THE BANANA PLANT AS A SOURCE OF ROUGHAGE FOR CATTLE FED MOLASSES AND UREA[1]

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Ten Zebu bulls weighing between 215 and 260 kg were assigned to treatments (2 per group). All animals were given free access to molasses containing 2.5% urea (w/w). m e five treatments consisted of different levels of banana tops (leaf and petiole) calculated, in terms of fresh material, as 1.5, 3.0, 4.5, 6.0 and 7.5% of animal liveweight per day. During the trial which lasted for 105 d the animals were weighed every 14 d for 98 d and then again 7 d after this penultimate weighing. The rate of gain of each animal was estimated from the least squares relationship between liveweight and time. The daily feed intake of each group of animals was estimated throughout the trial. The intake of molasses was constant for all groups of animals (2.87 ± 0.14 kg DM/d), while that of banana tops varied from 0.62 at the lo. level to 2.66 kg DM/d at the upper level. The mean growth rate for all animals was 540 ± 31 g liveweight/d, and there was no relationship between the level of DM intake and animal growth rate. It is suggested that the poor feed conversion efficiency observed when high levels of banana tops were given was due partly to reduced DM digestibility at the higher levels of feed intake and partly to less efficient microbial growth and fermentation occurring in the rumen--n when a large quantity of slowly digestible fibre was present.

Key Words: Cattle, fattening, banana forage, molasses, urea

In many tropical countries sugar is the main export, and bananas and plantains are grown as a major source of human food for the domestic markets. The by-products of these two industries are, in the case of sugar cane: molasses and bagasse; and, in banana production: the stem and leaves of the plant which are normally left on the ground to decay when the fruit has been harvested. In a previous experiment, in which molasses and banana forage were fed to cattle, growth rates were between 300 and 600 g liveweight/d (Fernandez et al 1978). It has also been shown that when different ratios of chopped sugar cane and banana tops were used to provide the roughage component of a ration based on liquid molasses, there was a positive response in liveweight gain to increasing levels of banana tops (Rowe and Preston 1978).

In this experiment, the aim was to determine whether the level at which the banana forage was included in the ration would affect the rate of liveweight gain and feed conversion efficiency when cattle were fed banana tops as the only source of roughage and protein in a molasses based diet.

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Materials and Methods

Animals: Ten Zebu bulls weighing between 210 and 260 kg were assigned to five pens (2/pen), in order to have the mean liveweight of the bulls in all pens approximately equal. The experiment started after a two week period, during which time the animals adapted to the rations and to the experimental conditions.

Feeding: The banana forage was prepared from the portion of the plant remaining after the stem and the fruit had been removed. The banana tops (leaves and petioles) were then chopped in a forage harvester immediately before being given to the animals. The banana tops were fed each morning with 80 g of a mineral supplement (sodium chloride and dicalcium phosphate; 1:1). A molasses/urea mixture (20% urea w/w) was added to the banana at the rate of 50 g/kg fresh material. Molasses containing 2.5% urea was available in a separate trough, ad libitum.

Table 1:
Feed intake and growth rates of bulls given molasses ad libitum and five levels of banana

	Level of fresh banana tops (%of liveweight)				
	1.5	3.0	4.5	6.0	7.5
Intake kg/d[1]					
Banana tops	3.86	6.82	10.35	14.60	16.61
Molasses (10% urea)	0.19	0.34	0.52	0.73	0.83
Molasses (2.5% urea)	3.75	3.28	3.70	3.55	3.97
Total DM intake	3.42	4.66	4.68	5.35	6.02
N x 6.25, g/d[2]	87	153	232	328	372
NPN, g/d[3]	62	70	92	110	124
Liveweight, kg					
Initial	243	231	234	239	238
Final	291	273	273	284	283
Daily gain, g/d	485	430	360	454	462
Feed conversion[4]	7.1	10.8	13.0	11.8	13.0
Consumption Index[5]	1.29	1.85	1.84	2.03	2.29

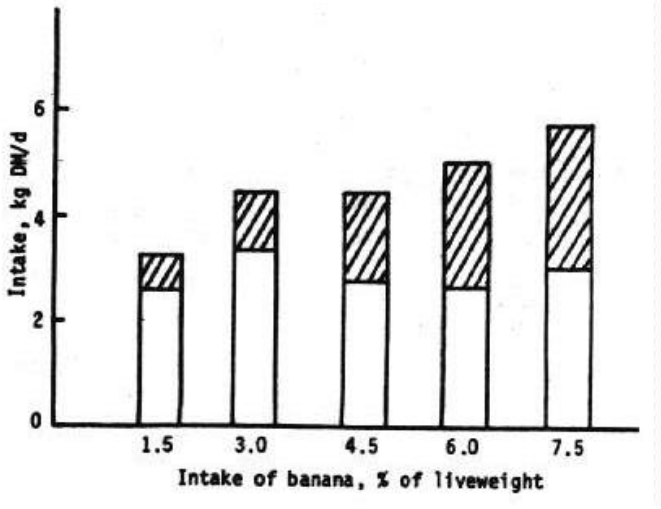
[1] Fresh material
[2] In banana tops
[3] Urea N
[4] kg feed DM/kg gain in weight
[5] kg feed DM/100 kg liveweight

Treatments and Measurements: Each pair of bulls received a different amount of banana tops. The five levels were calculated as percentages of mean liveweight of the animals in each pen. On a fresh weight basis, the banana tops were given at 7.5, 6.0, 4.5, 3.0 and 1.5% of mean liveweight. The lowest level at which banana tops were given was set at the minimum amount required to avoid molasses toxicity. At the upper level, intake of banana tops was ad libitum (see Rowe and Preston 1978). A sample of chopped banana tops was taken each week for DM analysis. The mean rate of liveweight gain of each animal was estimated, during an experimental period of 105 d, by the least squares method for the relationship between liveweight and time. Nine estimates of liveweight were made: initial weight, 7 periods of 14 d, and a final weighing, 7 d after the penultimate.

