

THE BANANA PLANT AS CATTLE FEED: DIGESTIBILITY AND VOLUNTARY INTAKE OF MIXTURES OF SUGAR CANE AND BANANA FORAGE¹

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Four young Zebu bulls of 200 kg live weight were used in a 4 x 4 latin square design to determine digestibility and voluntary intake of mixtures of chopped whole sugar cane and banana forage (80% pseudostem : 20% leaves fresh basis). The treatments were four ratios of whole sugar cane and banana forage - 100 : 0, 67 : 33, 33 : 67 and 0 : 100 (DM Basis). The diets were made isonitrogenous with urea; Both in terms of digestibility (71/8%) and in voluntary DM consumption index (2.15 kg DM/100 kg live weight/ d), the 67 : 33 cane/banana forage diet was significantly better than all other diets. The sugar cane control diet was the poorest in digestibility (49.4%) while the banana forage control had the lowest value for voluntary consumption index (1.07). Replacing 33% of the sugar cane with banana forage led to increases of $46 \pm 12\%$ in DM intake and $103 \pm 18\%$ in digestible DM intake. It is considered that this increase in intake was attributable mainly to improved rumen function due to the physical nature of banana forage and to a lesser extent by the protein in the banana leaves.

Key words: Cattle, sugar cane, banana forage, digestibility, voluntary intake

As part of the programme on the use of the banana plant for the feeding of ruminants (Ffoulkes et al 1978), an experiment was carried out to measure the digestibility and voluntary intake of mixtures of whole cane and the forage component of the banana plant.

Materials and Methods

Animals, Design and Treatments: Four young Zebu-bulls with initial weights of about 200 kg were used in a 4 x 4 latin square design with periods of 14 days. The animals were assigned to the following diets (treatments) consisting of different proportions of whole cane and banana forage:

Diet	Dry matter basis		Fresh matter basis	
	Cane	Banana	Cane	Banana
A	100	-	100	-
B	67	33	40	60
C	33	67	15	85
D	-	100	-	100

The diets were made approximately isonitrogenous by adding 56 g of molasses/urea (20% w/w) for each kg of fresh weight of cane; and 12 g of the same molasses/urea mixture and 8 g of pure molasses for each kg of fresh banana forage. The proportion of pseudostem and leaves of the banana in the diets was set at the

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ratio of 80 : 20 (fresh basis), in order to simulate the usual composition of the forage proportion of the plant (Ffoulkes et al 1978).

Procedure: These were as described by Ffoulkes and Preston (1978). A fifth period, the dietary treatments of which were exactly the same as those of the fourth, was added to the 4 x 4 latin square in order to check the validity of the one week adaptation period.

Results

The results for apparent dry matter (DM) digestibility and intake for the dietary treatments are presented in Table 1. In terms of digestibility and DM intake, the 67 : 33 cane/banana diet was significantly better ($P < .02$; $P < .01$) than all other diets. The sugar cane control diet was the poorest in digestibility (49.3%), while the banana forage control had the lowest value for voluntary consumption index (1.07 kg DM/100 kg live weight/day).

Table 1:
Digestibility and voluntary consumption of mixtures of chopped whole sugar cane and banana forage fed to 200 kg Zebu bulls

	Sugar cane: Banana forage (DM basis)			100	± SE _x
	100	67:33	33:67		
Apparent digestibility, %	49.3	71.8	64.1	67.9	3.65
Voluntary intake, kg /d					
Dry matter	3.40	4.60	3.00	2.29	0.22
Digestible dry matter	1.70	3.30	2.12	1.53	0.25
Consumption index ¹					
Dry matter	1.59	2.15	1.41	1.07	0.14
Digestible dry matter	0.79	1.55	1.00	0.73	0.12

¹ kg feed/100 kg live weight/day

In Table 2, the DM percentages and the Brix of the cane are shown for each period. There was considerable variation between periods within treatments for both measurements.

The effects on voluntary intake of substituting sugar cane with banana forage are illustrated in Figure 1, Replacing 33% of the sugar cane with banana forage led to increases of $46 \pm 12\%$ in DM intake and $103 \pm 18\%$ in digestible DM intake. Diets with higher proportions of banana forage were worse than the sugar cane control for DM intake, but superior in digestible DM intake; however, the differences were less pronounced.

Discussion

The salient features of the results are (i) the low digestibility of the basal sugar cane ration, (ii) that daily intake of digestible dry matter was almost doubled by substitution of one third of the sugar cane DM with banana forage; and (iii) that further substitution with banana forage led to an equally rapid decrease in rate of intake of digestible DM.

