

## **A SEMINAR PAPER**

**ON**

### **Mechanism of Sugar Loss in Post Harvested Sugar Crops**

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## ABSTRACT

The sugar recovery process is highly dependable with different quality parameters of sugar crops. Sucrose losses are a severe problem which is caused by delayed transportation with unfavorable storage conditions. Keeping the fact in view a review study presenting with integrated possible physiological and biochemical causes of sucrose loss as well as the inversion activities in harvested crops that adversely affects sucrose content lowering in sugar recovery. Post-harvest deterioration, as well as sucrose loss, is less in such genotypes which have high rind hardness, less fibre %, wax content, less weight, high marc content with larger size beetroot, 12<sup>th</sup> to 13<sup>th</sup> month mature cane characters etc. The rate of sucrose inversion in stored sugarcane is increased at ambient temperatures 35 - 40.5 °C. Stored crops quality starts adversely deteriorate after the first 10 days of storage period and a rapid increase in invertase activity favored sucrose inversion, which is responsible for the reduction in sucrose per cent in juice. The invasion of microorganisms in sugar crops through the sudden abrupt changes of the atmospheric temperatures or through the growth cracks, cut ends of the harvested crops, physical damage during crop possessing etc. provides favorable conditions for the growth of microorganisms. The cold climate favors yeast and summer seasons helpful for *Lactobacillus*, *Leuconostoc* for their growth and proliferation. Moreover, *Leuconostoc* produces a long-chain polysaccharide, known as dextran, and sugar alcohol, mannitol, as the major two degradation products of juice which not only causes lower sugar recovery but also a hindrance in the crystallization process of sugar.

Keywords: Sugar crops, postharvest, deterioration, invertase and sugar loss.

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## CHAPTER I

### INTRODUCTION

Sugar crops are those crops which are cultivated firstly for the manufacture of sugar and secondly for the production of alcohol and ethanol. There are two main sugar-producing crops: sugarcane (*Saccharum officinarum* L.) and sugar beets (*Beta vulgaris* L.). Both crops constitute the two main sources of sucrose (pure crystalline sugar) for human consumption; approximately 86% is obtained from sugarcane and the remaining is extracted from sugar beet (FAO, 2019). In the developing countries of the tropical belt of Asia, Africa and America, where the human diet is poor in protein, sugar is very important. Sugarcane alcohol, which is a biofuel, could become an important weapon against the greenhouse effect. Sugar producing crops like sugarcane and sugar beet are perishable crop it is ought to be processed quickly after harvest. Delayed transportation after harvest with unfavorable environmental conditions causes postharvest sugar loss is one of the alarming problems of the sugar industry during the sugar recovery process. Solomon *et al.*, (2007) have indicated that approximately 20-30% of the total sucrose synthesized by sugarcane is lost during the various stages of raw material handling and processing. Plant physiological process is disrupted due to the sudden abrupt changes of the atmospheric temperatures or through the growth cracks, cut ends of the harvested canes, physical damage during cane possessing etc. these effects increase with lengthening period between harvest and extraction of sucrose. Increase in storage time resulted from a significant decline of extractable sucrose per cent in juice. A rapid increase in acidity and weight loss of sugarcane was also observed with increasing storage (Verma *et al.*, 2012). During storage, sucrose contents decreased while fructose, glucose and titratable acidity increased. Major factors which affect the cane deterioration include ambient temperature, sugarcane genotype, and the humidity. In determining the cane yield and sugar recovery, genetic potentials of a clone play a significant role. All the cane clones are prone to post-harvest deterioration but the rate of moisture loss may vary due to their physical, chemical and biochemical constitution as well as prevailing environmental conditions. The genetic nature and the morphological features of cane such as thickness, fibre %, rind hardness, wax coating etc., decide the extent of postharvest deterioration (Sarath *et al.*, 2015). In case of sugar beet, there is some evidence that the content of cell wall components (marc) of genotypes, root tip breakage during harvesting and cleaning are related to storage losses. In high temperature (35–40 °C) and low atmospheric humidity, (25–35%) deterioration effects on cane juice quality have been reported by Priyanka and Solomon (2013). In commercial beet cultivation, sugar beet is stored in field clamps under ambient conditions, in that case fluctuating temperatures between day and night,

temperature changes during the storage period and the exposition of the clamp result in high variability of storage losses (Hoffmann and Schnepel, 2016). Singh *et al.*, (2014) find out that deterioration of cane stored at 27.1°C occurred faster than that stored at 10.1°C. Fresh sugarcane juice became spoiled after 4 days when stored at 5.1°C and 1 day when stored at 27.1°C. Accretion of unwanted forms of carbohydrates, phenols, and alcohols in high concentrations as postharvest changes also affect the milling process. The time lag between harvesting and processing generally outgoes 3-7 days which leads losses of recoverable sugar due to temperature increases as a result of high respiration in storage condition. Sugarcane is not significantly in the loss if crushed within 24 hours of harvest, but after 24 hours significant losses occur due to loss of moisture and a low percentage of sucrose in juice (Sarath *et al.*, 2015). Another way of sugar loss occurring due to the formation of metabolites from microorganisms that invade in sugarcane at growth stage or during processing. Accumulation of no sugar contaminants is carried out by the microbial communities mainly *Lactobacillus*, *Leuconostoc*, yeast moulds etc. during extreme climatic conditions are largely responsible for the loss of recoverable sugar. Mishra *et al.*, (2017) reported that cold climate favors yeast growth and proliferation while *Lactobacillus* predominates in summer seasons. Invert sugar has recently been introduced as a new parameter for beet quality assessment in the Netherlands (Vermeulen, 2015). Several findings showed that soil lactic acid bacterium *Leuconostoc mesenteroides* is the major cause of microbiological losses in sugar processing. Under favorable conditions, these organisms multiply and formed nodular colonies which uses sucrose as a food source and produces a long-chain polysaccharide, known as dextran, and sugar alcohol, mannitol, as the major two degradation products.

