THE EFFECT ON PARAMETERS OF RUMEN FERMENTATION, RUMEN VOLUME AND FLUID FLOW RATE OF ZEBU BULLS GIVEN CHOPPED SUGAR CANE SUPPLEMENTED WITH RICE POLISHINGS OR CASSAVA ROOT MEAL

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Two experiments were carried out to study supplementation of a basal diet of sugar cane, urea and minerals. The design in each case was a 4 x 4 latin square, Using 4 rumen cannulated Zebu bulls. In the first experiment, the supplement was rice polishings at levels of 0, 0.5. 1.0 or 1.5 kg/d. In the second, the supplement was 0, 0.4, 0.8 or 1.2 kg/d cassava root meal. In neither experiment was there any effect on VFA Proportions, although the highest level of supplementation accounted for 20% of dry matter intake. Supplementation tended to reduce slightly rumen pH (6.4 vs 6.03 for the 0 and 1.5 levels of rice polishings; 6.28 vs 5.92 for the 0 and 1.2 levels of cassava 6 hr after feeding) and increase total VFA levels (128 vs 147, and 164 vs 173 mequiv/litre for the same treatments, respectively). 1.5 kg/d rice polishings significantly (P .01) increased rumen flow rates from 56 to 72 litres/d; rumen volume was unchanged at about 30 litres. The effect of cassava root meal on flow rate was much less (from 44 to 51 litres/d). Rumen volume was also not significantly changed (from 23 to an average of 30 litres).

Key words: Sugar cane, rice polishings, cassava root meal, rumen VFA, rumen fluid flow.

Supplementation of sugar cane diets with rice polishings consistently stimulates growth and feed intake (Preston et al 1976; Lopez et al 1976). Cassava is a crop with considerable potential for tropical animal production, for the foliage contains 20-25% protein in dry matter, while the root is rich in starch. Both these products should be able to provide the glucose precursors which seem to be an important limiting factor with sugar cane diets (Leng and Preston 1976).

The objective of the experiments reported here was to study the effect on rumen fermentation, and fluid flow from the rumen when cattle were given chopped sugar cane/urea supplemented with different levels of rice polishings or cassava root meal.

Materials and Methods

Animals Design and Diets: Eight Zebu bulls weighing about 300 kg, and fitted with permanent rumen cannulas, were used in two experiments of 4 x 4 latin square design (balanced for carry-over effects (Cochran and Cox 1962)), with periods of 15 days, The animals were kept in concrete floored pens in an open-sided building. The basal diet was chopped whole sugar cane to which was added an aqueous urea solution (10 g urea/kg cane). All animals received minerals (50 g salt, 47 g rock phosphate, 3 g trace minerals) at the rate of 60 g/d and, in experiment 2, 400 g/d of a mixture of fishmeal/ soybean meal (25:75).

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Treatments: In experiment 1 these were: 0 (control) .5 1.0 or 1.5 kg/d of rice polishings; and in experiment 2, 0 .4 .8 or 1.2 kg/d dried cassava root meal.

Procedure: The whole sugar cane was chopped by machine immediately prior to feeding which was twice daily at 0800 and 1400 hr. The appropriate supplements were given before the morning feed.

Rumen Fluid Samples: These were taken on days 10, 12 and 14 of each period immediately before the first feed (0), and at 3 and 6 hr afterwards. These were analysed for pH, VFA (totals and proportions) protozoal biomass (an index of the protozoal population in the rumen) and rumen ammonia by the methods described by Minor et al (1977); and lactic acid by the method of Barker and Summerson (1941). Rumen volume and flow rates were determined by the method of Hyden (1961). On day 15 of each period, 80 g of polyethylene glycol 4000 (PEG) were introduced into the rumen immediately before feeding. The PEG was dissolved in 250 ml water, and 50 ml of this solution was mixed into each of 5 five 200 ml samples of fresh rumen liquor malt from the same animals. The five PEG/liquor mixtures were immediately re-introduced into the rumen, a plastic tube being used to ensure as wide a distribution as possible. Samples were then taken after 1.5,3,6,9, 14, 19 and 24 hr and analysed for PEG using the method of Malawar and Powel (1967). The volume at time 0, and fluid flow rate were calculated from the regression of log PEG concentration on time (Hyden 1961).

Results and Discussion

Rumen Fermentation:
Experiment 1 [Rice polishings): Parameters relating to rumen fermentation are given in table 1, and are also shown in figures 1 to 5. Supplementation with rice polishings resulted in a lower rumen pH, both 3 and 6 hr after feeding, the suggestion being that the effect was progressive. However although the differences between the control, and the highest level of supplementation were statistically significant (P <,05) at both times, the actual size of the effect was small.

