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STUDIES ON PRESERVATION OF SUGARCANE JUICE

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ABSTRACT

The variety CoP 92226 was selected for preparing sugarcane juice beverage on the basis of yield and sensory attributes from eight promising varieties of sugarcane. Sugarcane juice beverage samples were prepared by pasteurizing the sugarcane juice at 70°C for 10 minutes and adding citric acid (40 mg/100 ml), ascorbic acid (40 mg/100 ml) and potassium metabisulphite (150 ppm). Samples of sugarcane juice beverage were stored at room (30 ± 5°C) and refrigeration (4 ± 2°C) temperature in pre-sterilized glass bottles and analyzed for physico-chemical, microbiological and sensory attributes at every 15 days interval for 90 days. The pH, total soluble solids and total sugars decreased, whereas, titratable acidity and reducing sugars increased significantly ($P < 0.01$) during storage. An appreciable increase in total plate counts and yeast and mold counts were observed, however, no coliforms, were detected in sugarcane juice beverage during storage. The changes in different attributes were significantly ($P < 0.01$) higher at room temperature as compared to refrigeration temperature. The sugarcane juice beverage having citric acid and potassium metabisulphite showed minimum changes in sensory qualities during storage, both at room and refrigeration temperature. An acceptable quality beverage of sugarcane juice with satisfactory storage stability for 90 days at room as well as refrigeration temperature could be prepared.

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INTRODUCTION

The total production of sugarcane in India is about 271 million tonnes. It is grown mainly for producing sweeteners such as sugar, jaggery and khandasari [1]. A small portion of sugarcane is also utilized for other purposes. Sugarcane juice is available almost throughout the country. But the juice extracted from the canes turns dark brown and marked sedimentation appears during storage. Conventional heat processing imparts the taste of jaggery and the delicate flavour of juice is adversely affected [2]. Sugarcane variety and cultivation practices also affects the juice characteristics. Bucheli and Robinson [3] reported that the polyphenol oxidase is the major enzyme involved in the discoloration of sugarcane juice which can be improved by heat inactivation of enzyme. Addition of citric acid or ascorbic acid to juice also gave good pleasant dull orange colour to juice [4]. Addition of lemon and ginger followed by pasteurization and preservation with sulphurdioxide also reduced physico-chemical changes during storage of ready-to-serve bottled sugarcane juice [5].

In view of above information, the present investigation was envisaged to select a suitable high yielding variety of sugarcane for juice production and to optimise the process for the manufacture and preservation of ready-to-serve bottled sugarcane juice of high consumer acceptability.

MATERIALS AND METHODS

Sugarcane varieties namely CoJ 64, CoP 84211, CoP 92226, CoS 687, CoS 767, CoP 84212, CoP 90223 and CoP 93227 obtained from Crop Research Centre of G. B. Pant University of Agriculture and Technology, Pantnagar, U.P. (India) were screened for their suitability for juice production. Canes were cleaned, washed and crushed by hand driven brass crusher to obtain maximum possible juice yield. Juice was filtered through a four layered muslin cloth. Juice yields were recorded and juices were subjected to physico-chemical and sensory evaluation.

Optimization of Treatments

Concentration of citric acid (0, 20, 40, 60 and 80 mg/100 ml), ascorbic acid (0, 20, 40, 60 and 80 mg/100 ml), potassium metabisulphite (KMS) (0, 50, 100, 150, 200 and 250 ppm) and pasteurization temperature (60, 70, 80 and 90°C) for 10 min were studied for optimization of treatments on the basis of sensory evaluation of juice. Concentrations of citric acid 40 mg/100 ml, ascorbic acid 40 mg/100 ml, KMS 150 ppm and pasteurization at 70°C for 10 minutes were found optimum for the treatment of sugarcane juice.

Preservation of Juice

Different lots of sugarcane juices were subjected to pasteurization (at 70°C for 10 min), pasteurization after addition of citric acid (40 mg/100 ml), pasteurization after addition of citric acid followed by addition of potassium metabisulphite (150 ppm), pasteurization after addition of ascorbic acid (40 mg/100 ml) and pasteurization after addition of ascorbic acid followed by addition of potassium metabisulphite. Fresh sugar cane juice was taken as control. All the lots of juices were stored for 90 days at room (30 ± 5°C) and refrigeration temperature (4 ± 2°C). The samples were drawn and analysed for physico-chemical, microbiological and sensory attributes at an interval of 15 days.

