BANANA TOPS AND SUGAR CANE AS CATTLE FEED: OBSERVATIONS ON THE RATES OF FIBRE DEGRADATION AND FLUID TURNOVER IN THE RUMEN[1]

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Ffoulkes and Preston (1978) observed that when mixtures of sugar cane and banana tops were fed the intakes of DM were higher than when either forage was given on its own. In this experiment of Latin square design, 4 bulls prepared with rumen cannulae were given the following diets: sugar cane, mixtures of sugar cane and banana tops (2:1 and 1:2 on a fresh weight basis), and banana tops. Measurements were made of the dietary DM intakes, the rates of degradation of each feed component in the rumen, and the rate of fluid turnover in the rumen (using single injections of PEG). There was no effect of the diet on intake or on the rate of degradation in the rumen. The rate of flow of fruit from the wren was higher ($P < .05$) when banana tops constituted two-thirds of the ration, than when either sugar cane or banana tops was given individually. It is suggested that the primary factor limiting dietary intake in this experiment was the slow rate of degradation of each forage component in the rumen.

Key Words: Cattle, Sugar cane, banana forage, rumen function

Sugar cane has been used as a cattle feed, both in commercial systems and in experimental rations, for a number of years. In order to obtain economic growth rates it has been necessary to supplement the basal diet of sugar cane, and several cattle feeding systems have been developed using the by-products of other feed industries, for example rice polishings, cottonseed meal, soybean meal and wheat bran (see Preston 1977; Silvestre and Hovell 1978). In most cases, supplements that result in rapid growth rates when given with sugar cane, provide important amounts of protein, and there have recently been a number of studies to investigate the use of tropical forages as alternative sources of protein in sugar cane feeding systems. Ffoulkes and Preston (1978) showed that when banana tops banana tops were added to basal rations of either chopped whole sugar cane or of chopped cane stalk, the intake of dry matter (DM) was increased by approximately 20% without altering the apparent digestibility of the ration. It was suggested that these higher intakes were due to increased efficiency of microbial fermentation of dietary DM in the rumen, which in turn was brought about through improved availability of substrates (mainly protein and amino acids) to these micro-organisms (Ffoulkes and Preston 1978).

The aim of this experiment was to investigate the effect of different proportions of banana tops and sugar cane in a ration on the rate of fibre degradation in the rumen and on the rate of rumen fluid turnover.

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Materials and Methods

Animals and Treatments: Four crossbred bulls (Holstein x Zebu) weighing between 150 and 200 kg and fitted with permanent rumen cannulae were housed in individual stalls. A Latin square experimental design was used. Each of the animals received each of the following diets ad libitum for a three week period: (A) sugar cane; (B) and © two mixtures of sugar cane and banana tops (2:1 and 1:2 on a fresh weight basis); and (D) banana tops given on its own,

Measurements: The DM content of each forage was estimated each week during the experiment. The intake of fresh material was estimated during the last 9 d of each period, and in calculating the DM intake it was assumed that the composition of the refusals was the same as that of the feed offered. During the last 7 d of each period, the following parameters were measured. (I) Rumen volume and turnover rate were estimated from the rate of dilution (over 24 hr) of two separate single infusions of polyethylene glycol (PEG), each of 100 g; the second infusion was 3 d after the first. (ii) The rate of degradation of each of the forages (sugar cane and banana tops) was measured by suspending these forages in dacron bags in the rumen. The sample of sugar cane forage was prepared by washing out the water soluble components of the cane and then sun drying the remaining fibre. The banana tops were prepared by cutting the lamina of a leaf into squares (approximately 1 cm 2), which were then chopped more finely in a domestic blender. Five bags of each forage were placed in the rumen of each animal and subsequently removed at 21, 45, 69, 93 and 117 hr after insertion.

Table 1:
Intake of sugar cane and banana tops when given individually or as mixtures (1:2 and 2:1 on a fresh weight basis) to four bulls (weights 150 to 200 kg)

	Sugar cane only	High cane mixture	High banana mixture	Banana only
Fresh feed intake, kg/d				
Sugar cane	12.0	9.8	5.5	0
Banana tops	0	4.7	11.0	19.6
DM intake, kg/d				
Sugar cane	2.87	2.36	1.32	0
Banana tops	0	0.74	1.75	3.12
Molasses	0.40	0.49	0.52	0.64
Minerals	0.08	0.08	0.08	0.08
Total	3.35	3.67	3.67	3.84
Intake of N x 6.25[1], g/d	57	180	343	562
Intake of urea, g/d	107	131	139	171

