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Studies on preservation of sugarcane juice by using natural extracts

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Abstract

In this research, sugarcane juice was preserved using natural extracts. The physico-chemical properties (TSS, pH, Titrable acidity) and sensory attributes were determined by using different natural extracts. In natural extracts lemon extract, ginger extract, mint extract were added in same quantity only variation in ladies finger mucilage extract in treatments T₁, T₂, T₃ and T₄. Whereas, T₀ was the controlled sample contains fresh sugarcane juice. In controlled sample (T₀), TSS and pH decreased whereas, Titrable acidity increased, significantly. In the treatments T₁, T₂ and T₄ with natural extracts showed changes in pH, TSS, and Titrable acidity during storage. Treatment T₃ showed minor changes in physico-chemical attributes and was more acceptable to sensory panel after 20 days. It has TSS 19 °Brix, pH 4.75 (mol/lit), Titrable Acidity 0.274%. This naturally creates the potential for production and marketing of sugarcane juice.

Keywords: sugarcane juice, lemon extract, ginger extract, mint extract, ladies finger mucilage

1. Introduction

Sugarcane (*Saccharum officinarum*) is a tropical plant and grown as cash crop in the world. Sugarcane juice is liquid extracted from sugarcane. It is consumed as beverage in many of the countries. Sugarcane juice is sold by the street vendors throughout India. The vendors put the sugarcane in the machine which, presses and extracts the sugarcane juice out. Sugarcane juice is normally served with the dash of lime and ginger juice. It is a very popular pleasing, sweet and refreshing drink especially in summer as a part of refreshment and giving relief from the heat in many parts of India in both urban and rural areas (Karthikeyan and Samipillai, 2010) [11]. Sugarcane juice has great nutritional value. The nutritional value of sugarcane juice per 100 ml is given in Table 1.

Table 1: Nutritional value of sugarcane juice per 100 ml

Component	Per/100 ml
Calories	242 K/Cal
Protein	0.16 g
Total fat	0.40 g
Total fiber	0.56 g
Free sugar	12.85 g
Potassium	150 mg
Sodium	1.16 mg
Magnesium	13.03 mg
Iron	1.12 mg

Source: (NIN- National Institute of Nutrition)-Indian Food Composition (2019)

The Sugarcane juice has a short life and tends to spoil within hours of extraction due to lactic acid producing bacteria; *Leuconostoc mesenteroides* along with some yeast and molds are identified to deteriorate sugarcane juice (Singh *et al.*, 2015) [14]. The experiment was carried out during Jan to June 2021 in department of Food Process Engineering of SHUATS, Prayagraj, Uttar-Pradesh. This study was undertaken to determine physico-chemical and sensory attributes and shelf life of sugarcane juice with and without natural extract was studied.

2. Materials and Methods

This research deals with the description of various materials and methods used to accomplish the experimental work done to attain the desired objectives of the study entitled “Studies on

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Preservation of Sugarcane Juice by Using Natural Extracts” in different treatments. The experiment was carried out during Jan to June 2021 in department of Food Process Engineering of SHUATS, Prayagraj, Uttar-Pradesh.

2.1 Materials: The materials that were used for the preservation of sugarcane juice by natural ways are sugarcane of variety (cultivar 93A145), lemon extract, ginger extract; mint extract and ladies finger mucilage were collected from local market of Prayagraj, Uttar-Pradesh. The variety was chosen because of high juice content and also it is grown widely.

2.2 Methods

Sugarcane juice was extracted as given in Fig. 1

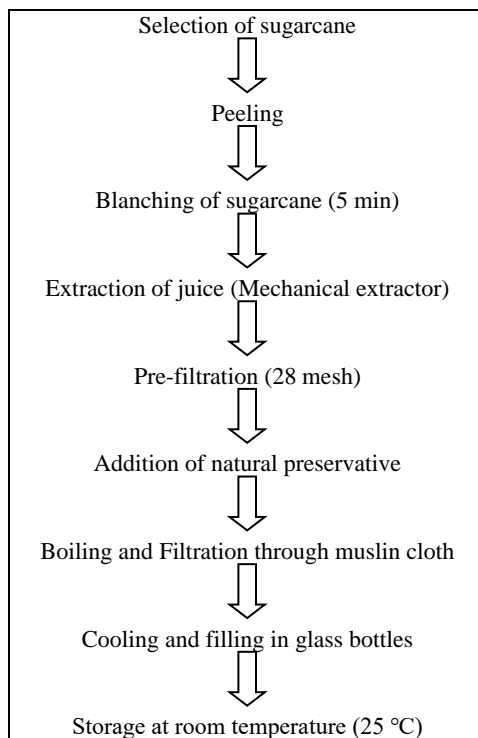


Fig 1: Preparation of Sugarcane Juice

3. Results and Discussion

Different types of natural extracts like lemon extract, ginger extract, mint extract were added in similar quantity in treatments T₁, T₂, T₃ and T₄ and ladies finger mucilage was varied in all the treatments. Physico-chemical attributes like total soluble solid (TSS), pH and Titratable acidity and sensory evaluation of sugarcane juice were evaluated. The shelf life of sugarcane juice with and without natural extract was studied.

