CASSAVA FORAGE AS A PROTEIN SOURCE IN SUGAR CANE DIETS FOR CATTLE: EFFECT ON RUMEN FERMENTATION OF DIFFERENT LEVELS OF CASSAVA FORAGE AND UREA[1]

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In a 4 x 4 latin square design, sugar cane/urea was substituted by cassava forage (levels of cassava were 0, 20, 40 or 60%). The diets were balanced for N content by adding a solution of urea and ammonium sulphate. The sugar cane had 27.5% DM and 14.2° Brix, the cassava had 20% DM and 2.4% N in the DM. The only other dietary supplement was a mineral mixture. There were no differences in the principal parameters of rumen fermentation (pH, protozoal biomass, total VFA, VFA molar proportion ammonia concentration) or in blood urea levels on the different dietary treatments. Voluntary intake of DM was significantly higher on the three cassava diets compared with the control containing only sugar cane/urea. Rumen fermentation parameters varied according to time of feeding following the pattern established by other workers in this field.

Key words: cattle, sugar cane, cassava forage, urea, rumen fermentation

The potential of cassava forage as a protein source has been established at the agronomic level (Moore 1976, Meyreles et al 1977a). However the early claims as to its nutritive value in sugar cane based diets (Moore 1976) have not yet been substantiated. In fact, at this Centre, growth rates have never exceeded 300 g/d when cassava has been the only protein source (Meyreles et al 1977 b,c,d).

Cassava leaf protein is of good quality and it has been suggested that the principal problem may be one of too high solubility in the rumen (Meyreles et al 1977b).

The following experiment was carried out to provide more information on rumen digestion end products with different dietary ratios of cassava forage and sugar cane/urea.

Materials and Methods

Treatments and Design: The 4 dietary treatments were chopped sugar cane/urea substituted by 0, 20, 40 or 60% chopped cassava forage. The diets were balanced for N content by the addition of varying quantities of a solution of urea and ammonium sulphate as shown in table 1. The experiment was a 2 x 2 latin square design with periods of 14 days.

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Table 1:
Daily intake of cane, cassava forage and nitrogen by Zebu bulls given different levels of cassava forage

	Proportion of Cassava, %				
	72	48	26	0	SEx
Daily intake					
Chopped whole cane, kg	4.9	9.7	12.7	14.3	±.55
Cassava forage, kg	12.4	8.7	4.4	-	±.17
Total dry matter, kg	4.8	5.2	5.0	4.2	±.19
Total N, g	74	77	73	69	
Proportion of diet N (%) as:					
Cassava forage	84	56	29	-	
Cane	8	14	20	23	
Urea/(NH_4) SO_4	8	30	51	77	

Animals and Diets: 4 Zebu bulls of 18 months of age fitted with permanence rumen cannulas were used. The sugar cane had an average DM of 27.5% and a Brix of 14.2!. The Brix level corresponds to a sugar content of 43.6% in cane DM (see Ferreiro et al 1977). The cassava forage was from the variety Zenon and consisted of the aerial part of the plant cut about 30 cm above ground level. It had a DM of 20% and contained 2,4% N in DM. The urea and ammonium sulphate were given as a solution (18 urea: 5 ammonium sulphate: 77 water) (w/w) which was mixed with the fresh sugar cane. The animals also received a mineral mixture containing equal parts of sodium chloride and dicalcium phosphate.

Procedure: The animals were kept in individual concrete floored stalls in a large open sided building. They were fed once daily in the morning. The sugar cane was available ad libitum and the quantity of cassava forage adjusted on the basis of the cane consumption the previous day. On the last day of each period, rumen samples were taken immediately before and 1, 2, 3 and 4 h after feeding. Blood samples were taken from the jugular vein immediately before, and 2 and 4 hr after feeding.

Measurements and Analyses: Rumen samples were analysed for pH (pH meter), protozoal biomass using the index method developed by Leng et al (1976), ammonia using a modification of the diffusion technique of Conway, total VFA by steam distillation, and the proportion of VFA by gas chromatography (see Minor et al 1977 for details of the methods).

The DM, pH and Brix of the cane and DM of the cassava were measured daily and N content of the cassava at intervals.

Results and Discussion

Overall means for the rumen parameters and urea levels in blood were remarkedly uniform (table 2); the changes observed were due mainly to time of feeding (figures 1-7).

