PRELIMINARY COMMUNICATION

Shelflife Enhancement of Sugarcane Juice

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Summary

Preservation of sugarcane juice was examined to reduce the spoilage and to increase the shelf life of the juice using chemical preservatives. The preservation of the juice was carried out using Potassium Meta bi sulphite (KMS), spices and mild heat treatment at different combinations under refrigeration temperature.

The result revealed that good quality beverage from sugarcane juice of variety Cos 767 with satisfactory storage stability of 60 days at refrigeration could be prepared from heat treated juice at 75 °C for 10 min after addition of 3.0 ml lemon as flavor enhancer and source of citric acid (anti oxidant) and 1.0 gm salt as flavoring compound, 0.6 ml ginger as flavor enhancer per 100 ml of sugarcane juice. Potassium Meta bi sulfite (KMS) addition at the rate of 225 ppm was found to be the best anti microbial agent. The lemon was able to lower the pH of sugarcane juice to 3.01 which gave a preservative action and inhibit the growth of micro-organisms during storage. Potassium Meta bi sulphite is also a known yeast and mold inhibitor and is being used widely for the preservation of foods.

Keywords: *sugarcane juice, shelf life, Potassium Meta bi Sulphite (KMS), anti microbial;*

Introduction

Sugarcane is an important industrial crop cultivated in tropical and subtropical regions of the world. India is the world second largest producer of sugarcane next to Brazil. Sugarcane has been used as a sweetener for millennia and today refined sugar is used in copious quantities to supplement the natural sugar (fructose) found in fruits and vegetables. (Phanikumar, 2011)

A part of sugarcane juice consumed as expensive and pleasing beverages in India. It possesses therapeutic value. (Banerji et al., 1997)

Sugarcane juice is commonly used as a delicious drink in both urban and rural areas. Sugarcane juice of 100 ml provides 40 Kcal of energy, 10 mg of iron and 6 µg of carotene (Parvathy, 1983). Sugarcane juice is rich in enzyme and has many medicinal properties. It contains water (75%-85%), reducing sugar (0.3-3.0%), non-reducing sugar (10-21%). (Swaminathan, 1995) Sugarcane juice is a great preventive and healing source for sore throat, cold and flu. It has a low glycemic index which keeps the body healthy. Even the diabetic can enjoy this one sweet drink without fear. It is because it has no simple sugars. It hydrates the body quickly when exposed to prolong heat and physical activity. It is excellent substitutes for aerated drinks and cola; it refreshes and energizes the body instantly as it is rich in carbohydrates.

In general sugarcane juice is spoiled quickly by the presence of simple sugars. The sugarcane juice can be introduced as delicious beverages by preventing the spoilage of juice with appropriate method. Biodegradation is caused by microorganisms mainly *Leuconostoc* sp. (*L. mesenteroides* and *L. dextranium*) also takes place. Soon after the harvest of sugarcane; endogenous invertase enzyme is activated and acts as a cause of deterioration. These organisms convert sucrose into polysaccharides, such as dextran. Besides, loss of sucrose, the presence of dextran even in very small amount creates problem of filtration, clarification, crystallization and alters the shape of sugar crystals thereby affecting the quality of sugar (Krishnakumar and Devadas, 2006).

Many commercial juices are filtered to remove fiber or pulp, but high-pulp fresh orange juice is a popular beverage. Common methods for preservation and processing of fruit juices include canning, pasteurization, freezing, evaporation, drying and addition of preservatives.

Materials and Methods

Sugarcane of CoS 767 variety were procured from the local fruits and vegetable whole sale market of Agra. Fresh sugarcane was used for the extraction of sugarcane juice. Fresh sugarcane stems were used for the juice recovery process. Graded sample were then washed by running tap water to get sugarcane free from any dust and dirt. Then skin and node of sugarcane stem were removed with the help of curved blade knife. Sugarcane juice were extracted by power operated screw juice extractor and filtered through the sieve and muslin cloth to remove the extraneous matter. The process flow chart for sugarcane juice recovery is given in Figure 1.

