

LEUCAENA LEUCOCEPHALA AS A PROTEIN SUPPLEMENT FOR SUGAR CANE BASED DIETS: EFFECTS ON RUMEN FERMENTATION AND TURNOVER RATE

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Twelve Swiss/Zebu steers with permanent rumen fistulas were used in a randomised design with four replications (individual animals) to compare the following treatments given as supplements to the basal ration of chopped whole sugar cane/urea: A) 3 hr/d grazing on *Leucaena leucocephala*; B) 3 hr/d grazing on leucaena + 0.5 kg/d of rice polishings; and C) 1.0 kg/d of rice polishings and no leucaena grazing. The experimental periods were 17 days, rumen samples being taken on days 14 and 16; on day 17 rumen flow rate was measured using PEG. There were no important differences attributable to treatments for the rumen parameters of pH, protozoal biomass and total VFA concentration. Molar proportion of acetate increased as rice supplementation was replaced by leucaena grazing; the opposite effects were noted with propionic acid and butyric acid which decreased as leucaena grazing was introduced. Both turnover rate and rumen outflow increased as rice polishings were replaced by leucaena grazing. Rumen liquid volume was higher on the treatment of leucaena grazing without rice polishings compared with the others. It is proposed that leucaena provided important roughage characteristics to sugar cane diets, leading to greater rumen motility and flow rate out of the rumen.

Key Words: Cattle, sugar cane, leucaena, rice polishings, rumen turnover, rumen outflow, rumen fermentation

Leucaena leucocephala has been used successfully to substitute up to 75% of the rice polishings which, up to the present time, has been considered to be the best supplement for sugar cane-based diets (Alvarez and Preston 1976; Alvarez et al 1977, 1978a). In all of these trials the leucaena was made available to the animals during a period of restricted grazing (3 hr daily). Results were less successful in a digestibility trial when the leucaena forage was cut and given to the animals in a way which prevented selection (Alvarez et al 1978b).

The following experiment was undertaken to provide more information as to the effect of this forage protein on some aspects of rumen function and fermentation.

Materials and Methods

Animals, Treatments and Design: Twelve Swiss/Zebu steers (approximately 300

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kg live weight and 2 yr of age) with permanent rumen fistulas were used in a completely randomised design with four replications (individual animals) to compare the following treatments given as supplements to the basal ration of chopped whole sugar cane/urea: A) 3 hr/d grazing on *Leucaena leucocephala*; B) 3 hr/d grazing on leucaena plus 0,5 kg/d of rice polishings; and C) 1.0 kg/d of rice polishings and no leucaena grazing.

Diets: All animals (except when grazing the leucaena) had free access to chopped whole sugar cane which had been sprayed with an aqueous solution of urea (20% w/v) at the rate of 50 ml/kg of fresh cane. There was also free access to a mineral mixture containing salt, rock phosphate and trace elements. The grazing treatment of leucaena was carried out between 7:00 and 10:00 a.m. using a pure 1 ha stand of leucaena divided into 4 paddocks. This area had been established approximately 1 yr earlier and was in good condition. There were intervals of 40 to 50 days between grazings so as to allow the DM content of the leucaena to rise above 25% approximately. The aim of this practice was to maximize DM yield per ha and to reduce the risk of mimosine toxicity. On the grazing treatments, which were initiated as the first activity in the morning, the sugar cane and rice polishings (in accordance with treatments) were made available after the animals returned to their pens from the grazing.

Sampling procedure: The total experimental period lasted 17 days with rumen sampling being carried out on days 14, 16 and 17. On day 14 and 16, samples of rumen fluid were taken through the rumen cannula at 7:00 a.m., immediately prior to giving the sugar cane (C) or initiating the grazing (A and B). Other samples were taken 3 and 6 hr later. On these samples, determinations were made of pH, protozoal biomass and total and molar proportion of the volatile fatty acids using the procedures described by Minor et al (1977). On day 17, Polyethylene glycol (PEG) was infused into the rumen of each animal and the rate of disappearance of this marker determined at intervals over the following 24 hr using the procedure described by Priego et al (1977).

