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RESEARCH PAPER

Biochemical changes of sugarcane juice during storage in different packaging materials

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SUMMARY : Sugarcane juice is commonly used as delicious drink. The different packaging materials selected for the study were glass bottle, polyethylene (400 gauge) and polypropylene (350 gauge). Fresh sugarcane juice was pasteurized at 80^0C for 15 minutes and added sodium benzoate preservative and then stored at 5^0C and 30^0C. The biochemical parameters studied were total soluble solids, total sugars, reducing sugars, pH and titratable acidity. At every 10 days interval, the biochemical parameters were tested until the storage period of 60 days. The fresh sugarcane juice was spoiled within a day when stored at 30^0C without addition of preservative. The study concluded that apart from glass bottle, there is a possibility to store sugarcane juice in polyethylene and polypropylene because of high acceptability from the consumer point of view as well as less reduction in biochemical qualities.

KEY **W**ORDS : Sugarcane juice, Packaging material, Storage, Quality

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Sugarcane (*Saccharum officinarum* L.) is one of the most important cash crops in the world. India is the second largest producer of sugarcane in the world next to Brazil. Sugarcane is mostly used for manufacturing of jaggery and crystallized sugars. Fresh sugarcane juice is popular throughout India as a pleasing, sweet and thirst-quenching beverage. Sugarcane juice is commonly used as a delicious drink in both urban and rural areas. It is served fresh without hygiene at many roadside stalls. The importance of the medicinal properties of sugarcane juice is also well known. Sugarcane juice of 100 ml provides 40 Kcal of energy, 10 mg of iron and 6µg of carotene (Parvathy, 1983). Sugarcane juice is rich in enzymes and has many medicinal properties. The sugarcane juice contains water (75-85%), non reducing sugars (sucrose, 10-21%), reducing sugars (glucose and fructose, 0.3 – 3%), organic substances (0.5-1), inorganic substances (0.2-0.6) and nitrogenous bodies (0.5-1) (Swaminathan, 1995).

In general sugarcane juice is spoiled quickly by the presence of simple sugars. The sugarcane juice can be introduced as a delicious beverage by preventing the spoilage of juice with appropriate methods. Glass bottle is an excellent packaging material for storing liquid foods, which is impermeable to moisture and gases, odour resistance, good transparency and tamper resistance. The flexible packaging materials are also highly suitable for food products due to their versatility and replacing conventional materials like paper, wood, glass, tin and aluminium. The selection of packaging materials for juice varieties depends upon several factors related to the type of package, the product, the environment in which the product is exposed as well as the product-package environment relationship. This study was, therefore, sought to find out the effects of certain packaging materials on various physico-chemical changes of sugarcane juice during storage.

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EXPERIMENTAL METHODS

Extraction of sugarcane juice :

High yielding variety of sugarcane (C0 86032) was purchased locally. The skin and node on both sides of the cane were removed and washed in plain water to remove foreign particles adhering on the cane surface. The fresh juice was extracted from the washed canes using three-roller power crusher.

Bottling of sugarcane juice :

The extracted juice was pasteurized at 80^0C for 15 minutes and filtered by using muslin cloth. The pasteurized juices were cooled and sodium benzoate preservative was added at a level of 100 and 125 ppm. The packaging materials selected were glass bottle, polyethylene (400 gauge) and polypropylene (350 gauge). The gauge thickness of polyethylene and polypropylene packaging materials selected for the study were based on the optimization study in regard to heat withstanding capacity and changes in biochemical qualities of juice during storage. The pasteurized juices were filled in sterilized packaging materials *viz.*, glass bottle, polyethylene (400 gauge) and polypropylene (350 gauge) at a volume of 250 ml and then processed at 80^0C for 15 minutes. The processed juices were stored at refrigerated temperature (5^0C) and at room temperature (30^0C). Sugarcane juice stored in glass bottle at room temperature (30^0C) was treated as control. The different symbols used in the treatments were control (T_1), sugarcane juice with 100 ppm preservative at 30^0C (T_2), sugarcane juice with 100 PPM preservative at 5^0C (T_3), sugarcane juice with 125 ppm preservative at 30^0C (T_4) and sugarcane juice with 125 ppm preservative at 5^0C (T_5).

Biochemical analysis :

The various physico-chemical parameters *viz.*, total soluble solids, total sugars, reducing sugars, pH and titratable acidity were estimated during the storage. The total soluble solids (^{0}Brix) were estimated using Erma hand refractometer, whereas total sugars, reducing sugars, pH and titratable acidity were estimated by using the procedure given by Ranganna, (1995). All the treatments were carried out in triplicates.