Analysis

The moisture, protein, fat, crude fiber and ash were determined by the AOAC [6] methods, minerals (calcium, phosphorus and iron), sugars (total, reducing and non reducing sugars), ascorbic acid and titratable acidity (as citric acid) were estimated by the methods described by Ranganna [7]. Total soluble solids, pH and viscosity were measured by using hand refractometer (Erma, Japan), digital pH meter (pH 5632, serial 316, Electric corporation of India Ltd.) and Viscometer (Brookfield Synchro-Lectric Viscometer, USA) using spindle no. 1 at 60 rpm. Samples were also analysed for total plate count, yeast and mold count, and coliform count according to the procedure described in APHA [8].

Juice samples were also evaluated for sensory attributes namely appearance, flavour and overall acceptability using a 10 members panel following a 9 point Hedonic scale. The results were analysed by multiple comparison test [9]. Statistical analysis of the data were carried out by 3 factor CRD ANOVA technique of Spedecor and Cochran [10].

RESULTS AND DISCUSSION

Evaluation of Varieties

The highest juice yield (56.41%) was obtained from variety CoP 92226. The juice yield from other varieties ranged between 48.38 to 56.14% (Table 1). These values are higher than the values reported by Sharma et al. [11] and lower than the values reported by Wandre et al. [12] and Bhupinder et al. [5] These variations in juice yield might be attributed to variety, cultivation practices and method of crushing.

All the physico-chemical characteristics of juices obtained from varieties screened in the investigation for juice preparation differed significantly

Table 1. Physico-Chemical and Sensory Characteristics of Juices Obtained from Different Varieties of Sugarcane

Characteristics	Varieties								CD ($P < 0.01$)
	CoJ 64	CoP 84211	CoP 92226	CoS 687	CoS 767	CoP 84212	CoP 90223	CoP 93277	
Juice yield %	56.14	53.91	56.41	56.07	48.38	50.96	48.81	49.16	2.353
Moisture %	80.00	81.70	80.12	81.20	81.50	81.10	81.24	81.10	0.275
Protein %	0.53	0.57	0.56	0.39	0.52	0.60	0.39	0.39	0.253
Fat %	0.19	0.16	0.16	0.19	0.17	0.14	0.14	0.15	0.446
Ash %	0.30	0.28	0.38	0.46	0.38	0.42	0.46	0.48	0.377
Crude fiber %	13.32	15.46	13.24	13.68	16.34	15.88	16.62	16.12	0.516
Total soluble solids (°Brix)	19.50	18.50	19.00	18.50	18.00	19.00	18.00	19.00	0.377
Total sugars %	19.10	18.10	18.60	18.30	17.60	19.00	18.10	18.60	0.308
Reducing sugars %	0.32	0.48	0.24	0.58	0.64	0.47	0.20	0.38	0.039
Calcium (mg/100 g)	162.25	148.28	139.32	125.68	132.58	180.72	173.21	169.65	2.38
Phosphorus (mg/100 g)	25.33	27.14	28.09	26.52	29.73	24.61	26.52	25.83	2.36
Iron (mg/100 g)	62.62	48.48	42.52	36.25	68.63	71.29	56.32	66.85	2.56
Vitamin C (mg/100 g)	1.98	1.76	1.33	1.87	1.76	1.92	1.82	1.78	0.049
pH	5.50	5.52	5.28	5.49	5.46	5.32	5.54	5.46	0.379
Acidity %	0.30	0.24	0.36	0.31	0.31	0.39	0.29	0.32	0.335
Viscosity (cp at 30 °C)	3.82	3.68	3.89	3.64	3.82	3.66	3.68	3.90	ns
Sensory scores: Appearance	7.40	7.50	7.70	7.30	7.20	7.40	7.40	7.40	0.427
Flavour	7.80	7.50	8.10	7.30	7.20	7.40	7.70	7.50	0.301
Overall acceptability	7.80	7.60	8.10	7.20	7.20	7.40	7.70	7.50	0.309

($P < 0.01$) with each other except viscosity (Table 1). Sugarcane juices contained very small quantities of protein (0.39–0.60%) and fat (0.14–0.19%). However, it contained very high moisture (80.00–81.70%), crude fiber (13.24–16.62%) and ash (0.28–0.48%). The values reported by Sharma et al. [13], Bhupinder et al. [5] and Madan et al. [14] for these proximate compositional constituents are in the close conformity with the findings of this investigation. Sugarcane juice also contained 18.0–19.5% total soluble solids which include mainly total sugars (17.6–19.0%). The sugar was mostly non reducing sucrose and small amount of reducing sugars (0.20–0.65%) were also present. Similar observations were also made by Sharma et al. [11], Bhupinder et al. [5] and Patil et al. [15].