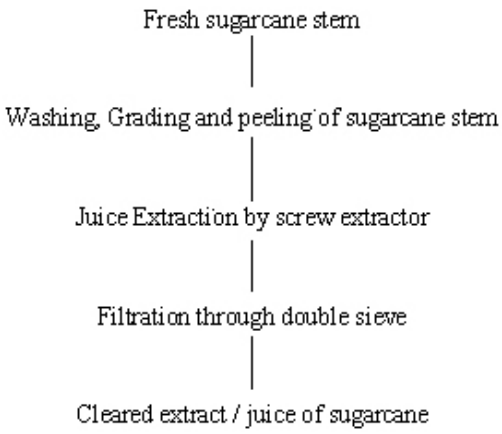

Figure 1. *Recovery process for sugarcane extract.*

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Lemons were cut into two pieces with the help of sharp blade knife. Then lemon pieces were squeezed by squeezer and lemon extract was filtered through the muslin cloth to remove the extraneous matter and seeds. The process flow chart for preparation of lemon extract is given on Figure 2.

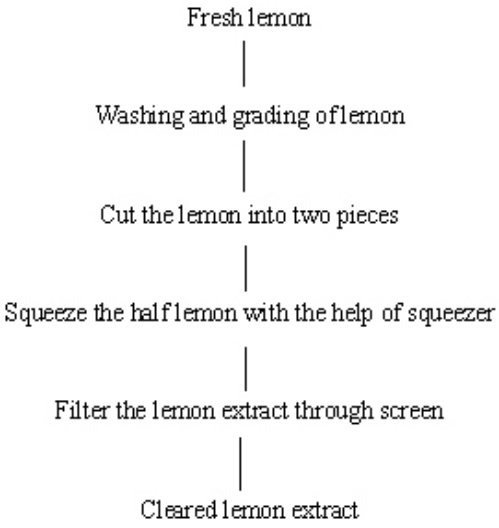

Figure 2. *Preparation of lemon extract.*

Gingers were peeled with the help of sharp blade knife. Then peeled ginger pieces were cut into small pieces. Then ginger extract was extracted by put into in muslin cloth and apply force to help in ease of extraction. After that ginger extract were filtered through muslin cloth and shreds of ginger were discarded. The process flow chart for preparation of ginger extract is given on Figure 3.

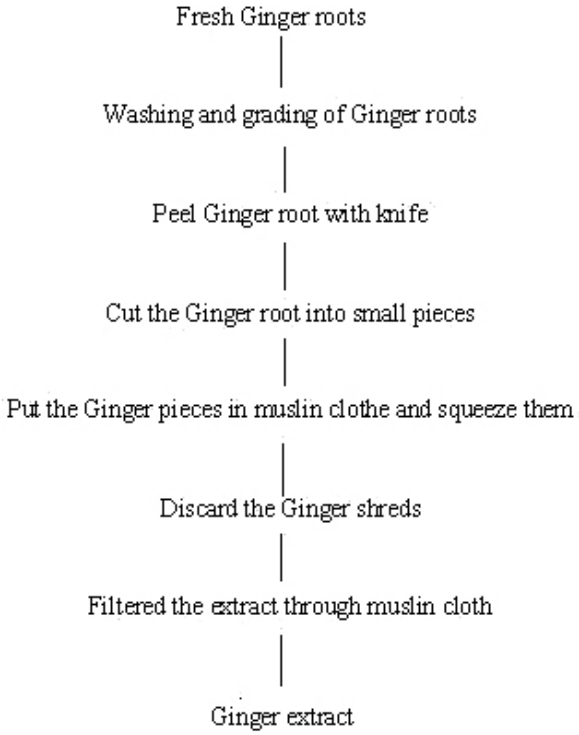

Figure 3. *Preparation of ginger extract.*

After the extraction of sugarcane juice, the ginger extract, lemon extract optimization of sugarcane juice beverage formulation was done by the addition of ginger extract, lemon extract and black salt to sugarcane juice in proper concentration as per the calculation made in table 1.0.

