ANIMAL PERFORMANCE AND RUMEN FERMENTATION WITH SUGAR CANE CHOPPED FINELY OR COARSELY

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Summary

The treatments consisted of chopping sugar cane stalk coarsely (10 to 20 mm particle size) or finely (less than 5 mm). The chopped cane stalk was mixed with chopped cane tops (40 to 50 mm particle size) in the ratio 75: 25. A solution of urea/molasses (200 g urea/kg solution) was added to the cane at the rate of 50 g/kg of fresh cane. The animals also received 600 g/d cotton seed meal and 100 g/d minerals. There was one group of 3 crossbred bulls on each treatment. The experiment lasted 138 days and samples of rumen liquor were taken on two occasions during the last month. There were no significant differences in live weight gain or feed conversion due to processing although there was a suggestion that feed intake was higher with the coarse chopping. Molar percent of butyric acid was higher with fine chopping but there were no differences in acetic and propionic acid.

The results support the general finding that particle size has little effect on nutrient value and cattle performance on sugar cane based rations.

Key words: Sugarcane, particle size, cattle

Introduction

The first studies on the use of sugar cane as the basis of a cattle fattening ration stressed the need to eliminate the less digestible rind in order to support adequate animal performance (Donefer et al 1975). However, it was shown subsequently that the advantages of removing the rind were more apparent than real, since in a large scale study with 400 cattle there were no significant differences in any aspect of animal performance on sugar cane which had been derinded or simply chopped (rind included) to a particle size of approximately 5 mm (Preston et al 1975). In this latter experiment (Preston et al 1975), emphasis was on chopping

the whole cane as finely as possible with the objective of producing a particle size similar to that resulting from the derinding technique. This degree of grinding is not easy to achieve under commercial conditions, and obviously results in increased power consumption.

It has since been reported (Montpellier and Preston 19763 that over a wide range of particle sizes ranging from less than 5 mm (in a high speed chopper) to as large as 20 mm (cutting the cane by hand with a machete) there were no apparent differences in either voluntary intake or digestibility.

The objective of the trial reported here was to investigate possible differences in the rumen fermentation pattern as between finely and coarsely chopped sugar cane and also to report preliminary animal performance data.

Material and Methods

Treatments and design:

The treatments were sugar cane stalk chopped (A) coarsely (10 to 20 mm) or (B) finely (2 to 3 mm). There was one group of 3 animals on each treatment. The experiment lasted 138 days.

Animals:

On the coarse sugar cane treatment there were three steers, a Charolais x Zebu, Chianina x Zebu and Angus x Zebu; on the fine cane there were two Charolais x Zebu and one Angus x Zebu. All were castrated males approximately 200 kg LW and 10 months of age at the start of the experiment.

Diets:

The chopped cane stalk was mixed with chopped cane tops (particle size of 40 to 50 mm) in the ratio 75% stalk: 25% tops. The ration was completed by a solution of molasses/urea (200 g urea, 200 g water and 600 g final molasses of 80°Brix) sprayed on the sugar cane at the rate of 50 g/kg of fresh cane; 600 g/d of cotton seed cake and 100 g/d of minerals (a mixture of 50% bone meal and 50% salt with trace elements) was also given . The mixture of cane and molasses/urea was fed free choice while the cotton seed and minerals were given in a separate feeder.

Table 1:
Daily intake of the diffferent components of the ration

	Fine	Coarse
Daily intake, kg		
Fresh cane	18.0	18.5
Molasses	.72	.74
Urea	.18	.18
Cotton seed meal	.57	.57
Salt	.045	.045
Bone meal	.045	.045

Rumen fermentation:

In the last month of the experiment, samples were taken of rumen fluid with a stomach tube. On one sample, measurements were made immediately of protozoal population . Other samples were preserved with concentrated sulphuric acid for subsequent analysis for volatile fatty acids (VFA).

Analytical procedures:

The technique for determining protozoa! biomass was that reported by Leng et al (1976). 10 ml of rumen fluid was incubated with 150 mg glucose in a centrifuge tube at 40° for 20 minutes. The protozoa stored starch and because of the increase in density settled to the bottom, whereas plant materials tended to float helped by gas production by the rumen organisms. The liquid above the protozoa was removed leaving 1 ml of residual material including the protozoa; this was mixed and added to a 1 ml hematocrit tube and incubated for a further 5 minutes at 40° . The protozoa again settled to the bottom and plant material floated. After centrifuging (1500 rpm) for [minute the packed cell volumne was read directly.

Animal measurements:

The cattle were weighed at intervals of 14 days while feed consmuptions were recorded daily. Rate of live weight gain was determined for each treatment group using the regression of live weight on days on trial, subsequently testing the significance of the difference between regression coefficients,by analysis of variance. Feed conversion was determined by regressing cumulative feed intake (DM) on live weight.

Results and Discussion

Animal performance:

There were no significant treatment effects on rate of weight gain or feed conversion (table 2). There was a suggestion that feed intake was higher on the coarse chopping treatment (P <.09).

Rumen fermentation:

Mean values for the molar proportions of the VFA are given in table 3. Molar proportion of butyric acid was significantly higher in animals fed finely chopped sugar cane, but there were no differences in molar proportions of acetic and propionic acid. Although there was a tendency for holotrich packed cell volume to be higher with fine chopping, the variability was extremely high and the difference was not significant.

