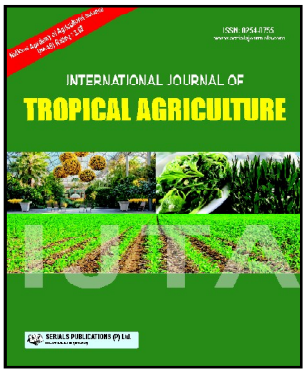

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Evaluation of Post-harvest Sucrose Losses in Early Ripening Sugarcane Varieties

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Abstract: Development of new sugarcane varieties is a normal process for enhancing the sugar yield as well as productivity, however, post-harvest sucrose losses in the commercially used new varieties is also one of the most important points to look out for. Thus, the present study focuses on evaluation of post-harvest sucrose losses in a newly released early ripening sugarcane variety. In the present study, the newly commercial used varieties were chosen, viz., CoPk 05191, CoLk 94184 with CoJ 64 as a control. Sucrose (%) in juice, reducing sugars, pH, Total soluble solids and CCS (%) were evaluated. The study revealed that CoPk 05191 had not shown better performance as compared to control variety, CoJ 64 at the time of harvest, however, CoLk 94184 showed better results against the control variety at the time of harvest. In addition to, better performance in post-harvest sugarcane deterioration was of both the varieties, CoLk 94184 and CoPk 05191 than in Control, however, comparative evaluation between the tested varieties revealed that CoLk 94184 had better performance than CoPk 05191.

Keywords: Post-harvest, Sugarcane, Deterioration, Sucrose, Reducing Sugars, CCS (%)

INTRODUCTION

Saccharum officinarum (L.), most important cash crops of the world, is the major raw material of sugar production and now a common producer for bio-fuel. It is well known that about 80 (%) of the world's sugar is obtained mainly from this crop. Sucrose loss after cane harvest is one of the major problems of sugar mills all over the world. Being a perishable commodity, sugarcane after harvest losses its sucrose content at a very rapid rate which affects the sugar production of cane growing countries (Solomon, 2009). Several negative aspects curtail the system of

cane supply that persists in Northern India which plays an essential role in the economical losses of farmers as well as sugar millers. The reason behind these losses are many, however, time difference in harvesting of crop as well as its crushing is one amongst the several causes of it which leads to many other associated problems which contribute to further enhancement of these losses like microbial invasion (Misra *et al*, 2016; 2016a; 2016b).

Sugarcane varieties development is an important factor for sustaining the crop productivity and yield. The target for developing a cane variety by plant breeders is to develop new varieties that are genetically powerful and puts an opportunistic impact both to cane farmers and sugar millers (Bischoff and Gravois, 2004). The process of developing newer sugarcane varieties with improvement is a normal process for enhancing the sugar yield as well as productivity, however, post-harvest sucrose losses in the commercially used new varieties is also one of the most important points to look out for. Thus, the purpose of this study is evaluation of post-harvest sucrose losses in early ripening sugarcane varieties.

MATERIALS AND METHODS

Sugarcane crop: The varieties selected were CoLk 94184, CoJ 64 and CoPk 05191. CoLk 94184 (Birendra) is an early maturing high sugar variety released from Lucknow, a rare combination of two desirable attributes, *i.e.*, early maturity and good ratooning ability. CoPk 05191 is also a newly released early ripening high sugar variety from Pratapkota. In addition, an early maturing high sugar variety, CoJ 64 known as "*wonder high sugar variety*", released in 1974 is used as control in the experiment.

Post-harvest sugarcane deterioration analysis: The experiment was conducted in February when the crop is ready for harvesting at ICAR-Indian Institute of Sugarcane Research, Lucknow. The details of weather conditions of the month of February are mentioned in the Table- 1. Whole cane stalks of each variety were kept in separate bundles and were left open in fields for analysis of post-harvest sugarcane deterioration. The juice was extracted from each bundle of variety at a time interval of 0 h, 48 h, 96 h, 144 h, 192 h and 240 h after harvest. Juice quality analyses were performed for all the varieties. Total soluble solids (°Brix) were measured by hand refractometer. Reducing sugars were estimated by Nelson Somoygi method (1944). Commercial cane sugars (%) was calculated by the formula given by Bakshi Ram et al., 2001. pH was determined by pH meter (Model APX 175E/C). Sucrose (%) in juice was determined by lead acetate method.