Table 1. *Optimization of sugarcane juice beverage formulation per 100 ml of juice.*

Sr. no.	Black Salt (gm)	Lemon (ml)	Ginger (ml)
1	1.00	2.50	0.5
2	1.00	2.75	0.5
3	1.00	3.00	0.5
4	1.00	2.50	0.6
5	1.00	2.75	0.6
6	1.00	3.00	0.6
7	1.00	2.50	0.7
8	1.00	2.75	0.7
9	1.00	3.00	0.7
10	1.25	2.50	0.5
11	1.25	2.75	0.5
12	1.25	3.00	0.5
13	1.25	2.50	0.6
14	1.25	2.75	0.6
15	1.25	3.00	0.6
16	1.25	2.50	0.7
17	1.25	2.75	0.7
18	1.25	3.00	0.7
19	1.50	2.50	0.5
20	1.50	2.75	0.5
21	1.50	3.00	0.5
22	1.50	2.50	0.6
23	1.50	2.75	0.6
24	1.50	3.00	0.6
25	1.50	2.50	0.7
26	1.50	2.75	0.7
27	1.50	3.00	0.7

Based on sensory evaluation, best combination was chosen. KMS (Potassium Meta bi sulphite) was added in different proportion. The sugarcane juice was then filled in sterilized glass bottles. The bottles after being filled were loosely covered with the tin crowns. The partially sealed glass bottles were exhausted at high temperature. After complete exhausting the glass bottle were sealed by double seamers and pasteurized. For the heat treatment purpose in bottle pasteurization method were used to heat treat the sample. The heat treatment temperature (60, 75, and 90 ^{o}C) for 10 min was studied for optimization of treatments based on sensory evaluation of juice.

Optimization of KMS (Potassium Meta bi sulphite) quantities was done based on physico-chemical and sensory characteristics changes during the storage life of sugarcane juice beverage. Sugarcane juice beverage at different level (150, 175, 200, 225 ppm) of KMS (Potassium Meta bi sulphite) were subjected to storage studies at refrigeration temperature for a

period of two months by drawing samples for determination of changes in physico-chemical, microbiological and sensory evaluation (Ranganna,1986) at ten days intervals to evaluate changes in chemical and micro-biological parameters.

Result and Discussion

Physico-chemical and sensory analysis of raw sugarcane juice

Physico-chemical characteristics of raw juice without addition of flavoring were analyzed. The juice content of sugarcane was found to be 51.8%. The TSS of Juice was 19.5 °Brix, which is higher than that found in the study of Krishnakumar and Devadas (2006). These variations in juice yield, and TSS might be attributed to cultivation process and crushing methods.

All the chemical characteristics was also analyzed, the sugarcane juice is acidic in nature pH 4.35.The vitamin C content were 1.25 mg/100 g. The data of various physico-chemical characteristics and sensory analysis are given in table 2.

Optimization of sugarcane juice beverage formulation per 100 ml of juice

In the optimization of sugarcane juice beverage formulation mainly the quantity of salt, lemon and ginger in sugarcane juice was optimized based on sensory evaluation. The sensory evaluation was based on three parameter flavor, appearance and overall acceptability. For the optimization process different ratio of black salt (1.0-1.5 gm), lemon (2.5-3.0 ml), and ginger (0.5-0.7 ml) were employed. The average score obtained by each ratio are given in table 3, in which the sample no. 6 (black salt 1.0 gm, lemon 3.0 ml, ginger 0.6 ml) obtained the best scores. This optimized beverage was used for shelf life study.

Physico-chemical and sensory analysis of sugarcane juice beverage prepared

Physico-chemical characteristics of prepared sugarcane juice beverage were analyzed. The TSS of Juice was 19.5 °Brix, which was higher than that found in the study of Krishnakumar and Devadas (2006). These variations in juice yield and TSS might be attributed to cultivation process and crushing methods.

All the chemical characteristics were also analyzed; the sugarcane juice beverage was acidic in nature with pH 4.09. The vitamin C content was 2.04 mg/100 g, which is higher than the value reported by Chauhan et al. (2001). The reducing sugar was found to be 0.6%.

The data of various physico-chemical characteristics and sensory analysis of prepared sugarcane juice beverage is given in table 4.