It has been hypothesised that on most feeds, efficiency of utilization is related to the proportions of VFA produced in the rumen, expressed as the non-glucogenic ratio NGR=(C2 + 2 C4) (0rskov 1975). While specifically on sugar cane-based diets, it has been suggested that animal performance is likely to be limited by availability of glucose precursors (see Leng and Preston 1976).

Regressions were therefore calculated between live weight gain and molar proportions of individual VFA, and also the non-glucogen: ratio (table 4).

All of the relationships were extremely low, and it is interesting to note that the non-glucogenic ratio gave no better prediction of animal performance than propionic acid alone. Although molar proportion of butyric acid was higher for finely chopped sugar cane, and there was a tendency for animal performance to

be poorer on this treatment , the relationship on an individual animal basis was less precise than that with propionic acid.

In terms of interelationships between rumen parameters, these were low between rumen VFA and holotrich packed cell volume Molar proportion of acetic acid was negatively related to both molar butyric acid and molar propionic acid. There was a tendency towards a positive relationship between propionic and butyric acid but the variability was high (see figure 1).

Table 2:
Mean values changes in live weight feed intake and conversion

	Fine	Coarse	Significance level
Live weight, kg			
Initial	222	204	
Final	320	306	
Daily gain[1]	.590 ±.04	.617±.04	NS
Intake of DM, kg/d	5.43 ±.017	5.57± .021	P<.09
Consumption index[2]	1.99	2.15	
Conversion[3]	8.13 ±.52	7.59 ±.10	NS

[1] Calculated by regression

[2] $\frac{\text{kg DM/d}}{\text{l00 kg LW}}$

[3] DM intake/gain LW

Figure 1:
Relationships between rumen VFA on finely (○) and coarsely (•) chopped sugarcane

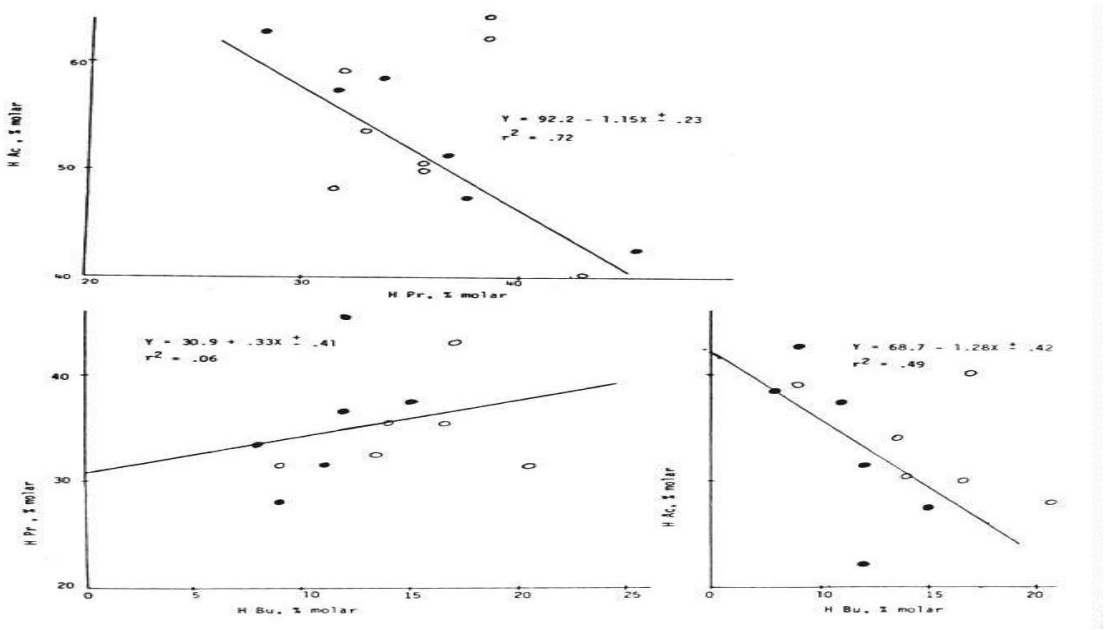

Table 3:
Mean values (x± Sx) for rumen fermentation parameters

	Fine	Coarse	SE_x	Significance level
Volatile fatty acids, %molar				
Acetic	50.3±2.6	53.4±3.1	±3.0	NS
Propionic	34.9±1.8	35.5±2.5	±2.1	NS
Butyric	15.1±1.6	11.2±1.1	±.52	P<.01
Holotrich packed cell volume, % rumen fluid	1.45	1.05	±.96	NS

Table 4:
Relationships between animal performance and rumen fermentation parameters

Y	X	b ± SEb	r^2	Syx
Gain in LW, g/d	Hac	- .092±1.34	.0005	30.6
Gain in LW, g/d	Hpr	- .310±1.82	.0030	50.5
Gain in LW, g/d	Hbu	- .270±2.46	.0012	30.6
Gain in LW, g/d	$\frac{C_2+2C_4}{C_3}$	- 3.38±21.1	.0024	30.4
HBu, % molar	PCV[1]	- .11±.81	.8019	3.93
HPr, % molar	PCV	- .023±1.10	.000045	5.31

[1] Packed cell volume as holotrich protozoa, % in rumen fluid

Conclusion

In view of the numbers of animals involved it is best not to put too much emphasis on the absence of relationship between rumen fermentation pattern and animal performance. Both small numbers, and the fact that samples were taken by stomach tube, 'could be expected to increase variability. In general, the results support other findings that degree of processing, in terms of final particle size, does not seem to be an important factor determining animal performance on sugar cane based rations.

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