Effect of Clarification on the Percentage Recovery of Sugar from Punjab Canes

TAFAZZAL HUSSAIN AND SULTAN AHMAD TREMAZI*

The effect of clarification on the percentage recovery of sugar from Panjab canes was investigated. The results obtained at 18° Baume milk of lime at various concentration are summarised.

Mixed juice had higher Brix values than that of first and second carbonation juices. On the other hand, clarified juice had usually lower Brix values than that of first carbonation. The Pol values of carbonated juices were slightly lower than that of the mixed juice. This decrease in Pol was mainly dependent on the losses of sugar in press-cake. Highest purity rise was found in case of clarified juice, whereas the maximum quantities of non-sugars were removed in case of first carbonation juice. The mixed juice had the lowest purity values. It was also observed that higher the purity value of clarified juice, the higher was the recovery of the sugar and *vice versa*.

The efficiency of clarification was affected to a large extent by the quality of juice, methods and level of liming. There was a high negative coorelation between the clarification efficiency and the production of molasses. Higher the clarification efficiency the lower was the production of molasses and greater the recovery of sugar. Lower the turbidity of clarified juice better was the clarification which was responsible for good quality and quantity of sugar. The clarification test is, therefore, helpful in evaluating the optimum results which may lead to locate the causes of poor factory clarification.

INTRODUCTION

The primary object of clarification is to remove from the juice the maximum quantity of impurities, both dissolved and suspended, which have harmful effect on the recovery of white sugar. It has been established that the amount of lime to be added to cane juices for a proper clarification had to be limited, as an excess of lime resulted in syrups and molasses of an extremely dark colour with high viscosity, causing great difficulties in the recovery of crystallized sugar. It has also been observed that the degree of clarification has great bearing on the subsequent sections of a sugar factory affecting the pan boiling, the centrifugaling, the quality of sugar and most important of all the yield of sugar.

*Department of Food Technology, West Pakistan Agricultural University, Lyallpur

The effect of double carbonation process of cane juice clarification on the percentage recovery of sugar from Punjab canes does not appear to have been studied. The present study was therefore, undertaken to find out the effect of clarification on recovery and quality of sugar. This information will be useful for sugar industry.

REVIEW OF LITERATURE

Clarke and Banerjee (1910) pointed out that the amount of crystallizable sugar obtained from massecuite was considerably influenced by the quality of the juice from which it was made. Maxwell (1931) observed that even with the best milling plant in the world and even with the aid of maceration a certain proportion of the sugar contained in the original juice was lost in bagasse. March (1956) pointed out that the screening of mill juice was a necessary technological operation to achieve different aims, such as, to avoid mechanical difficulties in the handling of juice as clogging up of valves, pumps and juice heaters. Honig (1953) stated that the total amounts of potassium and sodium in juice had a specific significance for the yield of recoverable sugar.

Lander and Chopra (1942) concluded that higher mineral matter in the Punjab canes was the main cause of low recovery of white sugar from them. Ochoa (1953) pointed out that good design of lime feeder, best system and way of liming, circular movement in the clarifier, reasonbale time of reaction between lime and cane juice as well as regular flow of juice into the liming tank were essential for good clarification. Prasad and Agarwal (1952) established that clarification factor was generally used for ascertaining the efficiency of clarification house. Higher the value of clarification factor, the better was the efficiency of clarification and hence better recovery of sugar. Ramaiah and Sharma (1960) recorded that the salt content of the clarified juice was responsible for the problem of scaling in evaporator tubes, low exhaustibility of molasses, and low recovery of sugar. Ramaiah and Agarwal (1960) pointed out that caramelisation of sugars affected markedly the colour of the crystals and was also known to retard the rate of crystalization of sucrose. Ansari (1964) observed that for fresh, ripe and mature canes lower value of pH gave good clarification and brilliantly defecated juice while for unripe, stale, over-ripe and diseased canes higher pH value would give good clarification. Delfin (1964) established that the clarification of cane juice was improved by adding to it, prior to adding other clarifying chemicals, at least 0.5 p.p.m. of a fluid organo-siloxane polymer in the form of an aqueous emulsion admixed with silica.