Table 1
Weather conditions in the month of February at Lucknow

Months	$T_{max.}$	$T_{min.}$	*RH at 7hrs*	*RH at 14rs*	*Sun Shine*	*EVP*	*Wind*	*Rain fall*	*Relative humidity*
February, 2016	26.2	12.3	92.6	46.9	7.3	2.48	2.64	15.6	2

RESULTS AND DISCUSSIONS

Sucrose (%) in juice: Variation in Sucrose (%) in juice in all the three varieties was observed from the very beginning of the harvest. At the time of harvest, Sucrose (%) in juice recorded 23.83 in CoLk 94184, 20.14 in CoPk 05191 and 24.15 in CoJ 64. This showed that CoPk 05191 had lowest sucrose (%) at the time of harvest in comparison to other two varieties, *viz.*, CoLk 94184 (Tested variety) and CoJ 64 (Control). After 240 h of harvest, sucrose (%) in juice fall from 23.83 to 18.83 in CoLk 94184, 20.14 to 15.55 in CoPk 05191 and 24.15 to 16.89 in CoJ 64 (Fig. 1). This showed that there was a fall of 5.07

units in CoLk 94184, 4.59 units in CoPk 05191 and 7.26 units in CoJ 64. This implies that after 240 h of harvest, CoPk 05191 had lowest decrease in sucrose (%) in juice as compared to control variety. In case of CoLk 94184 similar results were observed in sucrose (%) in juice. On comparing both the tested varieties among themselves, CoLk 94184 showed better sucrose (%) in juice after 240 h of harvest as compared to CoPk 05191.

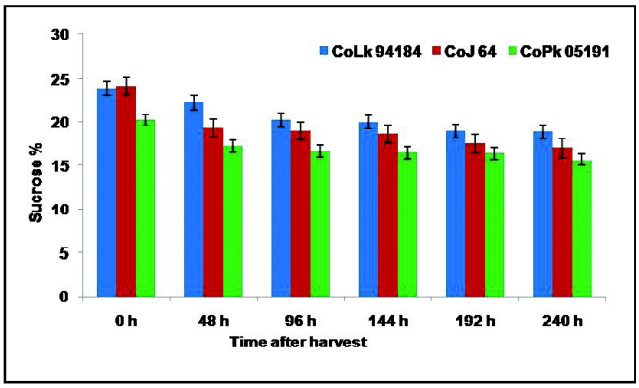

Figure 1: Sucrose % in different sugarcane varieties at 0, 48, 96, 144 and 240 h after harvest

Commercial cane sugars (%): Commercial Cane sugars (%) were recorded to be 3.42, 3.06 and 3.37 at the time of harvest in CoLk 94184, CoPk 05191and CoJ 64, respectively. This showed that at the time of harvest, highest CCS (%) was CoLk 94184. However, CoPk 05191 had relatively lesser CCS (%) than in control variety at the time of harvest. After 240 h of harvest, CCS (%) drop down from 3.42 to 2.68 in CoLk 94184 giving a decrease of 0.74 units, in CoPk 05191, CCS (%) drop down from 3.06 to 2.03 giving a decrease of 1.03 units while in CoJ 64 (control), CCS (%) drop down from 3.37 to 2.45 giving a decrease of 0.92 units (Fig. 2). This revealed that after 240 h of harvest decrease in CCS (%) in CoLk 94184 was relatively lesser than control variety while in CoPk 05191, it was *vice-versa*. Also, on comparing the both tested varieties among themselves, CoPk 0591 showed higher CCS (%) declination after 240 h of harvest as compared to CoLk 94184.