Considering the above fact, this review paper is presented to achieve the following objectives -

- i. To integrate the possible physiological and biochemical causes of sucrose loss in harvested crops and
- ii. To analyze the inversion activities of storage crops that adversely affects sucrose content lowering in sugar recovery.

## **CHAPTER II**

### **MATERIALS AND METHODS**

The seminar paper is exclusively a review paper. So, there is not any specific method involved in data collection. The data and relevant information were collected from the following secondary sources such as:

1. National and international journals
2. Publications and Reports
3. Internet Browsing and
4. Google and Google Scholar are very useful to collect the required information.
  - Attractive suggestions, valuable information and kind consideration from my honorable major professor, course instructors and other resource personnel were taken to enrich the seminar paper.
  - After collecting the necessary information, it has been compiled and arranged chronologically for better understanding and clarification.

## CHAPTER III

### RESULTS AND DISCUSSION

#### 3.1. Physiological basis of post-harvest sugar loss

##### 3.1.1. Factors responsible for sugar crop deterioration

Sucrose is the most important parameter of sugar crop with respect to sugar recovery. Many factors such as crop variety, crop maturity, storage temperature and humidity, length of storage etc. influence the sugar crop deterioration as well as postharvest sucrose loss.

##### 3.1.2. Crop varieties:

Postharvest deterioration of crop varieties depends on the genetic nature and the morphological features of clone such as thickness, rind hardness, wax coating, marc content etc. Solomon (2009) stated that the fibrous varieties show a higher reduction in sucrose compared to less fibrous type. Khan *et al.*, (2020) experimented on postharvest quality of three sugarcane genotypes including one check variety subjected to staling for a period of seven days. Where it is observed that all of the genotypes showed a reduction in sucrose% over time. However, the gradual decrement in sucrose% evaluated in genotypes 1254 showed excellent response and values were not only highest for this clone but it also showed a minimal rate of reduction (Fig. 1).

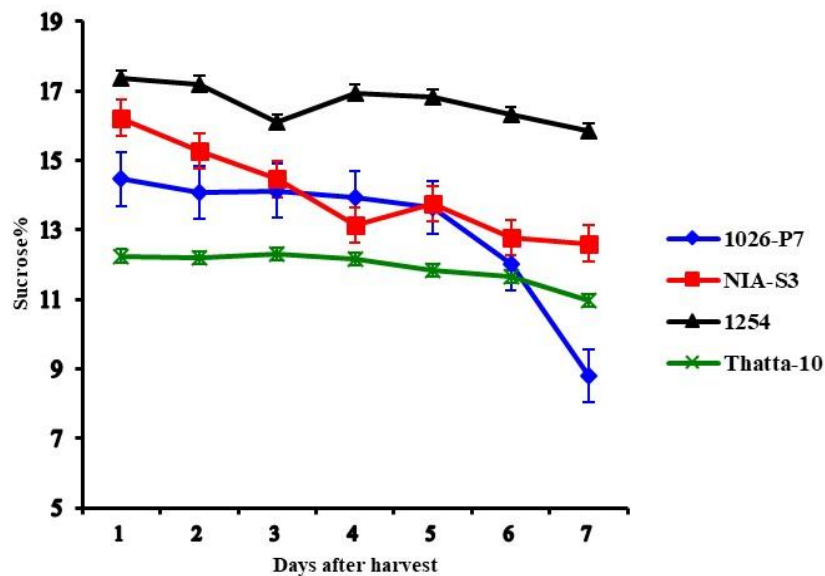


Fig. 1 Postharvest decline in sucrose contents of four sugarcane genotypes

Source: Khan *et al.*, (2020)

Moreover, NIA-S3 also showed good tolerance against a decrease in sucrose%. The highest rate of sucrose decline was observed in 1026-P7 before day 7. This decline in sugar contents is mostly attributed to high rind hardness that reduces less moisture, the enzymatic and microbial actions which convert sucrose into reducing sugars.

In case of sugar beet genotypes, Hoffmann and Schnepel (2016) point out that high marc content may feature a non-specific resistance, which reduces the infection, spread of pathogens and also decreased storage losses (Fig. 2).

