THE EFFECT OF FISTULA FEEDING SUGAR CANE OR WHEAT BRAN ON THE VOLUNTARY INTAKE OF SUGAR CANE

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Four Zebu bulls fitted with permanent rumen cannulae were used in an experiment of Latin square design. They were given chopped sugar cane ad libitum (supplemented with 20% molasses/urea to provide 10 g urea/kg fresh cane) , plus 1 kg/d of wheat bran and 80 g/d of a 50:50 mixture of salt and dicalcium phosphate. Voluntary intake was measured daily. The experiment were of nine weeks duration and in weeks 2, 4, 6 and 8 the animals were given A) 1.5 kg fresh cane; B) 3.0 kg fresh cane; C) 0.5 kg wheat bran; or D) 1.0 kg wheat bran which was placed via the fistula directly into the rumen in three feeds at 2 h intervals. Weeks 1, 3, 5, 7 and 9 were used as control periods. Voluntary intake of cane during the experimental week wee compared with the flanking control weeks. Rumen pH were measured at 0, 3 and 6 hours in relation to the first "fistula feed", 6 h corresponding to 2 h after the last "feed" . Voluntary intake (by mouth) of cane was reduced by fistula feeding cane, but little changed by fistula feeding wheat bran. The average changes (±SE) were A) -1.8, 8) -2.4, C) 0.6 and D) -0.4 ± 0.85 kg/d. There were no differences between treatments in rumen pH levels which were (A to D respectively): 0 h: 6.72, 6.65, 6.69 and 6.72; 3 h: 6.30, 6.26, 6.28 and 6.24; and 6 h: 6.22, 6.28, 6.22 and 6.18. Although there wee considerable variation between animals, it is concluded that this experiment demonstrated that one of the factors which limits the voluntary intake of cane is the slow rate of digestion of the fibre component and not the fermentative capacity of the rumen per se, for the amount of fermentable carbohydrate pro- vided by the cane or wheat bran placed into the rumen via the cannula was approximately equal.

Key words: Cattle, sugar cane, voluntary intake, fistula feeding

Sugar cane appears to be a very attractive feed for ruminants. Yields per unit area are high, and its digestibility is generally between 60 and 70% (Montpellier and Preston 1977; Ferreiro and Preston 1977; Ferreiro et al 1977a; Marte et al 1978). However, the productivity which can be obtained from an energy source, is defined by both the digestibility and the voluntary intake. Dry matter intakes, and hence growth rates of animals given sugar cane/urea with no supplementation are generally low (Preston 1977). It is important to emphasise that cane quality can vary considerably - both with season, and also with the maturity of the cane. The importance of this is demonstrated by Table 1. In this table, which uses data from our awn records, the sugar content of the cane try matter has been calculated from fresh cane dry matter and DBrix as described by Ferreiro et al (1977b). The remaining portion of dry matter has been termed Non-Sugar Dry Matter (NSDM). It can be seen that for every kg of NSDM that has to be processed by the rumen, cane D would supply 2.3 times as much sugar as cane A, with almost identical intakes of fresh cane (6.7 vs 6.3 kg). We know from experiments with dacron bags suspended in the rumen (Valdez and Leng 1976; Fernandez and Hovell 1978) that the rate of degradation of NSDM is very slow in comparison with a reasonable quality hay.

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Table 1:
Examples of sugar caned of different composition

Cane	Date[1]	Fresh basis		Dry basis		kg sugar per kg NSDM	kg fresh cane per kg NSDM
		%DM	°Brix[2]	%sugar	%NSDM[3]		
A	4/7/78	22.7	8.0	29.6	70.4	0.43	6.25
B	19/6/78	24.0	12.0	43.2	56.8	0.76	7.33
C	15/3/78	31.5	17.0	44.5	55.5	0.80	5.71
D	6/4/78	29.5	17.0	48.9	51.1	0.96	6.66

