analysis (feed offered and refusals) were ground to pass through a 1 mm screen using a Wiley mill. The diets were then analysed for DM (105^{o} C for 24 hours), organic matter (OM; ashing at 500^{o} C) and Kjeldahl nitrogen (AOAC, 1990). Neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) were analysed using the method of Van Soest & Robertson (1985).

The ANOVA procedure was used to compute analyses of variance (SAS, 1996) for DM and nutrient intake and the least significant difference (LSD) test was applied to compare diet means. Orthogonal contrasts were used to compare relationships between treatments. To assess diet effect on pH, rumen ammonia and volatile fatty acids, repeated measure analysis with time as the repeated term was applied. The data was therefore analysed as a split-plot design, with diet and period as the main plot and sampling time as the sub-plot.

Results

The chemical composition of the diets is shown in Tables 1 and 2. The DM content of diets increased progressively with an increase in the proportion of desmodium, but the opposite trend occurred with diets containing sweet potato vine. The inclusion of desmodium and sweet potato vine in the diets tended to increase OM levels and depress NDF and ash levels. ADL levels generally increased with increasing proportion of desmodium in the diet. The CP content of diets containing napier only (91 and 89 g kg^{-1} DM for experiments A and B respectively) was lower than that of the supplemented diets. The CP content increased with increasing proportion of supplement.

Table 1 Chemical composition of napier + desmodium* diets fed to steers in experiment A (DM: g kg^{-1}; OM, CP, NDF, ADL and ash: g kg^{-1} DM)

	Diet							
Composition	D0	s.d.	D1	s.d.	D2	s.d.	D3	s.d.
DM	150	4.1	154	3.9	162	4.7	175	5.6
OM	842	13.2	855	14.4	860	12.3	872	16.1
CP	91	3.5	97	3.7	108	2.5	117	5.8
NDF	603	11.6	591	10.4	583	9.8	575	8.7
ADF	311	7.2	315	6.6	319	5.2	323	6.2
ADL	28	2.2	40	1.2	46	3.1	52	2.9
Ash	158	8.1	153	7.5	147	8.5	143	7.7

*Mean CP for pure desmodium was 175 g kg^{-1} DM; s.d. = standard deviation; D0 = napier + 0% desmodium; D1 = napier + 10% desmodium; D2 = napier + 20% desmodium; D3 = napier + 30% desmodium; DM = dry matter; OM = organic matter; CP = crude protein; NDF = neutral detergent fibre; ADF = acid detergent fibre; ADL = acid detergent lignin.

Table 2 Chemical composition of napier + sweet potato vine* diets fed to steers in experiment B (DM: g kg^{-1}; OM, CP, NDF, ADL and ash: g kg^{-1} DM).

	Diet							
	S0	s.d.	S1	s.d.	S2	s.d.	S3	s.d.
DM	146	8.1	141	7.9	136	9.4	128	8.6
OM	829	11.9	841	13.2	853	10.5	867	12.7
CP	89	2.9	99	3.2	109	2.5	120	3.2
NDF	614	13.4	581	14.6	573	15.1	565	13.7
ADF	318	5.1	319	6.7	320	5.8	321	5.2
ADL	29	1.9	30	2.4	30	1.8	31	1.7
Ash	161	7.7	157	8.3	153	6.9	149	7.5

Mean CP for pure sweet potato vine was and 189 g kg^{-1} DM; s.d. = standard deviation; S0 = napier + 0% sweet potato vine; S1 = napier + 10% sweet potato vine; S2 = napier+20% sweet potato vine; S3 = napier+30% sweet potato vine; DM = dry matter; OM = organic matter; CP = crude protein; NDF = neutral detergent fibre; ADF = acid detergent fibre; ADL = acid detergent lignin.

Mean DM, OM, CP and NDF intakes are presented in Tables 3 and 4. There were differences in intake ($P < 0.05$) between the diets in both experiment A and B, and linear relationships ($P < 0.05$) were evident in nearly all cases. Intake of all components except NDF increased with an increase in the dietary level of desmodium and sweet potato vine. Neither DM nor OM intake differed ($P > 0.05$) between the unsupplemented diet and the 10% supplementation diet in either trial.