Sensory evaluation :

The sensory evaluation of the stored sugarcane juices was carried out by 12 untrained judges for colour, flavour, appearance and acceptability using the 9-point hedonic scale (1= dislike very much 9= like very much) (Ranganna, 1977). Statistical analysis was carried out by Factorial Completely Randomized Design (FCRD) using agres package.

EXPERIMENTAL FINDINGS AND ANALYSIS

The experimental findings of the present study have been presented in the following heads:

Total sugars :

Total sugars content was decreased during storage. Total sugars content in fresh sugarcane juice (T_1) was found to be 16.5 per cent. The decrease of sugar content of sugarcane juice was less (15.4%) in glass bottle for treatment T_5 followed by polyethylene and polypropylene packaging during storage (Table 1). This could be due to action of microorganism present in the juice, converted the total sugars into reducing sugars (glucose and fructose). All the treatments were found to be

Table 1: Effect of different treatments on total sugars (%) of sugarcane juice stored in different packaging materials

Storage periods (days)	Glass bottle				Polyethylene 400 gauge				Polypropylene 350 gauge			
	T_2	T_3	T_4	T_5	T_2	T_3	T_4	T_5	T_2	T_3	T_4	T_5
10	15.2	16	15.5	16.2	14.8	15.9	15.3	16.1	14.6	15.7	15.2	15.9
20	14.8	15.7	15.3	16.0	14.6	15.6	15.0	15.9	14.5	15.3	14.9	15.7
30	14.7	15.5	15.1	15.9	14.5	15.4	14.8	15.8	14.3	15.0	14.6	15.6
40	14.5	15.2	14.9	15.7	14.3	15.1	14.7	15.6	14.2	14.9	14.5	15.4
50	14.0	15.0	14.6	15.6	13.9	14.9	14.5	15.5	13.8	14.7	14.3	15.1
60	13.8	14.9	14.5	15.4	13.6	14.8	14.4	15.3	13.5	14.6	14.2	15.0

Table 2 : Effect of different treatments on reducing sugars (%) of sugarcane juice stored in different packaging materials

Storage periods (days)	Glass bottle				Polyethylene 400 gauge				Polypropylene 350 gauge			
	T_2	T_3	T_4	T_5	T_2	T_3	T_4	T_5	T_2	T_3	T_4	T_5
10	18.0	18.9	18.5	19.0	17.8	18.5	18.9	19	17.7	18.4	18.8	18.9
20	18.0	18.8	18.4	18.9	17.6	18.3	18.8	18.9	17.6	18.3	18.6	18.8
30	17.8	18.6	18.3	18.8	17.5	18.3	18.6	18.8	17.4	18.2	18.6	18.6
40	17.7	18.5	18.2	18.8	17.5	18.2	18.4	18.6	17.3	18.2	18.5	18.6
50	17.7	18.5	18.2	18.7	17.3	18.15	18.4	18.6	17.3	18.0	18.3	18.4
60	17.5	18.2	18.1	18.7	17.2	18.10	18.5	18.6	17.1	18.0	18.2	18.3

highly significant ($p<0.01$). Similar results were reported by Chauhan *et al.* (1997) and Yusuf *et al.* (2002).

Reducing sugars :

There was an increase of reducing sugars during storage. This might be due to the fact that the hydrolysis of non-reducing sugars (sucrose) into reducing sugars (glucose and fructose) by the action of microorganism. Reducing sugars content in the fresh sugarcane juice was 0.45 per cent (T_1). The increase of reducing sugars was less (0.81%) in glass bottle for treatment T_5 followed by polyethylene and polypropylene during the storage (Table 2). The reason for increase of reducing sugars in polyethylene and polypropylene might be due to the variation in permeability of material for gas and water vapour. All the treatments were found to be highly significant with storage temperature, storage period and preservative. This result is in agreement with Singh *et al.*(2002).

Total soluble solids (TSS) :

The total soluble solids decreased with increase in storage periods ($p<0.01$). This might be due to the action of microorganism present in the juice. The total soluble solids decrease was less in glass bottle (18.7^{0}Brix) for treatment T_5 during storage (Table 3). This is in agreement with the findings of Ghorai and Khurdiya (1998) in kinnow mandarin juice.

Titratable acidity :

The titratable acidity of sugarcane juice increased during storage (Table 4). This might be due to the fact that acetic and lactic acid production taken place during storage. Sugarcane juice stored at 30^{0}C recorded higher acidity range compared to those stored at 5^{0}C. The increase of acidity was less in glass bottle (1.19 %) for treatment T_5 followed by polyethylene and polypropylene.

