

THE MANUFACTURE OF HIGH TEST MOLASSES AT HULETT'S MOUNT EDGECOMBE MILL

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Hulett's Mount Edgcombe Mill

At the request of The South African Sugar Association, the management of Hulett's Mount Edgcombe mill accepted the challenge to manufacture High Test Molasses (H.T.M.) for export to Japan and the United Kingdom.

In 1938 a few thousand tons of this product had been produced in a small North Coast mill using the 'Acid Inversion' technique, whereas this new contract specified the use of yeast as the inverting agent. The specifications set down by the buyers defined (i) the brix of the H.T.M. in terms of spindle brix on a 1 in 1 dilution, (ii) the maximum percentage of sucrose, (iii) the minimum percentage of total sugars (reducing sugars + sucrose), (iv) the maximum percentage of soluble non-sugars, and (v) the pH of the final product.

Plant

The "C" massecuite house, consisting of 20 crystallizers of 1,000 cu. ft. each, and 4 pans also of 1,000 cu. ft. capacity each, was made use of for the inversion and concentration of the syrup. All crystallizer doors had to be sealed, and pipes, fitted with valves, welded to the bottom of each crystallizer for discharging the inverted syrup. These pipes in turn were connected to a pump which pumped the inverted syrup to the pan supply tank. A small tank was erected above the crystallizers where the yeast slurry could be injected into the flow of syrup, and from which the syrup could be discharged into any one of 18 crystallizers by a branched system of pipes and valves. The two remaining crystallizers were isolated from the circuit to act as receivers for the final concentrated H.T.M., before being weighed through an automatic Servo Balans. Two stainless steel tanks, each fitted with a stirrer and perforated air pipes, were erected for slurring the yeast paste.

Yeast Quality and Activity

The yeast, *Saccharomyces cerevisiae*, or more commonly, Bakers Yeast, was obtained from two sources, namely Durban and Johannesburg. Only the daily requirement was ordered and the drums received were used in strict rotation so as to eliminate the possibility of deterioration. The activity of each consignment was carefully ascertained daily, by the method described later, and the quantity used per crystallizer adjusted when a fall off in activity was noted.

Manufacture

It was decided to concentrate the syrup in the evaporators to $53^{\circ} \pm 1^{\circ}$ Brix, since above 55° Brix the inversion rate falls off rather rapidly, and at too low a concentration it would not prove practical due to the increased volume of syrup, and the corresponding increase in evaporation that would be required from the pans.

The syrup was then pumped to the "C" massecuite house where 100 gallons of yeast slurry containing 85 lb. of yeast was injected into the flow of syrup per crystallizer. As it was not practical to use the cooling coils of the crystallizers as stirrers, care had to be taken to ensure a uniform addition of slurry to the syrup. To achieve this aim, the slurry tanks were calibrated to the volume of slurry to be used for each quarter of a crystallizer. The available retention time in the crystallizers could vary between $6\frac{1}{2}$ and 9 hours depending on the crushing rate of the milling tandem. Apart from the activity of the yeast, the retention time available had also to be taken into consideration when assessing the weight of yeast to be used per crystallizer. It was always the aim to over-invert the syrup in the crystallizers and then to correct for sucrose content by drawing uninverted syrup onto the inverted syrup in the pan while concentrating. The inverted syrup was drawn into the pan, concentrated to approximately 70° Brix at 700 cu. ft., and a sample from the proof stick sent to the laboratory for analysis. From the data supplied to him by the laboratory, the pan boiler would add the calculated volume of uninverted syrup and concentrate to a refractometer brix of 83.5° , each pan being boiled batch-wise.

Control

(a) Yeast Control

The activity of the yeast was determined on a 55% solution of refined sugar, adjusted to 6.0 pH with ammonium citrate, containing 1% yeast on solids, kept in a water bath at 55°C for 1 hour. The normal weight of the solution, clarified with 3 ml of lead acetate, was made up to 100 ml and polarized in a 200 mm tube. A yeast giving a reading of 15°S , representing 55% inversion, was considered acceptable. The range of activity could vary between 9°S (63% inversion) and 36°S (28% inversion).

(b) Quality Control

The sample of H.T.M. received by the laboratory from each pan was tested for (i) Reducing Sugars %

and (ii) Total Sugars, after acid inversion on a 0.5% solution by the Eynon and Lane method for Reducing Sugars, and the volume of uninverted syrup to be added to the pan to meet the specifications was calculated from a given table.

Manufacturing Results

(a) Composition of the High Test Molasses

Spindle brix (1 in 1)	85.3°
Sucrose %	21.40
Reducing Sugars %	55.03
Total Sugars %	76.43
Total Sugars as Invert %	77.56

(b) Performance Data

Tons H.T.M. produced	199,209 short tons
Total Sugars as Invert recovered	} 98.46
% Sugars as Invert received	
% uninverted syrup added to pans	} 17%
Tons H.T.M. produced per ton sucrose in clear juice	
	} 1.41

Acknowledgements

We would like to express our gratitude to Mr. J. B. Alexander, Research and Development Consultant, the members of the staff of Hulett's Research Department, and in particular Mr. V. Dawes, for their co-operation, and to the Management of Hulett's S.A. Sugar Mills & Estates Limited for allowing this paper to be presented.

Discussion

Dr. Roth: The yeast application seems very high and I wonder what solvent was used and whether the same results could not have been achieved using a lesser concentration.

Mr. Hulett: The solvent was water, about 100 gallons of water containing 85 lb. yeast. We were working blind with no previous experience and to fairly narrow specifications so we were hesitant about experimenting too much. With a particularly good

yeast we were able to cut down to 75 lb. yeast but the average was 85 lb.

Dr. Roth: As unsterilised water was used your yeast requirements would be higher because of bacteria or contaminants affecting the yeast. Sterilised water would probably allow you to use less yeast.

Mr. Alexander: I have recently met the recipients of the H.T. molasses made by Mount Edgecombe and they were completely satisfied with the product.

I do not think there is much point in using sterilised water because when the yeast solution is added to syrup at a temperature of 55°C the yeast cells will be killed almost immediately. Only the invertase in the yeast cells is being used to invert the sucrose.

Dr. Roth: Quite a number of thermophilic bacteria can live at 50°C and over, even up to 60° and if they accumulate under the right conditions they will grow on the yeast killed at 55°C as this will provide a good nutrient.

Dr. Matic (in the chair): Have you given any thought to manufacturing your own yeast?

Mr. de Broglio: As we did not know how long we would be producing H.T. molasses we did not consider manufacturing our own yeast.

Mr. Buchanan: Were other types of yeast, apart from baker's yeast, tried?

Mr. Alexander: All other available commercial yeasts were tried but the two we chose were quite the best.

Mr. de Broglio: We relied on yeast from three other sources and the quality often varied. On one particular day we were using 175 lb. per 100 gallons of water.

Mr. Francis: Was the amount of yeast used related to varying retention times?

Mr. Hulett: We had to take into account the quality of the yeast and the mill crushing rate.