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The Microbial Count in Sugarcane Juice Obtained from Common Crusher and Effect of its on Changes of Color

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Abstract

The microbial cell population present in sugarcane juice and their role in colour formation in sugarcane juice have been ascertained. Their cell population in sugarcane juice has been determined. The data obtained revealed that the mesophiles and thermophiles were present in sugarcane juice. The microbial density decreases as cane juice progress through different temperatures. The microorganism plays an important role not only in the deterioration of various types of juices but also results in the development of more colour due to the formation of metabolic products of microbes. Colour analysis of sugarcane juice carried out by the International Commission for Uniform Methods of Sugar Analysis (ICUMSA) methods showed that variation of colour values was observed. The Colour deterioration of sugarcane juice was also studied at various time periods at intervals of four hours each.

Keywords: Sugarcane juice; Mesophiles; Thermophiles; MPN method; Colour balance; ICUMSA colour; Colour deterioration

Introduction

Sucrose, the most commonly used sweetener, is extracted and purified from sugarcane (*Saccharum Officinarum*) and beet (*Beta Vulgaris*) [1]. Microorganisms such as *Bacillus stearothermophillus, B. coagulans, Clostridium thermosaccharolyticum and C. nigrificans*, cause spoilage of products at the same time increase in colour certain mesophilic bacteria [2,3]. Plant and equipment sanitation as well as water quality have been identified as factors affecting microbial contamination.

It is generally accepted that sugarcane starts deteriorating immediately after it has been cut. This deterioration is essentially caused by two types of processes. The first involves the inversion of sucrose by enzymes naturally present in the cane while the second, which predominates in wet, warm weather and can cause rapid and involves the infection of the cane by micro-organisms which convert sugar to invert sugar and beyond mainly to organic acids and volatile as well as non-volatile acids.

The present study has been undertaken to explore the possibility of bacterial contamination and the extent of microbes has been determined by the ICUMSA method, MPN method and pour plate method.

Materials & Methods

Sugarcane juice is a common man's refreshing beverage and it is sold at most of the public places at reasonable prices. Hygienic standards are not maintained by the sellers and no pasteurized commercial sugarcane juice is available in our region. Five samples of fresh sugarcane juice were collected in sterile containers and transported to the laboratory in ice boxes.

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Determination of microbial cell population

It was done by pour plate method using serial dilution technique, as enumeration in ICUMSA methods GS-2/3-43-1994 (for thermophilc bacteria) [4,5]. The microbial cell populations of these microorganisms were determined in sugarcane juice and clear juice. Three samples and each of them was serially diluted suitably using sterile distilled water, to different dilutions, depending upon the probable cell count in a particular sample. As each, the dilutions were varied between 100 to 10 million times so that the incubated plate may have, as far as possible, a colony count in the range of 30 to 300. For each sample, three appropriate dilutions were used and each dilution was plated in triplicate. After inoculation with the diluted samples, all plates were incubated at the appropriate temperature for a suitable time sufficient to allow visible colony formation. Applying the two methods for determining the microbial cell population as a pour plate

Determination of colour of sugarcane juice by ICUMSA method

Analysis of the colour of sugarcane juice and Clarified sugarcane was done by diluting all the samples with distilled water to about 50 Brix followed by method GS 1-7 (ICUMSA Method Book 1994) [6-10].

Thermophilic flat sour Count

The MPN (Most Probable Number) method is used for counting the bacteria in sugarcane juice samples. These bacteria have a special property of growing at a temperature of 44°C to 55°C or more and are reported to tolerate still higher temperatures even up to 95°C. Several of these bacteria, like lactic acid bacteria, form organic acids as such their growth may be ascertained with the help of a suitable dye like Bromocresol Purple (BCP) which changes its colour to yellow in the presence of an acid. Thermophiles can be divided into three groups. Group 1 comprises the flat sour bacteria, of which the type of species is Bacillus stearothermophilus. They reproduce without gas formation. Group 2 consists of gas-producing thermophilic anaerobes of which the type species is Clostridium thermosaccharalytium. In their activity, hydrogen and CO_2 are the two gases produced with a cheesy or butyric acid odour predominating. Group 3 includes sulphide spoilage bacteria with *Clostridium nigrificans* as a type of species. Hydrogen sulphide is their basic end product. The optimum temperature of growth temperature is at 55°C and the maximum growth temperature is 75°C.

Mesophilic Bacteria

These bacteria flourish in the temperature range of 20°C to 35°C, which prevails in India for the most part of the year. Therefore, the chances of mesophilic bacteria occurring in sugarcane juice and other products are quite high.

Deterioration of colour

In the microorganism, they consume sugar with the formation of different types of metabolic products like acetic, lactic, butyric, propoinic acid and other acids through in sugarcane juice after crusher. In clear sugarcane juice, usually, temperature is high which help prevent growth of microorganisms but many of thermophilic bacteria producing different acids as a results of their metabolic activity survive and make their presence in sugarcane juice and ultimately are responsible for colour deterioration.