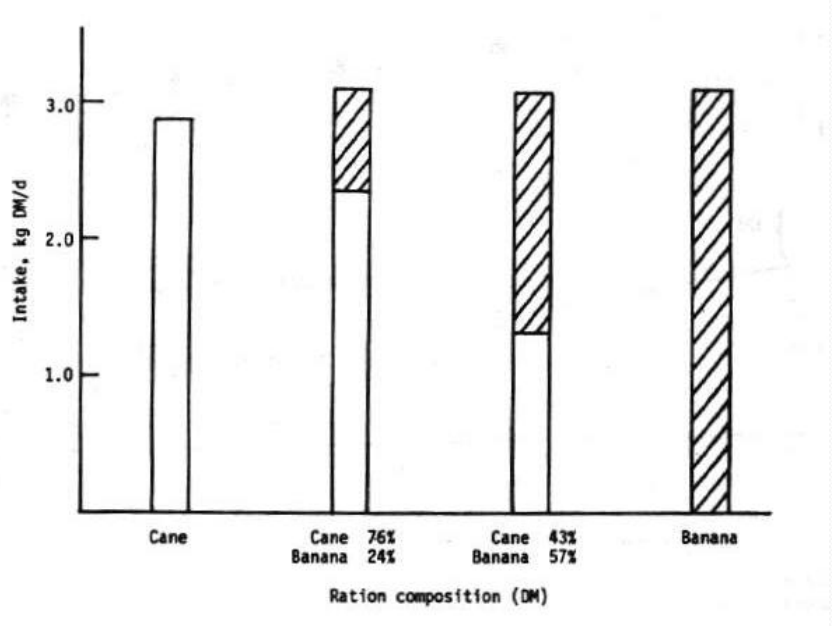
[1] Assume 2.88% N in the DM of banana tops, and 0.32% N in the DM of sugar cane

Results

The intakes of fresh and dry material and of crude protein (N x 6.25) by animals given each diet are shown in Table 1. There were no significant differences in the total

DM intakes between the different rations. The DM intakes of the three rations containing banana were higher than that of sugar cane alone (see Figure 1); however, this difference was not significant. There was no effect of the diet on the rate of

Figure 1:
Mean intake of banana tops■ and whole sugar cane □ by 4 bulls (weight 150- 200 kg)



degradation of either of the forages in the rumen. The rates of degradation of each forage, measured in all animals and averaged over all diets, are shown in Figures 2 and 3 for sugar cane fibre and banana tops respectively. The rate of degradation of each forage within the rumen was well described by the general equation for single exponential decay, i.e.

$$Y = A.e^{-mt} \qquad \ldots\ldots \quad (1)$$

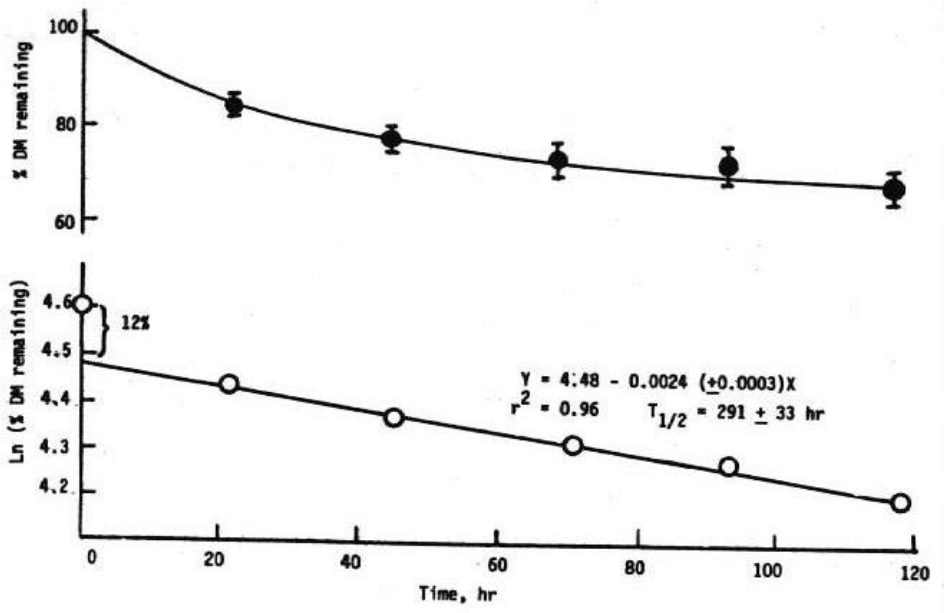
where Y is % DM undegraded at time t; A is the time 0 intercept; and m is the rate of degradation.

