

RUMEN FUNCTION AND FERMENTATION ON SISAL PULP BASED DIETS

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4 steers with permanent rumen cannulas were used to compare the following supplements added to a basal ration of sisal pulp plus urea/ammonium sulphate (3.84 and .96 g/kg of pulp respectively) (a) no supplement (control); (b) 400 g/d of concentrates (mixture of cereal and oil seed meals); (c) 4 hr/d grazing on African Star grass; (d) concentrates and grazing. The design was a 4 x 4 latin square with experimental periods of 15 days. Rumen fluid was sampled on the last day of each period before giving the feed in the morning, and 1.5 and 3 hr after feeding. Mean values for the 4 treatments were: pH in rumen fluid, 6.9, 7.3, 6.9 and 7.0. Molar proportions of VFA (%) Ac 64, 73, 64, 69; Pr 18, 15, 18 and 17; Bu 18, 12, 17 and 14. On the last day of the last period, 80 g of PEG were added to the rumen and samples were taken of rumen fluid for the following 24 hr. The turnover rate of rumen fluid (per day) was increased by supplementation, the mean values being 1.15, 1.75, 2.01 and 2.35; there were no differences in rumen fluid volume (46, 43, 56 and 44 litres). Rumen fluid flow rate was 62, 75, 112, 103 litres/d for the 4 treatments. The results show an important effect of grazing on rumen liquid flow rate on sisal pulp diets. Both grazing and the concentrate supplement increased the turnover rate. Grazing did not affect the VFA pattern in the rumen however the concentrate supplement led to an increased in acetic acid and a reduction in butyric acid with no change in propionic acid.

Key words: Cattle, sisal pulp, rumen fermentation flow rate, turnover rate, supplementation

Sisal pulp is an improvement on the traditional sisal bagasse, brought about by further extraction of intermediate-length fibres and the pressing out of some of the juice (Cordemex 1977). Early developmental work with this product as a feed for dairy cows showed important increases in animal performance when, in addition to supplementation with urea, minerals and small amounts of concentrates, the cattle were allowed to graze Star grass pasture for a limited period (4 to 6 hr daily) (V Rios, personal communication). Sisal pulp, in appearance and composition, (contains only .9% nitrogen in DM, and its carbohydrate component is either highly soluble sugars or of cell wall origin) resembles the product resulting from the derinding of sugar cane (Preston et al 1976). Animals fed derinded sugar cane supplemented with urea and minerals also show important improvements in growth and feed conversion when given some long fibre (as cane tops) and concentrates such as rice polishings which are known to provide by-pass nutrients (Preston and Leng 1978)

The objective of this experiment was to obtain preliminary information on the rumen fermentation and some parameters of rumen function on diets based on sisal pulp supplemented with grazing and/or concentrates.

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Materials and Methods

Treatments and Design: The treatments in a 4 x 4 latin square design were: A) sisal pulp (*Agave Fourcroydes*) supplemented with 3.8 g urea and .96 g ammonium sulphate per kg of fresh pulp; B) the same as (A) but with the addition of 400 g/d of a commercial concentrate based on cereals and protein meals; C) the same as (A) but with 4 hr grazing per day; D) the combination of (B) and (C). The experimental periods were of 15 days with measurements of rumen fermentation and function being made on the last day of each period.

Animals: Four crossbred Swiss x Zebu steers of average weight 135 kg were fitted with permanent fistulas in the rumen. The animals were the progeny of the dairy herd managed at the sisal pilot plant of Cordemex and had been receiving a diet based on sisal pulp since weaning.

Procedure: The sisal pulp was given daily as a single feed at 9:00 a.m having previously been sprayed with an aqueous solution (16% urea and 4% ammonium sulphate w/v) at the rate of 24 ml/kg of fresh pulp. The pulp was fed in quantities exceeding the animals' appetite. The animals on treatments © and (D) grazed for 4 hr daily between 9:00 and 11:00 a.m. on a high quality Star grass pasture. The concentrate supplement for treatments (B) and (D) were given at the same time as the sisal pulp. The concentrate was of commercial origin and contained 12% crude protein; from its appearance it appeared to be based on cereal and oil seed by-products.

