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Effective of Different Flocculants on Fresh and Stale Sugarcane Juice Clarification

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Abstract

The sugarcane deterioration will be start in the field after harvesting, factory storage pile, or during factory milling processes, that it has become a subject of major concern in recent years. The present work aims at to study the application of different synthesized and commercial flocculants such as poly(acrylamide) (P.A.M), poly(acrylic acid) (P.A.A), and Magnafloc LT-27, Separan AP-30 on sugarcane variety Co-62175 for fresh and stale cane juice clarification. The result reveals that synthasized flocculant P.A.A gave better turbidity of juice compared to the commercial flocculants, and also commercial flocculant Separan AP-30 shows good settling time compared to all other flocculants. On the other hand if the time lag is more between harvest to crush Magnafloc LT-27 gave good results even then juice clarified after 48 hr. Generally if the sugarcane crushed after 24 hr definitely it consumes more flocculants and due to this manufacture of commercial sugar because expensive.

Keywords: Fresh cane, stale cane, losses of sucrose.

Introduction

The quality of standing sugarcane tends to improve with age, reach a maximum, and then decline, whatever the quality at time of harvest, rapid deterioration begins from the moment the cane is cut. For the whole industry stale cane is an anathema which cause, growers lose tonnage and processors lose sugar. After cutting, sugarcane loses water (1-2% daily for the first week)[1], hence the sugarcane deterioration will be started in the field, factory storage pile, or during factory milling processes, that it has become a subject of major concern in recent years. S. Bose[2] et al reported that sugarcane starts deterioration as soon as it is harvested in the field. Manufacture of commercial sugar becomes more expensive due to the production of more invert sugar as a result of deterioration. The inversion process in stale cane is so rapid that the amount of invert sugar in the juice goes up to 10 to 15% per 100° Bx in 120 hours after harvesting, thus lowering purity. In India, one of the most important commercial crops is sugarcane (*Saccharum hybrid*) that largely is used for white sugar production and also Indian sugar industry is one of the oldest and second largest industry in the country[3]. In this country sugar productivity is between 6 to 12 ton sugar per hectare in year, but under subtropical conditions, the average sugar productivity is around 6 to 7 ton per hectare in year. In India, during the optimum crushing period, sugar recovery in the cane processing units usually range is between 8.5 and 9.5 percent cane, a relatively low figure, therefore reducing net sugar production from this area. In the other word in sub-tropical area, the lost between harvesting to processing is nearly 1.0 unit sucrose (sucrose % cane) in an average crushing season, losses are greater longer the time delay between harvest and crushing (processing) of the cane. In the majority of sugar factories, when transporting cane from field to factory takes 3 to 6 days, leading to huge losses in recoverable sucrose. P.Rein[4] reported that in stale cane, loss of recoverable sugar in cane averaged about 1% per day, although some much larger numbers have been reported. Apart from harvest-to-process delays, other factors that usually overlooked by the sugar factory management, and responsible for a decline in sugar recovery are cane variety, ambient temperature, humidity, activities of soluble invertases in cane, maturity status[5-7].

On the other hand stale cane is very costly to the cane grower because of, loss of cane weight, lower cane quality, lower cane payment, lower relative factor and reduced quota. M. Hylton[8] reported that in Barbados recorded weight losses averaging 0.75% per day for green cane and 1.5% for burnt cane, both exposed in windrows in the field. Assuming similar results in Jamaica, quite apart from sucrose loss, a farmer could easily lose approximately $16.00 ton cane per day. For sugar industry staling losses are virtually most detrimental, that affect the cane tonnage which has to bear to the cane growers, also in 1997 indicated an average of 0.45 units per day of delay in processing in Jamaica. S. Solmon[9] made recent survey in Northern India revealed that in an average crushing season, nearly 1 – 1.5 units of sucrose (sucrose % cane) is lost between harvesting to processing. Losses due to low recovery from deteriorated cane, and even lead to a factory shut-down. The sugarcane varieties although varies for such losses but altogether each and every variety loses its cane weight and sugar after harvesting[10]. S. Solmon[11] have indicated that within period of 72 hours of harvest, decline in sucrose percent in cane to the extent of 2.0