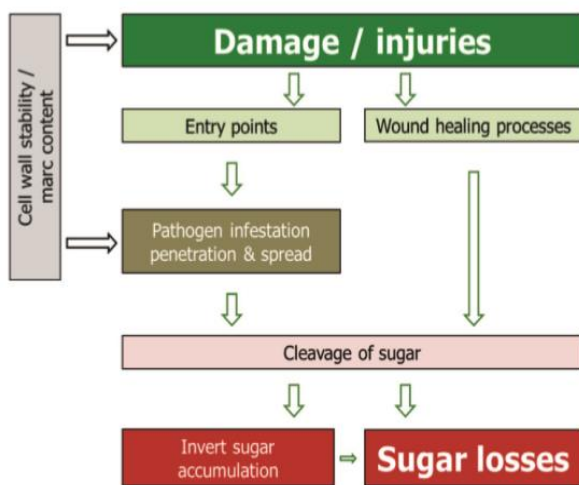


Fig. 2 Causes for genotypic differences in storage losses of sugar beet

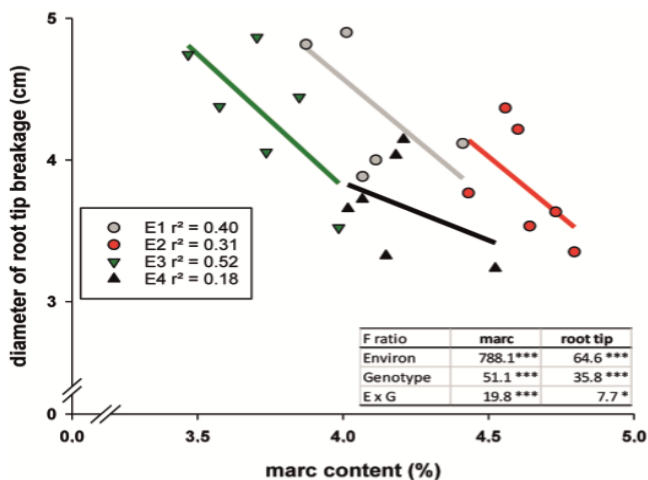


Fig. 3 Diameter of root tip breakage as related to the marc content of sugar beet genotypes

Source: Hoffmann and Schnepel (2016)

Additionally, after cleaning the diameter of root tip breakage was inversely related to the marc content of sugar beet genotypes (Fig. 3). Genotypes E2 with a higher marc (4.59%) content showed a lower diameter of root tip breakage over the lowest (3.69%) marc content genotypes E3. Sugar beet root tip breakage enhances pathogen infestation and inverts sugar content of the genotypes during storage.

### 3.1.3. Crop maturity

Cane maturity is a major factor governing the rate of inversion and subsequent reduction of stored sucrose in harvested cane. The fully mature cane will not deteriorate as rapidly as either immature or over a mature cane. This deterioration is relatively faster in hot weather. Solomon (2009) observed that as maturation level increased the extent of deterioration slackened. Rikkyapan *et al.*, (2009) experimented on the stage of cane maturity and quality at harvest affects the rate of post-harvest deteriorations of staling cane up to 120 hr. from 12<sup>th</sup> to 14<sup>th</sup> months of age sugarcane varieties.

**Table 1. Effect of staling in juice quality parameters from 0 to 120 hours after harvest**

	Variety	Reducing Sugars (%)		
		12 <sup>th</sup> month	13 <sup>th</sup> month	14 <sup>th</sup> month
Zero	Co 85019	0.62	0.68	0.62
24	Co 86032	0.90	0.68	0.72
48	Co 86249	1.03	0.95	1.09
72	Co 91010	1.48	1.42	1.75
96	Co 94005	1.71	1.55	2.41
120	Co 94008	2.46	2.58	3.58
	Mean	1.40	1.30	1.70

Source: Rikkyapan *et al.*, (2009)

From table 1 it is pointed out that during five days (120 hr.) of storage (Table 1), sucrose inversion to reducing sugar was quicker in canes harvested at 14<sup>th</sup> month than cane harvested at 12<sup>th</sup> month. It is more than four to five-fold increase from 0 to 120 hrs. of staling period. This may be due to the moisture loss in the staling period and juice gets concentrated, which probably results in an increase in invertase and also other hydrolytic enzymes activity during storage. Chandra *et al.*, (2014) reported that acid invertase enzymes are involved in the degradation of sucrose during cane maturity and post-harvest. Hydrolytic enzymes are responsible for a decline in its quality. These enzymes in harvested cane play a major role in the loss of sucrose. Maximum cane harvest continues up to 13<sup>th</sup> months. For the late-milling season (high ambient temperature), varieties with high rind hardness/fibre along with high wax content should be preferred. This will reduce considerable moisture and sugar loss from the cane.

#### **3.1.4. Storage temperature and humidity**

The ambient temperatures when approximately 35-40.5°C, the rate of sucrose inversion in stored sugarcane is increased. Low humidity and high temperature have a significant effect on sugar metabolism in stored cane juice. The activity of invertases is largely associated with the decline in cane quality. At high temperature a rapid increase in acid invertase (AI) and neutral invertase (NI) activity was noticed by Verma *et al.*, (2012), where higher AI and NI enzyme activity favored sucrose inversion, which is responsible for the reduction in sucrose per cent in the juice of the harvested and stored cane.

