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GREEN BANANA SUPPLEMENTATION FOR CATTLE
II. EFFECT OF ON THE INTAKE OF SUGARCAENE TOPS[1]

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18 dairy heifers were used to determine the variation in the intake of sugarcane tops as a result of a green banana supplementation. These animals averaged two years and 210 kg of age and weight, respectively. The levels of banana studied were 0, 0.394, 0.800, 1,200, 1,560. and 1.976 kg DM/100 kg LW/day, which in turn represented 0, 14.9, 27.3, 42.9, 51.8 and 63.8% of total dry matter intake, respectively. Additionally, the animals consumed sugarcane tops ad libitum and a meat meal and urea supplement (40:60) in varying quantities to make rations isoproteic (325 g CP/100 kg LW/day). Animals were distributed at random among the six treatments and intake results were analysed by regression. Total dry matter intake averaged 2.88 kg, varying between 2.64 and 3.09 kg/100 kg LW/day, with no defined tendency as to the level of supplementary banana. On the other hand, the intake of sugarcane tops (Y) in function of the level of supplementary banana (X_1) was described by the equation $Y = 2.377 - 0.841\ X_1$ ($r^2 = 0.96$, $P \leq 0.01$). Of the functions tested to predict the intake of sugarcane tops based on rumen degradation of the same forage, the highest reliability ($r^2 = 0.94$) was attained when using the digestion acceleration rate of the cell wall constituents.

Key Words: Sugarcane tops, green banana, intake, digestion rate, intake prediction

Energy supplements habe been shown to have substitutive effect on forage intake (Beaudouin 1968; Lamb and Eadie 1979; Villegas 1979), this being most marked in hight-quality forages (Campling and Murdoch 1966; Leaver 1973). However, with medium-quality forage (Ruiz and Aragón 1979) and low quality forage (Elliot 1967; Fick et al 1973), small quantities of energy and/or protein supplement may promote intake, stimulating growth and the cellulolytic activity of rumen bacteria.

In a previous study, San Martín et al (1983) observed that when the supplementary banana represented more than 21.6% of the rations based on sugarcane tops, this has a deleterious effect on the rumen degradation rate of the cell wall constituents of sugarcane tops. On the other hand, Gill et al (1969) and Demarquilly and Chenost (1969) point out that the parameters of rumen digestion may be utilized to adequately predict forage intake; nevertheless, this proposition is not supported by the data of Pezo et al (1977) nor by D R Metens, cited by Van Soest (1982). Consequently, the present study was conducted to observe what are the repercussions of a drop in sugarcane top digestibi-

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lity caused by supplementing green banana on intake and to explore the possibility of predicting the intake of sugarcane tops based on the digestion parameters of the fibrous fraction of this forage.

Materials and Methods

Animals and their management: 18 dairy heifers of the Criollo and Jersey breeds, Criollo/Jersey crossbreeds (F_1) and Ayrshire Crossbreeds x F_1, averaging two years of age and 210 kg weight were used. The animals were confined in groups of three, in corrals with a 32 m^2 area. Before beginning the experiment, the heifers were dewormed, sprayed and given doses of vitamins A, D and E.