units, that it is depending upon the sugarcane genotype and milling season. Therefore, to avoid the sugar losses due to staling and its losses are virtually most detrimental to sugar industry; the raw materials should be crushed as early as possible. When the cane juice comes from the mills is turbid and viscous in nature, it may also contain impurities (soluble and insoluble), and is not fit to be worked for white sugar manufacture without suitable chemical treatment. Removal of impurities from sugarcane juice, even in treatment of water[12&13] or other fruit juices by clarification, is an essential part. The clarification of them can be done by coagulation, flocculation, and precipitation of the colloids and pigmented substances which are later eliminated by decanting and filtration, i.e. Hence, necessary to remove the maximum quantity of impurities (non-sugar) from the expressed juice at the earlier stages to obtain pure crystallizable sugar. It is well known that poor rate of settling disturbs clarification and this results not only in an inferior sugar quality but also in a reduced rate of crushing. The present work made an attempt to assess the post harvest sugar losses, pH, turbidity and settling time of the juice obtained by Co-62175 which is abundantly grown in Mandya region by applying different commercially available flocculants such as Separan AP-30, Magnafloc LT-27 and synthesized flocculants polyacrylamide (P.A.M) and polyacrylic acid (P.A.A).

Material and Methods

The state of Karnataka is third big state in India that growing sugarcane and sugar production. In the state, sugarcane is cultivated on four lakh hectares area with productivity of 90 ton per hectare which it is good compared to national average. However, there is still a lot of scope for increasing the productivity as compared to neighboring Tamil Nadu state. In India Tamil Nadu state has highest productivity of 109 ton per hectare[14]. On the other hand in Karnataka state sugarcane variety Co-62175 is abundantly grown on the farms in the Mandya district, it is late maturing variety[15&16], thick cane and the yield potential is about 180 ton per hectare and it possess moderate juice quality. The period of present investigation was spread from zero to 96 hours. All bundles exposed to existing environmental conditions. Everyday juice was extracted from one bundle on an electrically operated crusher and used for determining the various quality parameters. The juice was analysed for pH, Turbidity and settling time.

Preparation of stock solution: 0.05% solutions were prepared by taking 0.5 g from each of different flocculants such as polyacrylamide (PAM), polyacrylic acid (PAA), Separan AP-30 and Magnafloc-LT-27 were separated weighed and 80ml of water was added to each of them and kept for about 1 hour for complete soaking while being stirred intermittently. Then, there were slightly warmed and made up to 100ml with water respectively and pipette out 10ml into a 100ml separated volumetric flask and the made up to the mark with water.

Results and Discussion

Table 1 and figure 1 have shown that the fall in pH and increase in acidity is more in stale cane. In other words by increase time between harvest to mill, juice pH will be reduce and it will get acidity condition. This indicates that the increase in acidity of juice is indicative of the deterioration process of the cane.

The increase in turbidity of sugarcane juice Co-62175 was in accordance with sucrose loss. The increase in impurity of raw sugarcane juice Co-62175 from 1040 (NTU) to 1253 (NTU), may be ascribed to initial loss of moisture and inversion of sucrose. Table 2 and figure 2 clearly explain of the effect of pre-harvest staling of cane on purity of crusher juice. Use of different flocculants results in fall in impurity juice, that PAA shows low turbidity(NTU) in compared to other flocculants, but after that Separan AP-30, Magnafloc LT-27 and P.A.M will be better respectively, but P.A.M after 48 hours will get more turbidity content that will be more than content standard solution for turbidity.

It is observed from table 3 and figure 3 that settling time (Min.) in sugarcane juice Co-62175 was faster in the case of fresh cane with treatment different flocculants compared to stale cane juice. The cane that was crushed and treatment with Separan AP-30 in the fresh cane had settling time 27.12(Min.) and after that Magnafloc LT-27, P.A.M and P.A.A were good. After 72 hours Separan and P.A.A have shown more than 133 minutes, whereas that is less for Magnafloc LT27 and P.A.M. on other words after 96 hours settling time was around 1 hour for Magnafloc LT27.