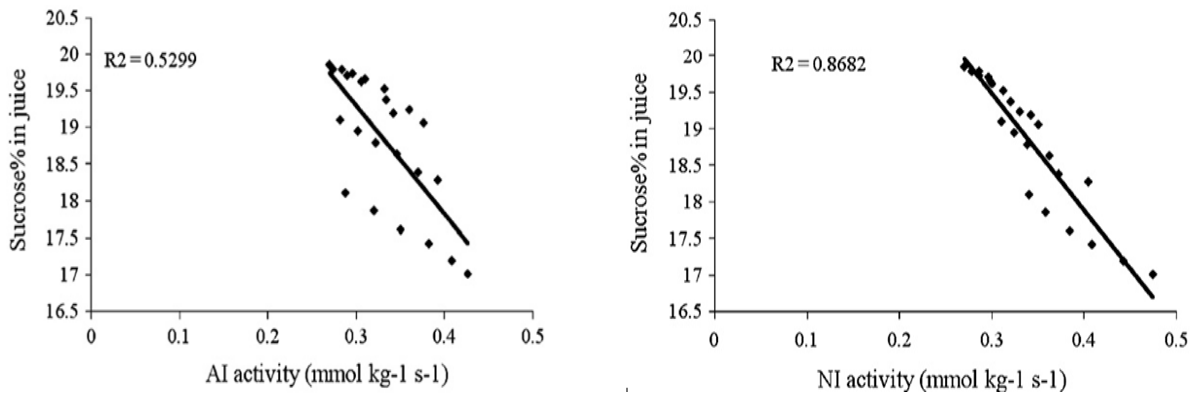


Fig. 4 Relationship between change in invertase activities and sucrose(%) in juice from harvest to 120 h of storage

Source: Verma *et al.*,(2012)

It can be summarized from fig. 4 that there is a negative correlation between the reduction in sucrose (%) in juice and activity of the invertases (AI and NI) on 24-120 h during storage. A sharp increase in AI and NI leads to increase in reducing sugars and consequently a drop in sucrose (%) in juice. By changing juice pH, the activity of acid invertases enhanced mobilization of cell invertase and encourages the synthesis of cut induced invertase and decreased activities of sucrose synthesizing enzymes.

In case of sugar beet after harvesting, the production of inverted sugar is the result of sucrose hydrolysis and metabolic processes of respiration. At first of storage, the quantity of inverted sugar decreases as a result of the decrease of invertase activity and consumption of the reducing sugars in metabolic processes. Therefore, the quantity of inverted sugar increases constantly by a rate depending both on storage conditions and health state of beet. Barna *et al.*, (2012) studied the performance of sugar beet cultivar victor for 60 days. It is usually the maximum storage period of sugar beet processing after harvest.

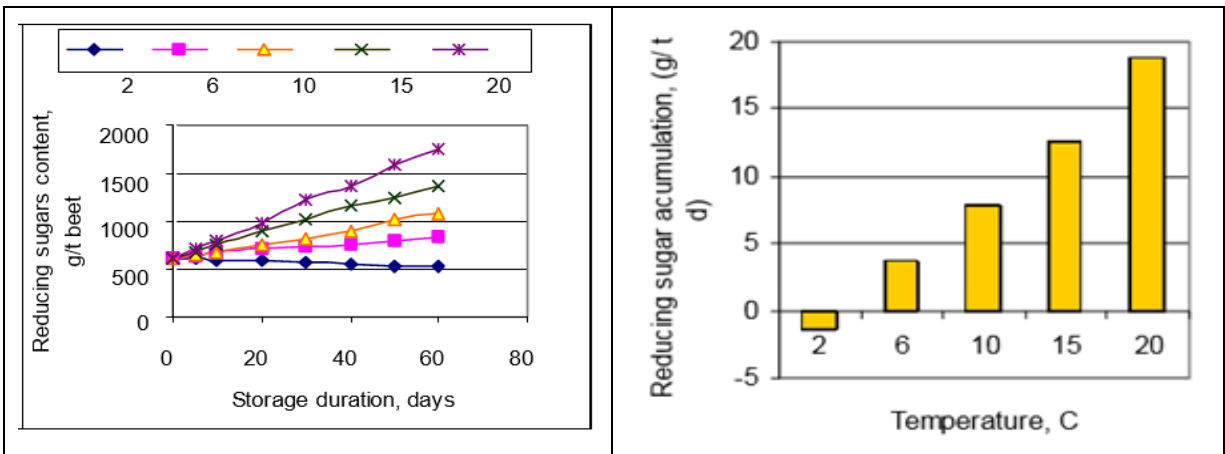


Fig. 5 Reducing sugar content of cultivars Victor stored at different temperatures during storage

Source: Barna *et al.*, (2012)

The average value of the accumulating rate of reducing sugars depending on temperature is also observed in fig. 5 After harvesting to until processing of sugar beet stored at heat level of 2°C, there is a slight decrease of reducing sugars content and a limiting tendency towards up to the 60 days of storage. When the storage temperature is raised up to 6°C, there is a continuous increase of the parameter. At temperatures scaled up of 10, 15 and 20 °C there is a further significant increase of the reducing sugars content with small variations specific to each heat level.

### 3.1.5. Length of storage

After harvesting of sugarcane, plant physiology is disrupted and these effects increase with the increasing period between harvesting and extraction of juice. If sugarcane is crushed within 24 hours of harvest, then the sucrose loss is minimum, but harvesting after 24 hours significant sucrose losses occur due to loss of moisture.