Physico-chemical and microbiological changes during storage of sugarcane juice

Changes in physico-chemical characteristics are shown in above Table and Figures. The total soluble solids (reduced by 10%) during storage of sugarcane juice at refrigeration temperature, however, the decrease was of lesser extent in sample no. 4 which contained 225ppm of KMS. The decrease in total soluble solids is due to conversion sugars to acids during storage because of biochemical reactions in the juice. The content of reducing sugars in juice increased significantly during storage due to the hydrolysis of non-reducing sugars. Addition of lemon (ascorbic acid) to heat treated sugarcane juice beverage restricted the degradation of total soluble solids and total sugars during storage at refrigeration temperatures. The pH decreased whereas acidity increased significantly during storage of sugarcane juice. Addition of Potassium Meta bi sulphite to

Table 2. *Physico-chemical and sensory analysis of raw sugarcane juice.*

Sr. no.	Characteristics	Analysis
1	Juice Yield (%)	51.8
2	TSS (° Brix)	19.5
3	Vitamin C (mg/100 g)	1.25
4	pH	4.35
5	Acidity (%)	0.128
6	Appearance	7.0
7	Flavor	7.5

Table 3. *Optimization of flavoring (salt, ginger and lemon) per 100 ml of juice.*

Sr. no.	Black Salt (gm)	Lemon (ml)	Ginger (ml)	Overall Sensory Score
1	1.00	2.50	0.5	6.2
2	1.00	2.75	0.5	7.2
3	1.00	3.00	0.5	8.0
4	1.00	2.50	0.6	6.6
5	1.00	2.75	0.6	8.5
6	1.00	3.00	0.6	9.0
7	1.00	2.50	0.7	7.0
8	1.00	2.75	0.7	8.2
9	1.00	3.00	0.7	8.0
10	1.25	2.50	0.5	7.6
11	1.25	2.75	0.5	6.8
12	1.25	3.00	0.5	7.6
13	1.25	2.50	0.6	7.6
14	1.25	2.75	0.6	7.9
15	1.25	3.00	0.6	8.0
16	1.25	2.50	0.7	6.6
17	1.25	2.75	0.7	7.2
18	1.25	3.00	0.7	7.6
19	1.50	2.50	0.5	6.0
20	1.50	2.75	0.5	6.2
21	1.50	3.00	0.5	7.0
22	1.50	2.50	0.6	6.2
23	1.50	2.75	0.6	6.6
24	1.50	3.00	0.6	6.8
25	1.50	2.50	0.7	6.6
26	1.50	2.75	0.7	6.8
27	1.50	3.00	0.7	7.0

Table 4. *Physico-chemical and sensory analysis of sugarcane juice beverage prepared.*

Sr. no.	Characteristics	Analysis
1	Juice Yield (%)	51.8
2	TSS (°Brix)	19.5
3	Reducing Sugar (%)	0.6
4	Vitamin C(mg/100 g)	2.04
5	pH	4.09
6	Acidity (%)	0.256
7	Appearance	9.0
8	Flavor	8.5
9	Overall Acceptability (10)	8.5

juice reduced the microbial activity during storage resulting in significantly less reduction in pH and less increase in acidity specially in the beverage containing 225 ppm KMS.

Total Plate Count (TPC) test was performed periodically after 10 days. The bacteria, yeast and mold population increased during storage of sugarcane juice. The least growth was observed in the sample no. 4 whereas the sample no. 1 showed the highest growth.

The various physico-chemical and microbiological changes are shown in the Figure 4 to 10.