In order to study variations in microorganisms and the colour of sugarcane juice collected from a common crusher (in the village) analysis was carried out. Colour values obtained in ICUMSA and for determining the microbial cell populations present in different sugarcane juice.

Results and Discussion

Samples of sugarcane juice were collected from a common crusher (in the village) and analysed for various parameters including the microbial count. The results in **TABLE 1** showed that in the samples of sugarcane juice and clear sugarcane juice, the number of mesophiles was 160.24 million/ml, and 0.24 million/ml. The population of mesophiles in clear juice was found to be comparatively less than in sugarcane juice. The decline in mesophilic bacterial population during the clarification is quite natural since it is being heated at high temperatures.

Cane sugar products as a source of thermophilic flate sour bacteria were first reported and this work examined the number of thermophilic flat sour counts in sugarcane juice [3]. The results showed that thermophilic flat sour were found as contaminants in sugarcane juice in the range of 1.0×10^4 CFU/ ml - 9.7×10^3 CFU/ ml **(TABLE 1)**.

TABLE 1. **The averages bacteria counts of sugarcane juice.**

Type of microorganism	Sugarcane juice	Clear sugarcane juice
Total bacteria (CFU/ml))	9.7×10^{6}	2.6×10^{6}
Total thermophile (CFU/ml)	1.0×10^{4}	9.7×10^{3}
Total mesophile (CFU/ml)	1.6×10^{7}	2.4×10^{5}

Abundant microflora in filtered clear juice showed that colour removal and purity rise in clarification cannot be considered as criteria for assessment of the removal of bacteria. The filtered juice must be properly disinfected and not further exposed. The high content of the thermophilic microflora in sugarcane juice indicated that infection is either soil or waterborne or both. Filtration and evaporation reduced appreciably the bacterial count.

Variation in the ICUMSA colour values from sugarcane juice and clear sugarcane juice in five different samples is given in **TABLE 2**. The colour of sugarcane juice depends on different factors like maturity and variety of sugarcane, time lag between harvesting and crushing, and harvesting conditions (burnt or green). The colour of sugarcane juice has in the range of 15,972 IU to 24713 IU in these five samples.

TABLE 2. **ICUMSA Colour balance data in the processing of five sample.**

Particulars	Colour in ICUMSA unit				
	Ist sample	IInd sample	IIIrd sample	IVth sample	Vth sample
Sugarcane juice	16312	20750	15972	24713	23520
Clear sugarcane juice	5221	7111	6235	7395	12110

The colour of clear sugarcane juice depends upon the quality and optimum dosing of lime, pH control and temperature. **TABLE 2** reveals that about 60% -70% of the colour of sugarcane juice is removed in the stage of clarification (by addition of lime and heat) (samples No. 1 to 4) and in sample number 5 due to poor clarification, only 48.51% colour was removed Gue to heat colour formation takes place in the juice during evaporation due to the formation of melanoidins & other colouring compounds.

TABLE 3 gives the data obtained report being variations in the colour of sugarcane juice in 20 hours. Results show that the rate of deterioration of mixed juice increases with an increase in storage time, as a consequence of more development of microbial contamination and formation of their metabolic byproducts. As is evident from **Table 4** the ICUMSA colour deterioration of sugarcane clear juice is ba it lower than sugarcane juice. It is due to the fact that the contamination of microbes is slightly removed during the clarification process.

It can be concluded that microorganisms play an important role not only in the deterioration of sugarcane juice but also results in the development of more colour due to the formation of metabolic products of microbes.

TABLE 3. **Deterioration of colour (in ICUMSA unit) of sugarcane juice during 20 hour.**

Time (hours)	Sample No-1		Sample No-2		Sample No-3		Sample No-4		Sample No-5	
	colour	% change	colour	% change	colour	% change	colour	% change	colour	% change
0	16312	-	20750	-	15972	-	24713	-	23520	-
4	16504	1.16	21140	1.84	16380	2.49	24970	1.03	23810	1.22
8	16684	2.23	21430	3.17	16620	3.89	25230	2.40	23980	1.92
12	16980	3.93	21560	3.76	16720	4.47	25540	3.24	24180	2.73
16	17104	4.63	21912	5.30	16845	5.18	25660	3.69	24380	3.52
20	17205	5.19	22140	6.28	17042	6.27	25970	4.84	24630	4.50

TABLE 4. **Deterioration of colour (in ICUMSA unit) of sugarcane clear juice during 20 hour.**

Time (hours)	Sample No-1		Sample No-2		Sample No-3		Sample No-4		Sample No-5	
	colour	% change	colour	% change	colour	% change	colour	% change	colour	% change
0	5221	-	7111	-	6235	-	7395	-	12110	-
4	5314	1.75	7230	1.64	6295	1.0	7480	1.14	12320	1.70

8	5405	3.40	7290	2.45	6325	1.40	7602	2.72	12505	3.16
12	5445	4.11	7310	2.72	6397	2.53	7690	3.83	12720	4.80
16	5495	4.98	7380	3.64	6470	3.63	7780	4.95	12850	5.78
20	5515	5.30	7460	4.67	6526	4.43	7820	5.43	13105	7.60

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