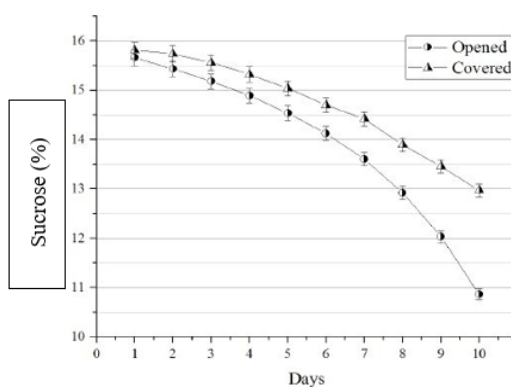


Fig. 6 Average sucrose percentage

Source: Hussain *et al.*, (2018)

Hussain *et al.*, (2018) conducted an experiment regarding losses of sucrose percentage over storage duration up to 10 days (Fig. 6). Initial sucrose percentage was observed 15.90%, which then decreased to 10.87% and 12.97% respectively for sugarcane kept open and covered with trash. The loss in sucrose may be due to the ageing of harvested cane through continuing inversion and their biochemical and microbiological agents. Rakkiyappan *et al.*, (2009) who reported that each day delay in the processing of harvested cane decrease pol/sucrose in cane.

Sugar beet genotypes differ in the rate and degree to which they lose sucrose or recoverable sugar during storage. Small size beets are more prone to sucrose loss than larger size beets because in storage condition ventilation are more in larger size beets pile, so respiration rate is also less. In a storage condition, temperature increases due to respiration. Pre-harvest and harvested beet quality (e.g. root tip breakage) also affect recoverable sugar loss in storage condition. El Shahaby *et al.*, (2014) conducted an experiment and summarized that significant amounts of recoverable sucrose were lost during storage.

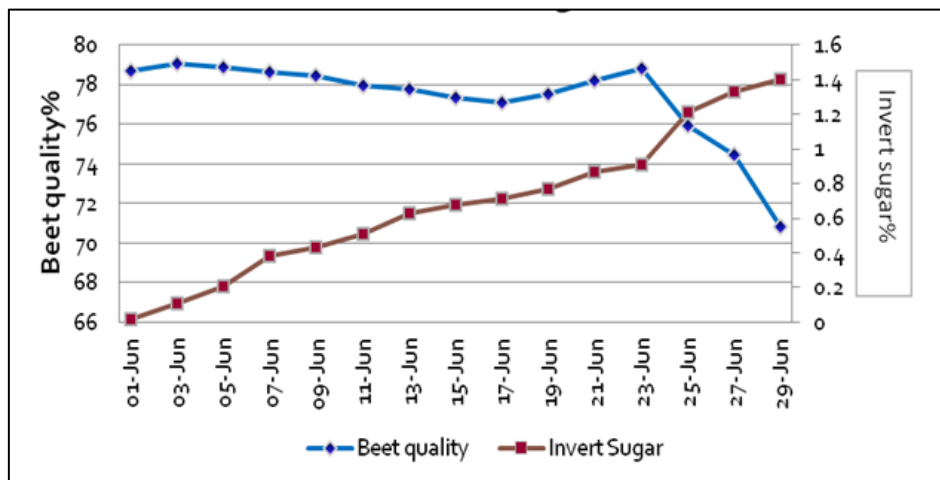


Fig. 7 Beet quality and invert sugar analyses through 29 days of beet roots storage  
Source: El Shahaby *et al.*, (2014)

The beet quality (%) (Fig. 7) is higher at the first period's storage and decreased gradually, whereas invert sugar (%) was low at first and increased gradually and reached the maximum of decreasing at the end of the study period. Deterioration of beet quality and biochemical conversion of sucrose to glucose and fructose (increase in invert sugar %) may be due to the storage condition, length of storage and increasing of microbial load. Form the above figure it can be said that the beet quality starts adversely deteriorate after the first 10 days of storage period.

### 3.2. Biochemical basis of post-harvest sugar loss

Another way of sugar loss occurring due to the formation of metabolites from microorganisms that invade in sugarcane or during processing. After the physiological loss, the major losses of sucrose in post-harvest sugarcane are from microorganisms. Products formed from sugarcane are the most nutritive source for growth and proliferation of microorganisms.



Plate 1. Possible infestation regions of *Leuconostoc* sp. in sugarcane (a) cut ends of harvested sugarcane b) cracks in sugarcane at lower internodes

Source: Misra *et al.*, (2017)

These microbes grow at a rapid pace and forms products that deteriorate sucrose of the cane stalk thereby hindering the production of the final product, sugar (Misra *et al.*, 2016). The invasion of microorganisms in sugarcane stalks is well known due to the sudden abrupt changes of the atmospheric temperatures or through the growth cracks, cut ends of the harvested canes, physical damage during cane possessing etc. provides favorable conditions for the growth of microorganisms (plate 1).

The microorganisms like bacteria, yeasts and moulds respectively are entered into the juice rich region of cane in wet and warm weather. Then they rapidly multiply but the number may vary qualitatively from place to place and season to season (Fig. 8). The cold climate favours yeast growth and proliferation while *Lactobacillus* predominates in summer seasons. Both these microbes are known to grow and consume sugar at a very fast and more than one per cent of cane sugar is lost and results in hindrance on sugar processing. They also affect the sugar recovery and as well as negatively affects the quality of sugar obtained Misra *et al.*, (2017).