Table 2:
Mean values for Brix of sugar cane and dry matter (DM) percent in the different diets for each period

Periods	Sugar cane °Brix	Sugar cane: banana forage (DM basis)			
		100:0	67:33	33:67	0:100
1	10.9	23.4	14.3	11.1	11.2
2	13.8	26.1	15.4	12.1	9.5
3	16.0	31.0	17.6	11.7	8.1
4	14.0	31.9	16.7	11.8	8.1
5	13.3	26.5	16.4	12.7	10.3
Mean values	13.6	27.8	16.1	11.9	9.44
SE _x	0.82	1.6	0.57	0.26	0.61

Figure 1:
Mean values (and SE_x) for consumption index on sugar cane/banana forage mixture

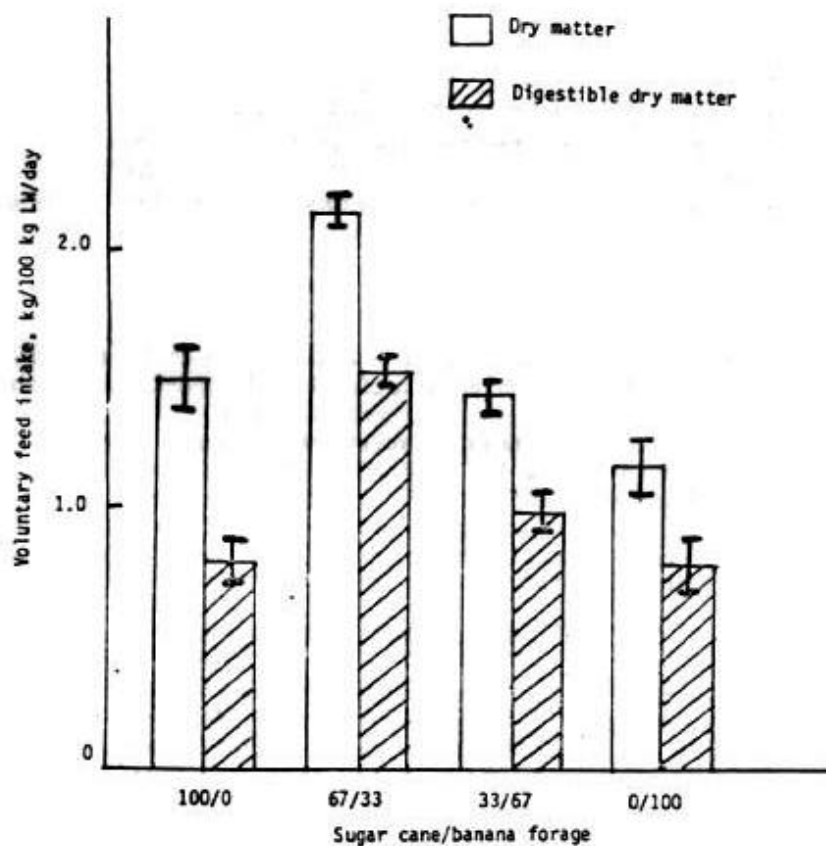


Table 3:

Mean values for intake of dry matter and protein from sugar cane and banana forage and N from urea

	Proportion sugar cane : banana forage (DM basis)			
	100:0	67:33	33:67	0:100
Intake of DM, kg/d				
Sugar cane	3.40	3.08	0.99	-
Banana forage	-	1.52	2.01	2.29
Total	3.40	4.60	3.00	2.29
Intake of protein, g/d				
Banana forage	-	115	150	157
Intake of N, g/d				
As urea	65	74	39	28
As banana forage	-	18	24	25
Total	65	92	63	53

The low digestibility of the basal sugar cane diet is unusual as moot values reported in the literature (including those for low Brix sugar cane) have been in the range 60-65% (Montpelier and Preston 1977a,b; Ferreiro and Preston 1976; Ferreiro et al 1977). The sugar cane used in this experiment was relatively mature (the DM content was in the range 26-32% for all except the first period, where the value was 23%) and it is possible that the low digestibility reflected therefore the combination of a low sugar content (mean Brix was 13.6) with a more lignified, and hence less digestible, fibre (see Pate 1977).

The high rate of digestible DM intake with one third substitution of sugar cane by banana forage was the result of both a higher digestibility coefficient and higher voluntary intake of DM compared with the other diet combinations. Since the amount of potential by-products protein in the banana forage was relatively low (a maximum of 115 g/d), it is perhaps reasonable to conclude that the high rate of digestible DM intake was the results of enhanced microbial activity in the rumen. This implies that in some way the banana forage helped to create a superior ecosystem in the rumen which favoured both rate of microbial degradation and also rate of turnover of digesta.

The subsequent fall in rate of digestible DM intake (as banana forage content increased) possibly was caused by progressive imbalancing of the energy and nitrogen substrates, ie soluble sugars were replaced by cell wall components, whereas the bulk of the nitrogen remained unchanged being provided by soluble, and therefore rapidly fermentable, NPN (urea).

Rate of intake of digestible DM per 100 kg live weight on the basal banana forage diet in this trial (0.73) was less than that predicted from the data reported by Ffoulkes and Preston (1978) for a mixture of 80% stem and 20% leaf (0.99).

Conclusion

Previously it had been thought (Leng and Preston 1976) that the limitations to rate of animal productivity on sugar cane based diets were related primarily to a need to provide by-pass nutrients. Subsequently, it was proposed that manipulation of the rumen microbial ecosystem might also lead to beneficial results, with special reference to the use of additives for control of the protozoa (Preston and Leng 1978). The data from our experiment suggest that rumen function on cane diets can be improved in other ways, for example through addition of banana forage. Whether this improvement in rumen function will be manifested in improved animal productivity remains to be investigated.

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