THE BANANA PLANT AS CATTLE FEED: GROWTH OF ANIMALS GIVEN DIFFERENT PROPORTIONS OF BANANA TOPS AND SUGAR CANE WITH MOLASSES AD LIBITUM

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Twelve Zebu bulls weighing 170-225 kg were housed two per pen. Molasses containing 2.5% urea was given ad libitum to all animals and different proportions of whole sugar cane to banana tops were given as the roughage component of the ration. The six ratios of sugar cane to banana tops were used: (on fresh basis) 100:0, 80:20, 60:40, 40:60, 20:80 and 0:100. The trial was continued for 77 d. All animals were weighed after 21 d and then every 14 d, and the mean liveweight gain for the animals in each pen was estimated as the least squares relationship between mean liveweight and time. The composition (DM and N) of each feed component was estimated each week, and the level of intake wee measured each day during the trial. The rate of liveweight gain wee closely related (r^2 = 0.92) to the proportion of roughage given as banana tops. This was mainly accounted for by the higher level of protein intake when banana tops were consumed (r^2=0.82 between liveweight gain and protein intake). Inefficient utilization of feed (19.1 kg feed DM/kg liveweight gain) wee observed when sugar cane provided the only source of roughage and it wee suggested that this could be due to the incidence of secondary fermentation in the rumen.

Key words: Cattle, banana forage, sugar cane, molasses, urea, growth

When cattle are fed high levels of molasses (ad libitum), it is extremely important to provide some form of forage in order to ensure efficient rumen function (Preston and Willis 1974). Banana and sugar cane are two of the highest yielding forage crops (tone dry matter/ha) that grow in the tropics. In experiments where either sugar cane or banana have been given as the forage source to cattle fed molasses ad libitum, the rates of liveweight gain have tended to be poorer for sugar cane (100400 g/d) (Salads et al 1977) than for banana forage (300-600 g/d) (Fernandez et al 1978). More recent studies, in which rations containing only banana and sugar cane were given to cattle, indicated that the highest levels of digestible dry matter (DM) intake were achieved when the amount of banana forage in the diet represented 33% of the ration DM (Ffoulkes and Preston 1978).

In the studies reported here, the objective was to determine whether higher rates of liveweight gain could be realized when cattle fed molasses ad libitum were given a combination of sugar cane and banana forage, as compared with either of these forages on its own.

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Materials and Methods

Animals: Twelve Zebu bulls weighing 170 to 225 kg were randomly assigned to six pens (2 per pen). A period of two weeks was allowed prior to the start of the experiment for the animals to adapt to the experimental rations and for the social order to become established.

Feeding: The two roughages used were whole sugar cane (approximately one year old) and banana tops, which consisted of the leaves and petioles, after the fruit had been harvested and the stem removed. This portion of the banana plant represents approximately 25% of the DM of the plant. Both roughages were given to the cattle within 24 h of being harvested and were chopped with a forage harvester immediately before feeding. A molasses/urea mixture (20% urea w/w) was added to the roughage at the rate of 50 g/kg fresh material. Molasses containing 2.5% urea was continuously available in a separate trough. A mixture of NaCl and dicalcium phosphate (1:1) was given each day (80 g/animal).

Treatments and Analysis: Each pair of animals was given a different ration of roughage slightly in excess of their ad libitum intake. The six ratios of banana tops to whole sugar cane (fresh basis) were: 100:0, 80:20, 60:40, 40:60, 20:80, 0:100. For the duration of the trial, samples of each component of the feed were taken weekly for the analysis of DM content. Every day the feed refusals from the previous day were collected from each pen and weighed. The DM content of these refusals was assumed to be similar to the DM content of the feed components. All of the animals were weighed after the first 21 d and then every 14 d. The mean rate of weight gain of each pair of animals over the 77 d trial was estimated by the least squares method for the relationship between liveweight and time.