Measurements: Voluntary intake of the sisal pulp was measured daily throughout the experimental period. On the last day of each period samples of rumen fluid were taken through the rumen cannula prior to feeding and subsequently at 1.5 and 3 hr after feeding. pH was determined immediately and analyses were made for protozoal biomass using the sedimentation procedure described by Minor et al (1977). Other samples were retained for VFA analysis after addition of sulphuric acid. At the end of the third experimental period, on the same day that rumen samples were taken, 80 g of polyethylene glycol (PEG) were infused into the rumen of each animal in a single application (at 9:00 a.m.). Samples were then taken at intervals over a 24 hr period in order to determine the rate of disappearance of the PEG from the rumen.

Chemical Analyses: The procedures were those described by Minor et al (1977) and Priego et al (1977).

Results and Discussion

Voluntary intake of the principal components of the diet and parameters of rumen function are given in table 1. It was not possible to estimate the consumption of pasture but a reasonable assumption is that it would represent at least some 30% of total voluntary DM intake (based on findings with sugar cane and restricted grazing; Alvarez et al 1978). On this assumption, total DM intakes were estimated for treatments © and (D) in order to compare them with the actual intakes recorded on the treatments which did not include grazing (A y B).

Table 1:
Mean values for voluntary intake and some rumen function parameters for diets based and sisal pulp/urea

	Supplement				SE _x
	None	Concentrate	Pasture	Pasture plus concentrate	
Feed intake, kg/d					
Sisal pulp	11.2	9.88	9.28	8.09	± .43
Urea	.035	.032	.030	.026	
Concentrate		.40		.40	
Total DM ²	2.11	2.22	2.43	2.63	
Rumen parameters ¹					
Liquid volume, litres	45.5	42.9	55.5	43.7	
Turnover rate/d	1.15	1.75	2.01	2.35	
Flow rate, litres/d	52.3	75.1	111.0	103	

¹ Measured only during fact period of latin square

² See text for explanation

Voluntary intake of the fresh sisal pulp was highest on the control unsupplemented treatment, all of the supplements acting as partial substitutes for the sisal pulp. However, total DM intake was apparently stimulated both by the addition of concentrates (2.43 vs 2.27 kg DM/d) and, to a greater extent, by grazing (2.53 vs 2.16) (Overall means for with and without concentrates; and with and without grazing respectively). These increases in total voluntary DM intake brought about by concentrate supplementation and by restricted grazing are similar to the effects of these supplements with sugar cane (Preston et al 1976; Alvarez et al 1978).

It was not possible to analyse statistically the data for rumen function parameters as there was only one observation on each of the treatments. Nevertheless, there was a strong suggestion that dietary effects on turnover rate and flow rate reflected those observed for total DM intake. Such effects are also similar to those reported for sugar cane (Priego et al 1977; Alvarez et al 1978).

There appeared to be no important differences in the pattern of rumen fermentation as characterized by the ratios of the VFA. Molar proportions of acetate tended to be higher on the treatments with pasture and/or concentrates. Such a trend is in line with the original observations of Harrison et al (1974) concerning the relationship of rumen liquid outflow and VFA proportions and more specifically of Alvarez et al (1978) in a trial with sugar cane, rice polishings and restricted grazing of leucaena.

Figure 1:
Molar proportions of VFA ($\bar{x} \pm SE\bar{x}$) for sisal pulp supplemented with concentrates, grazing or both

