ANIMAL PERFORMANCE ON ENSILED SUGAR CANE[1]

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In a 56 day trial with 18 Zebu steers, growth rate and feed consumption were determined on rations based on: (A) fresh sugar cane; (B) sugar cane ensiled without additives: and (C) ensiled with 2% of a 2:1 (v/v) solution of molasses/ammonia (28% NH_3). Lactic in DM was 4.4% in Band 6.3% in C. Each diet was made isonitrogenous by edition of urea and fed free choice with and without 0.5 kg/d of rice polishings in a 3 x 2 factorial design with 3 replications (individually penned animals). Live weight was only maintained on all the diets without rice polishings but gains were (A) 381, (B) 327 and (C) 446 g/d when rice polishings were present. Growth differences between silage treatments were not significant. In a double change over design with diets A and C with two steers fitted with rumen cannulas, pH of rumen fluid was not affected by treatment but the ensiled sugar cane gave significant lower propionate and higher acetate proportions.

Key words: sugar cane, cattle, ensiling, rumen fermentation

Chopped whole sugar cane has been successfully used as the basis of complete rations and as a supplement during the dry season. At this time of year, sugar cane reaches its maximum nutritive value (Banda and Valdez 1976; Alvarez and Preston 1976a) generally coinciding with the time of lowest pasture production. In some tropical areas, however, there can be difficulties in grazing during the wet season, and sugar cane silage prepared in the dry season might afford a solution to such problems. With sugar cane there is also the possibility of increasing the nutritive value due to microbial synthesis during the ensiling process.

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James(1973) reported low consumption and poorer animal performance with ensiled derinded sugar cane, probably due to a high acetic acid and alcohol content. The use of various additives (e.g. molasses/ammonia in the ensiling of maize (Henderson et al 1971) has been studied extensively and has been shown to improve animal performance. Comparing various additives in the preparation of laboratory silos made with sugar cane, Preston et al (1976) reported that molasses mixed with ammonia reduced alcohol production and loss of sugars. Alvarez and Preston (1976 b) found that the level of ammonia which gave the highest lactic production in ensiled sugar cane was equivalent to 1.6 g N (as NH_3)/kg of fresh cane. Ravelo and Preston (1974) reported similar findings in terms of improved chemical parameters for sugar cane ensiled with ammonia.

The objective of the present experiment was to measure animal performance on sugar cane ensiled alone or with molasses/ammonia in comparison with the fresh material.

Material and Methods

Silages:

These were prepared in 4 bunker silos each of 10 tons capacity made from wood and lined with plastic sheet They were filled with chopped whole sugar cane (variety POJ 2878; 14 months old) using a forage chopper modified so that solutions of additives could be introduced into the chopping chamber. Two silos were prepared with chopped sugar cane without additives and two with the inclusion of 2% of a molasses/ ammonia mixture (33% aqueous ammonia (28%NH_3): 67% of molasses of 80°Brix).

The silages were sampled at different depths for determination of lactic and acetic acids by gas chromatography (Gonzalez and MacLeod 1976).

Experiment 1: Growth trial

Animals: 18 Zebu bulls, 18 months old of average weight 300 kg, were housed in individual corrals with a palm roof and a concrete floor and separate troughs for forage, water and minerals.

Treatments and Design: 6 animals were allotted to each of the following principal treatments which formed the basis of the rations: (a) Freshly chopped sugar cane; (b) sugar cane ensiled without additives; (c)sugar cane ensiled with molasses/ammonia. Each treatment was divided into sub-treatments, with and without 0.5 kg rice polishings/animal/day. The sugar cane/silage components of the diet were fed ad libitum, after mixing with urea/molasses solutions (283 g urea 207 g water and 857 g molasses) at rates of addition of 46, 47, and 35 ml/kg of sugar cane (fresh basis) for diets A, B and C, to make the basic diets isonitrogenous. The animals had free access to a mixture of minerals (50% salt, 47% rock phosphate and 3% trace elements) and water. The sugar cane was given twice daily at 8 a.m. and 2 p.m. There was a 22 day period of adaptation and 56 days of growth trial. The animals were weighed at intervals of 14 days.

Experiment 2: Parameters of rumen fermentation

Two Brown Swiss x Zebu bulls fitted with rumen cannulas were used in a double change over design of 2 periods of 14 days, with 9 days for adaptation and 5 for sampling. The experimental treatments were fresh sugar cane or sugar cane ensiled with ammonia/molasses (treatments A and C of experiment 1) Each animal received 0.5 kg daily of rice polishings and minerals as well as the sugar cane.