Results

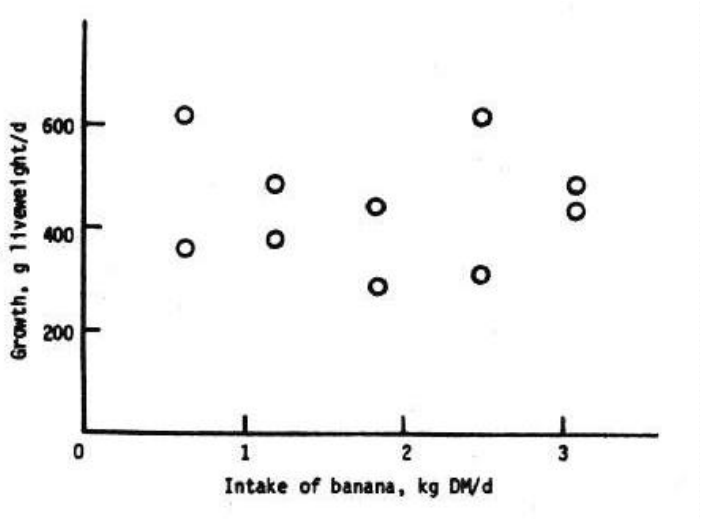
The mean daily intakes of feed of each pair of bulls is given in Table 1, and the relative intakes of molasses and banana tops (on a DM basis) are shown as histograms in Figure 1. The DM content of the molasses mixture was approximately

Figure 1:
Intake of molasses (□) and banana tops (■) (means of 2)



70% and of the banana tops was 16.1 ± 1.4% (x ± SEx) for the duration of the trial. The intake of molasses was similar at al] levels of banana intake 2.87 ± 0.14 kg DM/d, for all animals. The intake of protein was estimated from the total N content of the banana tops (x 6.25) and the nonprotein N intake was estimated from the total intake of urea (see Table 1). The mean liveweight gain of each pair of animals is given in Table 1, with estimates of the efficiency of feed utilisation for growth, and of DM intake relative to body weight. In Figure 2, the mean rate of liveweight gain of each animal is shown in relation to the mean daily consumption of banana tops for each pair of animals. No relationship was observed between the rate of liveweight gain and the

Figure 2:
Growth rates over 103 d of ten Zebu bulls given different quantities of banana tops and ad libitum access to molasses/urea



quantity of banana tops consumed. The total DM consumption increased with increase in the quantity of banana tops given, however, this was not associated with higher rates of liveweight gain. The food conversion efficiency was therefore poorer when the banana tops constituted a higher proportion of the dietary DM.

Discussion

In molasses feeling systems, a growth response is commonly observed with addition of protein to the ration (Preston 1972). The better growth rate is usually brought about by an increase in the intake of molasses and it has been hypothesised that the effect of the protein is at the level of the duodenum, leading to an increase in voluntary intake (Preston and Leng 1978). In this experiment, the range in protein intake was between 87 and 372 g/d and no differences in liveweight gain were observed. This suggests that although the intake of protein varied widely, the quantity of protein actually digested beyond the rumen remained constant over all treatments.

Experiments on the rate of degradation of banana tops in the rumen of animals given a variety of rations have shown that approximately 40% of the DM disappears from dacron bags suspended in the rumen during 24 hr (Bobadilla and Rowe 1979). It is therefore likely that not all of the protein in the banana tops was degraded in the rumen and that a significant proportion passed undegraded to the duodenum. However, it is possible that proteins passing undegraded from the rumen are subsequently unavailable for absorption from the intestine because the same characteristics that prevent their total fermentation by bacteria are also effective against acid digestion post-ruminally.

The apparent lack of response in liveweight gain to increasing levels of DM intake observed in this experiment may be due to a decrease in the digestibility of the ration at higher levels of intake, and, in addition, there is the possibility that the efficiency of rumen function could be reduced when large quantities of a slowly digestible fibre

were consumed Because of the wide range in the feed conversion rate (7.1 to 13.0 kg feed/ kg gain) in animals growing at approximately the same rate, it is tempting to speculate as to the reasons for the increasing inefficiency at the higher levels of banana intake. When increasing amounts of a slowly digestible fibre are consumed the pool size of rumen DM will increase, and this will probably be associated with a decrease in the size of the rumen fluid pool. This would result in a shift in the partitioning of the microbial population, towards a higher proportion being associated with the "fibre fraction" in the rumen, either through more organisms using this fraction as substrate or through the increased physical, filter-like effect, restricting the free movement of small particles and microorganisms in the liquid phase. Since the turnover rate of the fibre-DM fraction of the rumen contents is very much slower than that of the fluid fraction, this shift would have the effect of reducing the effective turnover rate of the microbial population.

Reduced efficiency of microbial protein yield at slower turnover rates has been well documented (see Stouthamer and Bettenhausen 1973; Isaaceon et al 1975). In addition to this, it is possible that a longer mean retention time of micro-organisms in the rumen may select for organisms specialising in the secondary fermentation of rumen VFA (Rowe et al 1979). Both inefficiency of microbial protein yield and the occurrence of secondary fermentation in the rumen would contribute to the reduced efficiency of feed utilization for liveweight gain that was observed in this experiment for the animals consuming the higher levels of banana tops.

The effects of the type of tropical forage and the quantity given, on the DM content of the rumen and on the efficiency of microbial protein yield, are at present being studied in these laboratories.

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