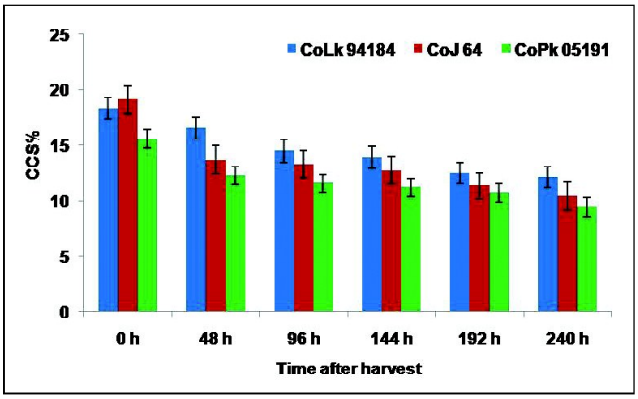

Figure 2: CCS (%) in different sugarcane varieties at 0, 48, 96, 144 and 240 h after harvest

Reducing sugars: At the time of harvest, reducing sugars was 55.2 mg/ml, 66.08 mg/ml and 42.4 mg/ml in CoLk 94184, CoPk 05191 and CoJ 64, respectively. This showed that at the time of harvest reducing sugars were least in CoJ 64 (Control) followed by CoLk 94184 and CoPk 05191. After 240 h of harvest, there was an increase in reducing sugars in all cane varieties, however, there was an increase of 3.96 (%) in CoPk 05191 and 2.21 (%) in CoLk 94184 against 6.62 (%) increase of reducing sugars in CoJ 64 (Fig. 3). This implies that with the increase in time after harvest both the tested varieties, CoLk 94184 and CoPk 05191 had relatively lower increase in reducing sugars in respect to the control variety, CoJ 64. On comparing both the tested varieties amongst themselves, CoLk 94184 showed better results than CoPk 05191 after 240 h of harvest.

Total soluble solids (°Brix): Variation in Total soluble solids was also observed in all the three cane varieties. At the time of harvest, CoLk 94184 recorded 20.6 °Brix in juice while CoPk 01591 recorded 23.0 °Brix but the control variety CoJ 64 recorded 19.2 °Brix. This showed that CoPk 05191 had highest °Brix compared to both the varieties (CoLk 94184 and CoJ 64) at the time of harvest. After 240 h of harvest, there was an increase in °Brix in all the varieties, however, the increase varies within each variety. In CoLk 94184, there was an increase of 16.50%, in CoPk 05191 an increase of 16.52%

was seen against an increase of 21.87% in CoJ 64 as control variety. This indicated that CoPk 05191 had relatively higher increase in total soluble solids than CoLk 94184 and relatively lesser than CoJ 64, as the time after harvest increases.

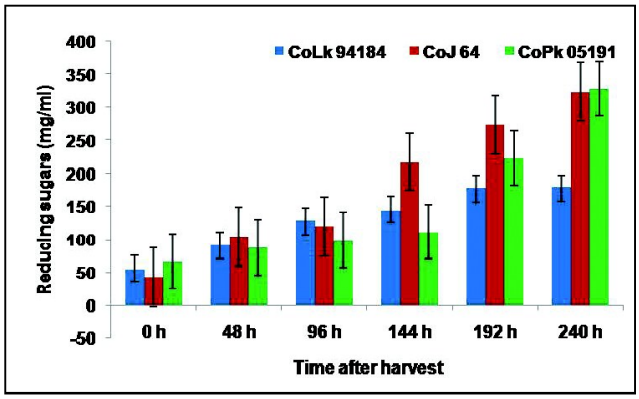

Figure 3: RS (mg/ml) in different sugarcane varieties at 0, 48, 96, 144 and 240 h after harvest