There was an indication that supplementation increased total VFA levels at 3 and 6 hr post feeding (table 1, figures 2 and 3), the differences between the control and 1.5 kg/d rice polishings approaching significance (P (.07). The relative proportions of VFA were very constant between treatments as seems to be a feature of sugar cane based diets (Minor et al 1977).

Rumen ammonia levels (table 1; figure 4) increased after feeding. There were no clear treatment effects 3 hr after feeding, but at 6 hr, the levels of ammonia were significantly lower when the supplement was as given, although there was no effect of the actual level of supplementation. One possible explanation of the lower ammonia levels is that they were associated with increased microbial synthesis. In this context, it is interesting that supplementation also tended to be associated with a greater protozoal (table l; figure 5), although the variation was generally too great biomass for this to be detected with certainty.

Table 1:
Effect of rice polishings on rumen fermentation parameters

Item	Time, hr[1]	Rice Polishings kg/d 0	0.5	1.0	1.5	SEx	Probability[2]
pH	0	6.61	6.65	6.59	6.57	±.03	.99
	3	6.36	6.25	6.17	6.10	± .05	.04
	6	6.21	6.14	6.11	6.03	± .05	.21
Protozoa % PCV in rumen fluid	0	.30	.38	.38	.30	± .09	.80
	3	.68	1.23	1.23	1.10	± .05	.001
	6	.83	1.00	1.00	.95	± .50	.45
Total VFA, m-equiv/litre	0	98	103	104	98	± 7.5	.91
	3	124	137	133	149	± 8.1	.27
	6	128	132	152	147	± 6.2	.10
Molar % VFA							
Acetic	0	78	79	80	79	± .75	. 32
	3	72	72	71	72	± .89	.32
	6	20	70	74	72	± 1.37	.26
Propionic	0	15	14	12	14	± .53	.09
	3	19	20	20	21	± .68	.35
	6	21	21	19	20	± 1.06	.82
Butyric	0	6	6	6	6	±.36	.63
	3	8	7	7	7	±.54	.52
	6	9	9	7	8	±.57	.11
Ammonia m-equiv/litre	0	5	5	5	5	±.42	.81
	3	11	12	11	12	±.96	.86
	6	14	11	10	11	± .53	.01

[1] After feeding (0=immediately before feeding)
[2] Significance of F test

Experiment 2 (Cassava): Parameters relating to rumen fermentation are given in table 2 and figures 6 to 11, As with rice polishings, there was a small but significant (P< .05) effect of supplementation on rumen pH at both 3 and 6 hr after feeding. Again there was the suggestion that supplementation might have slightly increased rumen VFA levels (statistically not significant). There was no effect on VFA proportions and rumen ammonia levels were not affected by supplementation with cassava. Protozoal biomass was not significantly affected by supplementation either, although the control vs the highest level of supplementation comparison approached significance (P=.10). The levels of lactic acid (figure 11) remained low on all treatments.

Table 2:
Effect of cassava root meal on rumen fermentation parameters

Item	Time, hr[1]	Cassava root meal kg/d 0	0.4	0.8	1.2	SEx	Probability[1]
PH	0	6.68	6.63	6.57	6.69	±.035	.15
	3	6.36	6.18	6.12	6.18	±.064	.08
	6	6.28	6.04	5.94	5.92	±.033	.001
Protozoa Biomass, %PCV in rumen fluid	0	.29	.34	.41	.41	±.06	.47
	3	1.21	1.04	1.27	1.68	±.17	.15
	6	1.33	1.08	1.38	1.77	±.26	.40
Total VFA, m-equiv/litre	0	147	154	134	137	± 9.0	.45
	3	161	173	173	120	±11.0	.45
	6	164	165	186	173	± 7.3	.22
Molar %VFA							
Acetic	0	82	79	79	81	± 1.0	.32
	3	75	74	74	734	± 1.5	.89
	6	73	73	74	75	± .90	.47
Propionic	0	13	14	13	12	± .84	.47
	3	18	18	16	18	± 1.51	.77
	6	20	19	15	17	±.02	.07
Butyric	0	5	7	7	7	± .34	.80
	3	7	7	10	8	± 1.52	.80
	6	7	7	10	9	± .65	.26
Ammonium-e qiv/litre	0	7	7	5	6	± .55	.38
	3	10	11	11	10	± 1.33	.91
	6	11	11	10	9	± 1.47	.75
Lactic Acid m-eqiv/litre	0	.66	.88	.88	.94	±.19	.76
	3	.68	.70	1.11	.86	±.12	.25
	6	.79	.98	.77	.83	±.16	.80