The linear relationships between in (Y) against time (see Equation 1) for each forage are shown in Figures 2 and 3. The mean times for the digestion of 50% of forage DM (T1/2) were estimated from these equations, from the relationship:

$$T_{1/2} = \frac{\ln(2)}{m} \qquad \ldots\ldots \quad (2)$$

$T_{1/2}$ was 152 ± 35 hr for banana tops, and 291 ± 33 hr for sugar cane fibre. The difference between the observed zero time intercept and the theoretical 100 percent was 23% of the banana tops and 12% of the cane fibre DM.

Figure 2:
Disappearance of sugarcane fibre (DM) from dacron bags suspended in the rumen

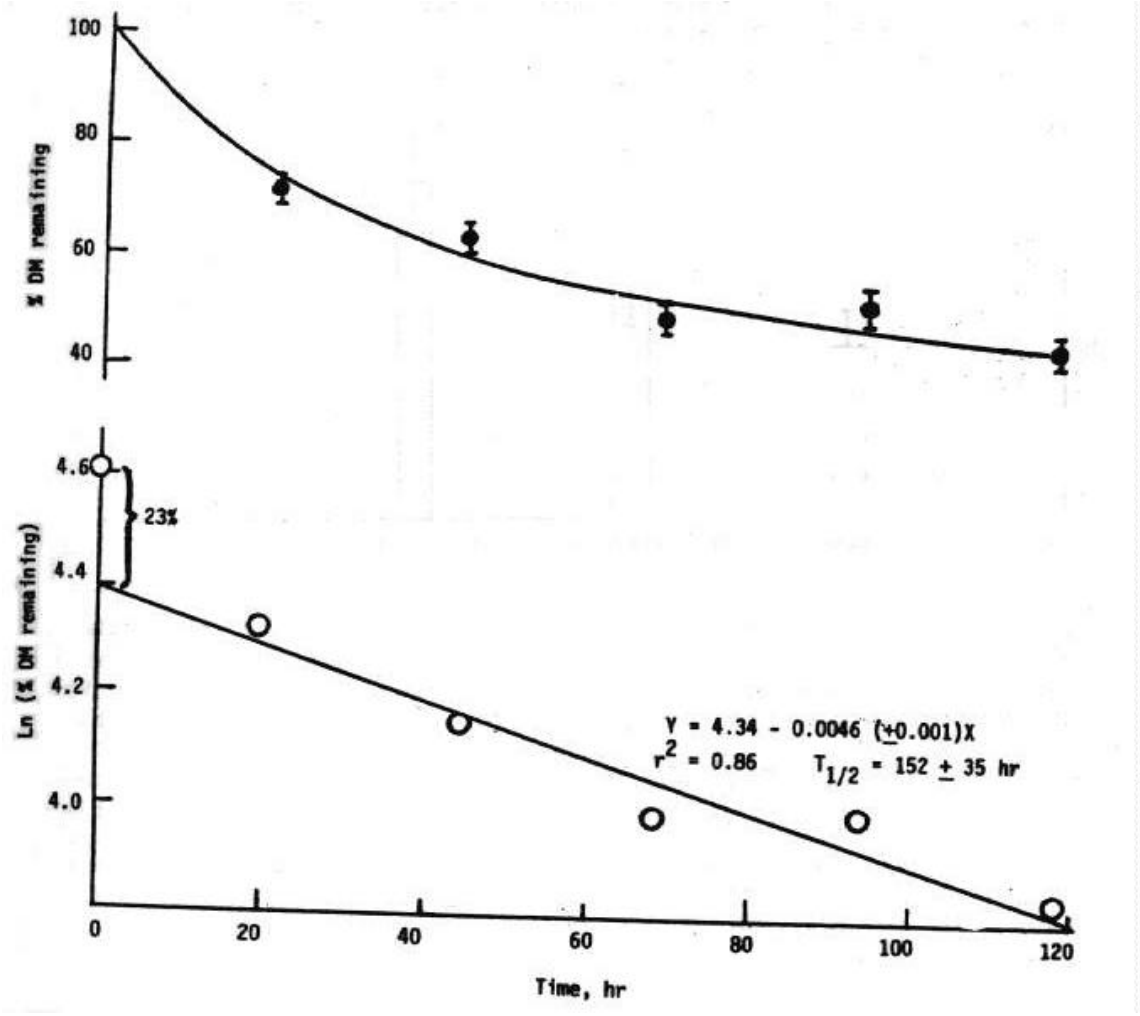


Discussion

The results obtained in this experiment agreed with the findings of Meyreles and Preston (1978). In both of these experiments, the inclusion of banana tops in the ration did not increase DM intake above that observed when sugar cane was fed on its own. These observations are contrary to the results of Ffoulkes and Preston (1978), however, the reasons for the differences between these results are not clear. The experimental periods in the present study and in the trial of Meyreles and Preston (1978) were of 21 d, whereas the experimental periods used by Ffoulkes and Preston (1978) were only 14 d. It is possible that the longer period allowed for adaptation to the rations prior to making estimates of voluntary intake may have been important in establishing stable conditions of fermentation and turnover in the rumen.

