INTAKE AND DIGESTION OF DIFFERENT PARTS OF THE BANANA PLANT

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Four crossbred bulls with permanent rumen cannulae were used in an experiment of Latin Square design to study the effect of feeding banana tops or stem as the forage component of a molasses based diet. The four treatments were molasses (with 2.55 urea) plus: (a) banana tops; (b) banana stem; (c) tops and stem (50:50); and (d) banana stem with 500g soyabean meal/d. The effect of dietary treatment on voluntary intake and various parameters of rumen fermentation were used. There was no difference in forage intake on a fresh basis, but there was a significant ($P < 0.01$) increase in the DM intake when the forage was 100% or 50% banana tops. It is suggested that the bulk of fresh forage may have been a factor limiting its intake. There were no significant differences in rumen volume or rate of turnover associated with the different diets (means:25.5 litres and 2.7 vol/d respectively) nor in ammonia NH concentration (mean: 153 mg NH3/litre). Volatile fatty acid concentration and rate of DM degradation (estimated from the rate of DM disappearance from rumen bags) were significantly ($P < 0.05$) higher when soyabean meal was given with the chopped banana stem than when the stem was fed alone. It was concluded that although the DM intake was higher when the tops were given as the only source of forage, the whole banana could probably be used as efficiently as tops alone, if supplementary dietary protein was provided to improve the efficiency of rumen function.

Key words: Cattle, banana plants, rumen fermentation, intake

In cattle given diets based on liquid molasses, the types and quantities of roughage and protein given have been shown to influence intake and growth rate (see Preston 1972). In previous studies in which the banana plant has been fed, to provide the roughage and protein component of a molasses-based diet, the leaves and petiole (tops) of the plant have been used and growth rates have been in the range of 300 to 600g/d (Fernandez et al 1978; Rowe et al 1979). The objective of the present study was to examine the use of banana stem in comparison to tops. The two major differences between the composition of these parts of the banana plant are, that the stem has a far lower DM content than the leaves (about 7.5% DM versus 16%) and contains very little protein. Differences in intake parameters of rumen fermentation resulting from feeding the two parts of the plant individually or as a mixture were studied.

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Materials and Methods

Animals, design and feeding: Four crossbred bulls (Zebu x Brown Swiss) weighing 140 and 180 kg and fitted with permanent rumen cannulae were used in an experiment of Latin Square design. Each period lasted 21d, the first two weeks being for adaptation to the diet and the final 7d for the measurement of intake and certain parameters of rumen fermentation. The forage was offered to the animals each morning at about 9.00am and the molasses (containing 2.5% urea) in a separate trough was filled up as required. The four dietary treatments were available ad libitum, the refusals being collected and weighed each day. The forage treatments were as follows : (a) banana tops chopped from a stationary Hesston forage harvester; (b) banana stems chopped into transverse sections 2-5 cm wide with a large knife; (c) a mixture (50:50) of tops and stem prepared as above; and (d) chopped stem supplemented with 500 g soyabean meal per day.

Estimation of parameters of rumen fermentation: Rumen volume and turnover rate were measured using two single intraruminal injections of 100 g polyethylene glycol (PEG) given two 70 days apart, during the final 7 d of each period. The concentration of PEG in rumen fluid was estimated by the method of Malawar and Powell (1967). The concentrations of NH and volatile fatty acids (VFA) in rumen fluid were measured by titration following steam distillation. The rate of DM degradation in the rumen was estimated from the rate of DM disappearance when dacron bags containing finely chopped banana leaf were suspended in the rumen over a period of 72 hours. The half time (T1/2) for disappearance of DM was estimated from the semi-log plot of DM against time (see Bobadilla and Rowe 1979).

Results

The intakes of forage and molasses/urea are given in Table 1 as fresh material and DM. The average DM contents of feeds measured over the period of the trial were: molasses/urea, 71%; banana tops 16% and banana stem 7.5%.