Table 3 Intake, *in sacco* rumen degradation and organic matter fermented in the rumen (DOMR intake, g kg$^{-0.75}$) of steers fed napier grass diets supplemented with various levels of desmodium (Experiment A)

	Diet					Contrasts	
	D0	D1	D2	D3	SED	Lin	Quad
Intake (kg DM day^{-1})							
DM	7.8^{a}	8.1^{ab}	8.7^{bc}	9.4^{c}	0.4	**	NS
OM	6.8^{a}	7.2^{ab}	7.6^{b}	8.4^{c}	0.3	**	**
Intake (g kg$^{-0.75}$)							
OM	74^{a}	76^{a}	83^{b}	90^{c}	2.1	**	*
CP	7.6^{a}	8.5^{b}	11.3^{c}	13.0^{d}	0.2	**	**
NDF	53^{a}	52^{a}	51^{a}	51^{a}	1.7	NS	NS
Degradation characteristics (g kg^{-1} DM)							
a	197^{a}	189^{b}	186^{b}	190^{b}	4.1		
b	492^{a}	481^{a}	488^{a}	453^{b}	8.1		
c	0.044^{a}	0.043^{a}	0.046^{a}	0.045^{a}	0.006		
PD	667^{a}	688^{a}	727^{b}	715^{b}	9.2		
ED	468^{a}	533^{b}	543^{b}	584^{b}	20.7		
DOMR intake	34.6	40.5	45.1	52.6	-		
Increase in DOMR intake (%)	0	17.1	30.3	52.0	-		

D0 = napier + 0 % desmodium; D1 = napier + 10% desmodium; D2 = napier + 20% desmodium; D3 = napier + 30% desmodium; S.E.D. = standard error of the difference; DM = dry matter; OM = organic matter; CP = crude protein; NDF = neutral detergent fibre; a = soluble fraction; b = slowly degradable fraction; c = degradation rate; PD = potential degradation; ED = effective degradation; DOMR intake = OM intake*ED; ^{a,b,c}Means within a row without common superscripts differ ($P < 0.05$); Lin, Quad = linear and quadratic orthogonal contrasts; **, * significance at $P < 0.05$ and 0.01 respectively; NS = not significant.

Table 4 Intake, *in sacco* rumen degradation and organic matter fermented in the rumen (DOMR intake, g kg$^{-0.75}$) of steers fed napier grass diets supplemented with various levels of sweet potato vine (Experiment B)

	Diet					Contrasts	
	S0	S1	S2	S3	SED	Lin	Quad
Intake (kg DM day^{-1})							
DM	8.2^{a}	8.6^{ab}	8.7^{b}	9.7^{c}	0.2	**	**
OM	7.1^{a}	7.5^{a}	7.7^{b}	8.2^{a}	0.2	**	*
Intake (g kg$^{-0.75}$)							
OM	78^{a}	80^{ab}	86^{b}	94^{c}	2.8	**	*
CP	7.9^{a}	8.7^{b}	12.3^{c}	12.9^{d}	0.2	**	**
NDF	55^{a}	51^{ab}	47^{bc}	46^{c}	2.2	**	NS
Degradation characteristics (g kg^{-1} DM)							
a	202^{a}	201^{a}	211^{a}	198^{a}	5.3		
b	462^{a}	463^{a}	480^{a}	477^{a}	10.3		
c	0.044^{a}	0.044^{a}	0.048^{a}	0.046^{a}	0.006		
PD	663^{a}	682^{a}	715^{b}	747^{c}	8.8		
ED	465^{a}	515^{b}	541^{c}	553^{c}	5.1		
DOMR intake	36.3	41.2	46.5	52.0	-		
Increase in DOMR intake	0	13.5	28.1	43.3	-		

S0 = napier + 0% sweet potato vine; S1 = napier + 10% sweet potato vine; S2 = napier + 20% sweet potato vine; S3 = napier + 30% sweet potato vine; S.E.D. = standard error of the difference; DM = dry matter; OM = organic matter; CP = crude protein; NDF = neutral detergent fibre; a = soluble fraction; b = slowly degradable fraction; c = degradation rate; PD = potential degradation; ED = effective degradation; DOMR intake = OM intake*ED; ^{a,b,c}Means within a row without common superscripts differ ($P < 0.05$); Lin, Quad = linear and quadratic orthogonal contrasts; **, * significance at 0.05 and 0.01 respectively; NS = not significant.

The soluble fraction (a) and the rate of degradation (c) were not associated ($P > 0.05$) with the level of desmodium or sweet potato vine in the diet in either experiment (Tables 3 and 4). The slowly degradable fraction showed a similar trend except that in experiment A, D3 was different ($P < 0.05$) from the other means. The supplements increased ($P < 0.05$) the values of ED and PD. However, the PD did not differ ($P > 0.05$) between the unsupplemented diet and the 10% supplementation diet in either experiment. The DOMR intake improved ($P < 0.05$) from 34.6 to 52.6 g $kg^{-0.75}$ (desmodium) and from 36.3 to 52.0 g $kg^{-0.75}$ (sweet potato vine) with an increase in the level of supplementation.