3.1 Physiochemical and Sensory Attributes of Sugarcane Juice after Treatment: Table 2 shows the parameters of fresh sugarcane juice. It is evident from the table that, sugarcane juice is slightly acidic. A similar value for all testing parameter has been reported by (Krishnakumar and Devdas, 2006) [10].

Table 2: Parameters Reported in Fresh Sugarcane Juice

Parameters	Value
Titrate Acidity	0.20%
pH	5.34 mol/lit
TSS	19.3 °Brix

3.1.1 Total Soluble Solids (TSS): The variation in TSS value of sugarcane juice with storage period with and without natural extracts is shown in Table 3. The total soluble solids were in range of 18 to 19 °Brix for fresh untreated sugarcane juice in all the samples. It was 11 °Brix for fresh while 16, 17, 19 and 22 °Brix for T₁, T₂, T₃ and T₄, respectively after 20 days’ time storage. The TSS of control sample T₀ decreased as compared to other Treatments of sugarcane juice with natural extract i.e. T₁, T₂, T₃, and T₄ respectively. Overall trend showed there was a decrease in TSS level. T₀ decreased during storage may be because of fermentation process, similar observation was made by Krishnakumar and Devdas, 2006 [10]. The total soluble solids decreased significantly ($P < 0.01$) during storage of sugarcane juice at room temperature however; the decrease was of lesser extent at refrigeration temperature (Bhupinder *et al.*, 1991) [2]. The TSS in treatment T₃ showed best results as compared to treatment T₁, T₂ and T₄. The decrease in TSS of sugarcane juice during storage might be due to action of microorganism on sugar which acts as an easy source of energy for proliferation of microorganisms. Addition of lemon (ascorbic acid) to heat treated sugarcane juice beverage restricted the degradation of total soluble solids during storage at refrigeration temperature (Khare *et al.*, 2012) [8].

3.1.2 pH: The Variation in pH values with storage period with and without natural extract is shown in Table 3. The pH of fresh untreated sugarcane juice without natural extract is 5.34 in all the samples. It was 2.89 for fresh while 3.75, 3.89, 4.75 and 6.45 for T₁, T₂, T₃ and T₄, respectively after 20 days’ time storage. Overall trend showed there was decrease in pH level. The pH was decreased in fresh sugarcane juice in storage. The pH decreased whereas acidity increased significantly ($P < 0.01$) during storage of sugarcane juice. The pH was high in samples T₃ and T₄ because all colloidal particles were removed might be responsible for decrease in pH in storage. The decrease in pH upon storage might be due to production of lactic acid and acetic acid during fermentation, similar observation was made by Krishnakumar and Devdas, 2006 [10]. Ladies Finger mucilage has binding properties due to hydroxyl group of sugar, when mixed with the sugarcane juice and heated, binds with the pigments of the juice, complex with other impurities, coagulates and forms a scum on surface (Chavan *et al.*, 2007) [4]. The high pH preserves the sugar in the form of sucrose and prevents reactions that would convert sucrose to other undesirable changes in sugarcane juice. The treatment T₃ showed better results than treatments T₁, T₂, and T₄.

3.1.3 Titrable Acidity: The variation in Titrable Acidity with storage period with and without natural extract shows in Table 3. The Titrable acidity was in range of 0.2% for fresh untreated sugarcane juice in all the treatments. It was 0.69 for fresh while 0.541, 0.422, 0.274, 0.134 for Treatment T₁, T₂, T₃ and T₄, respectively after 20 days’ time storage. Overall trend showed there was increase in TA level. The acid content of sugarcane juice was increased with increase in storage period. This could be due to acetic acid and lactic acid production by fermentation, similar observation was made by Krishnakumar and Devdas, 2006 [10]. It was observed that the TA generally increased in storage for treatments without natural extracts and TA in treatments T₃ and T₄ shows less increase in acidity.

3.1.4 Sensory Evaluation: Sensory evaluation of sugarcane juice processed by different treatments was carried out, using a nine-point hedonic scale, as described by (Dutcosky, 2013) [6]. The attributes like appearance, taste and flavor were evaluated by semi-trained panelists and consumers. The juice was served at a temperature of about 12 °C. Sensory evaluation score at 5 days storage interval of all treatments were shown in Table 4. The overall acceptability of sugarcane juice was calculated by composite scoring of appearance, taste and flavor score of all treatments T₀, T₁, T₂, T₃ and T₄. Treatment T₀ was the control sample and it has undesirable appearance, flavor and taste. The decrease in appearance score is due to increasing PPO activity and invert sugar that causes browning due to which the juice became darker it was decreased in appearance score as well as taste, similar result found by (Mao *et al.*, 2007) [12]. The decrease in the flavor score was observed due to high level of acid that react with the product forms unpleasant odor. Due to slight fermentation of juice and gas production, overall acceptability of the juice also decreased. These findings were accordance with the Chauhan *et al.*, (2002) [3]. In Hedonic scale treatment T₁ and T₂ shows overall acceptability score 7 and 8, respectively. Treatment T₃ showed overall acceptability score 9 after 20 days of storage time.

