SISAL BY-PRODUCTS AS CATTLE FEED: EFFECT OF SUPPLEMENTING ENSILED PULP WITH RICE POLISHINGS AND RAMON (BROSIMUM ALICASTRUM) ON GROWTH RATE, DIGESTIBILITY AND GLUCOSE ENTRY RATE BY CATTLE[1]

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Two groups of four Brown Swiss x Zebu bulls of initially about 180 kg were used to evaluate effect of supplementation of ensiled sisal pulp (plus urea and minerals) with 1 4 /d rice polishings; ramon (Brosimum alicastrum) forage at 2% of liveweight; or both supplements together. The experiment was split into two periods of 45 d. In each period one group of animals was used to measure digestibility according to a Latin square design (11 d periods, collection the last 5 d) and the other group to measure growth (one animal/treatment). After 45 d, the groups were changed over. There was no effect of supplementation on the voluntary intake of sisal pulp silage. Therefore total DM intake was increased due to the contribution of rice polishings and/or ramon forage. Liveweight gain (LWG) reflected DM intake (DMI). Dry matter digestibility (DMD) and glucose entry rates both tended to be increased by supplementation. Results for the ensiled pulp alone; with rice polishings; with ramon or with rice polishings and ramon were (± SEx): sisal pulp intake (fresh silage) 16.2, 16.0 15.2 and 15.8 ± 1.2 kg/d. DMI (total) 3.7 4 6, 50 and 6.1 ± 0.22 kg/d; DMD 54.7, 62.6, 60.1 and 64.3 ± 3.5% glucose entry rate (one observation/diet) 60, 140, 130 and 160 mg/min.

Key Words: Sisal pulp, supplementation, digestibility, glucose entry, cattle

An experimental programme is in progress at this Centre to examine the constraints to animal performance on a basal diet of sisal (or henequen) pulp. The pulp represents a refinement on the traditional sisal bagasse in that some of the shorter fibres are removed when the juice is pressed out to extract various steroids (Cordemex 1977).

Digestibility trials with the fresh pulp supplemented with urea were reported for sheep by Yerena et al (1978); dry matter (DM) digestibility was 64% compared with 49% for the traditional bagasse. Voluntary intake on both feeds (supplemented only with urea and minerals) was much lower than that on other natural forages.

In studies with cattle, Ferreiro et al (1978) found that there was greater voluntary DM intake when the fresh sisal pulp (containing urea) was supplemented with a protein-rich concentrate and with pasture. Increases in the rates of rumen fluid turnover and flow were also observed. The response in these appeared to be additive when both supplements were given together.

In these early trials with sisal pulp, it was fed fresh as the experimental facilities in each case were situated close to the factory producing the product. For the

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experiment described in this paper, the fresh pulp was ensiled in a bunker silo without additives. This was necessary because the Veterinary School, where the trial was carried out, is situated some 60 km from the sisal processing factory. It was therefore impossible to secure fresh pulp on a daily basis and resort was made to ensiling in order to provide a uniform product. It has since been shown (Godoy et al 1979) that the ensiling process results in the partial fermentation of the soluble sugars (normally present in the pulp at about 12% of DM) to end-products such as organic acids and alcohol, Although these fermentation end-products are metabolizable, they are not efficiently used for microbial synthesis in the rumen and since this is the main source of protein for animals given diets based on by-products such as sisal, this pre-fermentation may result in a decrease in the nutritive value of the feed.

Materials and Methods

Treatments, Design and Animals: Eight Brown Swiss x Zebu steers with a mean initial weight of 184 kg were arranged in a 2 x 2 factorial design with 2 replications (individual animals) of the following treatments:

(A) ensiled sisal pulp supplemented with urea
(B) the same basal diet (A), but with I kg/d rice polishings
(C) the same basal diet (A), but with ramon forage (Brosimum alicastrum) at the rate of 2% liveweight (fresh basis)
(D) the combination of treatments (B) and (C).

Procedure: The sisal pulp was obtained from the pilot processing factory of Cordemex at Ixil, Yucatan, and taken by truck to the Veterinary School where it was ensiled in a bunker silo, No additives were used and, as shown by Godoy et al (1979), this almost certainly resulted in the conversion of about half of the sugars to volatile acids and alcohol. At the time of feeding, an aqueous solution of urea was added to the pulp to provide 3.5 g urea/ kg fresh pulp. In addition, each animal received 60 g/d of a mixture of salt and essential minerals. The rice polishings contained approximately 40% starch, 12% protein and 12% lipid. The ramon forage consisted of the leaves and small twigs cut from the branches of the tree, and it contained 44% DM and 4.7% N in the DM. The sisal pulp/urea was fed ad libitum and the supplements were given as a single feed in the morning before placing the sisal pulp in the feed troughs.