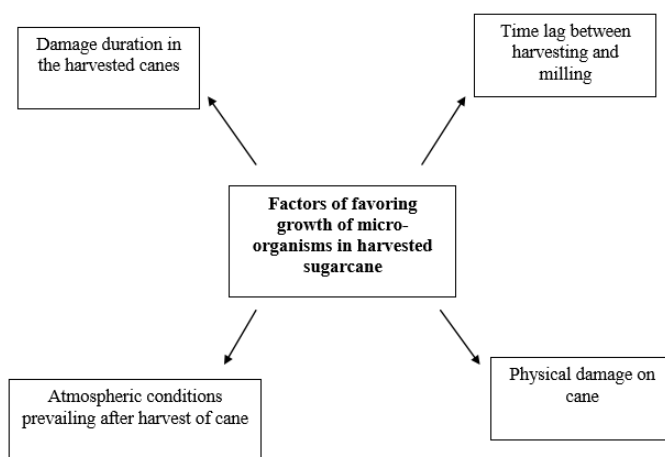


Fig. 8 Growth factors of microorganisms in harvested sugarcane  
Source: Misra *et al.*, (2017)

After infestation, these microorganisms reach the internal tissues of cane stalks where sucrose is hydrolyzed into monosaccharide like glucose and fructose. Solomon *et al.*, (2006) found that yeasts, *Leuconostoc*, *Xanthomonas* and *Aerobacter* were present at the cut or damaged sites of the cane which have the potential to convert sucrose into a polysaccharide, dextran. The conversion of sucrose into dextran indicates that sugarcane has deteriorated its sucrose content.

In case of sugar beet, long term storage (116 days) a white fungus named *Minilla* had spread over the beet clamp (Plate 2). Some other moulds like *Penicillium*, *Botrytis*, *Fusarium* and *Sclerotinia* etc. (Plate 3) are identified in case of long-time storage (Huijbregts *et al.*, 2013).



Plate 2. *Monilla* in a sugarbeet clamp after 16 days of storage



Plate 3. Mould damage to sugarbeet in long-term storage

Source: Huijbregts *et al.*, (2013)

For long term storage, the main threat for sugar beet is mould infections and the ultimate result is rotting. If a slight infection by *Penicillium* and *Botrytis* can increase respiration rate in stored beets and greatly enhance the content of invert sugar, as a result, sugar loss occurred.

### 3.3. Biodeterioration and metabolic conversion basis post-harvest sugar loss

The deterioration due to microorganism is also known as biodeterioration and caused by mainly *Leuconostoc* sp. (*L. mesenteroides* and *L. dextransicum*). The microorganism is a facultative anaerobe and reproduces rapidly under anaerobic conditions (Fig. 9), such as mud-coated canes and cane stored in large piles with poor ventilation.

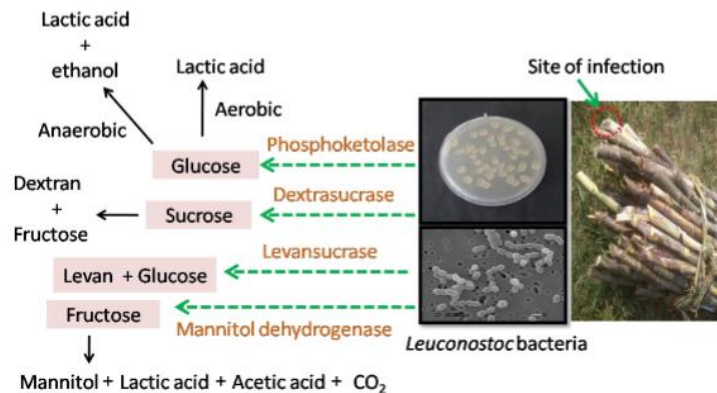


Fig. 9 Biochemical changes induced by *Leuconostoc* sp. infestation during post-harvest deterioration of sugarcane

Source: Misra *et al.*, (2017)

According to Eggleston *et al.*, (2017), soil lactic acid bacterium *Leuconostoc mesenteroides* is the major cause of microbiological losses in sugar processing.

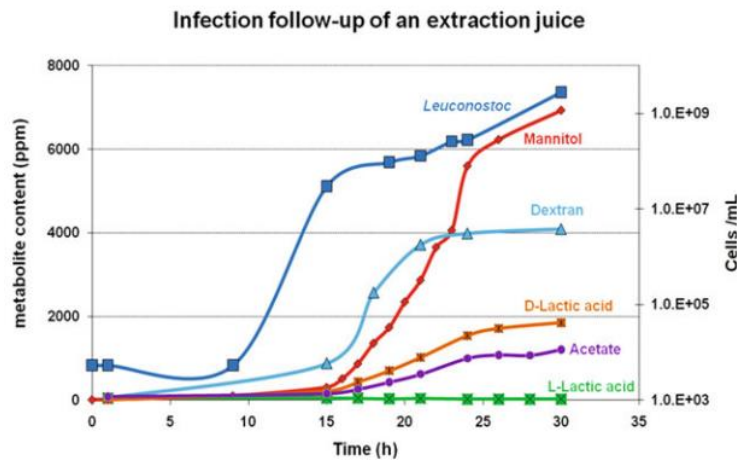


Fig. 10 Production of metabolites (degradation products) after a sugar juice was infected with *Leuconostoc mesenteroides* bacteria  
Source: Eggleston and Huet, (2012)

Under favorable conditions, these organisms multiply and formed nodular colonies which uses sucrose as a food source and produces a long-chain polysaccharide, known as dextran, and sugar alcohol, mannitol, as the major two degradation products (Fig. 10).