Phansalkar and Bhattacharya (1960) observed that in modern sugar factories great attention was paid to the boiling of C-massecuites in order to secure maximum extraction of sugar. Athenstedt (1965) stated that in

low-grade curing using B.M.A.K. 1000 continuous centrifugals output was considerably affected by massecuite viscosity. Spencer and Meade (1952) quoted the findings of Winter who established that one part of non-sucrose held 0.4 parts of sucrose in the final molasses.

Sen (1960) enumerated the salient features for wide differences in sugar recovery between South and North regions of India. He established that higher recovery irrespective of juice quality in the South was 0.5 per cent for different agronomic operations, 0.2-0.3 per cent for supply of fresh cane to the factory and 0.1 per cent for factory efficiency.

MATERIALS AND METHODS

Laboratory scale experiments on the effect of double carbonation process of cane juice clarification on the percentage recovery of sugar from Punjab canes were laid out at the Crescent Sugar Mills and Distillery Ltd., Lyallpur. These experiments were made in accordance with mill routine procedure, on mixed juice having an average purity of 80.20 per cent. It was then preserved with mercuric chloride (0.025 per cent) and was subjected to modified De-Haan's double carbonation process of cane juice clarification using the milk of lime with the following variations: (*a*) Concentrations: 15°, 16°, 18° and 20° Baume as were used in the mill, and (*b*) Doses: 6, 7, 8, 9, 10, 11 and 12 per cent on volume basis in contrast to normal mill doses of 8, 9, 10 and 11 per cent. The milk of lime and carbon dioxide gas utilized were the same which were being used in the mill and the doses used in the mill were taken as standards for comparison.

RESULTS AND DISCUSSION

The present study was carried out to investigate the effect of different densities and doses of milk of lime on the characteristics of cane juice. The results obtained at 18° Baume milk of lime yielded significant results when compared with standard Mill doses (Tables 1 and 2).

TABLE 1. *Analysis of Mixed and First Carbonation Juice at 8 per cent Standard Mill Dose of 18° Baume Milk of Lime.*

Characteristics	Mixed Juice	Doses of Milk of Lime						
	Control	6%	7%	8%	9%	10%	11%	12%
pH ..	5.5	10.2	10.3	10.2	10.3	10.1	10.2	10.4
Brix (per cent) ..	17.27	14.33	15.03	14.83	14.38	13.72	14.43	15.14
Pol (per cent) ..	13.83	12.04	12.64	12.50	12.14	11.60	12.18	12.77
Purity (per cent)	80.08	84.02	84.10	84.29	84.42	84.55	84.41	84.35
CaO in mg/Litre.		440	465	460	445	410	430	477
Settling rate in .. c. c. after 30 min.		295	318	339	336	367	380	406

TABLE 2. *Analysis of Second Carbonation Juice at 8 per cent Standard Mill Dose of 18° Baume Milk of Lime.*

Characteristics*	Second Carbonation Juice of						
	6%	7%	8%	9%	10%	11%	12%
pH ..	8.5	8.5	8.5	8.4	8.4	8.5	8.4
Brix (per cent) ..	13.86	13.19	13.31	13.46	13.78	13.79	13.27
Pol (per cent) ..	11.71	11.17	11.28	11.42	11.86	11.70	11.25
Purity (per cent)	84.49	84.68	84.74	84.84	84.95	84.84	84.77
CaO in mg/Litre.	240	222	233	222	213	230	223
Turbidity ..	20.25	17.83	16.58	15.66	14.66	15.75	16.83
Nonsugars .. Removal (per cent).	26.58	27.34	28.02	28.71	29.13	28.73	28.55

*Average of three samples of mixed juice. It was subjected to First Carbonation process, analysed and then submitted to Second Carbonation.

It is seen from Tables 1 and 2 that the pH values of mixed juice averaged to 5.5, whereas that of first carbonation juice ranged from 10.1 to 10.4. This variation in pH did not depend upon the quality of mixed juice but was also influenced by the extent of liming and gassing with carbon dioxide. But in the second carbonation, the standard and the optimum dose recorded slightly lower pH. It is concluded that in the first carbonation the fluctuations in the pH values were greater than that of the second carbonation juice.