Rumen samples were taken at 30 minutes interval from 9 a.m. to 1 p.m. and at hourly intervals from 1 p.m. to 5 p.m. for determination of pH. Total VFA and individual molar proportions were determined from the samples taken at 0 and 10 a.m. and at 5 p.m. The procedure for measuring VFA was that described by Gonzalez and MacLeod (1976).

Table 1 :
Mean values for changes in live weight, feed intake and conversion (3 animals per sub-treatment for 56 days)

	Fresh sugar cane		Sugar cane ensiled with			
			Ammonia		No additives	
Rice polishings, g/animal/d	0	500	0	500	0	500
Live weight, kg						
Initial	304	312	256	304	296	308
Final	306	333	300	329	296	326
Daily gain	.036	.381	.077	.446	.01	.327
Feed intake, kg/d						
Fresh cane/silage	13.1	14.7	13.5	14.9	12.0	13.5
Rice polishings	0	.5	0	.5	0	.5
Molasses	.518	.551	.406	.448	.500	.545
Urea	.171	.192	.134	.148	.165	.180
Minerals	.05	.05	.05	.05	.05	.05
Total DM	4.53	5.52	4.16	5.05	4.09	4.90
Consumption index[1]	1.48	1.71	1.40	1.60	1.38	1.55
Conversion[2]	125	14.5	54.0	11.3	409	15.0

[1]Daily intake of DM (kg)/100 kg LW [2]Intake of DM/gain in LW

Results and Discussion

There were no significant differences between the three sugar cane treatments in terms of live weight gain, dry matter consumption or consumption index (table 1). The addition of 0.5 kg rice polishings gave highly significant improvements in live weight gain and intake, as was to be expected from earlier work with sugar cane based diets (Preston et al 1976, Lopez et al 1976a). There were no interactions between type of cane and level of supplementation. Although the differences between the principal treatments (fresh or ensiled sugar cane) were not significant, there was a tendency for sugar cane ensiled with ammonia to be better than fresh sugar cane (by 16%) while sugar cane ensiled without additives was worse than fresh sugar cane by 17%. These findings differ from those reported in the Dominican Republic by Silvestre et al (1976), where sugar cane ensiled with ammonia gave inferior growth performance compared with fresh cane. these workers did not report on lactate content however it is likely that the values were lower than in the experiment described here, in view of observations that in the Dominican trials compaction was difficult due to the use of more coarsely chopped material (Silvestre R, personal communication).

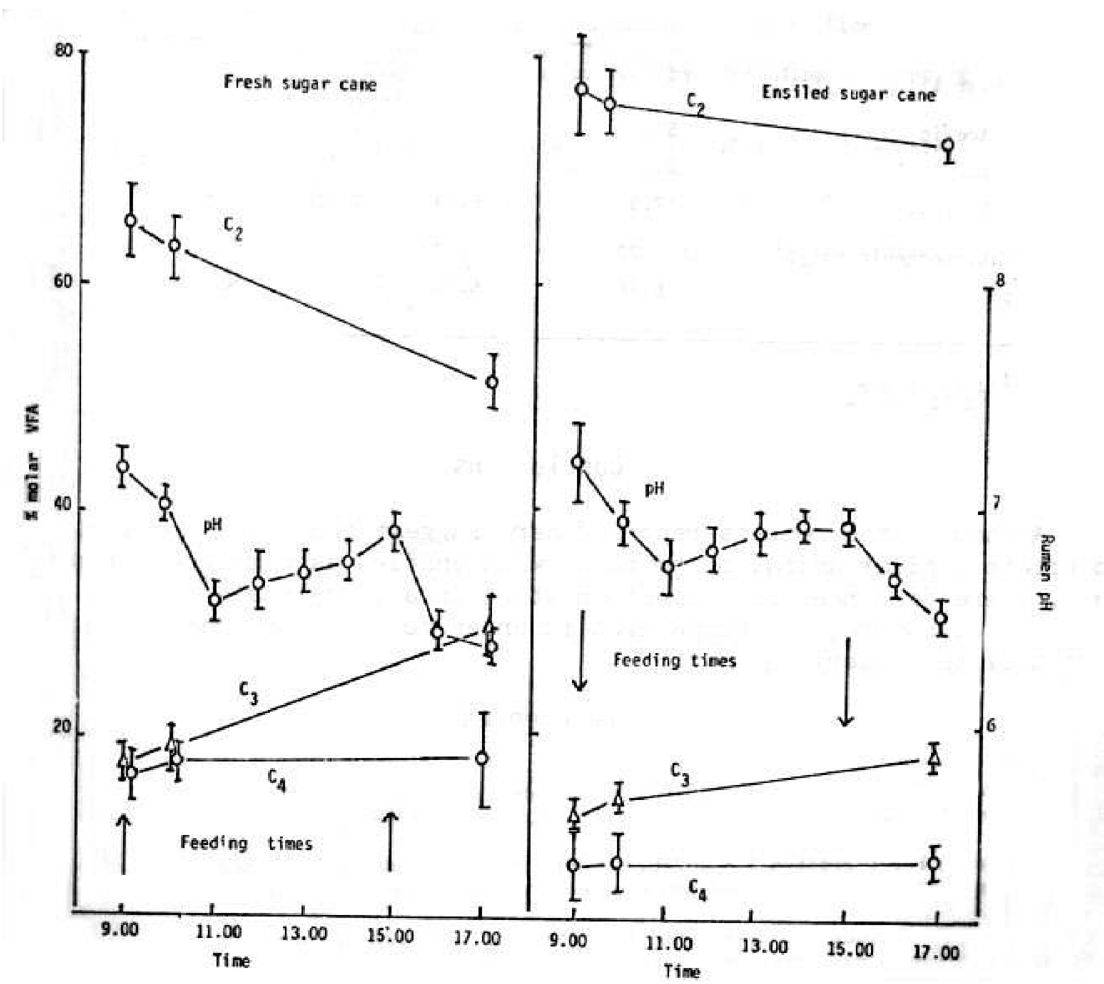
Table 2 :
Lactic and acetic acid contents of the silages at different depths in the silo