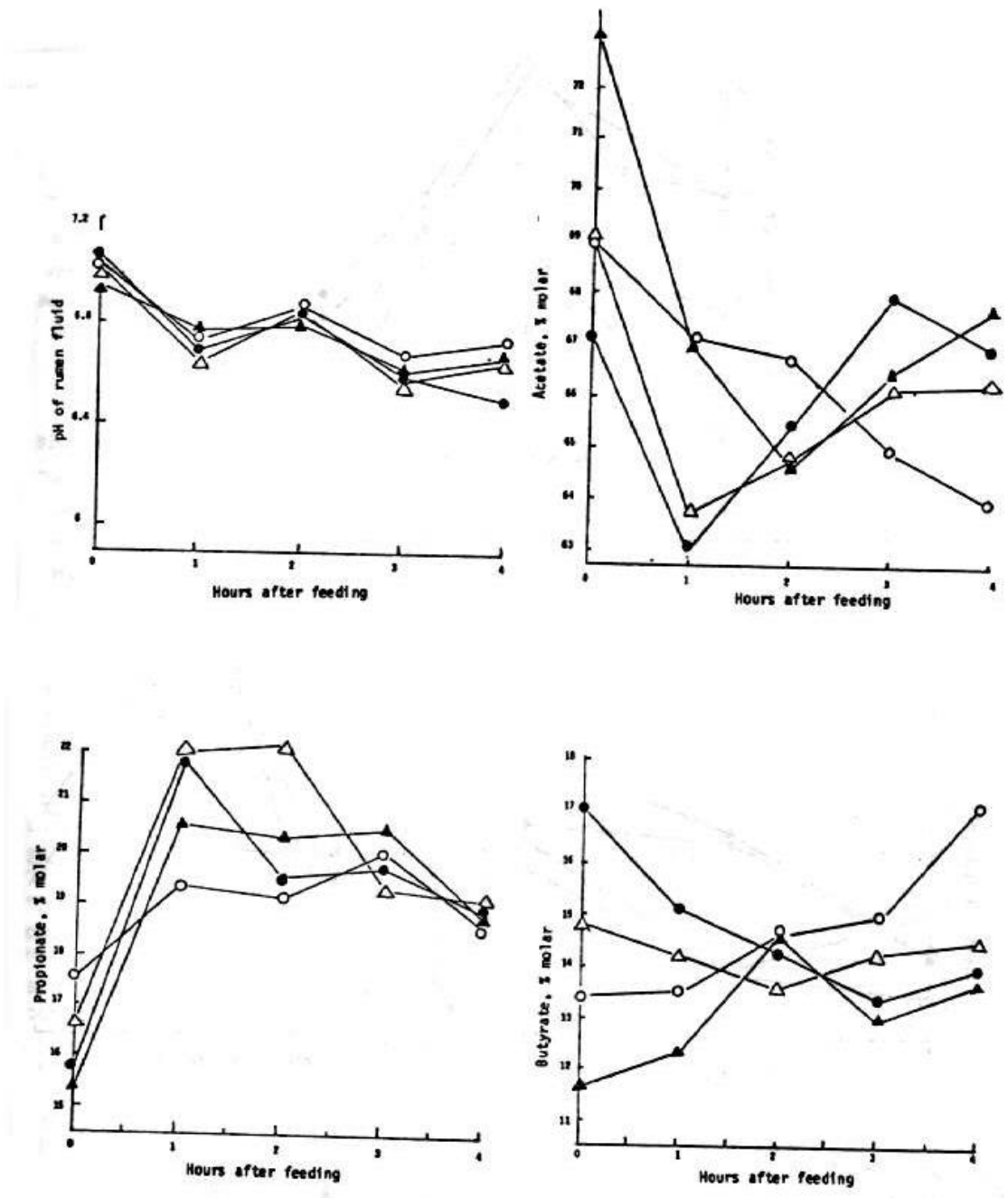
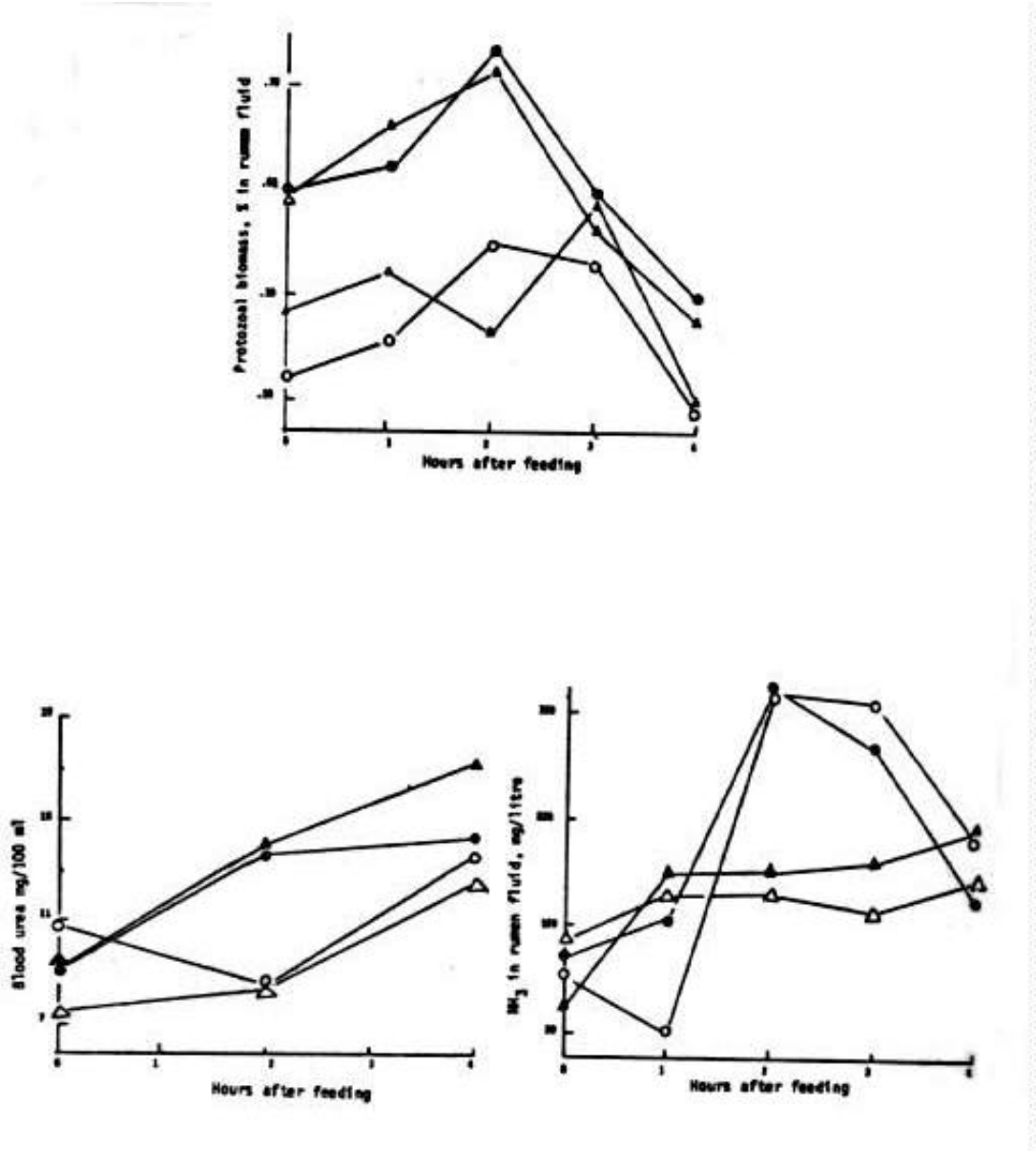