Sugarcane juice also contained appreciably high content of calcium, phosphorus and iron and the results obtained were in agreement with Rao et al. [16]. Sugarcane juice is acidic in nature (pH 5.28–5.54 and acidity 0.24–0.39%). Bhupinder et al. [5] made similar observation. The viscosity values of juices obtained from different varieties ranged between 3.64–3.90 centipoise at 30°C. Kulshreshtha [17] reported slightly lower values of viscosity for sugarcane juice. Variety CoP 92226 gave juice of highest sensory scores for appearance, flavour and overall acceptability (Table 1). Juice yield from this variety was also maximum. Therefore CoP 92226 was selected as the best variety for further studies.

Optimization of Treatment

Sugarcane juice was pasteurized at 60, 70, 80 and 90°C for 10 min. Sensory evaluation revealed that product obtained highest sensory scores for appearance, flavour as well as overall acceptability when pasteurized at 70°C for 10 min. Heating at high temperature caused browing and produced undesirable jaggery flavour. Kapur et al. (4) and Bhupinder et al. [5] suggested pasteurization of sugarcane beverage at 80°C for 15 min whereas Sivasubramanian and Pal. [2] obtained best beverage after pasteurizing sugarcane juice at 80°C for 1 min. A lower temperature of 63°C for 10 minutes was, however, found optimum for pasteurising sugarcane juice by Mann and Singh [18].

Preliminary trials were conducted by adding 20, 40, 60 and 80 mg citric acid per 100 ml of sugarcane juice to improve the appearance, flavour and overall acceptability. The panellists awarded highest sensory scores to sugarcane juice with 40 mg citric acid per 100 ml of juice. Higher concentrations of citric acid made the juice too much sour. Kapur et al. [4] suggested 0.2% citric acid as optimum for sugarcane beverage.

Ascorbic acid at a concentration of 40 mg/100 ml of sugarcane juice also gave beverage with highest sensory scores for appearance, flavour and overall acceptability. The results of sensory evaluation of sugarcane juices

Table 2. Physico-Chemical Changes During Storage of Sugarcane Juice

	Storage Time (days) and Temperature (R = Room, RF = Refrigeration)													
	0		15		30		45		60		75		90	
Treatments	R	RF	R	RF	R	RF	R	RF	R	RF	R	RF	R	RF
	Total Soluble Solids (°Brix)													
A	22.0	22.0	21.9	22.0	21.6	22.0	20.2	21.8	19.5	21.7	18.9	21.5	18.1	21.2
B	22.0	22.0	22.0	22.0	21.4	21.8	20.9	21.8	20.5	21.8	20.1	21.6	19.8	21.4
C	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.7	21.8	21.5	21.5	21.5	21.5
D	22.0	22.0	22.0	22.0	21.8	22.0	21.2	21.9	21.1	21.6	19.7	21.3	19.3	21.1
E	21.9	21.9	21.9	21.9	21.8	21.9	21.6	21.8	21.1	21.5	19.8	21.4	19.7	21.3
	CD ($P < 0.01$): Treatment = 0.273, Storage Time = 0.323 and Storage Temperature = 0.173													
	Total Sugars (%)													
A	20.8	20.8	20.4	20.5	19.0	20.0	18.1	19.6	17.2	19.0	16.5	18.5	16.0	18.0
B	21.0	21.0	20.1	20.8	19.0	20.5	18.6	20.1	17.9	19.6	17.0	19.1	16.2	18.8
C	21.0	21.0	20.6	20.9	20.0	20.8	19.1	20.5	18.6	20.1	18.0	19.9	17.5	19.1
D	20.1	20.1	20.8	20.5	20.1	20.0	19.0	19.4	18.2	19.0	17.5	18.4	16.9	18.0
E	20.1	20.1	20.5	20.7	19.8	20.1	19.1	19.8	18.5	19.2	17.8	18.6	17.0	18.3
	CD ($P < 0.01$): Treatment = 0.301, Storage Time = 0.356 and Storage Temperature = 0.191													
	Reducing Sugars (%)													
A	0.49	0.49	0.65	0.55	0.82	0.72	0.98	0.88	1.17	1.08	1.36	1.26	1.52	1.42
B	0.51	0.51	0.61	0.58	0.78	0.67	0.89	0.81	1.10	0.98	1.25	1.12	1.38	1.25
C	0.51	0.51	0.60	0.56	0.71	0.63	0.82	0.74	0.98	0.89	1.07	0.99	1.17	1.09