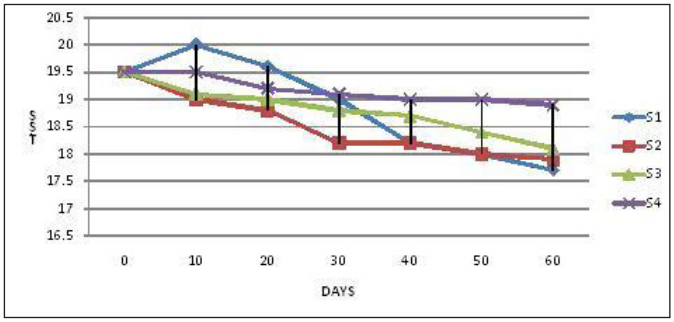

Figure 4. *Changes in TSS (°B) during storage of sugarcane juice.*

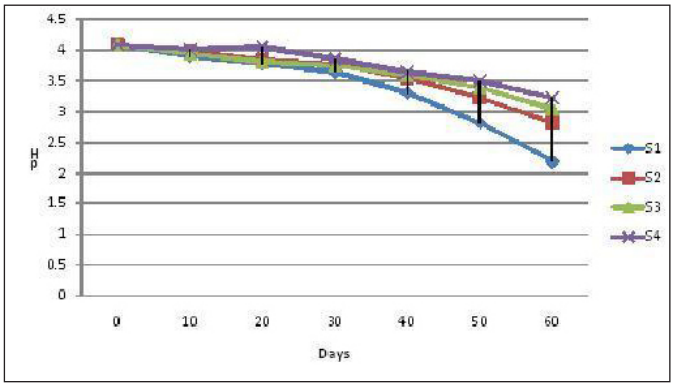

Figure 5. *Changes in pH-value during storage of sugarcane juice.*

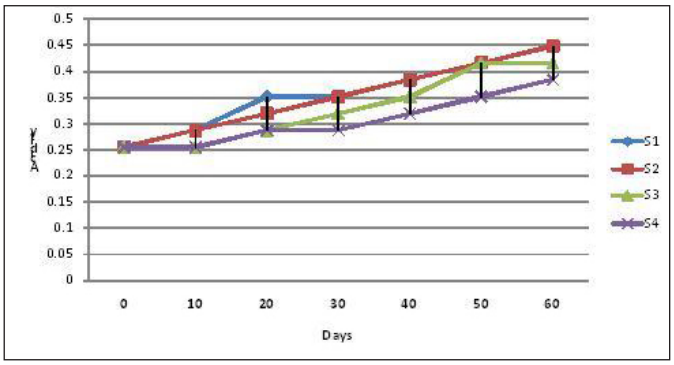

Figure 6. *Changes in acidity (%) during storage of sugarcane juice.*

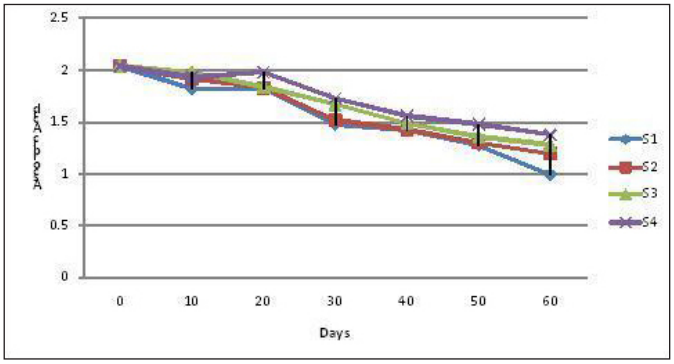

Figure 7. *Changes in ascorbic acid concentration (mg/100 ml) during storage of sugarcane juice.*

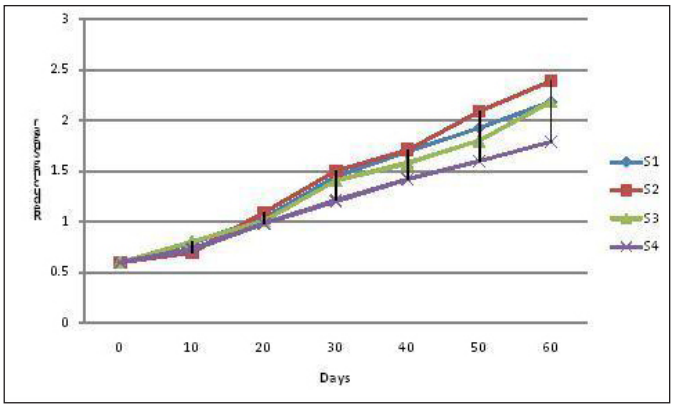

Figure 8. *Changes in reducing sugar concentration (mg/ml) during storage of sugarcane juice.*

