# SPONTANEOUS FERMENTATION OF SUGAR CANE

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## Summary

Sugar cane was prefermented either alone, with a solution of urea/molasses (100 g urea/kg) at the level of 100 g mixture/ kg fresh cane or 90 g urea/molasses solution plus 20 g ammonium sulphate/kg fresh cane. Each of these treatments was applied to whole sugar cane which had been chopped finely (less than 5 mm) or coarsely (10 to 20 mm). The mixtures were allowed to ferment in open plastic buckets for 24 hr respectively. Growth of yeast and production of alcohol were accelerated when the sugar cane was chopped finely and in the presence of urea. The initial and final pH was higher in the presence of additives and lower for the fine as opposed to coarse chopping. There was a tendency to a higher concentration of acetic acid in the presence of additives but there was no effect on this parameter attributable to the finess of chopping.

Key words: Sugarcane, fermentation

## INTRODUCTION

The procedure usually adopted in the feeding of sugar cane to cattle has been to chop the whole plant to a particle size of about 5 mm and feed this in a fresh form. Supplementation with urea has been carried out by two principal methods: (A) dissolving urea in water, or in a partially diluted solution of final molasses and then adding this to the sugar cane to make a homogeneous mixture; and (B) preparing a solution of sugar in final molasses (usually 10% concentration) and giving this on a free choice basis, with the chopped sugar cane in a separate feeder.

In contrast with almost all other feeds, sugar cane has a high content of soluble sugars and moisture. As a result, once the cane is chopped, there begins a process of spontaneous fermentation.

The objective of the experiment described here was to characterize certain aspects of this fermentation process using sugar cane alone and mixtures of sugar cane with molasses and urea.

## Materials and Methods

*Treatments and Design:*

The three principal treatments were: (A) chopped whole sugar cane without additives; (B) chopped whole sugar cane mixed with 10% of a solution of molasses/urea (100 g urea/ litre); (C) chopped whole sugar cane mixed with 10% of a solution of molasses/urea/ammonium sulphate (90 g urea and 20 g ammonium sulphate/litre). On each principal treatment there were two subtreatments consisting of coarse (particle size 10 to 20 mm) and fine chopping ( 5 mm). The design was a 3 X 2 factorial with one replication.

*Procedure:*

The different mixtures were put in open plastic buckets which were kept under cover at ambient temperature (approximately 30°). Samples were taken at 0, 24, and 48 hr and the following analyses carried out: dry matter (DM), pH, Brix, Alcohol, lactic acid, volatile fatty acids (VFA) and yeast counts.

*Analytical Methods*

The juice was squeezed from the different mixtures using a screw press and preserved with 5 drops of hydrochloric acid for each 10 ml of juice. Brix was measured directly on the juice with a hand refractometer. DM content was determined by drying in an oven at 90Q for 48 hr . For the determination of alcohol, lactic acid and VFA, a gas cromatograph (Carle Instruments) was used with a column of resoflex Lac-I-R-296.

The temperature was set at 70° for alcohol, 105° for lactic acid, and 120° for the VFA. Hydrogen was used as a carrier gas at a pressure of 2-5 lb/in for alcohol, 8 for lactic acid and 10 for VFA.

The yeasts were isolated on the following media: yeast extract (Difco), glucose, agar and distilled water (Mossel and Quevedo 1967). A solution of terramycin was added to this mixture at the 1% level (100 ml/litre of media). Dilutions were made directly from the cane juice transferring duplicate 1 ml quantities to petri dishes.

The number of colonies was counted 4 days after seeding.

**Figure 1: Production of alcohol and growth of yeast in sugarcane allowed to ferment spontaneously without additive (▲), with urea(•), or urea and $(NH_4)_2SO_4$ (○)**

