

## Post-Harvest Losses and Management in Sugarcane

Raktim Bhagawati<sup>1</sup> and Shantonu Paul<sup>2</sup>

<sup>1</sup>M.Sc Scholar, Dept. of Agronomy, Assam Agricultural University<sup>1</sup>, Jorhat-13, Assam

<sup>2</sup>Farm Manager, Krishi Vigyan Kendra Dibrugarh, Assam Agricultural University, Dibrugarh 786010, Assam

### SUMMARY

Post-harvest loss of sugarcane is two types of viz. sugar inversion and microbial infection. Sugar inversion is the primary reason for reduced sucrose content in most cases. A lower temperature reduces the inversion process. Canes must be stored at a temperature below 34°C. Sucrose inversion is also very high at low pH. Therefore, milled cane juice must be kept in containers with a near-neutral pH. The origin of microbial infection can be traced back to the moment at the time of harvest where the adhering soil particles facilitate the entry of the pathogen through the cut ends of the stalks. These microbes produce sour canes and destroy the sweetness of canes. The sugar recovery percentage of infected canes is also quite low. Therefore, canes must be treated with a bactericide (Polycide, Bactrino-100) in combination with an anti-inversion chemical (sodium metasilicate, Sodium lauryl sulphate).

### INTRODUCTION

The first reports of loss of sugar in harvested canes came by the end of the 19th century (Slubbs 1895; Weinberg 1903; Cross and Belile 1914). Browne and Blouin (1907) reported the role of 'Invertase' in the deterioration of harvested canes. A considerable loss in juice purity in stored canes was reported by Muller Von Czernicki (1900) and Browne and Blouin (1907). In a study conducted by Cross and Belile in 1915, they found that during storage, the activity of the inverting enzymes was much higher in millable stalks and milled cane juice. All these early reports suggest that the problem of post-harvest deterioration in sugarcane was evident from the very early days of the industrial revolution or even earlier. There are two kinds of post-harvest deterioration in sugarcane. The development of stale cane and sour cane is a result of two different processes. The former is a result of metabolic conversion of sucrose to lesser economically important products like organic acids, ethanol, gum, etc. by enzymes which eventually lessen the percentage of sucrose present in the canes. The cane loses its sweetness and juiciness. The latter is a result of microbial infection. *Leuconostoc* is a genus of lactic acid bacteria that ferment the sugar present in canes. Eventually, the canes start to develop a sour odor. In most cases, both types of deterioration occur simultaneously in stored canes.

### The Problem of Inversion and Microbial Infection

Inversion is the breakdown of sucrose into its constituent monosaccharides viz. fructose and glucose. This reaction is catalyzed by the enzyme invertase. Studies by Cross and Belile (1915) have shown that the quantity of invertase enzyme increases during storage. Therefore, stale canes have much higher quantities of this enzyme than a fresh cane. Hence, staling beyond 24 hrs has shown to decrease sugar content considerably. Stale canes also suffer from weight loss and decrease the recovery percentage of sugar as the period of staling increases. This poses a vexing problem for the growers, transit personals as well as factory owners. A well-ripened cane may lose its sugar within a few days. The losses are correlated to harvest methods, ambient temperature, injuries during transportation, and microbial infection. The loss in sugar in canes is positively correlated to ambient storage temperature. A higher temperature hastens the process of inversion. Therefore, it is advocated to store sugarcane in refrigerated conditions. In factories, secondary losses occur in the form of dextran development, acidification, and alcohol formation due to inefficient and improper processing of sugar. Microbial infection of canes is also known as bio-deterioration. This can occur in various instances; during harvest (through cut wounds), injuries during transportation, dirty storage facilities, etc. The organism that infects is a lactic acid-forming bacterium from the genus *Leuconostoc*, order; lactobacteriales. There are mainly two species namely *L. mesenteroides* and *L. dextranum* that are actively involved in the conversion process. This results in the development of sour canes. They convert sucrose into polysaccharides such as dextran. The presence of dextran, even in trace quantities creates a problem in filtration, clarification, and crystallization process of sugar. Dextran alters the shape of sugar crystal thereby, reduces the quality of sugar.

### Ways to Combat Inversion and Bio-Deterioration

Sugar inversion is a vexing problem for growers and industries. Hence, care should be taken during storage of the harvested canes. Studies suggest that a lower temperature can lower the rate of inversion and canes can be stored for a longer period (Wasna Jaturnusmee and Withawat Mingvanish, 2008). A temperature below 34° C is ideal for storing the harvested canes. Inversion in milled cane juice is also a similar problem. The sucrose inversion is higher at lower pH. At a pH of 3, the amount of reducing sugar increased and sucrose decreased (Wasna Jaturnusmee and Withawat Mingvanish, 2008). Therefore, a near-neutral pH should be maintained in milled juice storage containers to lower the inversion process. Research to overcome post-harvest bio-deterioration in cane suggested that harvested cane should be stored in a shade, covered with trash, and sprinkled with water. Spraying Formalin or Polycide on a harvested cane or dipping them in Actin ID solution (0.015%) or Leukokil (1.0%) was effective in minimizing sugar losses. Other bactericides like Bactrino-100, BD Mill sanitizer, Potassium permanganate can be recommended to check the deterioration of cane and milled juice. A combination of anti-bacterial and anti-inversion chemicals (sodium metasilicate, Sodium lauryl sulphate) are effective in minimizing sucrose losses in sugarcane. Vacuum packaging and treating the canes with a preservative is also effective in inhibiting the activity of invertase enzymes.

### CONCLUSION

The problem of post-harvest deterioration of sugarcane has frustrated growers and processors for centuries. However, with the recent advancement in science and technology, scientists were able to discover the underlying principles of sugar inversion and microbial infection. These studies help to reduce sugar losses, improve processing outputs, and reduce production costs. However, a proper vigilance at each of the marketing chain is important to ensure healthy and good quality canes are procured, from farmers to factories for processing. The canes must be handled with scientific methods at each stage as this will not only improve sugar recovery percentage but also lower the production cost of processed products.

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