D	0.50	0.50	0.63	0.59	0.80	0.70	0.93	0.89	1.12	1.05	1.28	1.15	1.41	1.30
E	0.50	0.50	0.61	0.57	0.73	0.66	0.85	0.83	1.02	1.00	1.14	1.10	1.25	1.17
	CD ($P < 0.01$): Treatment = 0.031, Storage Time = 0.037 and Storage Temperature = 0.020													
	Titratable Acidity (% citric acid)													
A	0.38	0.38	0.52	0.48	0.78	0.58	0.96	0.92	1.24	1.13	1.78	1.38	2.38	1.66
B	1.24	1.24	1.36	1.28	1.52	1.32	1.78	1.40	1.89	1.49	2.10	1.56	2.25	1.71
C	1.24	1.24	1.30	1.25	1.40	1.28	1.59	1.32	1.71	1.39	1.92	1.46	2.05	1.55
D	0.86	0.86	1.28	0.88	1.49	0.95	1.72	1.11	1.92	1.19	2.18	1.28	2.37	1.35
E	0.86	0.86	1.07	0.88	1.15	0.92	1.29	0.98	1.40	1.05	1.65	1.14	1.92	1.30
	CD ($P < 0.01$): Treatment = 0.035, Storage Time = 0.042 and Storage Temperature = 0.023													
	pH													
A	5.47	5.46	4.93	5.35	4.53	5.26	3.95	5.08	3.41	4.72	2.88	4.45	2.42	4.01
B	4.95	4.96	4.50	4.80	4.13	4.52	3.82	4.24	3.50	3.95	3.10	3.76	2.76	3.75
C	4.92	4.91	4.82	4.88	4.65	4.76	4.38	4.65	4.04	4.52	3.62	4.44	3.15	4.30
D	5.11	5.12	4.59	5.06	4.01	4.89	3.56	4.71	3.07	4.58	3.00	4.29	2.64	4.21
E	5.08	5.05	4.96	5.02	4.59	4.93	4.27	4.80	3.81	4.68	3.69	4.52	3.48	4.33
	CD ($P < 0.01$): Treatment = 0.012, Storage Time = 0.013 and Storage Temperature = 0.007													
	Viscosity (cp at 30 °C)													
A	3.82	3.80	3.81	3.81	3.81	3.81	3.80	3.81	3.78	3.80	3.76	3.80	3.80	3.79
B	3.82	3.82	3.81	3:82	3.80	3.82	3.80	3.82	3.80	3.80	3.78	3.78	3.76	3.77
C	3.83	3.82	3.83	3.82	3.82	3.80	3.80	3.81	3.80	3.78	3.80	3.79	3.79	3.79
D	3.82	3.83	3.81	3.81	3.81	3.82	3.80	3.82	3.80	3.80	3.79	3.81	3.78	3.80
	3.82	3.82	3.82	3.82	3.82	3.82	3.81	3.81	3.81	3.81	3.79	3.80	3.78	3.78
	Differences were Statistically Non-Significant													

Treatments: A = Pasteurization, B = Pasteurization+citric acid, C = Pasteurization+citric acid+KMS, D = Pasteurization+ascorbic acid, E = Pasteurization+ascorbic acid+KMS.