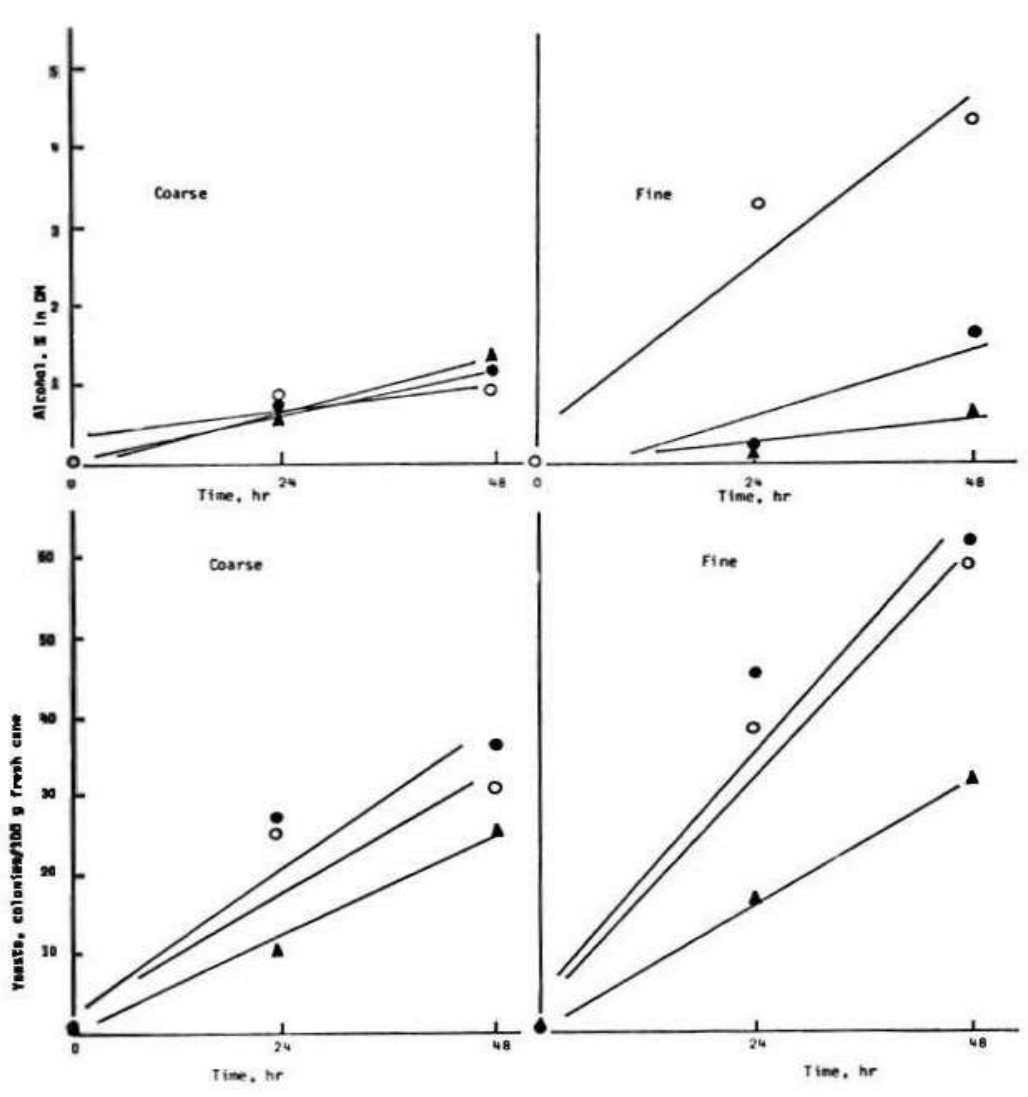

**Table 1:**
**Biochemical parameters in sugarcane fermented for 48 hr**

| | Coarse | | | Fine | | |
|---|---|---|---|---|---|---|
| | Control | Urea | Urea $(NH_4)_2SO_4$ | Control | Urea | Urea $(NH_4)_2SO_4$ |
| pH | | | | | | |
| 0 hr | 4.2 | 4.9 | 5.0 | 5.4 | 5.2 | 5.4 |
| 24 hr | 3.1 | 4.5 | 4.1 | 2.8 | 4.1 | 3.8 |
| 48 hr | 2.9 | 4.0 | 3.9 | 2.4 | 3.8 | 3.7 |
| Brix in juice | | | | | | |
| 0 hr | 13.8 | 21.8 | 21.8 | 14 | 21.5 | 19 |
| 24 hr | 12.3 | 18.0 | 18.0 | 13 | 18.2 | 16.1 |
| 48 hr | 9 | 15.5 | 17.0 | 10.5 | 13 | 11.0 |
| Yeast Count, colonies/ 100 g fresh cane | | | | | | |
| 0 hr | 0 | 0 | 0 | 0 | 0 | 0 |
| 24 hr | 10 | 27 | 25 | 15 | 45 | 38 |
| 48 hr | 25 | 36 | 30 | 31 | 61 | 59 |
| Dry matter, % | | | | | | |
| 0 hr | 23.5 | 30.0 | 29.4 | 26.0 | 29.1 | 24.0 |
| 24 hr | 21.6 | 25.0 | 24.2 | 24.6 | 25.0 | 25.1 |
| 48 hr | 22.5 | 23.5 | 22.4 | 24.8 | 24.7 | 23.5 |
| Acetic acid, %in DM | | | | | | |
| 0 hr | 0 | .06 | .23 | 0 | .16 | .02 |
| 24 hr | . 86 | .77 | 1.18 | .08 | .89 | .49 |
| 48 hr | .96 | .81 | 1.50 | .23 | 1.34 | .97 |
| Alcohol, %in DM | | | | | | |
| 0 hr | 0 | 0 | 0 | 0 | 0 | 0 |
| 24 hr | .55 | .75 | .86 | .11 | .17 | 3.30 |
| 48 hr | 1.4 | 1.14 | .89 | .61 | 1.63 | 4.28 |