The following some important metabolites of microbial origin have been mentioned which is used as an indicator of cane deterioration-

**3.3.1. Organic acids:** Organic acids such as lactic acid, acetic acid and butyric acid produced by microorganisms leads to loss of sucrose and lowering of juice pH. An increase in acidity of the sugarcane juice was observed by Khan *et al.*, 2020. They (Fig. 11) were recorded a decline in juice pH was observed overtime after one to seven days of staling. A general trend of decline in pH values was observed in all sugarcane genotypes during day 1 and 2, after which the values maintained until day 5, followed by a rapid decline until day 7. The pH values of NIA-S3 were observed to remain highest until day 6.

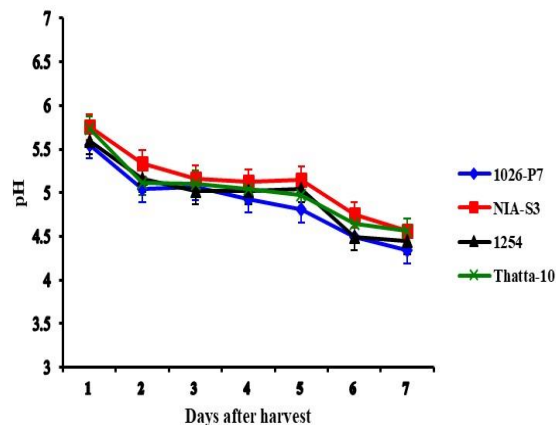


Fig. 11 Post-harvest effects on pH of sugarcane juice of four genotypes  
Source: Khan *et al.*, (2020)

The development of acidity is attributed to lactic and acetic acid engendered in harvested sugarcane. **3.3.2. Ethanol:** In deteriorated juice, a large number of yeasts is constantly present which not only favors the acid but also produce ethanol, which causes expensive for production of sucrose. Ethanol accumulation is used as an indicator of sugar loss in cane extracts and as an indicator of delay harvesting to the milling process. It is 2-3 times higher for burned cane as compared to unburned cane (Solomon, 2009).

**3.3.3. Dextran:** Engenderment of dextran is one of the main causes of sucrose losses and cane deterioration. Sucrose is biologically converted to dextran by *Leuconostoc mesenteroides* with the help of enzyme dextransucrase. The enzyme causes polymerization of dextrose into a polysaccharide, called dextran. Dextran is a gummy substance which hinders sugar processing and quality of sucrose. Priyanka and Solomon (2013) executed an experiment and find out that in December at low-temperature dextran concentration (6553/100 Brix) was low at the time of harvest, which increased 2.6 times after 240 hours from harvest. In April, during the high-temperature period, the dextran content started at 7959/100 Brix and increased by 4.84 times after 240 hours of harvest (Fig. 12)

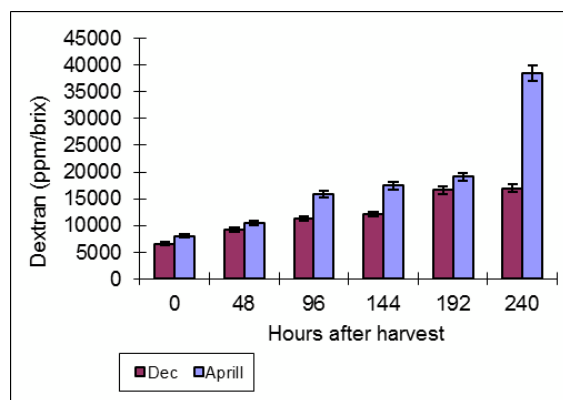


Fig. 12 Formation of dextran during at low and high temperatures for different delay times

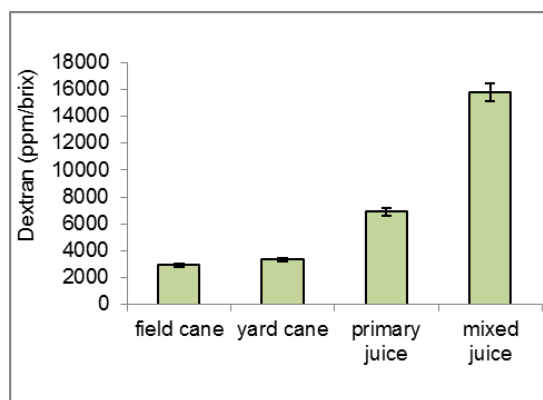


Fig. 13 Formation of dextran between harvesting and mixed juice

Source: Priyanka and Solomon (2013)

The dextran content (Fig. 13) which was 2920/100 Brix in field cane increased to 15800/100 Brix in mixed juice. This increase in dextran is the progressive decline in sucrose which, in turn, reduces sugar recovery and impacts processing efficiency in the factory. Dextran causes an increase in cane juice viscosity which hinders the crystal formation in the cane. This study has demonstrated the deterioration of cane was higher during the high-temperature conditions in April. and juice quality over 240 hours between harvesting and processing at the factory as indicated by a progressive increase in dextran.

**3.3.4. Oligosaccharides:** The accumulation of oligosaccharides during the post-harvest period is also indicative of enzymatic, bacterial activity. The kestoses (1-6-and neokestoses) were found to be the main oligosaccharides formed (Solomon, 2009).