Table 3. Microbiological Changes During Storage of Sugarcane Juice

	Storage Time (days) and Temperature (R = Room, RF = Refrigeration)													
	0		15		30		45		60		75		90	
Treatments	R	RF	R	RF	R	RF	R	RF	R	RF	R	RF	R	RF
	Total Plate Count (Log of Colony Forming unit/10 ml)													
A	1.65	1.65	2.25	2.08	2.53	2.45	2.92	2.66	3.30	2.96	3.72	3.09	4.27	3.14
B	1.48	1.48	1.85	1.65	2.03	2.06	2.34	2.49	2.68	2.73	3.03	2.99	3.37	3.06
C	1.30	1.30	1.70	1.45	1.86	1.76	2.02	1.96	2.49	2.30	2.89	2.51	3.00	2.89
D	1.54	1.54	1.90	1.70	2.05	2.11	2.37	2.57	2.72	2.79	3.10	3.04	3.43	3.21
E	1.40	1.40	1.78	1.58	1.89	1.82	2.06	2.04	2.53	2.33	2.91	2.61	3.09	2.96
	Yeast and Mold Count (Log of Colony Forming unit/10 ml)													
A	0.45	0.45	0.81	0.62	1.27	1.10	1.75	1.51	2.11	1.88	2.46	2.11	2.83	2.61
B	0.40	0.40	0.60	0.58	1.02	0.88	1.60	1.32	1.89	1.68	2.20	1.96	2.45	2.40
C	0.36	0.36	0.49	0.48	0.83	0.79	1.12	1.04	1.38	1.40	1.76	1.65	2.10	1.99
D	0.41	0.41	0.70	0.64	1.12	0.92	1.70	1.42	1.96	1.74	2.34	2.07	2.62	2.45
E	0.38	0.38	0.65	0.54	0.86	0.81	1.22	1.11	1.51	1.51	1.85	1.76	2.15	2.04

Treatments: A = Pasteurization, B = Pasteurization + citric acid, C = Pasteurization+citric acid+KMS, D = Pasturization+ascorbic acid, E = Pasteurization+ascorbic acid+KMS.

Table 4. Changes in Sensory Scores During Storage of Sugarcane Juice

	Storage Time (days) and Temperature (R = Room, RF = Refrigeration)													
	0		15		30		45		60		75		90	
Treatments	R	RF	R	RF	R	RF	R	RF	R	RF	R	RF	R	RF
	Appearance													
A	8.0	8.0	7.8	8.0	7.4	7.8	7.0	7.5	6.8	7.0	6.0	6.7	5.6	6.1
B	8.3	8.3	8.2	8.3	8.0	8.2	7.8	8.0	7.4	7.7	7.0	7.2	6.5	6.6
C	8.5	8.5	8.3	8.5	8.1	8.4	7.9	8.1	7.5	7.9	7.2	7.5	7.0	7.2
D	8.2	8.2	8.1	8.2	8.0	8.1	7.5	7.8	7.3	7.5	7.0	7.0	6.4	6.5
E	8.1	8.1	8.0	8.1	8.0	8.0	7.7	7.9	7.2	7.6	7.0	7.1	6.5	6.7
	CD ($P < 0.01$): Treatment = 0.115, Storage Time = 0.183 and Storage Temperature = 0.98													
	Flavour													
A	8.0	8.0	7.8	7.9	7.2	7.5	6.3	6.8	5.2	6.1	4.5	5.6	3.4	5.0
B	8.5	8.5	8.1	8.5	7.8	8.1	7.0	7.6	6.1	7.0	5.2	6.4	4.4	5.7
C	8.3	8.3	8.2	8.3	8.0	8.2	7.5	7.9	6.9	7.3	6.4	6.8	5.7	6.1
D	8.2	8.2	7.9	8.1	7.4	7.9	6.8	7.4	5.6	6.8	4.9	6.0	4.0	5.4
E	8.1	8.1	8.0	8.1	7.8	8.0	7.1	7.5	6.6	6.9	5.2	6.1	4.6	5.5

(continued)