**Table 2:**
**Regression coefficients (b) standard errors {Sb) and r² values relating yeast and alcohol concentration with fermentation time (hr)**

| | Control | Urea | Urea/$(NH_4)_2SO_4$ |
|---|---|---|---|
| Yeast count colonies/100 g fresh cane | | | |
| Fine | | | |
| b | .65 | 1.27 | 1.22 |
| Sb | ±.012 | ±.35 | ±.21 |
| $r^2$ | .99 | .43 | .97 |
| Coarse | | | |
| b | .52 | .75 | .63 |
| Sb | ±.060 | ±.22 | ±.24 |
| $r^2$ | .99 | .92 | .87 |
| Alcohol, %in DM | | | |
| Fine | | | |
| b | .013 | .034 | .089 |
| Sb | ±.005 | ±.016 | ±.028 |
| $r^2$ | .88 | .83 | .91 |
| Coarse | | | |
| b | .029 | .024 | 019 |
| Sb | ±.O04 | ±.004 | ± .010 |
| $r^2$ | .98 | .97 | .78 |

## Results and Discussion

The comprehensive analytical data are given in table 1. The most interesting findings were in relation to production of alcohol and yeast growth and the data of these parameters are presented graphically in figure 1 with regression coefficients in table 2. Table 3 gives mean values after 48 hr of fermentation for pH, yeasts and alcohol concentration.

**Table 3:**
**Mean values (±$SE_x$ ) and significance levels for pH and yeasts after 48 hr fermentation**

| | Particle Size | | Additive | | |
|---|---|---|---|---|---|
| | Fine | Coarse | Control | Urea | Urea/ $(NH_4)_2SO_4$ |
| pH | | | | | |
| Mean values | 3. 3 | 3.6 | 2.05 | 3.9 | 3.8 |
| $SE_x$ | ±.07 | | | ±.09 | |
| Significance level | P< .10 | | | P< .02 | |
| Yeasts, colonies/100 g fresh cane | | | | | |
| Mean values | 50.3 | 30.3 | 28 | 48.5 | 44.5 |
| $SE_x$ | ±5.0 | | | ±6.1 | |
| Significance level | P< .11 | | | P < .24 | |
| Alcohol, %in DM | | | | | |
| Mean values | 2.17 | 1.14 | 1.0 | 1.39 | 2.59 |
| $SE_x$ | ±.87 | | | ±1.07 | |
| Significance level | P<.49 | | | P <.63 | |

The most important findings relate to the growth of yeast and, as a consequence, formation of alcohol as final products of the fermentation. This process was accelerated when the cane was finely chopped and when a source of nitrogen was included (see figure 1). As was to be expected the final pH was lower with finely chopped cane and higher when urea and ammonia sulphate were included (table 3).

There was a suggestion that the presence of sulphur (as ammonia sulphate) stimulated the production of alcohol although this occurred only with finely chopped cane and was not reflected in yeast growth. The production of acetic acid tended to increase when urea or urea and ammonium sulphate were mixed with the cane, but there was no effect of chopping.

The next phase must be to investigate the effect of these biochemical changes in the fermented cane on rumen fermentation in vivo and on animal performance.

## References

Mossel D A & Quevedo 1967 Control microbiológico de los alimentos 1ra edicion Acribia:España

*Received 24 March 1976*

# ANIMAL PERFORMANCE AND RUMEN FERMENTATION WITH SUGAR CANE CHOPPED FINELY OR COARSELY

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## Summary

The treatments consisted of chopping sugar cane stalk coarsely (10 to 20 mm particle size) or finely (less than 5 mm). The chopped cane stalk was mixed with chopped cane tops ( 40 to 50 mm particle size) in the ratio 75: 25. A solution of urea/molasses (200 g urea/kg solution) was added to the cane at the rate of 50 g/kg of fresh cane. The animals also received 600 g/d cotton seed meal and 100 g/d minerals. There was one group of 3 crossbred bulls on each treatment. The experiment lasted 138 days and samples of rumen liquor were taken on two occasions during the last month. There were no significant differences in live weight gain or feed conversion due to processing although there was a suggestion that feed intake was higher with the coarse chopping. Molar percent of butyric acid was higher with fine chopping but there were no differences in acetic and propionic acid.

The results support the general finding that particle size has little effect on nutrient value and cattle performance on sugar cane based rations.

Key words: Sugarcane, particle size, cattle

## Introduction

The first studies on the use of sugar cane as the basis of a cattle fattening ration stressed the need to eliminate the less digestible rind in order to support adequate animal performance (Donefer et al 1975). However, it was shown subsequently that the advantages of removing the rind were more apparent than real, since in a large scale study with 400 cattle there were no significant differences in any aspect of animal performance on sugar cane which had been derinded or simply chopped (rind included) to a particle size of approximately 5 mm (Preston et al 1975). In this latter experiment (Preston et al 1975), emphasis was on chopping