3.2 Shelf life of Sugarcane Juice: The physico-chemical and sensory parameters of the stored sugarcane juice were Evaluated at 5 days storage interval for assessment of shelf

life in treatments shown in Table 4. Fresh sugarcane juice deteriorates within 2 h of extraction at room temperature and 4 h in refrigeration temperature. The main problem associated with fresh sugarcane juice is its short shelf life and heat sensitivity. This contributes to the variation in TSS of fresh sugarcane juice causes change in flavor and other sensory attributes. Observed that the rapid increase in Titrable acidity and viscosity lead to the deterioration of fresh sugarcane juice with an obvious browning (Mao *et al.*, 2007) [12]. Processing and marketing of sugarcane juice is limited because of its rapid deterioration (Prasad and Nath, 2002) [13] and (Yusof *et al.*, 2000). Samples processed by different natural extracts treatments were packed in sterile glass bottle and stored under refrigerated conditions of storage for 20 days. The possible reason for the microbial growth might be due to presence of oxygen and water vapor in the packaging material. A similar result on increase in microbial population during storage of sugarcane juice in polypropylene film was reported by (Krishnakumar and Devdas 2006) [10]. After 20 days the physio-chemical and sensory attributes were evaluated Similar results (Dilip and Priyanka, 2016) investigated the effect of Indian herb and chemical on shelf life of sugarcane juice. *Pudina* and *Tulsi* treated juice have shown maximum value of sensory attributes than the fresh juice.

Form all treatments after 20 days storage time it was concluded that the sample T₃ showed best results in all parameters as compared to fresh sugarcane juice. It has TSS was 19 °Brix, pH 4.75 (mol/lit), Titrable Acidity 0.274%.

Table 3: The variation in physico-chemical Parameters of sugarcane juice with storage (Days) with and without natural extracts.

Treatments	Storage (Days)	Parameters		
		TSS (°Brix)	pH (mol/liter)	TA (%)
T ₀	0	19	5.34	0.2
	5	16	4.32	0.43
	10	14	3.43	0.54
	15	13	3.12	0.62
	20	11	2.89	0.69
T ₁	0	19.2	5.36	0.212
	5	18	4.86	0.292
	10	17.5	4.24	0.354
	15	17	3.97	0.431
	20	16	3.75	0.541
T ₂	0	19.5	5.37	0.265
	5	18.4	5.02	0.293
	10	17	4.96	0.312
	15	18	4.52	0.397
	20	17	3.89	0.422
T ₃	0	19.7	5.39	0.267
	5	19.5	5.03	0.214
	10	19.2	4.98	0.245
	15	19	4.87	0.257
	20	19	4.75	0.274
T ₄	0	20	5.41	0.269
	5	19	6.23	0.196
	10	20	6.27	0.198
	15	21	6.34	0.154
	20	22	6.45	0.134

TA; Titrable Acidity

Table 4: Sensory evaluation score at Storage (Days) of all treatments.

Storage (Days)	Treatments	Sensory Parameters			
		Appearance	Taste	Flavor	Overall Acceptability
0 th	T ₀	7	7	6	7
	T ₁	7	7	7	7
	T ₂	7	8	7	7
	T ₃	7	9	8	8
	T ₄	6	7	7	7
5 th	T ₀	0	0	0	0
	T ₁	6	7	7	7
	T ₂	7	7	8	7
	T ₃	8	8	7	8
	T ₄	7	7	6	7
10 th	T ₀	0	0	0	0
	T ₁	5	6	6	6
	T ₂	6	7	7	7
	T ₃	7	8	7	7
	T ₄	6	6	5	6
15 th	T ₀	0	0	0	0
	T ₁	5	6	6	6
	T ₂	7	7	6	7
	T ₃	7	8	8	8
	T ₄	6	6	5	6
20 th	T ₀	0	0	0	0
	T ₁	5	6	6	6
	T ₂	6	7	7	7
	T ₃	7	8	7	7
	T ₄	5	7	6	6

4. Conclusion

Addition of natural extracts in sugarcane juice (physicochemical attributes) delayed the increase in Titrable acidity and decrease in TSS and pH of sugarcane juice in 20 days storage. The sensory (overall acceptability) taste, appearance and flavor score of treatment T₃ was best after 20 days storage which is same to the fresh sugarcane juice. The Treatment T₃ showed physicochemical parameters were TSS 19° Brix, pH 4.75 (mol/lit), 0.274% Titrable Acidity after 20 days storage. Overall Acceptability score of sugarcane juice was 7 after 20 days so, it is concluded that treatment T₃ has 20 days shelf life.

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