Table 4. Continued

Treatments	Storage Time (days) and Temperature (R = Room, RF = Refrigeration)													
	0		15		30		45		60		75		90	
	R	RF	R	RF	R	RF	R	RF	R	RF	R	RF	R	RF
	CD ($P < 0.01$): Treatment = 0.128, Storage Time = 0.152 and Storage Temperature = 0.080													
	Overall Acceptability													
A	7.6	7.6	7.2	7.4	6.5	6.9	6.0	6.3	5.0	5.7	4.4	5.0	3.6	4.1
B	8.1	8.1	8.0	8.0	7.6	7.6	7.0	7.0	6.2	6.5	5.6	6.0	4.8	5.5
C	8.0	8.0	8.0	8.0	7.8	7.9	7.2	7.6	6.7	7.0	6.0	6.4	5.2	6.0
D	7.9	7.9	7.4	7.6	6.9	7.0	6.1	6.4	5.2	5.9	4.5	5.1	3.8	4.3
E	7.8	7.8	7.5	7.7	7.1	7.4	6.6	6.8	6.0	6.0	5.4	5.3	4.3	4.6
	CD ($P < 0.01$): Treatment = 0.178, Storage Time = 0.211 and Storage Temperature = 0.113													

Treatments: A = Pasteurization, B = Pasteurization+citric acid, C = Pasteurization+citric acid+KMS, D = Pasteurization + ascorbic acid, E = Pasteurization+ascorbic acid+KMS.

with 50, 100, 150, 200 and 250 ppm of potassium metabisulphite revealed that no adverse effect could be observed by adding potassium metabisulphite upto 150 ppm on the appearance, flavour and overall acceptability of juice. Bhupinder et al. [5] also suggested 140 ppm of potassium metabisulphite as preservative in sugarcane beverage.

Changes During Storage of Sugarcane Juice

Fresh sugarcane juice sample spoiled within 3–4 h at room and 8 h at refrigeration temperature of extraction, therefore, results for control could not be obtained.

Physico-Chemical Characteristics

The total soluble solids and total sugars decreased significantly ($P < 0.01$) during storage of sugarcane juice at room as well as refrigeration temperature, however, the decrease was of lesser extent at refrigeration temperature (Table 2). These observations are in agreement with the findings of Bhupinder et al. (5). They attributed the decrease in total soluble solids and sugars to acids during storage as a result of action of microorganism present in the juice. The content of reducing sugars in juice increased significantly ($P < 0.01$) during storage due to the hydrolysis of non-reducing sugards. Addition of citric acid or ascorbic acid to pasteurized sugarcane juice restricted the degradation of total soluble solids and total sugars significantly ($P < 0.01$) during storage at both room and refrigeration temperatures. Addition of potassium metabisulphite to the juices further reduced the extent of changes in total soluble solids, total and reducing sugars probably due to the suppression of microbial activity.

The pH decreased whereas acidity increased significantly ($P < 0.01$) during storage of sugarcane juice (Table 2). Addition of organic acids to juice also increased its acidity and decreased pH. Addition of potassium metabisulphite to juice restricted the microbial activity during stroage resulting in significantly ($P < 0.01$) less reduction in pH and less increase in acidity. The reduction in pH and increase in acidity was, however, higher when the juice samples were stored at room temperature. No significant change in viscosity could be observed as a result of addition of organic acids or potassium metabisulphite and storage at room or refrigeration temperature. Similar results were also obtained by Bhupinder et al. [5].

Microbiological

The microbiological population (total plate counts, and yeast and mold counts) increased during storage of sugarcane juice (Table 3). The extent of

increase in microbial population was also higher at room temperature as compared to refrigeration temperature. Highest counts were obtained during storage of pasteurized juice followed by pasteurization and addition of ascorbic acid, pasteurization and addition of citric acid. Addition of potassium metabisulphite to juice further reduced the counts appreciably. Raw sugarcane juice had 10 to 20 colonies of coliforms per 10 ml. The coliforms disappeared after pasteurization and no coliform could be detected throughout the storage.

Sensory Quality

The sugarcane juice just after preparation was awarded sensory scores ranging between 7.5 to 8.5 for appearance, flavour and overall acceptability by the panellists. The sensory scores reduced significantly ($P < 0.01$) with the advancement of storage. However, the reduction in sensory scores of samples stored at room temperature was of significantly ($P < 0.01$) greater magnitude than those stored at refrigeration temperature. A significantly ($P < 0.01$) lower reduction in sensory scores was observed in sugarcane juice pasteurized after addition of citric acid and potassium metabisulphite followed by pasteurization after addition of ascorbic acid and potassium metabisulphite, pasteurization after addition of citric acid, pasteurization after addition of ascorbic acid, and pasteurized only.