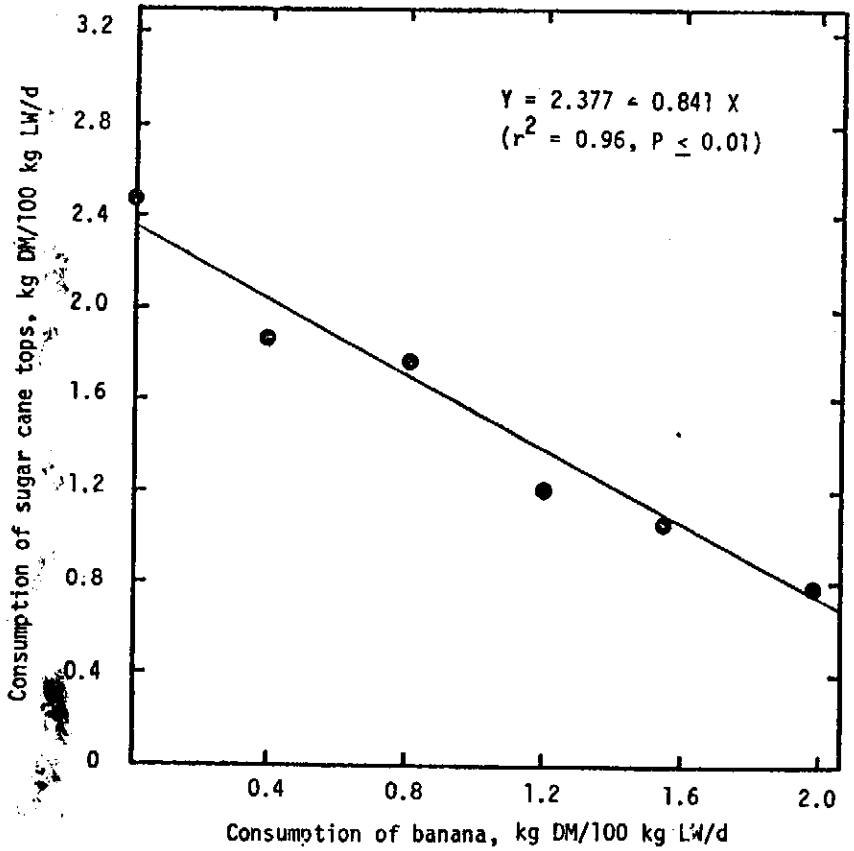
Animal feeding: The heifers were fed sugarcane tops (*Sacharum officinarum*) ad libitum, waste green bananas at varying levels according to the treatments studied, and a protein supplement in which the meat meal and the urea represented 40 and 60 percent of the nitrogen, respectively. Additionally, a minimal quantity of molasses was given as the protein supplement vehicle. The amount of meat meal and urea offered to each experimental group was variable, as efforts were made to maintain a constant intake of crude protein in all the treatments (325 g/100 kg LW/day). The energy supplement (green banana) was offered once a day, together with the protein supplement, the latter mixed with 4 kg of sugarcane tops to allow for the simultaneous intake of the supplement by the three animals in each group, with minimal competition. Once consumed, an additional quantity of sugarcane tops was distributed between two meals, to insure an amount remaining in the feeder equivalent to 15% of the forage intake. Sugarcane tops were offered cut, the size of particles being 3 - 5 cm. Furthermore, all animals were given water and mineralised salt blocks ad libitum.

Phases of the intake trial: The voluntary intake trial consisted of a pre-experimental phase and one of data collection. The 30 day pre experimental phase sought to adapt animals to consume different components of the rations. This phase was considered concluded when all groups had consumed the entire protein supplement and the green banana assigned to each treatment. Furthermore, the criteria exercised was that intake of sugarcane tops tended to become constant. During the 11 day data collection phase the given quantities and residues of sugarcane tops were weighed, and intake estimated by difference.

Treatments: The supplementary green banana levels studied were 0.0, 0.39, 0.80, 1.20, 1.57 and 1.98 kg DM/100 kg LW/day, which in turn corresponded to 0.0, 14.9, 27.3, 42.9, 51.8 and 63.8% of the total dry matter intake, respectively. The animals were distributed at random among the different treatments. The data on total dry matter intake and sugarcane top intake was analysed by linear regression models.

Intake prediction in function of the digestion parameters: Different non-linear regression models were tested to predict the intake of sugarcane tops dry matter, in function of the acceleration rate (Z_1) and the mean digestion time (Z_2) of the cell wall constituents. The

Figure 1:
Consumption of cane tops (Y) in function of the level of supplementary green banana (X)



magnitude of these digestion parameters, for the levels of supplementary banana (X), was estimated by using the equations:

$$Z_1 = 0.20 - 0.59_e^{-98.05/X} \quad y \quad Z_2 = 25.8 + 17133.0_e^{-394.6/X}$$

which had been developed by San Martín et al (1983).