The experiment, which lasted 90 d, was divided into two parts of 45 d each. During the first period, 4 animals (representing one replicate) were kept in metabolism cages to measure the digestibility of each of the four rations, in a Latin square type of design. Faeces were collected over the last 5 d of each 11 d period. The other replicate group of animals were weighed every 14 d to estimate growth rate. During the subsequent 45 d, the two replicate groups were interchanged and the same measurements repeated.

At the end of the experiment, glucose entry rates were measured on the 4 animals (one on each diet) that were in the metabolism cages. The procedure was that described by Ravelo et al (1978).

Results and Discussion

The estimations of digestibility and of voluntary intake corresponding to the "digestibility" period are shown in Table 1, together with the glucose entry rates estimated in one animal on each of the diets, Table 2 shows the growth rates, feed intakes and feed conversion ratios for all the animals during the whole experimental period.

Table 1:
Mean values for voluntary intake and DM digestibility in Zebu bulls fed ensiled sisal pulp/urea and supplements of rice polishings and/of ramon forage

	Sisal pulp/urea and:				SEx (P)[1]
	No supplement	Rice polishings	Ramon forage	Ramon and rice polishings	
Intake, kg/d					
Fresh pulp	15.0	16.1	13.8	14.5	
Total DM	3.44	4.60	4.81	5.67	
DM digestibility, %	54.7	62.6	60.1	64.3	±3.5(.35)
Consumption index[2]	1.99	2.59	2.48	3.08	±.17(.01)
Glucose entry rate,mg	60	140	130	160	

[1] Probability of F test in analysis of variance
[2] kg DM/100 kg LW/d

Table 2
Mean values for liveweight (LW) change, feed intake and conversion of Zebu bulls fed ensiled sisal pulp/urea and supplements of rice polishings and/or ramon forage

	Sisal pulp/urea and:				SEx (P)[1]
	No supplement	Rice polishings	Ramon forage	Ramon and rice polishings	
Initial LW, kg	164	167	130	156	
LW gain, g/d	99	271	282	460	±65(.07)
Feed intake (fresh wt), kg/d					
Sisal pulp	16.2	16.0	15.2	15.8	±12(.75)
Urea	.057	.056	.053	.055	
Ramon	-	-	3.6	3.56	
Rice polishings	-	1.0	-	1.0	
Total DM	3.69	4.56	5.03	6.05	±.22(.01)
Consumption index[2]	2.04	2.63	2.31	2.97	±.11(.02)
Conversion[3]	37	17	18	13	± 20(.37)
Glucose entry rate,mg/min	60	140	130	160	

[1] Probability of F test in analysis of variance
[2] kg DM/100 kg LW/d
[3] DM intake /gain in LW

The coefficient for DM digestibility on the sisal pulp supplemented with urea was 9 units less (55%) than the value reported for sheep by Yerena et al (1978). The voluntary consumption index was significantly improved by supplementation with rice polishings and with ramon forage, when these were given separately. There was also an indication of an additive effect on intake when both supplements were given together. Digestibility coefficients (62-64%) appeared to be higher when the supplements were given, as compared with sisal pulp alone (55%). Although it was not possible to apply statistical analysis to the-data for glucose entry rate, the differences were of such a magnitude as to indicate that this parameter was higher when the rice polishings or ramon forage were given, than when sisal pulp/urea was fed alone.

It is probable that the overall growth rate, determined in this experiment, was negatively affected, since the animals spent an extended time in metabolism cages. Therefore, it is suggested that the differences due to treatments are more important than the absolute values achieved.

The rate of liveweight gain was significantly faster when rice polishings or ramon forage were given separately as supplements to the sisal pulp/urea, when alone, barely supported maintenance (99 g/d). The growth rate when rice polishings or ramon forage were given together was significantly higher than when either one was fed separately (460 vs 271 and 282 g/d; SEx ±65).

The data for voluntary intake was similar to that for growth rates and the same pattern of differences were observed when the animals were on the digestibility trial as were seen in the feeling trial.

Conclusions

As pointed out in an earlier paper (Ferreiro et al 1978) sisal pulp, in appearance and composition, is quite similar to derinded sugar cane (Preston et al 1976), and it was hypothesized that, like derinded sugar cane feeding systems, there would be a response in animal performance to supplements providing by-pass nutrients (chiefly protein and starch).

The results of this trial, although based on a small number of animals and affected to some degree by the animals spending part of the trial in metabolism crates, appear to provide strong support for the original hypothesis. The increased voluntary intake of DM when both supplements were given is considered to indicate the advantage of by-pass protein, while the increase in glucose entry rate may show that the digestion and absorption of energy-providing nutrients post-ruminally was greater when either or both supplements were given (Preston and Leng 1979).

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