ROCK PHOSPHATE, AMMONIUM SULPHATE AND AMMONIUM HYDROXIDE AS ADDITIVES IN THE ENSILING OF SUGAR CANE

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Mature sugar cane of 30% dry matter and 18°Brix was ensiled in plastic bags of 3 kg capacity with the following additives: a) control; b) 3% final molasses and 2% aqueous ammonium hydroxide (28%.NH_3). c) 3.2% molasses, 1.5% ammonium hydroxide and 0.5% ground rock phosphate; d) 3.1% molasses, 1.6% ammonium hydroxide and 1% phosphate; e) 3.1% molasses, 1.6% ammonium hydroxide, 0.8% water and 0.8% ammonium sulphate. There were 8 bags of each silage, 2 of which were opened for analysis at days 1, 2, 5 and 20 after ensiling. The average ambient temperature was 25°C. The initial pH in the control treatment was 5, while for the mixtures with additives it was 8.9-9.2. After 20 days, the pH for the silages with additives varied from 4.1 to 4.3 while that of the control was 3.5. The losses in°Brix during the 20 day ensiling period were 50% for the control and 8.7 to 13.0% for the silages with additives. Lactic acid varied from 2.6% of dry matter in the control, to between 4.6 and 7.2% with additives.

Key words: Sugar cane, ensilage, additives

When sugar cane is fed to cattle, it is usual to give it fresh, immediately after harvesting and chopping. There are however, two reasons in favour of conserving it in a more permanent way. One relates to the problem of fermentation which begins immediately after chopping, due principally to the growth of yeasts. This fermentation seems to be more intense when the cane is chopped finely (less than 5 mm) and when there is additional nitrogen (Gonzalez and MacLeod 1976). The second factor is the possibility of increasing the protein content of sugar cane (normally about 3% in dry matter; Banda and Valdez (1976)by means of a controlled fermentation, evidence for which was presented by Preston et al (1976).

The advantages of using ammonium hydroxide were pointed out by Alvarez et al (1976) who reported similar results to those obtained in the ensiling of maize, i.e. reduced losses of dry matter and a higher content of lactic acid (Henderson and Geasler 1970).The objective of the present experiment was to examine the effect of combinations of calcium phosphate (as ground rock phosphate) and ammonium sulphate with aqueous ammonia.

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Materials and Methods

Treatments: The treatments were different combinations of molasses, ammonium hydroxide, rock phosphate and ammonium sulphate. The mixtures used are shown in table 1. Whole sugar cane was used (30% dry matter and 18°Brix) and was finely chopped (less than 5 mm) prior to mixing with the different additives. The mixed material was then compressed in plastic bags with a capacity of 3 kg which were filled tightly so as to ensure anaerobic conditions. The silages were maintained at a temperature of 25° for up to 20 days. Two bags,were opened after periods of 1, 5 and 20 days in order to study the changes in the pattern of fermentation with time.

Table 1:
Additives used in sugar cane silage (1% by weight of fresh material)

Treatments	Sugar cane	Molasses	NH_4OH[1]	Rock phosphate	H_2O	$(NH_4)_2SO_4$
Control	100.0	-	-	-	-	-
NH_3	95.0	3.0	2.0	-	-	-
NH_3/ phosphate (.5%)	94.8	3.2	1.5	0.5	-	-
NH_3/ phosphate (1.0%)	94.3	3.1	1.6	1.0	-	-
NH_3/ $(NH_4)_2S0_4$	93.7	3.1	1.6	-	0.8	0.8

[1] Contains 28% NH_3

Measurements: The following measures were made: DM, Brix (by hand refractometer) and pH (by pH meter) of the mixtures determined before and after ensiling. Lactic acid was determined on the ensiled samples according to the following procedure: 25 g of ensiled material was mixed with 2.5 ml of saturated mercuric chloride and 22.5 ml of distilled water. This was stored at -15°C until analysed by gas chromatography using a Carle 311 gas Chromatograph.

Results and Discussion

Changes of pH, Brix and lactic acid with time are shown by figures 1-4. The proportional changes in the Brix and dry matter of the ensiled samples (to 20 days) together with the concentration of lactic acid after 20 days,are given in table 2.

All the silages with additives appeared to be better than the control in terms of lactic acid concentration and losses of sugar (Brix) and dry matter.