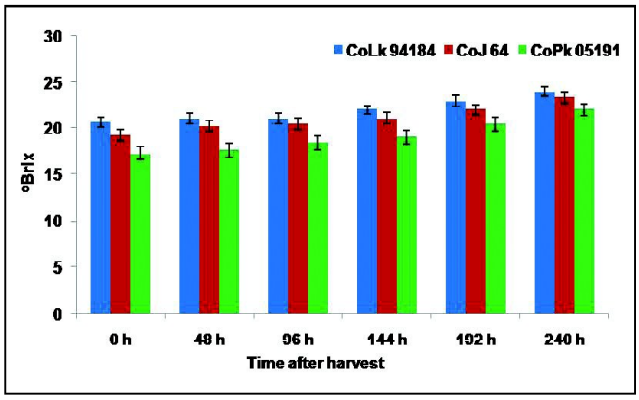

Figure 4: °Brix in different sugarcane varieties at 0, 48, 96, 144 and 240 h after harvest

pH: Acidity of juice is determined by pH of the juice. At the time of harvest, pH value was observed to be 5.24, 5.10 and 5.33 in CoLk 94184, CoPk 05191 and CoJ 64, respectively. This showed that at the time of harvest pH value of CoPk 05191 had relatively lesser pH value than the other two varieties, *viz.*, CoLk 9484 and CoJ 64 (control). Similar results were obtained in pH of CoLk 94184. After 240 h of harvest, decrease in pH value was observed in all the varieties. In CoLk 94184 showed a similar amount of decline in pH value as of Control variety (of 0.29 units and 0.23, respectively) while in CoPk 05191, there was a decline of 0.30 units. This revealed that CoPk 051941 had highest decline in pH value as time increases in respect to CoLk 94184 and CoJ 64.

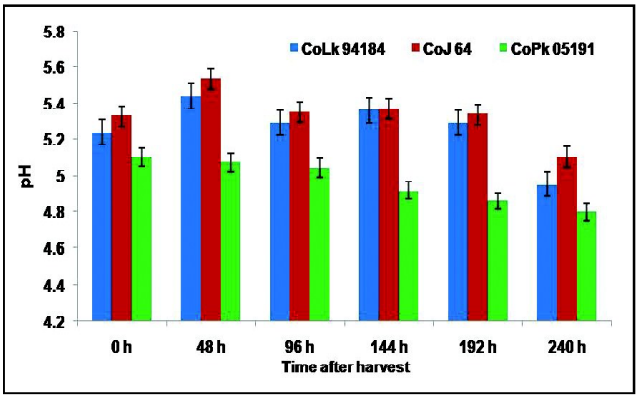

Figure 5: pH in different sugarcane varieties at 0, 48, 96, 144 and 240 h after harvest

CONCLUSION

The study showed that at the time of harvest, CoPk 05191 had lowest sucrose (%) in comparison to other two varieties, *viz.*, CoLk 94184 (Tested variety) and CoJ 64 (Control). But highest CCS (%) was recorded in CoLk 94184. However, CoPk 05191 had relatively lesser CCS (%) than in control variety at the time of harvest. In case of reducing sugars and total soluble solids in juice, CoPk 05191 stands in first position followed by CoLk 94184 and CoJ 64. Besides, juice pH of CoPk 05191 was relatively lesser than the other two varieties, *viz.*, CoLk 9484 and CoJ 64 (control). This concludes that although CoPk had less pH value, Higher total soluble solids but it has higher amount of reducing sugars causing it to have lesser amount of sucrose % at the time of harvest. This means that CoPk 05191 had not shown better performance as compared to control variety, CoJ 64 at the time of harvest.

In respect to with the increase in time after harvest (up to 240 h of harvest), CoLk 94184 had lesser decrease in sucrose (%) in juice and CCS (%) as compared to CoPk 05191 and CoJ 64. In case of reducing sugars, both the tested varieties showed

lower increase in it than control variety but on comparing the tested varieties among themselves CoLk 94184 performed better. In total soluble solids, CoPk 05191 had relatively higher increase than CoLk 94184 and relatively lesser than control. Besides juice pH was declined highest in CoPk 051941 w.r.t. CoLk 94184 and CoJ 64. This showed that although both the varieties showed better results in post-harvest sugarcane deterioration than in Control, however, comparative evaluation between the tested varieties revealed that CoLk 94184 had better performance than CoPk 05191.

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