CONCLUSION

On the basis of facts stated above it may be concluded that good quality beverage from sugarcane juice of variety CoP 92226 with satisfactory storage stability of 90 days at refrigeration as well as room temperature could be prepared from pasteurized juice after addition of 40 mg citric acid per 100 ml and 150 ppm of potassium metabisulphite. The citric acid was able to lower the pH of sugarcane juice to 4.9 which gave a preservative action and inhibit the growth of micro-organism during storage. Potassium metabisulphite is also a known yeast and mold inhibitor and is being used widely for the preservation of foods.

REFERENCES

1. Shahi, H.N. Sugarcane: Diversification in Order. The Hindu Survey of Indian Agriculture. Chennai **1999**, 101–103.
2. Sivasubramanian, C.G.; Pal, J.S. Effect of Heat Treatment on the Quality of Sugarcane Juice. Indian Food Packer **1994**, *48* (2), 51–54.
3. Bhucheli, C.S.; Robinson, S.P. Contribution of Enzymic Browning to Colour in Sugarcane Juice. Journal of Agricultural and Food Chemistry 1994, *42* (2), 257–261.

4. Kapur, K.L.; Singh,V.P.; Garg, R.G. Preliminary Studies on Preservation of Sugarcane Juice. Indian Food Packer **1978**, *32* (2), 32–33.
5. Bhupinder, K.; Sharma, K.P.; Harinder, K. Studies on the Development and Storage Stability of Ready-to-Serve Bottled Sugarcane Juice. International Journal of Tropical Agriculture **1991**, *9* (2), 128–134.
6. AOAC. 1984. Official Methods of Analysis, 14 edition Association of Official Analytical Chemists, Washington D.C.
7. Ranganna, S. 1991. Handbook of Analysis and Quality Control for Fruit and Vegetable Products. 3rd edition. Tata Mcgraw Hill Publishing Col. Ltd. New Delhi.
8. American Public Health Association. 1992. In: Speck, M.L. ed., Compedium of Methods for the Microbiological Examination of Foods. Inter society/agency Committee on Microbiological Methods for Foods. A.P.H.A. Washington, 734.
9. Larmond, E. 1977. Laboratory Methods for Sensory Evaluation of Foods. Research Branch, Canada. Department of Agriculture, Publication Cananda.
10. Spedecor, G.W.; Cochran, W.G. 1967. Statistical Method. Oxford and IBH Publ. Co., Calcutta.
11. Sharma, S.C.; Johary, P.C.; Rao, G.S.C. Some Observation on the Chemical Composition of the Cane Juices of Different Promising Varieties Grown in North Bihar Conditions and their Clarification Characteristics. Indian Sugar **1979**, *29* (3), 141–147.
12. Wandre, S.S.; Shinde, A.G.; Gojare, D.G. 1985. Screening of Different Sugarcane Varieties for Quality Jaggery and Storability. In *National Seminar-cum-Group Discussion on Jaggery Manufacture and Storage*. IISR, Lucknow, India. Dec. 18–19: 48–54.
13. Sharma, K.P.; Kapur, J.; Kanwar, R.S. 1985. Studies on Cane Juice and Gur Quality of Promising Varieties. In *National Seminar-cum-Group Discussion on jaggery Manufacture and Storage*. IISR, Lucknow, India. Dec. 18–19: 60–66.
14. Madan, V.K.; Mishra, S.K.; Soni, Namita and Soloman, S. 1997. *Manual for Sugar Analysis*; IISR, Lucknow, India.
15. Patil, J.P.; Jadhv, H.D.; Wandre, S.S.; Hasabnis, A.B. Screening of Different Sugarcane Varieties for Quality Juggery and Storability. Indian Sugar. **1994**, *44* (2), 123–127.
16. Rao, P., Reddy, M.S., Ra, P.N., Narendranath, V.V.; Reddy, G.L.N. Juice Quality and Mineral Nutrient Status in Red Rot Infected Canes. Indian Sugar. **1984**, *34* (8), 615–620.
17. Kulshreshtha, M. Engineering Properties of Liquid, Solid and Powder Jaggery. Progress Report (1995–97): All India Coordinated Research Project on processing, handling and storage of jaggery and khandsari. Pantnagar, India 1996; 1–16.
18. Mann, R.S.; Singh, S. Processing, Packaging and Preservation of Sugarcane Juice. Indian Farming. **1988**, *37*, 15–17.

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