[1]See table 1 for explanations

Table 3:
Effect of rice polishings on feed intake and rumen fluid for parameters

	Rice polishings, kg/d 0	0.5	1.0	1.5	SEx	Prob[1]
Dry matter intake, kg/d						
Chopped sugar cane	4.74	4.41	4.54	4.46		
Urea	.18	.16	.17	.16		
Total	4.94	5.02	5.61	6.02		
Consumption index[2]	1.72	1.75	1.95	2.08	±.07	.03
Rumen function						
Turnover rate (Per day)	2.0	2.0	2.3	2.3	± 1.2	.58
Flow rate, litres/d	56	63	70	72	± 2.8	.03
Rumen liquid volume, litres	29	32	31	31	± 2.2	.80

[1] See table 1
[2] Daily DM intake/100 kg LW

Table 4:
Effect of cassava root meal on feed intake and on rumen fluid flow parameters

	Cassava root meal, kg/ d					
	0	0.4	0.8	1.2	SEx	Probability[1]
Dry matter intake, kg/d	4.59	3.99	4.11	3.68		
Sugar cane	4.59	3.99	4.11	3.68		
Urea	.17	.14	.15	.14		
Total	5.02	4.85	5.34	5.22		
Consumption index[1]	1.64	1.59	1.71	1.68	±.06	.29
Rumen function						
Turnover rate(per day)	1.9	1.8	1.9	1.8	±.40	.09
Flow rate, litres/d	44	61	52	49	±5.9	.29
Rumen liquid volume, litres	23	34	28	29	±3.0	.07

[1] See table 3 for explanations

Rumen volume, fluid flow and food intake:
Experiment 1 (Rice polishings): There were no differences between treatments m the consumption of sugar cane (table 3). The effect of supplementation was therefore to increase total dry matter intake (inclusive of rice polishings) and hence the consumption index, This is in contrast with the finding of Preston et al (1976), who reported that supplementation with rice polishings increased the consumption of sugar cane,

Rumen volume was not changed by supplementation with rice polishings. Fluid flow rate was increased by supplementation, the difference between the control and the highest level of supplementation being highly significant ($P < .01$).

Experiment 2 (Cassava): There was no significant effect of supplementation on the consumption index or total feed intake, although the data suggest (table 3) that the consumption of sugar cane was, if anything, reduced. In contrast with rice polishings, fluid flow rates were not significantly increased, and the variation was greater.

Conclusions

With both supplements there was no measurable effect on rumen VFA proportions, even though the supplement (at the highest level) amounted to some 20% of dry matter intake. Rice polishings were associated with greater fluid flow rates. The response to cassava root meal was less clear, although there was some indication that it too was associated with increased fluid flow.

Fig.1 Rumen pH

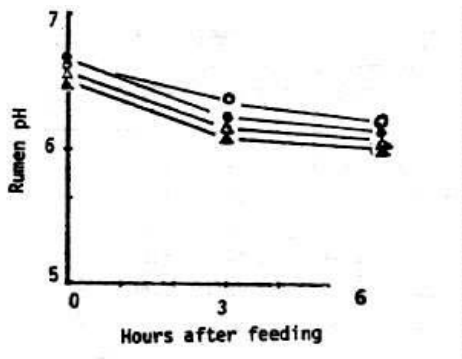


Fig. 2 Total VFA (mequiv/l)

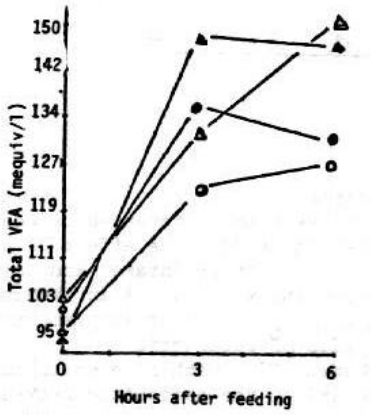


Fig. 3 Molar proportions of VFA (%)

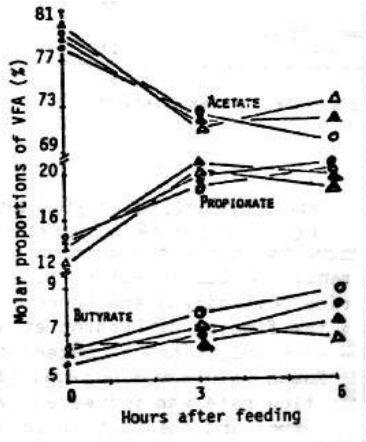


Fig. 4 Rumen NH_3 (mequiv/l)

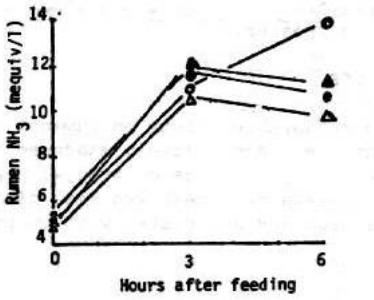
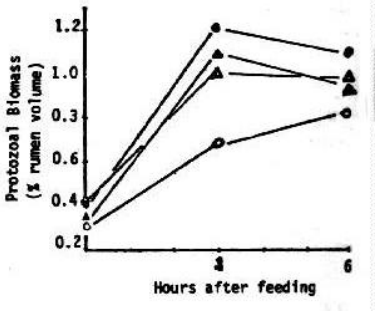


Fig. 5 Protozoal Biomass (% rumen volume)



Figures 1-5, (Experiment 1):
Parameters of the rumen fermentation of Zebu bulls given chopped whole sugar cane unsupplemented (○), or supplemented with 0.5 (●), 1.0 (△), or 1.5 (▲) kg/d rice polishings.