Conclusion

The present work have been tried to show that treatment by flocculants have good results, in connection with the settling time and turbidity. If increases the storage time of cane increased settling time and turbidity of the juice and pH of the juice decreases shown in both tables and figures. The effectiveness of clarification fresh sugarcane variety (Co-62175) juice studied by employing commercially available flocculants like Separan AP-30, Magnafloc LT-27 and synthasized flocculants such as P.A.M and P.A.A for turbidity and juice settling. The experimental results have revealed that synthasized flocculant gave better turbidity of juice compared to the commercial flocculants, but Separan AP-30 shows good settling time compared to all other flocculants. If the time lag between harvest and crush more Magnafloc LT-27 gave good results even then juice clarified after 48 hr. the present research work reveals if the sugarcane crushed after 24 hr definitely it consumes more flocculants, due to this, manufacture of commercial sugar because expensive, so it affects the economics of sugar industry, therefore, fresh cane is always best from the point of view of both process and economics.

Table -1
pH between fresh and stale cane Co-62175 variety

Materials	Days			
	1	**2**	**3**	**4**
Raw juice (Rj)	5.30	5.03	4.55	4.30
Rj + milk of lime (M.O.L)	10.65	10.42	8.70	8.55
Rj + M.O.L + PAM	10.49	9.50	9.10	8.83
Rj + M.O.L + PAA	10.40	9.90	9.24	8.23
Rj + M.O.L + Separan AP-30	10.42	9.84	9.47	9.22
Rj + M.O.L +Magnafloc LT-27	10.43	9.40	9.30	9.14

(Average of five trails)

Table-2
Turbidity (NTU) between fresh and stale cane Co-62175 variety

Materials	Days			
	1	**2**	**3**	**4**
Raw juice (Rj)	1040	1172	1230	1253
Rj + milk of lime (M.O.L)	302	308	345	356
Rj + M.O.L + PAM	60	77	101	131
Rj + M.O.L + PAA	58	65	70	94
Rj + M.O.L + Separan AP-30	59	68	73	77
Rj + M.O.L +Magnafloc LT-27	72	86	90	95

(Average of five trails)

Table-3
Settling time (Min.) between fresh and stale cane Co-62175 variety

Materials	Days			
	1	**2**	**3**	**4**
Rj + milk of lime (M.O.L)	58.40	67.43	75.15	88.02
Rj + M.O.L + PAM	34.26	50.20	65.37	70.00
Rj + M.O.L + PAA	62.42	75.41	85.42	135.45
Rj + M.O.L + Separan AP-30	27.12	39.46	60.30	133.29
Rj + M.O.L +Magnafloc LT-27	31.47	42.29	56.00	62.18

(Average of five trails)

