FATTENING STEERS ON A BASAL DIET OF ENSILED SISAL PULP AND MOLASSES/UREA SUPPLEMENTED WITH SUNFLOWER MEAL AND LEUCAENA FORAGE[1]

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Thirty two crossbred (Holstein and Brown Swiss with Zebu) steers of 205 kg initial liveweight were used in an experiment with a 4 x 2 factorial arrangement of treatments and with two replications to evaluate four levels of sunflower meal (400, 1000,' 1600 and 2200 g/d) and the absence or presence of fresh leucaena forage (22 of liveweight, fresh basis) using a basal diet of ensiled sisal pulp and molasses/urea. The urea concentration in the molasses was 10% (w/w). The mixture was given on a free choice basis as was the sisal pulp, but in separate troughs. The trial lasted 126 days.

Voluntary intake of molasses increased to a maximum of 3.5 kg/d between 30 ant 40 d after the start of the trial, then decreased steadily to 1-5 kg during the last 20 d. Average intake was 2.1 kg/d and was not affected by any of the experimental treatments. Addition of Leucaena forage causes increases in the voluntary consumption index (tally DM intake/liveweight). This was reflected in faster liveweight gain, but feet conversion rate was not changed. The sunflower meal increased both liveweight gain and feed conversion efficiency, but not the voluntary consumption index.

It is concluded that the effect of the leucaena forage was probably to stimulate more efficient rumen function, giving rise to higher voluntary intake and faster growth; and that the sunflower meal acted primarily at the post-ruminal level, in providing both protein and energy for direct-gastric digestion in the small intestine.

Key words: Cattle, sisal pulp, molasses/urea sunflower meal, leucaena forage, growth, feed conversion

The results of research carried out with ensiled sisal pulp (see review by Herrera et al 1980) suggest that three principal factors limit its utilization by ruminants. The first factor is the reduction in concentration of sugars when this material is ensiled, as a result of which it was suggested that a supplement rich in fermentable carbohydrates, such as molasses, would be a valuable additive. The second factor relates to the low level of protein in sisal pulp and therefore a need to introduce in the diet a supplement providing bypass protein. The third factor is the effect of high quality forage which appears to increase the efficiency of rumen function on sisal pulp diets (Ferreiro et al 1978) with subsequent improvements in feed intake and animal performance.

The present experiment is the first in a series aimed to test this hypothesis, and in so doing to develop a commercial feeding system using this byproduct as the basis of the diet.

The immediate objectives were to investigate the response of fattening steers to supplements providing bypass nutrients (sunflower meal) and high quality forage (leucaena) on a basal diet of ensiled sisal pulp.

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[1] *This project was financed partially by a loan from FIRA, Banco de Mexico SA, and with funds from the CONACYT Project on Sisal Byproducts*

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Materials and Methods

Treatments and design: The experimental treatments were four levels of sunflower meal (400, 1000, 1600 and 2200 g/d) and the presence or absence of Leucaena forage (2% of body weight) in a basal diet of ensiled sisal pulp and molasses/urea . The treatments were arranged as a 4 x 2 factorial with two replications and two animals in each experimental group. The experiment lasted 12 days and began in August 1976.

Animals: Thirty two crossbred steers (Zebu crossbred with Holstein or Brown Swiss) were used. The average weight at the beginning was 205 kg. The animals were treated for internal and external parasites before being allocated to the experimental treatments.

Diets: The sisal pulp was obtained from the sisal fibre extraction plants operated by Cordemex in Ixil, Sacapuc and Yaxkukul. The pulp differs from traditional sisal bagasse in that the shorter fibres are also removed together with some of the juice. The pulp was ensiled without additives in bunker silos of 5 and 7 m capacity for an average of 21 d before being fed. The sunflower meal was obtained from a local oil extraction plant (Hidrogenadora Yucateca, Merida). During the experiment three different batches were used with, respectively, 35, 24 and 30% of protein on an air dry basis. The variation in protein content was due to slight changes in the processing in the final extracted meal.

The leucaena forage was harvested daily from waste ground surrounding the experimental area. It was the native variety and had received no treatment of any kind. The molasses was from the State sugar mill Alvarez Obregon from the neighboring state of Quintana Roo. It had a density of 1.4 and was mixed with urea in the ration of 80 kg urea, 120 kg water and 450 litres (630 kg) molasses (10% urea w/w basis). The leucaena contained 31% dry matter (DM) and 20% protein in the DM.