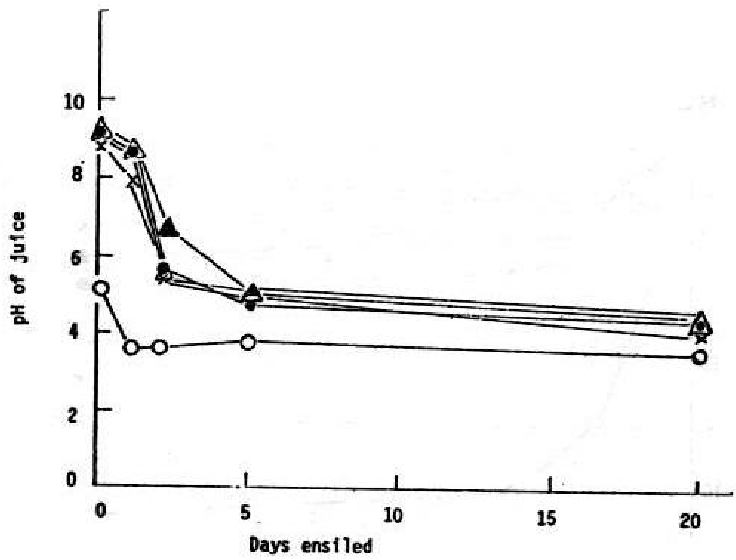

Figure 1:
Changes in pH during the ensiling period (in this and subsequent figures: ◦ control; • NH_4OH; △ NH_4OH + rock phosphate, .5%; ▲ NH_4OH + rock phosphate, 1.0%; **x** *NH_4OH + ammonium sulphate)*

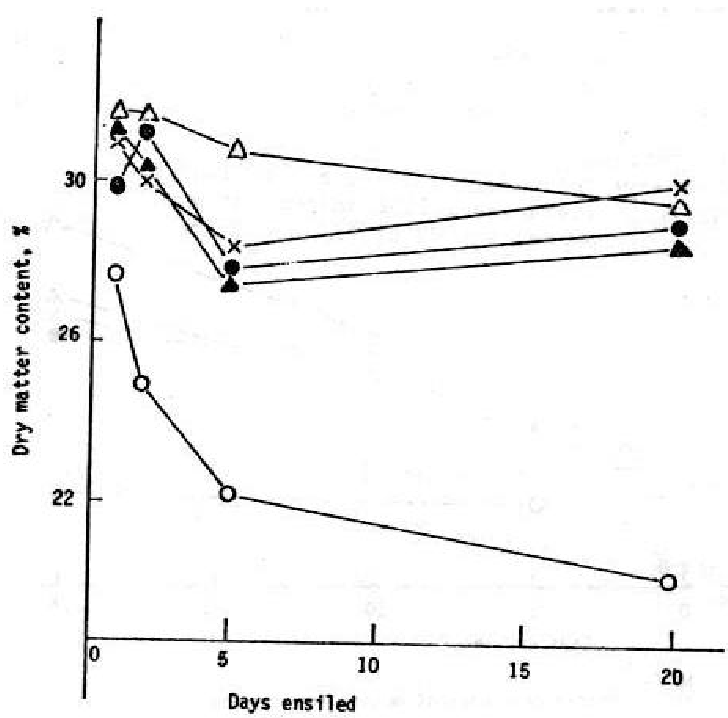

Figure 2:
Changes in dry matter content (by oven drying) during the ensiling period