Table 5 Rumen pH, concentration of NH_3-N (mg l^{-1}), total VFA, molar VFA proportions and acetate:propionate ratio in steers fed napier diets with various levels of desmodium (Experiment A)

	Diet				
	D0	D1	D2	D3	SED
Fermentation characteristics					
Rumen pH	6.6^{a}	6.8^{b}	6.6^{a}	6.7^{b}	0.1
Rumen NH_3-N	130^{a}	162^{b}	200^{c}	214^{d}	4.5
Volatile fatty acids					
Total VFA (mmol l^{-1})	87.3^{a}	88.3^{a}	89.2^{ab}	90.6^{b}	2.0
Molar percentage					
Acetate	68.8^{a}	70.3^{b}	70.2^{b}	68.6^{a}	0.4
Propionate	16.3^{a}	16.4^{a}	16.5^{ab}	17.4^{c}	0.2
Butyrate	10.4^{a}	10.5^{a}	11.2^{b}	11.0^{b}	0.2
Others	2.9^{a}	2.8^{a}	2.1^{b}	3.0^{c}	0.1
Acetate:Propionate	4.4^{a}	4.3^{a}	4.3^{a}	4.0^{b}	0.3

D0 = napier + 0% desmodium; D1 = napier + 10% desmodium; D2 = napier + 20% desmodium; D3 = napier + 30% desmodium; S.E.D.= standard error of the difference; Others = sum of iso-butyrate, valerate and iso-valerate; ^{a,b,c}Means within a row without common superscripts differ ($P < 0.05$)

Table 6 Rumen pH, concentration of NH_3-N (mg l^{-1}), total VFA, molar VFA proportions and acetate:propionate ratio in steers fed napier diets with various levels of sweet potato vine (Experiment B)

	Diet				
	S0	S1	S2	S3	SED
Fermentation characteristics					
Rumen pH	6.9^{a}	6.9^{a}	6.8^{a}	7.0^{a}	0.2
Rumen NH_3-N	139^{a}	162^{b}	214^{c}	235^{d}	6.5
Volatile fatty acids					
Total VFA (mmol l^{-1})	88.5^{a}	90.2^{ab}	88.3^{b}	90.2^{c}	1.7
Molar percentage					
Acetate	68.4^{a}	70.5^{b}	71.0^{c}	69.1^{a}	0.8
Propionate	16.2^{a}	15.8^{b}	15.8^{b}	15.0^{c}	0.2
Butyrate	10.3^{a}	10.7^{b}	9.9^{c}	11.3^{d}	0.2
Others	5.1^{a}	3.1^{b}	3.3^{c}	4.6^{d}	0.2
Acetate:Propionate	4.2^{a}	4.5^{b}	4.6^{b}	4.6^{b}	0.2

S0 = napier + 0 % sweet potato vine; S1 = napier + 10% sweet potato vine; S2 = napier + 20% sweet potato vine; S4 = napier + 30% sweet potato vine; S.E.D. = standard error of the difference; Others = sum of iso-butyrate, valerate and iso-valerate; ^{a,b,c}Means within a row without common superscripts differ ($P < 0.05$).

Means for rumen pH, rumen ammonia nitrogen (NH_3-N), total volatile fatty acids (VFA), molar percentages of each VFA and the acetate:propionate ratio are shown in Tables 5 and 6. Although rumen pH was influenced by changes in supplementation level ($P < 0.05$) the fluctuations were small. Concentrations of NH_3-N increased with increasing levels of desmodium and sweet potato vine in the diets ($P < 0.05$). Time of sampling significantly ($P < 0.05$) affected NH_3-N concentrations, but there were no significant interactions between diet and time of sampling. Maximum NH_3-N concentrations were recorded at 11:00 and 20:00, approximately three hours after the trough was filled with fresh feed. The minimum NH_3-N concentrations were recorded 12 hours post feeding. The variations in total and individual VFA were associated ($P < 0.05$) with the level of desmodium or sweet potato vine in the diets.

Discussion

This study showed that increasing the amount of desmodium and sweet potato vines in napier-based diets resulted in improved diet CP content, feed intake and rumen NH_3-N production. Increased PD, ED and DOMR indicated that rumen fermentation was improved by supplementation. The chemical analysis of refusals showed no evidence of selection, a probable indication of the effect of chopping prior to feeding. The mean CP content of napier grass in this study is within the ranges reported by Muia *et al.* (2000), Anindo & Potter (1994) and Wouters (1987) for the central Kenya region (68-112 g kg^{-1} DM). However, it was higher than the CP concentrations reported for the coastal region (56-79 g kg^{-1} DM) as recorded by Wouters, (1987), Muinga *et al*., (1995) and Abdulrazak *et al.*, (1996). The variation could be associated with differences between regions in soil fertility, climate and farming practices (Jaetzold & Schimdt, 1983; Mureithi *et al.*, 1998).