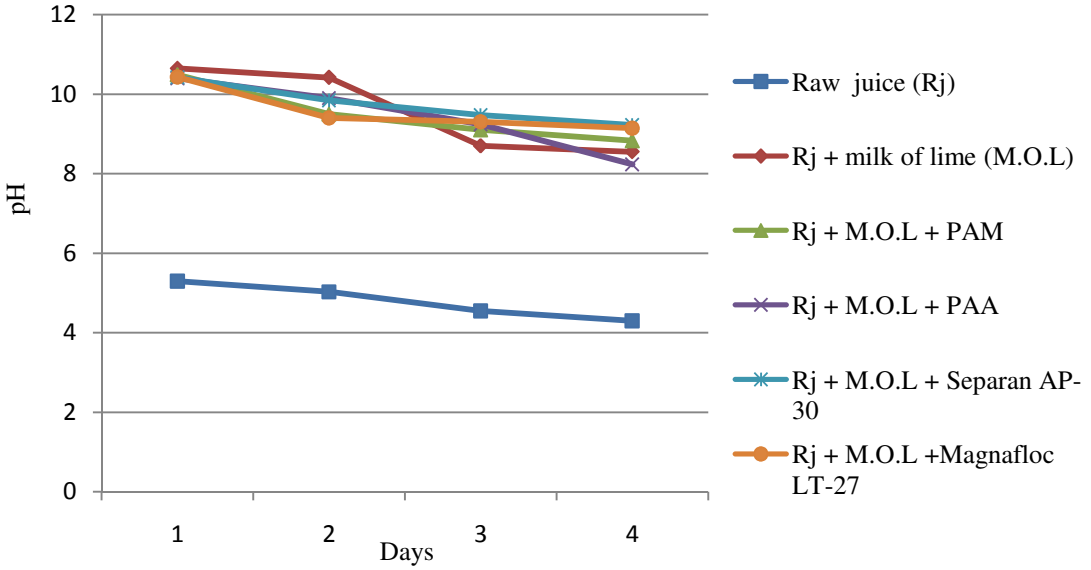

Figure -1
pH between fresh and stale cane Co-62175 variety

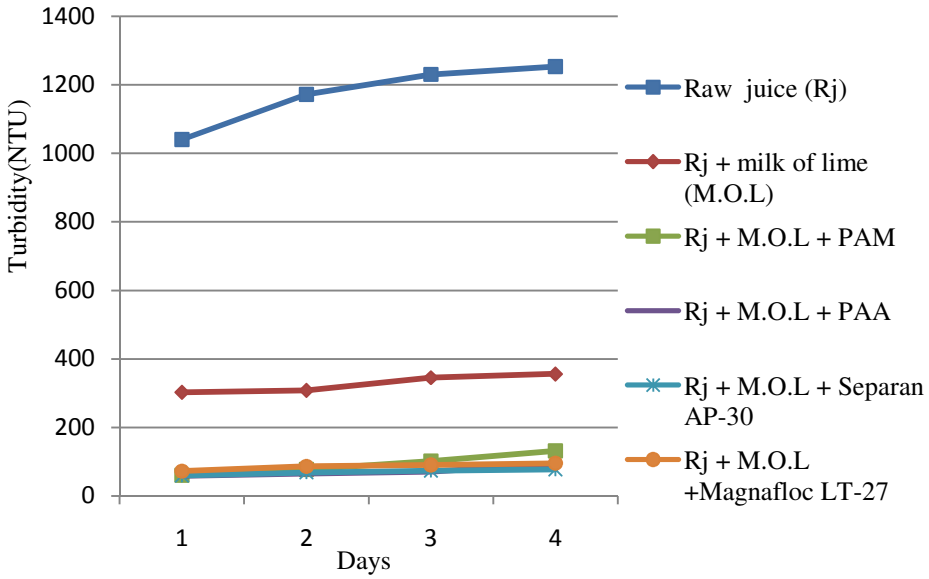

Figure-2
Turbidity between fresh and stale cane Co-62175 variety

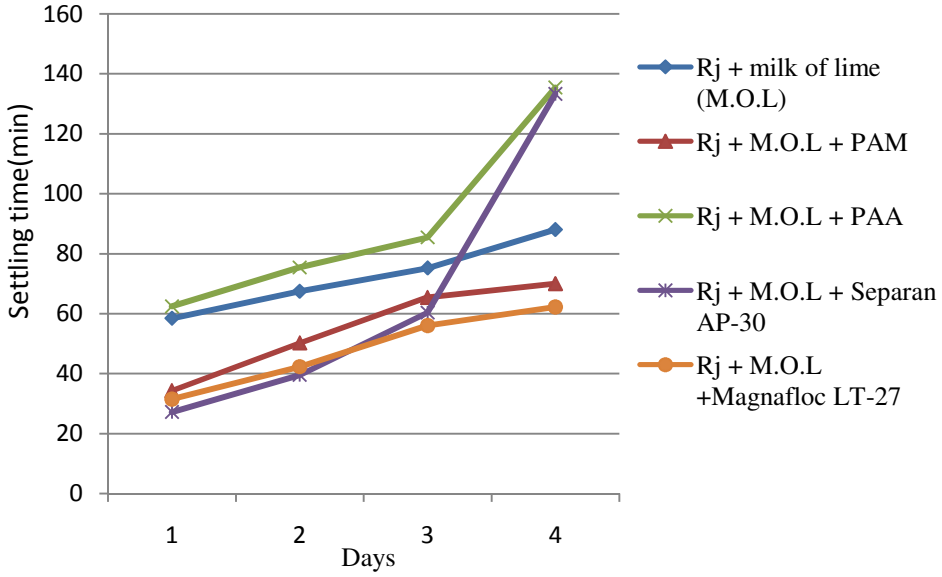

Figure-3
Settling time between fresh and stale cane Co-62175 variety

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