Results

The mean daily intakes of feed, on a DM basis, were estimated from the total intakes of feed during the 77 d trial, and are given in Table 1. The mean values for the DM content of the feeds were: banana tops 15.9 ± 2.3%; sugar cane 25.0 ± 1.5%; and molasses (2.5% urea) 68.8 ± 2%. Table 1 also shows the rate of liveweight gain, the feed conversion ratio and the feed consumption index. The feed consumption index (kg DM intake/100 kg liveweight) was estimated using the animal liveweight at the middle of the trial, as calculated from the regression relationship between liveweight and time. As the proportion of banana tops in the roughage portion of the ration increased, the rate of liveweight gain increased linearly (Figure 1). Associated with higher rates of liveweight gain were higher values for feed consumption index, and a more efficient conversion of feed to liveweight gain (Table 1).

The mean liveweight of each pair of animals at intervals during the 77 d period are shown in Figure 2. The weight loss between days 49 and 63 occurred during a period when the DM content of the molasses/urea mixture fell to 59% as compared with the 70-72% DM for the remainder of the trial. This was a result of the cleaning of the molasses tanks when the sugar mill closed down at the end of the season. The r^2 values for the relationships between liveweight and time (Figure 2) varied from $r^2 = .97$ to $r^2 = .42$ with the higher coefficients being associated with the higher rates of liveweight gain.

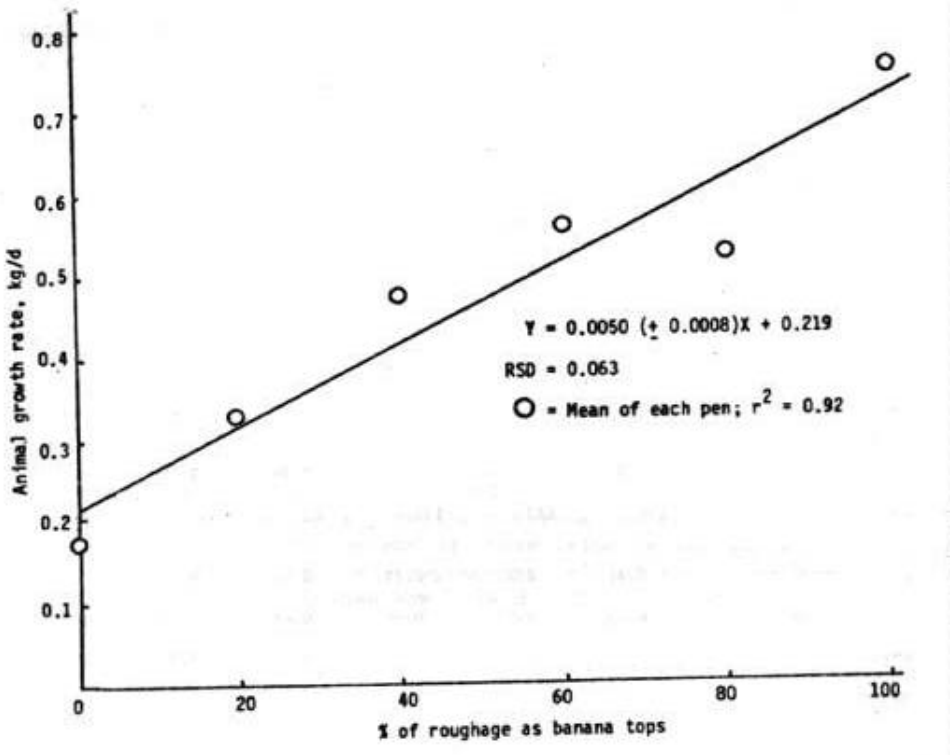
Table 1:
Mean daily intakes, growth rates and feed conversion ratios measured in animals given different proportions of sugar cane : banana tops as a roughage supplement for molasses/urea