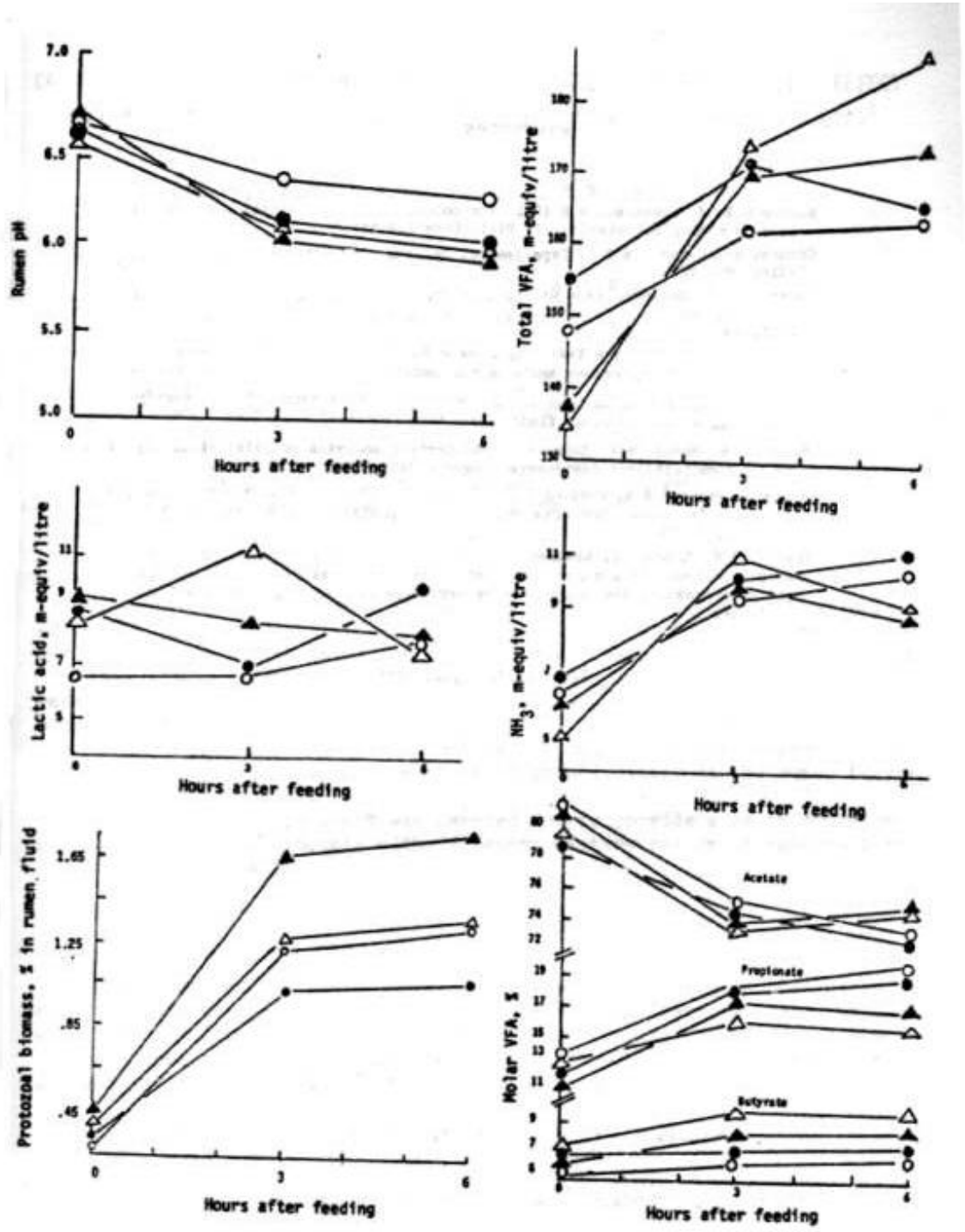


Figure 6-11, (Experiment 2) :
Parameters of the rumen fermentation of Zebu bulls given chopped whole sugar cane and soya/fishmeal without cassava root meal, or supplemented with 0.4 (♀), 0.8 (▲) or 1.2 (△), kg/d of cassava root meal.

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