[1] Date harvested
[2] Brix by refractometer
[3] Non-Sugar Dry Matter (NSDM)

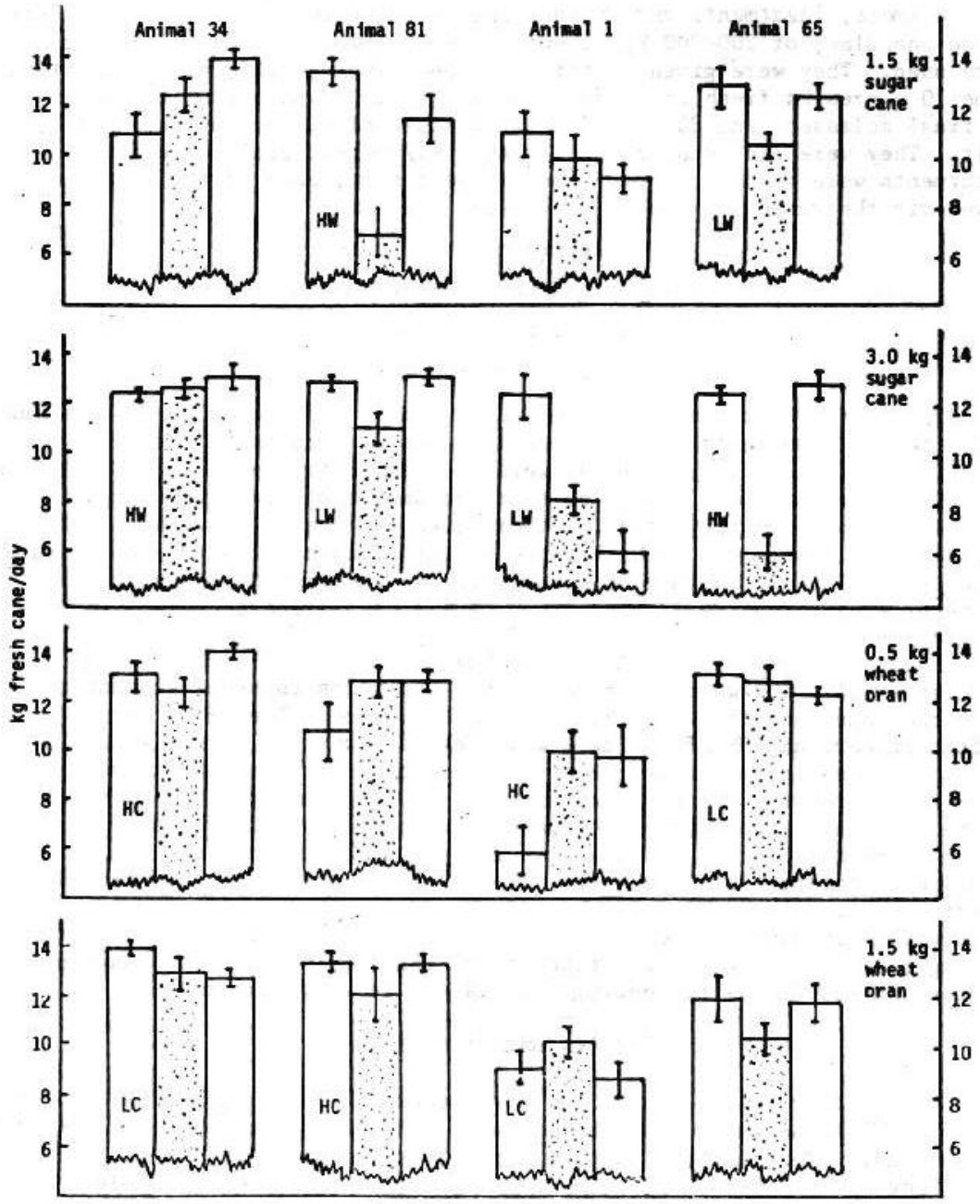
The actual digestibility of NSDM can be estimated by difference if it is assumed that the sugar is 100% digestible. Table 2 summarises some of the information available in the literature. The objective of the experiment reported here was to see whether the ability of the rumen to process cane was a factor limiting voluntary consumption. A provisional report of this experiment has been given previously (Ravelo et al 1978).