	Proportion of dietary roughage provided by chopped banana tops (% of fresh material)					
	100	80	60	40	20	0
Intake of fresh material, kg/d						
Sugar cane	0	1.46	4.84	1.83	2.74	2.86
Banana tops	13.99	10.24	9.15	1.86	0.69	0
Molasses	3.92	3.68	2.64	3.15	3.47	4.11
Intake of DM, kg/d						
Sugar cane	0	0.31	1.03	0.39	0.59	0.61
Banana tops	2.22	1.52	1.36	0.28	0.10	0
Total roughage	2.22	1.83	1.39	0.67	0.69	0.61
Molasses	2.70	2.53	1.82	2.17	2.39	2.83
Total	4.92	4.36	4.21	2.84	3.08	3.44
Total N intake, g N/d	160	133	131	62	61	60
Protein[1] intake in banana tops, kg protein/d	0.31	0.21	0.19	0.04	0.01	0
Liveweight gain, kg/d	0.75	0.53	0.56	0.48	0.33	0.18
Feed conversion ratio[2]	6.56	8.23	7.52	5.29	9.33	19.11
Feed consumption index[3]	2.18	2.16	2.04	1.22	1.44	1.67

[1] Estimated as: 6.25 x total N
[2] kg DM intake/kg gain
[3] kg DM intake/100 kg liveweight

The regression coefficients, r^2, and residual standard deviations for the relationships between the rate of liveweight gain, and several intake parameters are given in Table 2. The rate of liveweight change was closely correlated with the proportion of banana tops in the roughage (r^2= .92) (see Figure 1)2 and also with the quantity of protein consumed in the banana tops (r^2= .82). Total DM intake and molasses intake were not closely related to the rate of liveweight gain in this experiment (Table 2).

Figure 1:
Rate of liveweight gain plotted against the proportion of banana tops in the roughage portion of the ration. Each point represents the mean growth rate of two animals in the same pen



Discussion

The animal growth rates and the intakes of DM that were observed in this trial indicate that under conditions where molasses is fed ad libitum, it is better to give only banana tops as the roughage as opposed to mixtures of sugar cane and banana tops. When roughage based diets were fed using molasses as a carrier for urea, to provide additional non-protein nitrogen (Ffoulkes and Preston 1978; Meyreles and Preston 1978), it is probable that the mixture of sugar cane (containing more energy nutrients available to the animal than banana tops) and banana tops (with a higher protein content) provided a better balanced ration, than either feed on its own, and therefore stimulated higher intakes.

The linear relationship between the consumption of protein, as banana tops in the roughage component of the ration, and liveweight gain in this experiment, supports the general hypothesis (Preston 1972) that when molasses is provided in the ration ad libitum, the primary limiting nutrient is protein. The sugar cane (protein content 3% of DM) did not provide more energy nutrients to the animal than the molasses, and its high fibre content probably restricted the intake of banana tops (protein content 14% of DM).

The feed conversion ratio, estimated for the animals given sugar cane as the only source of roughage (19 kg DM/kg gain), was more than twice the value for any other group of animals in this experiment. It is suggested that this low efficiency may be associated with low rates of rumen turnover. Under these conditions, considerable inefficiencies may occur in the synthesis of microbial protein and its availability to the animal (Stouthamer and Bettenhaussen 1973; Isaacson et al 1975). Slow rumen turnover may also provide a favourable environment for "sludgetype" organisms to develop, which are associated with the oxidative fermentation of the end products of carbohydrate fermentation (Rowe et al 1979). Under these conditions there may also be a significant decrease in the amount of energy that is available to the animal. The ration, fed to the animals given sugar cane as the only source of roughage, contained approximately 90% of the fermentable organic matter intake as molasses.

Figure 2:
The mean liveweight of the animals in each pen plotted against time. The symbols ○, ●, △, ▲, □ and ■, and represent the proportions of banana tops in roughage: 100, 80, 60, 40, 20 and 0% respectively