Results

Sugarcane tops intake: Sugarcane top is a highly palatable forage for cattle, judging from the intake level attained by the animals that did not recive supplementary banana (2.49 kg DM/100 kg LW/day). Adding increasing levels of green banana to the rations caused a linear drop in the intake of sugarcane tops, the substitution rate of the sugarcane tops per kilogram of green banana offered (both expressed in terms of terms of DM), as shown in Figure 1.

Total dry matter intake: Contrary to what was observed with sugar cane top intake, no important changes were detected in the total dry matter intake, as presented in Table 1. This intake averaged 2.89 kg/ 100 kg LW/day.

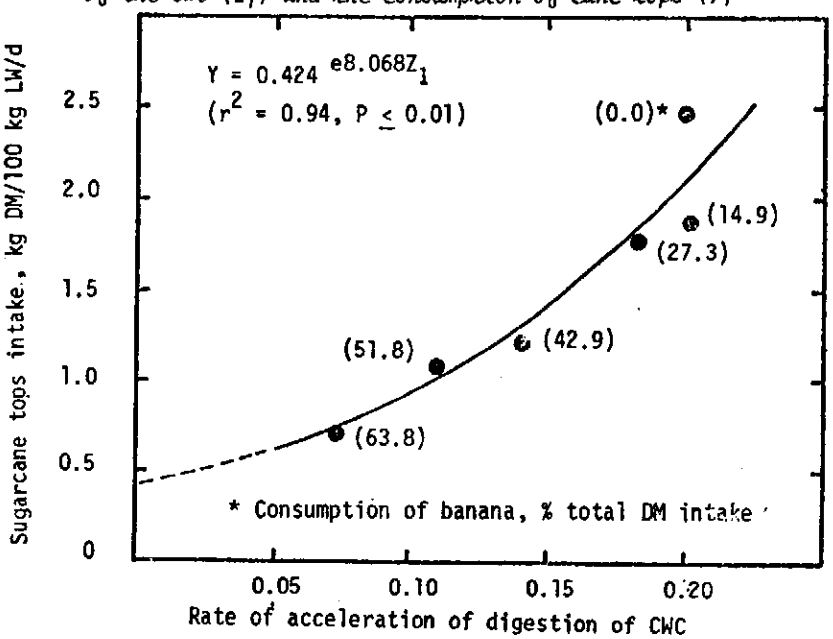
Table 1:

Total dry matter intake in function of the level of supplementary green banana kg DM/100 kg PV/day

Banana intake	Total dry matter intake
0.000	2.853
0.394	2.643
0.800	2.926
1.200	2.796
1.556	3.001
1.976	3.095

Figure 2:

Relationship between the rate of acceleration of digestion of the CWC (Z_1) and the consumption of cane tops (Y)

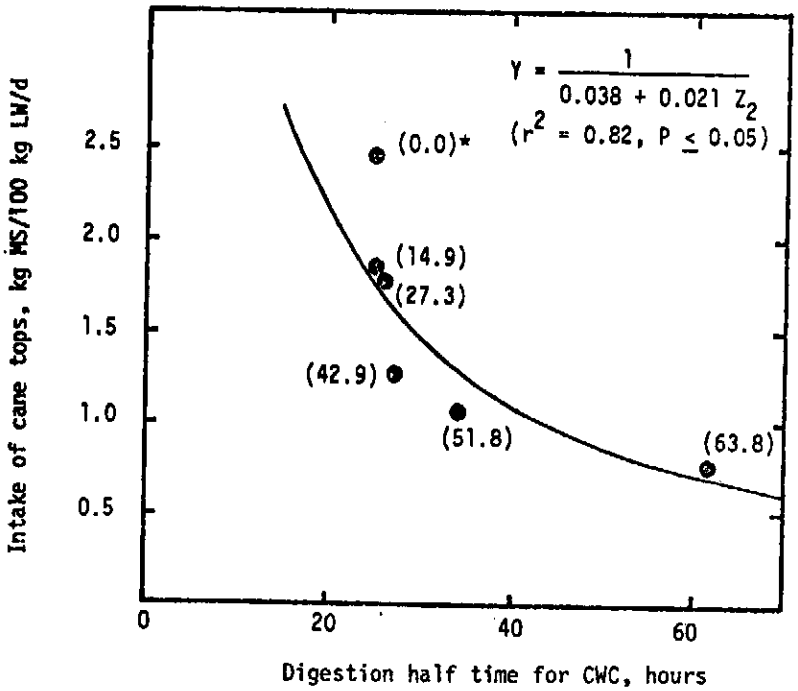


Relationships between digestion and intake parameters: Figure 2 illustrates how the intake of sugarcane top (Y) increases exponentially, as the degradation rate of the fibrous fraction of the sugarcane top (Z_1) gains speed. The function which best described this relationship was:

$$Y = 0.424\ e^{\ 8.068Z_1} \quad (r^2 = 0.94,\ P \leq 0.01)$$

Figure 3:

Relationship between the digestion half time of the cell wall constituents (Z_2) and the intake of cane tops (Y).



On the other hand, Figure 3 shows that there is an inverse relationship between the intake of sugarcane top (Y) and the mean digestion time of the CWC of this forage (Z_2). The following equation describes this relationship:

$$Y = \frac{1}{0.038 + 0.21Z_2} \quad (r^2 = 0.82,\ P \leq 0.05).$$

When the supplementary banana represented less than 14.9% of the ration certain discrepancies were detected between the intake values of the sugarcane tops estimated from forage digestion parameters, and those observed(Figures 2 and 3).

Discussion

Sugarcane tops constitute a valuable forage resource for cattle feeding, not only because of its digestibility (Ruiz and Aragón 1979; San Martín et al 1983) but also because of the intake level shown in the present study (2.49 kg DM/100 kg LW/day) and in other studies previously conducted (Armendáriz 1976; Ruiz and Aragón 1979).

The substitutive effect of the banana on sugarcane top intake observed in the present work, coincides with that found by other authors relative to the action that energy supplements have on forage, both in

the temperate zones (Campling and Murdoch 1966; Tayler and Wilkinson 1972; Leaver 1973) as well as in the tropics (Beaudouin 1968; Ruiz and Aragón 1979; Villegas 1979). However, apparently the magnitude of the forage substitution rate for energy supplements depends on the quality of the forage given (Blaxter et al 1961; Leaver 1973). In this sense, the substitution rate attained in this study (0.84 kg DM of forage/kg DM of banana) is similar to that obtained by Forbes et al (1966) and Taylor and Wilkinson (1972) in temperate zone forages, using cereals as an energy supplement. On the other hand, the additive effect on forage intake detected by Chenost et al (1976), when using banana levels lower than 20% of the ration, was not observed in this present study. Perhaps it was logical to expect the attainment of a performance similar to that indicated by said authors, as the data from San Martín et al (1983) show that sugarcane tops digestibility is not affected by banana levels lower than 21.6% of the ration.

With the data presently available it is difficult to stipulate what mechanisms are functioning as regulators of the total dry matter intake as this ramained practivally constant, althought it was expected to decrease as the level of the banana in the ration increased, be it because of a greater production of the propionic acid observed in diets rich in starch (Sutton 1979), which is know to have a deleterious effect on intake (Forbes, 1980), or because in high-caloric density diets the animal tends to reduce its dry matter intake, so that the energy intake does not exceed the demand (Van Soest 1982). As for the first hypothesis, there is no direct evidence from this work regarding the production of propionic acid, as the volatile fatty acids generated at the rumen level were not measured. Regarding the second hypothesis, however, the contribution of digestible energy resulting from sugarcane tops is know to be lower than that contribute when higher banana levels were used, both because of the lesser intake as well as due to a drop in digestibility (San Martín et al 1983). High levels of banana probably reduce the degradation of the banana either due to a greater rate of passage of same or because of an incomplete hydrolisis of the starch in the intestines (Little et al 1968).

The results emphasize the need to exersize preacution in the use of green banana as an energy supplement in cattle rations based on sugarcane tops, due to the fact that when the banana represents more than 21.6% of the ration, this not only has a substitutive effect on forage intake, but also a deleterious effect on rumen degradation of same and, consequently, on the quantity of digestible energy the animal may derive from forages.

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