### 3.3.5. Mannitol

Mannitol is a major degradation product of *Leuconostoc mesenteroides* activity (Fig. 9) in sugar crops and sensitive marker to predict processing problems. The rate of mannitol formation from the reduction of fructose by the enzyme mannitol dehydrogenase was much higher than associated with other oligosaccharides or ethanol. Priyanka and Solomon (2013) found that, in December, at low temperature (7–8 °C) mannitol concentration at the time of harvest was 1896 ppm/100 Brix which increased fourfold by 240 hours after harvest (Fig. 14). In April when at the time of harvest the ambient temperature was high (42–45 °C), mannitol content was 10521 ppm/100 Brix which increased by 5.6 times and was 59215 ppm/100 Brix at 240 hours after harvest. The high level of mannitol in freshly harvested cane, particularly during the hotter months, is likely due to damaged and diseased cane. It is a reliable indicator of cane and juice deterioration. So, from the above findings, it can be said that for every 1000 ppm/100 Brix rise in mannitol concentration there is around 0.8-1.0 units loss in sucrose.

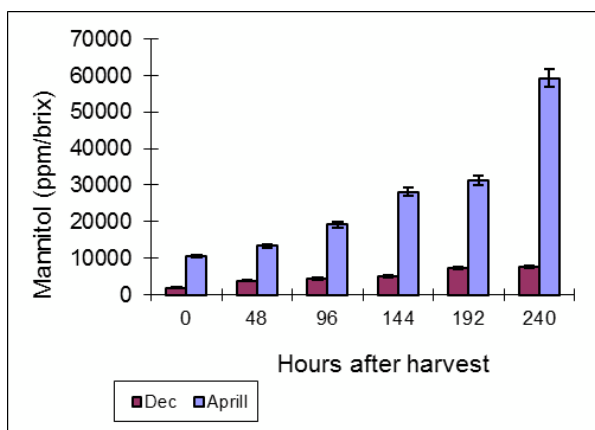


Fig. 14 Formation of mannitol during at low and high temperatures for different delay times

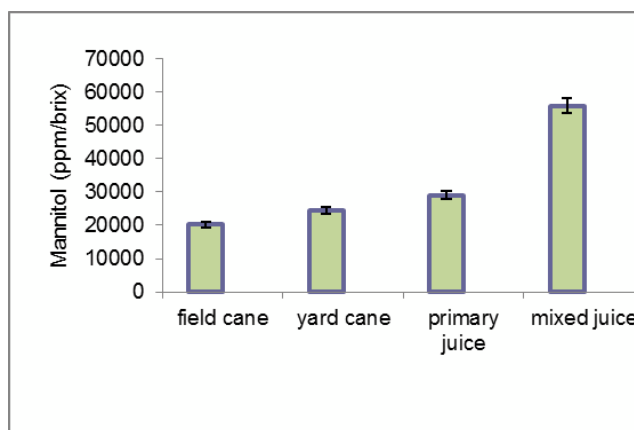


Fig. 15 Formation of mannitol between harvesting and mixed juice

Source: Priyanka and Solomon (2013)

From fig. 15 we can illustrate that mannitol formation in the juice from field cane was recorded 20150 ppm/100 Brix and it increased steadily through the yard cane juice to primary juice and then almost doubled between primary juice and mixed juice. Thus, it is clearly observed that during high temperature over 10 days between harvesting and processing, a progressive increase in dextran and mannitol contents deteriorates cane and juice quality.

## CHAPTER IV

### CONCLUSIONS

Post-harvest deterioration and sucrose loss is largely dependent upon the sugar crops physiological characters such as genotypes which have less weight, fibre % and sucrose% loss quality with a proper cane maturity period between 12<sup>th</sup> to 13<sup>th</sup> month. The fully mature cane will not deteriorate as rapidly as either immature or over a mature cane. Sugar beet genotypes with high marc content, low root tip breakage reduce the infection and spread of pathogens, resulting in lower storage losses. Low humidity, high temperature and length of storage have a significant effect on the activity of invertases which is largely associated with a reduction in sucrose per cent in the juice of the harvested and stored sugar crops. Due to the physical damage during cane possessing, provides favorable conditions for the growth of microorganisms and is further emphasized as time increases. The cold climate favors yeast and *Lactobacillus* predominate in summer seasons, for their growth and proliferation more than one per cent of cane sugar is lost and also a hindrance on sugar processing. They negatively affect sugar recovery and also obtained sugar quality.

Microorganisms especially *Leuconostoc*, *Xanathomonas* and *Aerobacter* are important to the production of acids and dextran like materials. The formation of these materials is the major cause of microbiological losses in sugar processing. Under favorable conditions, these organisms multiply and formed nodular colonies which uses sucrose as a food source and produces a long-chain polysaccharide, known as dextran, and sugar alcohol, mannitol, organic acids like, lactic and acetic acid, ethanol etc. degradation products with the help of enzyme dextransucrase, mannitol dehydrogenase, phosphoketolase and levansucrase. By analyzing the inversion activities, it is undoubtedly mentioned that during high temperature the deterioration of cane is highest. As well as juice quality over 240 hours between harvesting and processing is an indication of adversely affects sucrose content finally lowering in sugar recovery.

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