	Silages without additives	silage with ammonia/molasses	SEx
Lactic acid, % in DM			
30 cm[1]	4.80	6.76	
60	5.19	6.89	
90	2.60	5.74	
120	5.06	5.76	
Mean	4.41[a]	6.29[b]	±.48
Acetic acid, %in DM			
30 cm	1. 4	1. 8	
60	1.3	1.7	
90	.7	1.4	
120	1.5	1.7	
Mean	1.23[c]	1.65[d]	±.14

[1] Depth from floor of silo
[ab] Differ at P <.05 [cd] Differ at P <.08

Surprisingly, there was no benefit from the ensiling treatments in the absence of protein supplementation, which would tend to indicate that there was either negligible synthesis of microbial protein during the ensiling process, or that any protein which was synthesised was 100% soluble and therefore likely to be lost in the rumen. Analysis of the silages at different levels in the silos (table 2) showed considerable variation. The ammonia treated silage had a greater content of lactic (P C.03).and acetic acid (P <.08). Ratio of acetate to lactate was very uniform (0.27±.022) and independent of the presence of ammonia. The lactate content of the ammonia treated silage was within the low to middle range of that reported for maize(Klosterman et al 1960) and sorghum silage (Lopez et al 1976b),but lower than that-found in laboratory silos of sugar cane (Alvarez and Preston 1976b), probably due to difficulties experienced in compacting the silages in the rather rudimentary silos used in this experiment. Evidence of this was the fact that appreciable quantities of the tops and side of each silo had to be rejected due to putrefaction.

Figure 1:
Relation between sampling time and rumen fermentation parameters for fresh and ensiled sugar cane



The rumen fermentation on fresh and ensiled sugar cane showed no differences in pH pattern nor in total VFA, but the gluconeogenic ratio (C3/C2 + 2 C4) was higher for fresh sugar cane, due to higher proportions of propionic acid. It would therefore appear that the nutritional limitation in this experiment was not the supply of gluconeogenic precursors, unless there was a very large increase in microbial protein synthesis with the ensiled material, either during the ensiling process or in the rumen.

It is interesting that in this experiment, the use of silages containing up to 6.2% lactic acid did not cause an increase in the proportions of propionate in the rumen VFA, but rather a decrease. This would suggest that the principal metabolic fate for lactate was acetate rather than propionate.

Table 3 :
Volatile fatty acids (% molar) and pH in rumen fluid from steers fed fresh sugar cane or sugar cane ensiled with ammonia/molasses additive

	Sugar cane		SEx	Significance level
	Fresh	Ensiled		
Molar %				
Acetic	59.9	75.6	- 2.75	.001
Propionic	21.9	15.5	- 2.12	.04
Butyric	17.9	8.95	- 1.56	.001
Gluconeogenic ratio[1]	.23	.17		
pH	6.84	6.90	-.15	NS

[1] $C_3/C_2 + 2\ C_4$

Conclusions

Although the results reported here suggest that it is possible to obtain similar animal performance with ensiled as with fresh sugar cane, there is a need for experimentation on a large scale with silos which allow adequate compaction in order to secure correct preservation of the material.

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