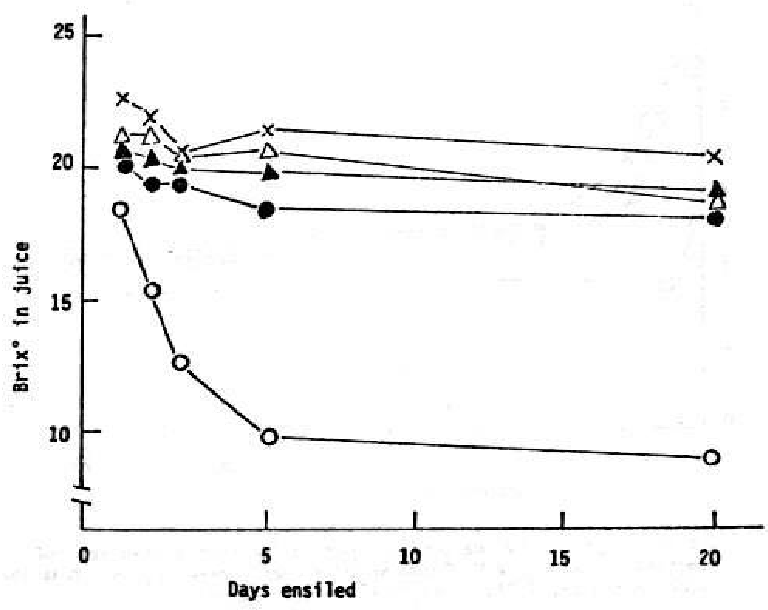

Figure 3:
Changes in Brix ° during the ensiling period

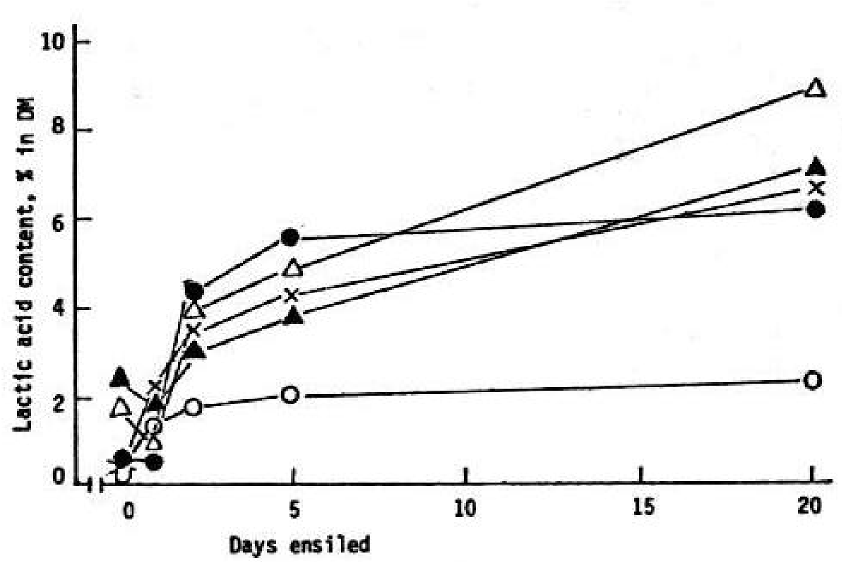

Figure 4:
Changes in lactic acid content during the ensiling period

Table 2:
Percent change (relative to unensiled material) in Brix and dry matter content: final concentration of lactic acid of the silages

	Brix	Dry Matter, %	Final concentrations of lactic acid (% DM)
Control	-51.0	-29.4	2.6
NH_3	-8.7	-2.7	6.2
NH_3/phosphate (.5%)	-13.0	-5.1	7.2
NH_3/phosphate (1.0%)	-9.6	-8.5	4.8
$NH_3/(NH_4)SO_4$	-10.6	-3 7	6.6

These advantages due to additives appear to be related to the less dramatic changes in pH during the ensiling period. The pH of the original material fell from about 5 to about 3.6 within 24 hr, remaining at this level up to 20 days. In contrast the mixtures containing additives had an initial pH in the range of 9 which fell more gradually. Up to 24 hr the pH was still close to 8 and was above 5.5 even after 48 hr. The minimum values of about 4 to 4.3 were not reached until 20 days. At all times the pH values in the silages with additives were significantly higher than those for the control silages. There appear to be no important advantages from the addition of either calcium phosphate (rock phosphate) or ammonium sulphate to the basic additives of ammonium and hydroxide and molasses. The final values for lactic acid were greater in the silages with additives than that of the control silage but were below those reported for maize ensiled with similar additives, where final lactic acid concentrations of between 10 and 12% in DM are frequently reported (Henderson and Geasler 1970).

Conclusions

It must be emphasised that these results were obtained at the laboratory level and it may be that in terms of their feeding value to cattle there could be advantages with specific additives. The results do however support the earlier finding of Preston et al (1976 and Alvarez et al (1976) that the use of ammonium hydroxide dissolved in final molasses is beneficial for the ensiling of sugar cane.

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