The observed increase in DM, OM and CP intake was attributed to the inclusion of desmodium and sweet potato vine in the diet. It was observed that, despite the improvement in intake being similar for the two supplements, the proportionate increase was lower than the fraction of supplement in the diet suggesting that some substitution occurred. Nevertheless, the results were in accord with previous studies where legume supplements offered to dairy cattle fed on napier grass increased feed intake (Muinga *et al.*, 1995; Kariuki *et al.*, 1999a, b). Abdulrazak *et al.* (1996) observed that zebu steers fed napier grass supplemented with grilicidia at levels varying from 7.5 to 22.5 g $kg^{-0.75}$ did not show any improvement in intake. This was most probably due to palatability problems with gliricidia. It is probable that desmodium and sweet potato vine stimulated intake by increasing the available nitrogen to the rumen microbes, enhancing the rate of digestion (Tolera & Sundstøl, 2000; Norton & Poppi, 1995).

Supplementation of napier grass with desmodium and sweet potato vine improved diet degradation. This is consistent with reports suggesting that legumes and other protein-rich forages have a great potential to improve the utilization of poor quality tropical grasses and crop residues (Preston & Leng, 1987; Nsahlai *et al.*,1998; Norton & Waterfall, 2000). The degradation characteristics of desmodium and sweet potato vine were similar, but recent studies have shown that the moderate levels of tannins (2-4%) contained in *Desmodium intortum* can exert beneficial effects on protein metabolism by increasing the proportion of bypass protein (Aerts *et al.*, 1999; Tolera & Sundstøl, 2001). Although the presence or absence of anti-nutritional factors in sweet potato vine has not been established (Woolfe, 1990), higher rumen NH_3-N concentrations were observed with sweet potato vine supplemented diets than with desmodium supplemented diets, a probable reflection of a more rapid degradation. The results indicated that both supplements had profound effects on fermentation and greatly improved DOMR by up to 52% for desmodium and 43% for sweet potato vine. The quantity of DOMR is related to microbial protein (MP) production and it is known that about 150 g of MP are formed per kg DOMR (Brun-Bellut *et al.*, 1990; Tamminga *et al.*, 1994). Indeed, Norton & Poppi (1995) reported that legumes have the greatest potential to improve the protein:energy ratios of tropical grass diets because of their inherently higher crude protein content and digestibility.

The pH values of all diets were between pH 6.0 and pH 7.0, a range that is considered to be optimum for the activity of cellulolytic microbes (Erdman, 1988) and VFA absorption (Dijkstra *et al.*, 1993). Supplementation increased rumen NH_3-N concentrations to levels above 150 mg l^{-1}, the minimum recommended for optimum microbial activity for tropical roughages (Preston & Leng, 1987). The results contrast with the preliminary findings of Dixon & Parra (1984) who recorded low NH_3-N concentrations (77

mg l^{-1}) when napier alone was fed to Zebu cattle, but are similar to those reported by Abdulrazak *et al.* (1996) and Muinga *et al.* (1995) for diets containing graded levels of leucaena and gliricidia. Unsupplemented napier grass diets resulted in NH_3-N concentrations that were below requirements, implying that such diets are likely to be inefficiently utilized. However, the optimum rumen NH_3-N concentration for maximum microbial protein production has remained a subject of debate, as Satter & Slyter (1974) recommended a concentration of 50 mg l^{-1}, Hoover (1986) recommended a concentration of 80 mg l^{-1}, while Dixon (1987) indicated that concentrations as high as 200 mg l^{-1} may be necessary for low quality roughages. In general, reduced protein supply decreases rumen fermentation, since less NH_3-N is available for microbial synthesis in the rumen.

Total VFA concentrations were generally higher in supplemented diets, indicating that desmodium and sweet potato vine had a positive effect on digestion. Ruminal proportions of VFA were not changed but the acetate to propionate ratio was within the expected range for forage diets and remained fairly consistent. The high proportion of acetate and low proportion of propionate are in accord with earlier studies in which napier grass was supplemented with *Canavalia ensiformis* (Dixon *et al.,* 1983) and with *Leucaena leucocephala* (Muinga *et al.,* 1995).

Conclusion

It was concluded that the inclusion of desmodium and sweet potato vines in napier grass diets will improve microbial degradation and rumen fermentation and that this will lead to increased intake and animal performance.

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