The analysis of Brix values revealed that the treatments were highly significant. The control assumed significantly the highest value of 17.27 per cent as compared to other treatments in both the carbonations, whereas the treatments among themselves were non-significant. Lower the Brix value, the higher was the removal of non-sugar and hence better recovery of sugar and *vice versa.*

In case of Pol values, the control did not differ significantly from 12.8 and 7 per cent doses in the first carbonation. The highest value of 13.83 per cent was recorded by the control, whereas 12 per cent dose gave the second highest value with 12.77 per cent. But the differences amongst the rest of treatments were non-significant. In the second carbonation, control was significantly better then the other treatments, whereas treatments among themselves were non-significant. The second highest value was obtained by 10 per cent dose yielding 11.86 per cent Pol.

In case of purity values, the treatments recorded the highly significant results. 10 per cent dose in both the carbonations attained the highest purity of

84.56 and 84.95, whereas the control assumed the lowest value of 80.08 per cent. But in case of first carbonation 10 per cent dose was significantly better than the other treatments.

The statistical analysis of lime salts revealed that in the first carbonation the treatments were non-significant, whereas in the second 6 per cent dose assumed the highest position by producing on an average 240 mgs. CaO per litre than the 10 per cent dose yielding 213.

An increase in settling rate was seen with an increase of level of liming. However, 9 per cent dose was optimum in the sense that it recorded, on an average, lower settling rate of 336 c. c. than the higher doses, but the 6 per cent dose gave, on an average, minimum settling rate of 295 c. c. per litre juice after 30 minutes.

The statistical analysis of turbidity values obtained at 18° Baume of various level of liming revealed that the treatments were highly significant. It was found that 10 per cent dose gave the lowest turbidity of 14.66 and was considered to be the optimum dose.

The statistical analysis of removal of non-sugars (clarification efficiency) revealed that the treatments were highly significant. The clarified juice at 10 per cent dose assumed the highest clarification efficiency of 29.13 per cent, whereas 6 per cent dose yielded the minimum of 26.58 per cent.

LITERATURE CITED

Ansari, S. H. 1964. Defecation Remelt Process. *4th Conv. Pak. Soc. Sugar. Technol. Proc.* Pt. 1, Gujranwala: 79-85.

Athenstedt, M. 1965. Low-grade and affinition work with continuous centrifugals. *Intern. Sugar. Jour.* **67**: 115.

Clarke, G., and S. C. Banerjee. 1910. The efficiency of the Hadi Process of sugar manufacture. *Agri. Jour. India.* **5**: 29-41.

Delfin, J. 1964. Method of clarifying cane sugar juice. *Intern. Sugar. Jour.* **66**: 95.

Honig, P. 1953. *Principles of Sugar Technology.* Elsevier Publishing Co., New York: 291-500.

Lander, P. E., and J. D. Chopra. 1942. Recovery of White sugar from the Punjab and the United Provinces. *Indian Jour. Agri. Sci.* **12**: 710-29.

Harch, M. C. 1956. Vibrating screans for mill juices. *Intern. Soc. Sugare. Technol. 9th Proc. India.* **2**: 614-17.

Maxwell, F. 1931. Modern Milling of Sugarcane. Norman Rodger Dunstan's Hill E. C. 3, London: 1-9.

Ochoa, G. E. 1953. pH controller in the sugar industry. *Sugar Jour.* **16**: 12, 14 and 40.

Phansalker, S. L., and H. C. Bhattacharya. 1960. Reduction of sugar losses in molasses. A new pan control instrument. *Annu .Conv. Sugar. Technol. Assoc. 28th Proc. Pt. II. India* : 185-88.

Prasad, S. G., and K. N. Agarwal. 1959. A study on clarification efficiency *Indian Sugar.* **9**: 325-27.

Ramaiah, N. A., and J. K. Sharma. 1960. Physico-chemical studies on clarification process. Studies on solubility of Calcium sulphite and calcium lactate in sugar solutions. *Ann. Conv. Sugar Technol. Assoc. 28th Proc. Pt. I, India*: 64-68.

Ramiah, N. A., and S. K. D. Agarwal. 1960. On the studies of kinetics of caramalization of sugars. Ibid: 101-104.

Sen, S. C. 1960. Critical studies of sugarcane crops of India. Annu. *Conv. Sugar Technol. Assoc. 28th Proc. Pt. II, India* : 111-24.

Silin, P. M. 1964. Molasses formation. *Internat. Sugar Jour.* **66**: 255-58.

Spencer, G. L., and P. Meede. 1959. *Cane Sugar Hand Book.* 8th edition. John Willey and Sons, New York: 588-631.