Results and Discussion

The data for pH, protozoal biomass and total VFA for the different sampling times are set out in table 1. The molar proportions of the VFA are given in table 2 and the data for rumen fluid volume, turnover rate and outflow in table 3.

There were no important differences attributable to treatment for the rumen parameters of pH, protozoal biomass and total VFA concentration. The rumen fermentation pattern, however, indicated significant differences. The molar proportions of acetate increased as rice polishings supplementation was reduced and leucaena grazing was introduced; propionic acid decreased as did butyric acid (table 2). There were also significant differences in rumen function. Rumen fluid volume was significantly higher on the treatment of leucaena grazing and no rice polishings compared with the rest. Turnover rate tended to increase as did rumen outflow when rice polishings was reduced and leucaena grazing introduced.

Table 1:

Mean values for some parameters of rumen fermentation in fistulated cattle given sugar cane/urea and /or rice polishings and leucaena grazing,

Leucaena grazing, hr/d	-	3	3		
Rice polishings kg/d	1.0	0.5	-	SE _x	Probability of "F" test
Ph					
0 hr	7.23	7.06	7.25		
3 hr	6.49	6.04	6.48		
6 hr	6.25	6.59	6.40		
Mean	6.65	6.56	6.71	.05	.01
Protozoal biomass ¹					
0 hr	.48	.60	.14		
3 hr	.35	.80	.60		
6 hr	.63	.63	.35		
Mean	.48	.68	.36	.06	.16
Total VFA, m-equiv/litre					
0 hr	69	71	91		
3 hr	119	84	104		
6 hr	120	123	140		
Mean	103	93	112	5.3	.27

¹ Packed cell volume as % rumen fluid

Discussion

The results indicate important effects of leucaena grazing both on the pattern of rumen fermentation and on rumen function. The principal effect of the leucaena was to increase the turnover rate and rumen outflow and presumably this was responsible for the changes in the rumen fermentation, specifically the increase in molar proportions of acetate at the expense of propionate and butyrate. These relationships are similar to those reported by Harrison et al (1974).

On sugar cane based rations of uniform physical composition (i.e. a fixed ratio of stalk to tops), the addition of rice polishings led to increases in rumen turnover rate and rumen outflow (Priego et al 1977; Elliott et al 1978). The fact that in the present experiment these parameters increased when animals were given access to leucaena grazing despite the fact that this dietary change was associated with decreased intake of rice polishings, indicates that probably it is the roughage characteristics of leucaena rather than its nutritive value per se, which has the greater stimulating effect on rumen turnover and outflow.

Table 2:

Mean values for rumen VFA (%molar) in fistulated cattle given sugar cane/urea and/or rice polishings and leucaena grazing

Leucaena grazing, hr/d	-	3	3		
Rice polishings, kg/d	1.0	0.5	-	SE _x	Probability of "F" test
Acetic	69.8	75.8	79.7	.88	.01
Propionic	19.4	17.2	13.8	.73	.01
Butyric	10.1	6.3	5.8	.48	.01
Valeric	.8	.7	.7		

Table 3:

Mean values for rumen turnover rate and flow rate in fistulated cattle given sugar cane/urea, rice polishings and leucaena grazing

Leucaena grazing, hr/d	-	3	3		Probability of "F" test
Rice polishings, kg/d	1.0	0.5	-	SE _x	
Rumen liquid volume	20	21	35	2.8	.02
Turnover rate/d	1.74	2.23	2.4	0.10	.25
Rumen out flow, litres/d	34	46	78.7	10.6	.09

It is well appreciated that the major problem in the feeding of sugar cane to cattle is the low voluntary intake. The fact that grazing on leucaena forage stimulated both rumen turnover rate and rumen outflow suggests that the use of other forages with good roughage characteristics as supplements for auger cane may well be a fruitful area of study, in terms of arriving at methods for increasing voluntary intake and hence animal performance on this feed.

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