Table 2:
Digestibility of Non-Sugar Dry Matter (NSDM) by cattle, calculated from data in the literature assuming sugar to be completely

Source	Form of cane	%NSDM	Digestibility (%)	
			Cane	NSDM
Ferreiro & Preston (1977) Expt 1	Chopped stalk 75 stalk:25leaf[1]	40.5	70.7	27.7
		47.9	63.9	24.6
Ferreiro et al (1977)	Chopped stalk(I)[2]	44.1	65.6	22.0
	Chopped stalk(M)[2]	48.6	62.1	22.0
Montpellier & Preston (1977)	Chopped	39.6	67.4	17.7
Marte et al (1978)	Chopped whole	61.0	60.5	35.2
				24.9 average

[1] Approximates to whole cane
[2] (I) Immature; (M) Mature

Figure 1:
The effect of fistula feeding fresh chopped cane or wheat bran on voluntary intake of chopped whose cane by Zebu bulls



The histograms (+ SE-) show voluntary intake for the weeks preceding and succeeding (white) the experimental week (dotted). The letters LC, HC, LW, HW show the preceding treatment (low cane, high cane, low wheat, high wheat) and relate to the week before the control period shown.

Materials and Methods

Animals, Treatments and Design: Four Zebu bulls fitted with permanent rumen cannulae, of 200-300 kg liveweight and between 3 and 4 years old were used. They were given a diet of chopped whole sugar cane at libitum, plus 10 g urea/kg fresh cane (given as a mixture of 20 urea : 20 water : 60 final molasses) and 80 g/d of a 1:1 mixture of dicalcium phosphate and salt. They were also supplemented with 1 kg/d wheat bran. The four treatments were either chopped cane or wheat bran, each at two levels, given via the rumen cannula as a "fistula feed" as:

A. 1.5 kg fresh chopped cane/d

B. 3.0 kg fresh chopped cane/d

C. 0.5 kg wheat bran/d

D. 1.0 kg wheat bran/d

The experiment was of Latin square design and of nine weeks duration. The experimental treatments were imposed in weeks 2, 4, 6 and 8, and the flanking weeks (1, 3, 5, 7 and 9) were used as control periods. The levels of fistula feeding were chosen so that the amount of digestible organic matter was approximately equal whether given as cane or wheat bran. The experimental design was such that the amount of material given per fistula (low or high) could be in contiguous periods, whereas the material given (cane or wheat bran) never was. Thus cane always preceded wheat bran, or vice versa.

Management and Measurement: The bulls were housed in individual concrete stalls and were fed once daily. The molasses/urea was mixed into the cane, and the wheat bran sprinkled on top. The ° Brix (by refractometer) and DM of the cane were recorded on five days a week, voluntary cane intake daily. Fistula feeding was started about two hours after feeding the animals, and the required amount given as three fistula feeds at two hourly intervals. Rumen pH was measured at 0, 3 and 6 hours in relation to the first fistula feed and thus the last pH measurement was two hours after the last fistula feed. Fistula feeding was continued for a week, and then one week was allowed for recovery. Ten days recovery was allowed between periods 2 and 3. Intake during the control period was taken to be that during the seven days preceding and seven days succeeding the fistula feeding period.

Results and Discussion

Composition of the cane: The dry matter (DM) and the °Brix of the cane and the DM of the wheat bran are given in Table 3. As can be seen the cane was of fairly constant composition throughout the experiment.

Rumen pH: Rumen pH for the different times are shown in Table 4. In all cases pH fell with time (after the first fistula feed), but only by approximately half a pH unit. There were no differences between treatments.