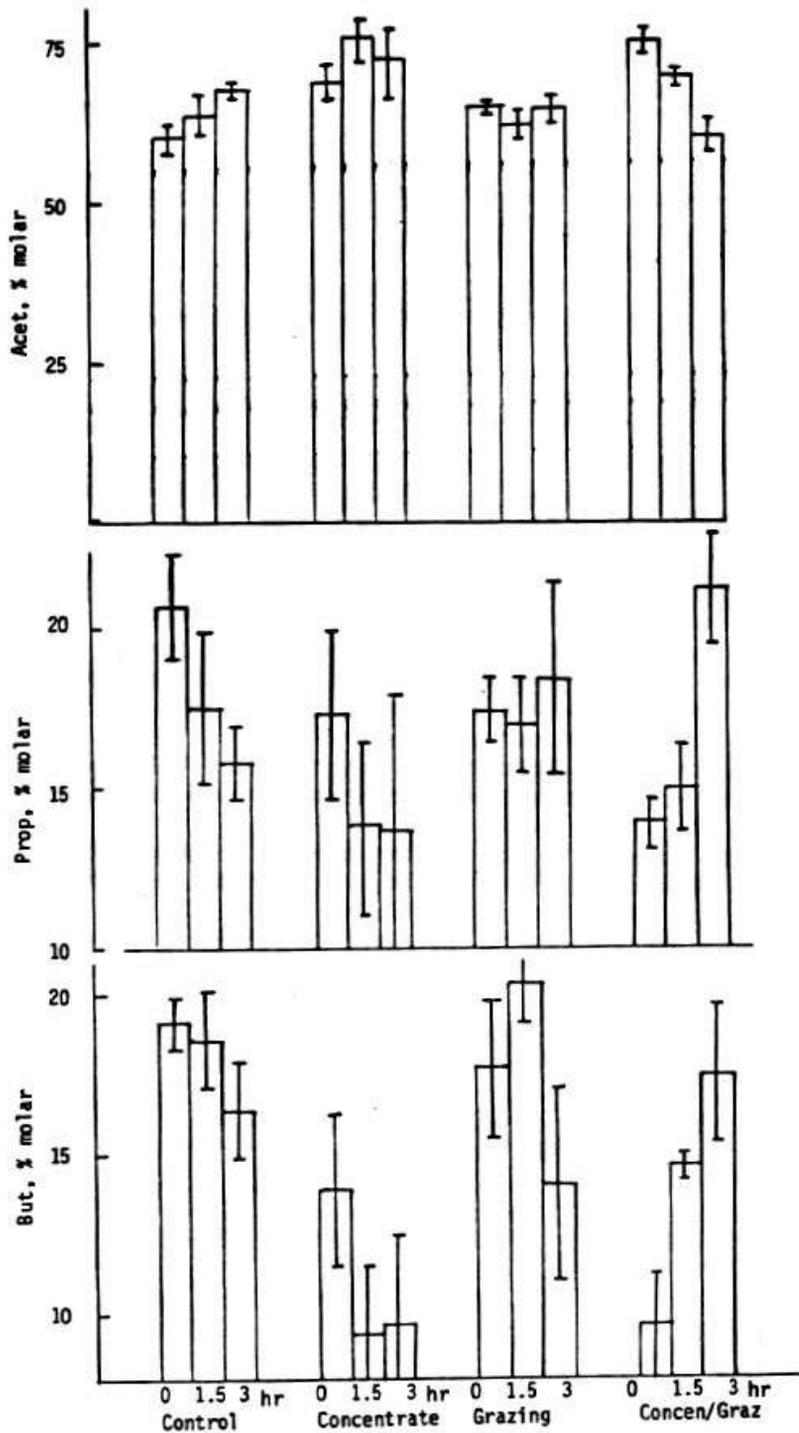


Table 2:
Mean values for molar proportions (%) of rumen VFA on sisal pulp/urea diets

	Supplement				SE _x
	None	Concentrate	Pasture	Concentrate & pasture	
Acetic					
0 hr	60	69	65	77	± 2.5
1.5 hr	64	77	63	70	± 2.8
3.0 hr	68	73	65	61	± 4.2
Propionic					
0 hr	21	17	17	14	± 2.0
1.5 hr	17	14	17	15	± 2.2
3.0 hr	16	16	18	22	± 3.4
Butyric					
0 hr	19	14	18	10	± 2.0
1.5 hr	18	9	20	15	± 1.4
3.0 hr	16	9	17	17	± 2.5

Conclusions

The results of this experiment lend support to the hypothesis that sisal pulp produced by the modified process (which also removes intermediate length fibres and some of the juice) is similar to chopped sugar cane in terms of the nutritional limitations governing, its nutritive value for ruminants. In other words, the sisal pulp should be supplemented both with sources of long fibres and bypass nutrients.

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