Procedure: The sisal pulp was given in one feed trough and the molasses/ urea solution in another. Both feeds were given on a free choice basis. The sunflower meal was given as the first feed in the morning, followed by the leucaena forage and finally the daily allowance of ensiled sisal pulp. A complete mineral mixture was given at the rate of 60 g/d. There was free access to water. The animals were housed in groups of two in simple pens (3 x 8 m) partially covered and open on all sides. Half of the floor area was concreted.

Measurements: The animals were weighed et the beginning of the trial and subsequently at intervals of 14 (first 42 d) then 21 d. Rate of liveweight gain was determined by the linear regression of weight against time. Unconsumed residues of ensiled pulp were weighed daily in order to determine voluntary intake. The amounts of molasses consumed were checked every 14 d for the first 42 days of experiment, and subsequently every 21!d. At the beginning of experiment there were some refusals of leucaena forage and sunflower meal, which were also measured. Both these supplements were consumed completely after the first month of the trial.

Results

Mean values for the effects of sunflower meal and leucaena on animal performance are summarized in Table 1. The analysis of variance for the principal traits are in Table 2. Changes in the consumption of molasses during the course of the experiment are given in Figure 1. The effects of sunflower meal on rate of liveweight gain in the presence or absence of leucaena forage are shown in Figure 2.

Table 1:
Mean values for animal performance on a basal diet of ensiled sisal pulp and molasses/urea supplemented with sunflower meal and Leucaena forage.

	Sunflower meal, g/d					Leucaena forage		
	400	1000	1600	2200	SEx	Without	With	SEx
Liveweight, kg								
Daily gain	.313	.520	.544	.638	±0,40	.456	.551	±.028
Feed intake, kg/d								
Fresh ensiled pulp	12.3	10.8	9.19	.12.7	±1.46	13.1	9.34	±1.03
Molasses/urea(litres)	2.77	2.87	2.59	2.58	± .19	2.60	2.80	± .14
Total DM	5.52	5.86	5.94	7.16	± .39	5.71	6.52	± .28
Consumption index[1]	2.38	2.61	2.46	2.78	± .14	2.40	2.71	± .10
Conversion[2]	18.9	11.5	11.1	11.4	±1.79	13.6	12.8	±1.26

[1] Daily intake of, DM (kg)/100 kg liveweight/d
[2] Intake of DM/liveweight gain

Table 2:
Analysis of variance for liveweight gain, consumption of ensiled pulp, total dry matter and conversion on a basal diet of ensiled sisal pulp and molasses/urea supplemented with Leucaena forage and sunflower meal for fattening steers

Parameter	Degrees of freedom	Mean square {and probability)			
		Weight gain	Consumption of sisal pulp	DM Consumption	Conversion
Individual treatments	7	78678	15.8	1.37	26.83
Principal effects					
Leucaena (L)	1	71253 (.03)	57.0 (.05)	2.63 (.10)	2.41
Sunflower meal (S)	3	149966 (.001)	10.1	2.06 (.13)	58.15 (.07)
Linear	1	398402 (.001)	-	-	105 .80 (.04)
Quadrate	1	25538	-	-	60.84
Cubic	1	25959	-	-	7.81
L x S	3	9864	7.80	0.27	3.13
Replications	1	1081	30.80	0.39	7.29
Error	7 (23)*	12843	8.56	0.62	12.77

*Degrees of freedom for analysis of liveweight gain

Consumption of molasses: The voluntary intake of molasses (the solution with urea contained 76% molasses w/w) reached a maximum between 30 and 40 d after the start of the experiment when daily intake was almost 3.5 kg. Thereafter, consumption decreased steadily to only 1.5 kg/d during the last 20 d. The average consumption was 2.1 kg|d which represented a level of approximately 0.84% of liveweight.

Effect of leucaena forage: The inclusion of leucaena forage at a level of 2.0% of liveweight caused increases in DM intake, expressed as kg/d or as consumption index(DM intake per 100 kg liveweight) (P = .10) and decreases in the intake of ensiled sisal pulp (P =.05). The greater DM intake with leucaena led to faster growth(P = .03) but feed conversion rate was not affected (P=.67).