Table 3:
Dry matter and brix of cane during the experiment

Week	DM %	Brix %
1 (Control)	24.7	13.7
2 (Experimental)	26.0	11.6
3 (Control)	24.9	13.0
4 (Experimental)	27.4	13.2
5 (Control)	26.0	12.4
6 (Experimental)	25.7	13.2
7 (Control)	27.6	11.2
8 (Experimental)	27.3	11.6
9 (Control)	25.3	13.5
Average	26.1	12.6
Wheat-bran	87.2	-

Table 4:
Rumen pH and voluntary intake oaf, chopped whole cane by Zebu bulls fistula fed chopped whole cane or v/heat bran (means of 4)

Intake (kg fresh material/d)	Treatments				SEx
	A	B	C	D	
By fistula:					
chopped whole cane	1.5	3.0	-	-	
wheat bran	-	-	0.5	1.0	
By mouth					
chopped whole cane (control)[1]	12.0	11.9	11.4	12.0	0.43
chopped whole cane (experiential)	10.2	9.5	12.0	11.7	1.03
Difference compared with control	-1 8	-2.4	0.6	-0 4	0.85
Probability[2]	0.08	0.03	0.51	0.65	-
Rumen pH[3]					
0 hour	6.72	6.65	6.69	6.72	0.08
3 hours	6.30	6.26	6.28	6.24	0.09
6 hours	6.22	6.28	6.22	6.18	0.03

[1] Voluntary intake during the control period taken as the mean of the preceding and succeeding weeks
[2] Probability of difference from zero (two tail)
[3] Time after first fistula feed

Voluntary Consumption of Cane: This is also shown in Table 4 and Figure 1. Although the between animal variation was high (about 28% of the variation in the analysis of the difference in cane consumption between the control and experimental periods), the effect of the fistula fed cane on reducing intake is clear. This is emphasised by Figure 1 in which it can be seen that three of the four animals reduced cane intake when fistula fed with chopped whole cane.

It is therefore concluded that, notwithstanding the between animal variation, this experiment provided some evidence that one of the factors limiting cane consumption is the ability of the rumen to process the cane. This is probably associated with the slow rate of fibre digestion. It is not due to the fermentative capacity of the rumen being exceeded, because the introduction of a similar amount of fermentable carbohydrate in the form of wheat bran was without effect on voluntary intake by mouth.

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References

Fernandez A & Hovell FD Deb 1978 The rumen degradation of rice and cane fibre in animals eating sugar cane or molasses Tropical Animal Production 3:196 abs 11

Ferreiro a M L Preston T R 1977 Digestibility and voluntary intake of derinded sugar cane stalk with and without addition of cane tops Tropical Animal Production 2 90-99

Ferreiro H M, Preston T R L Sutherland T M 1977a Digestibility of stalk and tops of mature and immature sugar cane Tropical Animal Production 2 100-104

Ferreiro H M, Sutherland T M 6 Preston T R 1977b Brix and dry matter content indices of urea requirements in diets bead on sugar cane Tropical Animal Production 2 213-218

Marte M A, Olivio F & Hovell H D Deb 1978 She digestibility of chopped sugar case supplemented with molasses or wheat bran Tropical Animal Production 3 54-ol

Montpellier FA 6 Preston TR 1977 Digestibility and voluntary intake on cager cane diets: effect of chopping the cane stalk in particles of different sizes Tropical Animal Production 2 40-43

Preston T R 1977 Nutritive value of sugar cane for ruminants Tropical Animal Production 2: 125-142

Ravelo G, Gonzalez F & Hovell Y D DeB 1978 The effect of fistula feeling sugar cane or wheat bran on the voluntary intake of cager cane Tropical A ' Animal Production 3 170 abs 12

Valdez R E & Leng R A 1976 In vivo digestion of fibre in sugar cane Tropical Animal Production 1:50 abs

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