Figure 1-4:
The effect of different levels of cassava forage (▲,0%;△, 26%;●, 48%;○,72%) on rumen pH and VFA proportions at 0, l, 2, 3 and 4 hours after feeding.



Figures 5-7:
The effect of different levels of cassava forage *(▲ ,0%;△, 26%;●, 48%;○,72%)* on rumen NH_3, blood urea rumen protozoal index (Biomass) at 0, 1,2, 3 and 4 hours after feeding.

Table 2:
Rumen parameters and brood urea levels in Zebu given cane diets supplemented with different levels of cassava forage. Values ate means of four samples taken 1, 2, 3 and 4 hr after feeding (rumen), or 2 and 4 hr after feeding (blood)

	Proportion of cassava in diet, % of fresh basis				
	72	48	26	0	SE of mean[1]
Rumen pH	6.75	6.66	6.68	6.71	± .49
Rumen VFA, mM/litre	166	218	183	182	± 14
Molar proportions, %					
Acetate	66	66	65	66	± 4.2
Propionate	19	20	21	20	± 1.3
Butyrate	15	14	14	13	± 1.1
Biomass, % in rumen fluid	0.26	0.53	0.51	0.29	± .14
Rumen ammonia, mg/100 ml	36.7	54.7	60.4	30.0	± 12.7
Blood urea, mg/100 ml	11.1	14.0	10.6	15.6	± 2.2

[1] Average of standard errors of individual means

Inevitably, in experiments of this kind, there is considerably confounding of dietary treatments with overall nutritional characteristics of the ration. Thus one effect of replacing sugar cane with cassava forage is to reduce the amount of fermentable carbohydrate (sugars) in the diet which, in turn, could mean a less favourable environment for the up-take of ammonia by the rumen microorganisms, Nevertheless, taking into account this limitation caused by the design of the experiment, the results would appear to lend support to the hypothesis that the protein present in cassava forage is readily soluble; since there were no significant differences in rumen ammonia and blood urea over the range of treatments (from 77% of dietary N as urea to 84% as cassava). The only indication of a "by-pass" protein effect was the significantly lower intake of total DM on the treatment which contained no cassava. As the principal effect of "by-pass" protein on sugar cane diets is to raise voluntary intake (Leng and Preston 1976), this difference could be interpreted as having been caused by some of the cassava protein by-passing the rumen,

There were considerable differences in the different parameters of rumen fermentation according to the time that the rumen samples were taken, These trends with time (figures 1-7) are typical of those reported by other workers for diets based on sugar cane (Montpellier et al 1977; Meyreles et al 1977c; Priego and Sutherland 1977; Silvestre et al 1977).

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