There was no effect of the diet on the rates of fermentation of either forage in the rumen. A proportion of the DM of banana tops (approximately 23%) was more rapidly fermented as indicated by the difference between the expected zero time intercept (100%) and that which was predicted by extrapolation from the straight line relationship for ln (% DM remaining in bag) against time, measured between 21 and 117 hr, This more rapidly fermented fraction of the banana tops probably consisted of the soluble cell contents, and the slower rate of degradation observed between 21 and 117 hr may represent the fermentation of the cell wall constituents. The value of the intercept for the sugar cane fibre is not important, as most of the soluble material was washed out of the fibre in preparing the material.

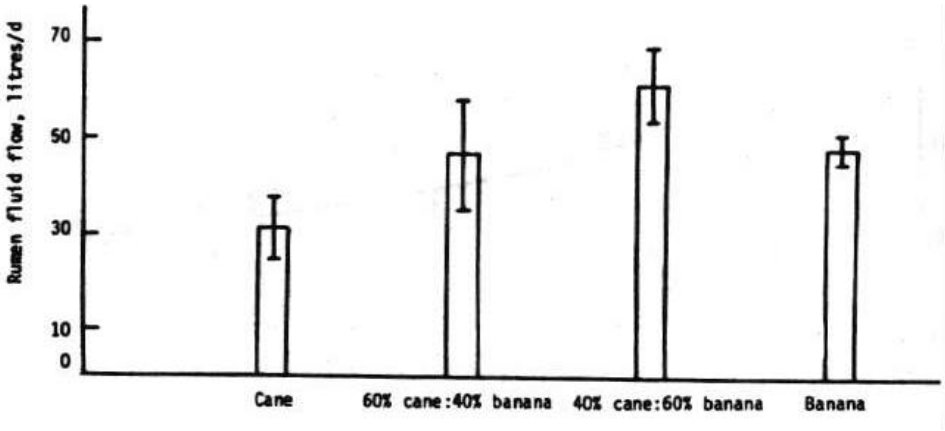
Figure 3:
Disappearance of banana tops (DM) from dacron bags suspended in the rumen



The reasons for the higher rate of fluid flow from the rumen (see Figure 4), when a mixture of sugar cane and banana tops (1:2, on a fresh weight basis) was fed, is not clear, If the liquid flow was related only to the DM content of the ration then the ration containing only banana tops would be expected to be associated with the highest rates of fluid flow. It is, therefore suggested that there are two factors that influence the fluid flow rate from the rumen in this situation: (I) the DM content of the feed; and (ii) the physical and chemical characteristics of the ration. For example, the sugar cane has a very rigid fibre component and also a soluble sugar fraction with a relatively high osmolarity; both of these characteristics may increase salivary flow rates.

In this experiment, there was no response in the intake of dietary DM to increasing levels of protein in the diet. This was surprising since the results of previous feeding trials showed a good correlation between protein intake and animal growth rate.

Figure 4:
Parameters of rumen function measured in bulls given rations containing different quantities of sugar cane and banana tops



This indicates that either the dietary protein was not available to the animal, because it was fermented in the rumen or it was not digested in the intestine; or, that there was a further factor besides protein acting to limit intake. It was also shown in this experiment that rate of digestion of the fibre components of both sugar cane and banana tops was very slow, and this suggests that the rate of fermentation in the rumen could be the main factor limiting intake in this situation. The physiological and/or microbiological changes that occur when certain supplements are given with sugar cane (eg rice polishings, Elliott et al 1978; or cottonseed meal, Fernandez - personal communication 1979), and which result in increased intakes of sugar cane, are as yet not fully understood.

References

Elliott R, Ferreiro H M, Priego A & Preston T R 1978 Rice polishings as a supplement in sugar cane diets: the quantities of starch (α -linked glucose polymers) entering the proximal duodenum Tropical Animal Production 3:30-35

Ffoulkes D & Preston T R 1978 The banana plant as cattle feed: digestibility and voluntary intake of mixtures of sugar cane and banana forage Tropical Animal Production 3:125-129

Meyreles L & Preston T R 1978 The banana plant as cattle feed: effect of different levels of banana leaves on voluntary intake of chopped sugar cane stalk Tropical Animal Production 3:229-233

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

Silvestre R & Hovell F D Deb 1978 Growth of fattening cattle given chopped sugar cane supplemented with different levels of wheat bran Tropical Animal Production 3:148-151

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