Table 1:
Intake of dietary components (kg/d)

	Tops	Stem	Tops & stem	Stem + soyabean
Intake of fresh material				
Forage	11.5 (0.5)[1]	10.6 (1.4)	12.0 (0.6)	10.5 (2.0)
Molasses/urea	3.6 (0.4)	4.1 (0.3)	3.3 (0.8)	3.4 (0.7)
Intake of DM				
Forage	1.84 (0.08)	0.80 (0.11)	1.41 (0.07)	0.79 (0.15)
Molasses/urea	2.56 (0.29)	2.88 (0.22)	2.35 (0.53)	2.41(0.46)
Total	4.40 (0.25)	3.68 (0.19)	3.76 (0.50)	3.66[2](0.31)

[1] Mean values with SE_ in parentheses
[2] Includes 500 g soyabean meal/d

There was considerable variation in intake between animals but no significant variation in intake between the different periods. Intake of fresh forage was similar on all diets, however, the DM intake was significantly ($P < 0.01$) higher when tops were given as the forage source either alone or combined with the banana stem. There was an apparently linear response ($r^2 = 0.97$) in forage DM intake to the inclusion of tops in the diet. There was no significant effect of forage source or supplementary soyabean meal on the intake of molasses/urea. The total DM intake of the diet in which banana tops were the only forage given, was significantly ($P < 0.05$) higher than the other diets.

The parameters of rumen fluid kinetics and of rumen fermentation measured in this experiment are given in Table 2. There were no differences in rumen volume or turnover rate in animals given the different dietray treatments nor in the concentration of NH_3 in rumen fluid. A higher ($P < 0.05$) concentration of VFA was observed in animals receiving the diets of banana stems and tops plus soyabean, than in animals receiving banana stems alone. There was a significant ($P < 0.05$) increase in the rate of DM disappearance when soyabean meal was added to the basic diet of chopped banana stem.

Table 2 :
Parameters of rumen fluid kinetics and fermentation.

		Diet description				SEx
		leaf	stem	leaf and stem	stem and soyabean	
Rumen parameters						
Volume	litres	27.0	24.8	24.4	25.8	2.6
Turnover	vol/d	2.6	2.6	2.8	2.9	0.2
NH_3 concentration	mg NH_3/litre	168	157	128	161	33
VFA concentration	m mol/litre	112	91	101	112	8
DM degradation*	$T_{1/2}$: hr	89	62	45	25	15

* Rate of disappearance of banana leaf DM from dacron bags suspended in the rumen.

Discussion

The fact that the intake of forage, on a fresh matter basis, was similar for all diets indicates that the bulk of the stem with its high moisture content may be one of the factors limiting its intake. A similar level of molasses intake over all treatments suggests that the level of protein in the banana leaves, or that given in the soyabean meal did not act to stimulate intake and animal production under these conditions. This could be due to the high rates of rumen fluid turnover which would provide an environment for efficient microbial protein synthesis and thus reduce the importance of dietary protein. The rumen NH_3 concentration was higher than that suggested as being critical for optimal microbial growth (Satter and Slyter 1974) and was unlikely to have limited microbial protein production.

The highest VFA concentrations appeared to be associated with (a) a higher DM intake in the case of the animals given banana tops as the roughage source, and (b) a more rapid rate of DM degradation in the rumen which was observed when soyabean meal was given with the chopped banana stem. In the latter situation the addition of dietary protein may have acted to stimulate microbial action providing an available source of preformed amino acids which have been shown to be essential for maximal microbial growth (Maeng et al 1976).

The results of this experiment show that, although the DM intake appears to be lower when the banana stem is included in the forage portion of a molasses/urea-based diet rather than when tops are given as the sole forage, there may be a compensatory improvement in rumen function (principally an increase in DM degradation rate) with the inclusion of a small amount of supplementary protein. In commercial feeding systems it would be more satisfactory to feed the whole banana plant, and from the results of this study it appears that this could be done without affecting the level of animal production, provided that a small amount of supplementary protein is included in the ration.

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