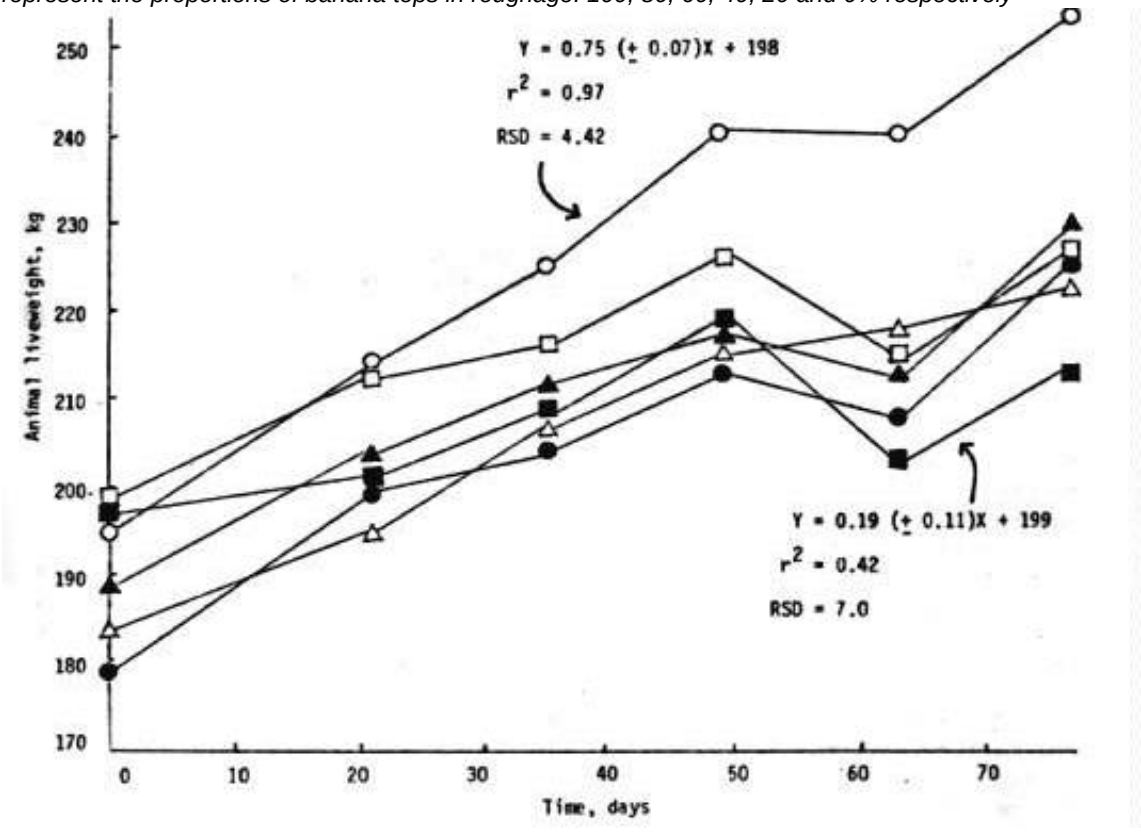


Table 2:
The relative importance of different components of feed intake (X) on the rate of liveweight gain (Y) as determined by least squares estimates of the relationships between these parameters (see Table 1 for data)

Y	X	r^2	b_1	± SE	RSD_2
Liveweight gain, kg/d	% banana tops in the forage fraction of the ration (see Figure 1)	0.92	0.005	0.000	0.063
"	Dietary protein supplied by banana tops, kg protein/d	0.82	1.40	0.32	0.09
"	Total roughage intake, kg DM/d	0.73	0.25	0.07	0.11
"	Molasses intake, kg DM/d	0.06	-0.13	0.26	0.21
"	Total DM consumption index, kg DM/100 kg liveweight	0.34	0.29	0.20	0.18

[1] Regression coefficient + Standard Error
[2] Residual Standard Deviation

This fraction is very rapidly fermented in the rumen and there will therefore be long periods when the availability of fermentable carbohydrate in the rumen is low. Under these conditions, microorganisms that have the ability to utilise the end products of primary fermentation may have a competitive advantage and become a quantitatively significant group of organisms within the rumen. Slow rumen turnover may be associated with the inefficient utilisation of energy nutrients, and also an inefficient net synthesis of microbial protein in the rumen. It is possible that this factor may be the principal cause of the low efficiency of feed conversion, that was observed in this study, when sugar cane was the only roughage source.

The possibility that banana tops given with molasses may increase the rate of rumen turnover and the efficiency of microbial protein production, (above that when cane is used as the roughage source) in these rations, is at present being studied in these laboratories.

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