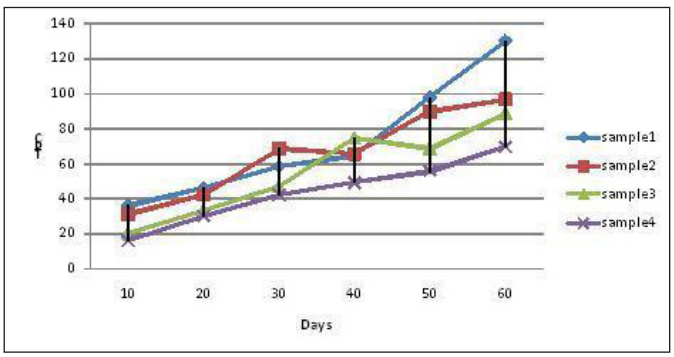

Figure 9. *Changes in Total Plate Count (TPC) (cfu/ml) during storage.*

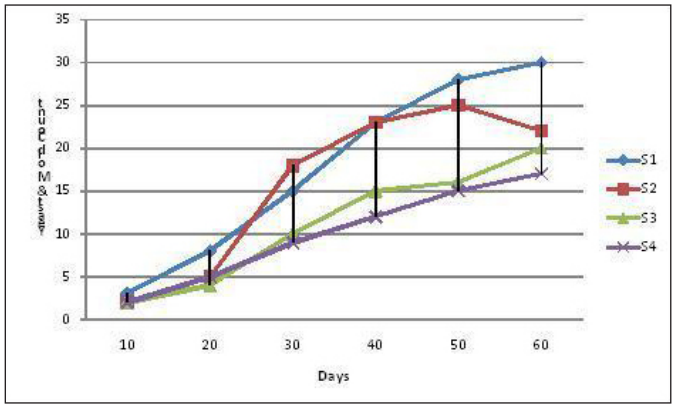

Figure 10. *Changes in Yeast and Mold Count (YMC) during storage.*

Changes in sensory attributes during storage of sugarcane juice

The sugarcane juice just after preparation was awarded sensory scores 8.5, 8.5, and 8.0 for appearance, flavor and overall acceptability respectively by the panelist. The sensory scores reduced significantly with the advancement of storage time. The lowest reduction in sensory scores was observed in sample no. 4 whereas in sample no. 1 maximum after 2 months. The sensory changes are given in Table 5.

Table 8. *Changes in sensory analysis during storage of sugarcane juice.*

Sample no.	Sensory Attributes	Days						
		0	10	20	30	40	50	60
1	Appearance	8.5	8.0	7.5	7.5	7.0	7.0	7.0
	Flavor	8.5	7.5	7.5	7.0	6.5	5.5	5.5
	Overall Acceptance	8.0	7.5	7.5	7.0	6.5	6.0	5.5
2	Appearance	8.5	8.5	8.0	8.0	8.0	7.0	7.0
	Flavor	8.5	7.5	7.5	7.0	6.5	6.0	5.5
	Overall Acceptance	8.0	7.5	7.5	7.0	6.5	6.5	6.0
3	Appearance	8.5	8.5	8.5	8.0	8.0	7.5	7.5
	Flavor	8.5	7.5	7.5	7.0	6.5	6.5	6.0
	Overall Acceptance	8.5	7.5	7.5	7.0	7.0	6.5	6.5
4	Appearance	8.0	8.5	8.5	8.0	8.0	7.5	7.5
	Flavor	8.5	7.5	7.5	7.5	7.0	6.5	6.0
	Overall Acceptance	8.0	7.5	7.5	7.5	7.0	6.5	6.5

Conclusion

On the basis of facts stated above it may be concluded that good quality beverage from sugarcane juice of variety Cos 767 with satisfactory storage stability of 60 days at refrigeration could be achieved from heat treated sugarcane juice beverage at 75 °C for 10 min after addition of 3.0 ml lemon as flavor enhancer and source of citric acid (anti oxidant) and 1.0 gm salt as flavoring compound, 0.6 ml ginger as flavor enhancer per 100 ml of sugarcane juice. Potassium Meta bi sulphite (KMS) added at 225 ppm exhibited the best anti microbial activity. The lemon was able to lower the pH of sugarcane juice to 3.01, which gave a preservative effect and inhibits the growth of micro-organisms during storage. Potassium Meta bi sulphite is also a known yeast and mold inhibitor and is being used widely for the preservation of foods.

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