Effect of sunflower meat: Increasing the amount of sunflower meal in the diet also led to increases in total DM intake (P= .13) presumably because this was associated with faster liveweight gain (P=.001) and therefore increasingly heavier animals, However, voluntary consumption index (which effectively corrects for liveweight) was not changed significantly (P=.29). In contrast with the effect of leucaena forage, the sunflower meal improved significantly (P=.07) the feed conversion rate.

Discussion

Although the intake of molasses was high in the early weeks of the experiment, the overall consumption at approximately 0.84% of liveweight indicated that, as with sugar cane diets, the inclusion of urea at a relatively high concentration is a means of controlling the consumption of molasses. In trials with sugar cane, when solutions of molasses with different amounts of urea were offered, it was found that the intake of molasses decreased as the urea concentration decreased; and that at a level of 10% urea the average consumption was 0.62 and 0.68% of liveweight (Ferreiro et al 1976 and Silvestre et al 1977, respectively.)

The level of feeding of leucaena forage was based on the findings of Hulman et al (1978), who compared different levels of leucaena forage as a supplement to molasses/urea at 2.5% concentration given on a free choice basis. Animal performance was best at a feeding level of 2% of liveweight and was not increased by higher levels. This level of leucaena feeding seemed to be effective in the present diet of ensiled sisal pulp, causing a 20% increase in the rate of liveweight gain. The better growth was obviously due to greater voluntary intake and there was no improvement in feed utilization efficiency, despite the higher liveweight gain. This, together with the reduction in intake of the sisal pulp, would indicate that the site of digestion of the leucaena was principally in the rumen, and that its effect was probably to increase the efficiency of rumen function, presumably by stimulating a faster rate of turnover and flow rate out of the rumen. When leucaena was used as a supplement in sugar cane diets, rumen turnover rate and flow rate were increased (Alvarez et al 1978a). On diets of ensiled sisal pulp, Priego et al (1979) found that turnover rate and flow rate from the rumen were increased by giving Leucaena forage. Similar findings were reported by Ferreiro et al (1978) when free grazing on African star grass was used as the supplement to fresh sisal pulp.

Restricted grazing on leucaena forage led to increases in milk production when the basal diet was tropical pasture (Flores-Ramos 1979; Saucedo et al 1980). Similar findings were reported when the basal diet was sugar cane (Alvarez et al 1978b). An increase in rate of liveweight gain on a basal diet of ensiled sisal pulp was also found by Ferreiro et al (1979) when Ramon (*Brosimum alicastrum*) was the forage used.

Figure 1:
Average intake of molasses during the trial

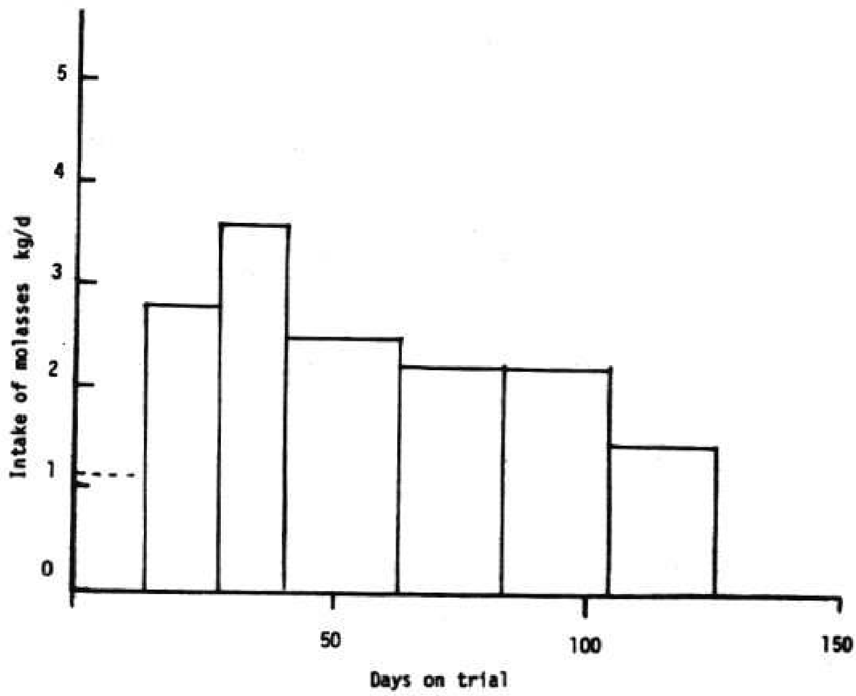
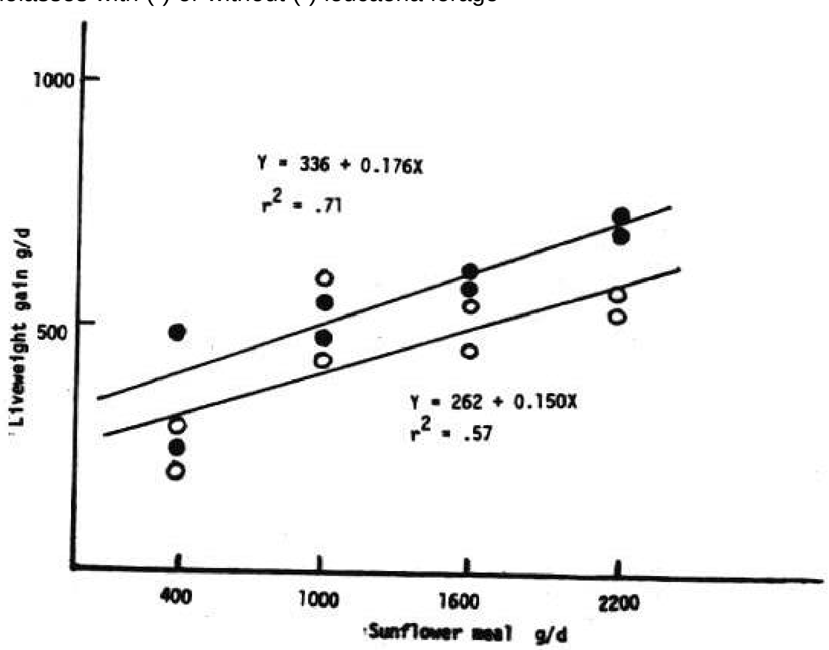


Figure 2:
Effect of sunflower meat on liveweight gain of steers given a basal diet of ensiled sisal pulp and molasses with (•) or without (◦) leucaena forage



As far as we are aware, sunflower meal has not previously been used as a supplement to low protein tropical feeds such as sisal pulp or sugar cane. The material used in this experiment was of only moderate quality (mean protein content was 30%) due apparently to quite a high rate of inclusion of husk. The effects on animal performance were slightly different to those encountered with leucaena forage in that both liveweight gain and conversion rate were improved significantly. but there was no effect on feed intake. This kind of response is typical of what is normally observed with the feeding of a supplement which makes energy available post rumen (Preston and Leng 1979). It is therefore concluded that, because the supplement did not increase voluntary intake, then the protein status of the animal was not the limiting factor (the basic level of 400 g/d sunflower meal would provide 120 g/d of protein) and the effect of the sunflower meal was probably to increase the energy status of the overall diet.

Conclusions

The results of this experiment can be interpreted as lending support to the original hypothesis that animal performance on ensiled sisal pulp is limited because this basic feed does not have sufficient roughage characteristics for efficient rumen function, and even when such forage is provided, the diet still requires to be supplemented with nutrients which provide both protein and energy at a post rumen level.

The sunflower meal increased liveweight gain and feed conversion without reducing voluntary intake of pulp and thus its effect is primarily at the level of the duodenum. In comparison, the fact that leucaena forage increased liveweight gain as a result of greater feed intake , but without concomitant increase in feed efficiency, is considered to be evidence that its effect is at the level of the rumen.

The inclusion of urea at the level of 10% of molasses is a way of controlling the consumption of this feed to the point where it represents about 30 to 40% of the total DM intake,

Acknowledgements

We are grateful to the Agricultural Development Division of the Bank of Mexico (FIRA, Banco de Mexico) and to CONACYT for the financial support, which made it possible to carry out this experiment, The sisal pulp was given by Cordemex 9A, Yucatan and we acknowledge their support and interest in this work.

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Received 28 December 1979