Table 3: Effect of different treatments on total soluble solids (^{0}Brix) of sugarcane juice stored in different packaging materials

Storage periods (days)	Glass bottle				Polyethylene 400 gauge				Polypropylene 350 gauge			
	T_2	T_3	T_4	T_5	T_2	T_3	T_4	T_5	T_2	T_3	T_4	T_5
10	0.49	0.47	0.48	0.47	0.51	0.48	0.50	0.48	0.52	0.51	0.51	0.50
20	0.57	0.50	0.53	0.49	0.62	0.52	0.56	0.52	0.65	0.56	0.59	0.53
30	0.64	0.58	0.59	0.53	0.68	0.62	0.64	0.58	0.71	0.64	0.68	0.60
40	0.82	0.65	0.76	0.60	0.86	0.74	0.82	0.64	0.92	0.75	0.86	0.65
50	1.10	0.80	0.94	0.72	1.18	0.86	1.10	0.80	1.24	0.91	1.20	0.87
60	1.25	0.92	0.98	0.81	1.32	1.12	1.24	0.87	1.38	1.23	1.27	0.98

Table 4 : Effect of different treatments on titratable acidity (% citrate) of sugarcane

Storage periods (days)	Glass bottle				Polyethylene 400 gauge				Polypropylene 350 gauge			
	T_2	T_3	T_4	T_5	T_2	T_3	T_4	T_5	T_2	T_3	T_4	T_5
10	0.95	0.89	0.91	0.87	0.98	0.90	0.94	0.91	1.10	0.93	0.98	0.93
20	1.15	0.94	0.97	0.90	1.21	0.95	0.99	0.92	1.26	0.98	1.10	0.95
30	1.20	1.0	1.10	0.98	1.25	1.14	1.15	1.10	1.32	1.20	1.17	1.19
40	1.23	1.14	1.17	1.10	1.28	1.20	1.20	1.15	1.38	1.25	1.25	1.22
50	1.28	1.18	1.20	1.14	1.32	1.24	1.24	1.18	1.43	1.28	1.28	1.25
60	1.35	1.22	1.25	1.19	1.39	1.28	1.28	1.20	1.45	1.32	1.32	1.28

Table 5: Effect of different treatments on pH of sugarcane juice stored in different packaging materials

Storage periods (days)	Glass bottle				Polyethylene 400 gauge				Polypropylene 350 gauge			
	T_2	T_3	T_4	T_5	T_2	T_3	T_4	T_5	T_2	T_3	T_4	T_5
10	4.90	4.98	4.95	5.0	4.8	4.90	4.90	4.90	4.65	4.80	4.70	4.85
20	4.52	4.65	4.60	4.70	4.3	4.50	4.40	4.60	4.40	4.55	4.45	4.63
30	4.21	4.42	4.40	4.63	4.2	4.30	4.25	4.42	4.0	4.25	4.15	4.20
40	4.05	4.25	4.25	4.50	3.90	4.10	4.05	4.15	3.85	4.05	4.0	4.10
50	3.90	4.10	4.05	4.43	3.50	3.95	3.90	4.00	3.73	3.86	3.80	3.95
60	3.75	4.05	4.0	4.21	3.43	3.85	3.75	3.90	3.65	3.72	3.70	3.80

pH:

The pH value of stored sugarcane juice was decreased at about equal rates during storage for all treatments. The reduction of pH during storage might be due to acetic acid production by the action of acetic acid bacteria. This result is in agreement with the study conducted by Chauhan *et al.*(1997).

Sensory evaluation :

Based on the sensory evaluation, the sugarcane juice stored in all packaging materials were found to be highly significant ($p<0.01$). From the mean values of statistical analysis, the glass bottle was found to be good for colour, flavour and overall acceptability followed by polyethylene and polypropylene.

Conclusion :

The fresh sugarcane juice (T_1) had shelf-life of 4 days without any spoilage when stored at refrigerated temperature (5^0C), but the juice became spoiled within a day when stored at room temperature (30^0C). The cost of storing sugarcane juice in flexible packaging materials was less compared to glass bottle. The reduction in sensory scored of samples stored at room temperature was of significantly ($p<0.01$) greater magnitude than juice stored at refrigerated temperature. Based on the sensory evaluation, the sugarcane juice colour and flavour was good when stored at refrigerated temperature than room temperature. Therefore, it is concluded that apart from glass bottle, there is a possibility to store sugarcane juice in polyethylene and polypropylene because of high acceptability from the consumer point of view as well as less reduction in biochemical qualities.

LITERATURE CITED

Bhupinder, K., Sharma, K.P. and Harinder, K. (1991). Studies on the development and storage stability of ready to serve bottled sugarcane juice. *Internat. J.Tro.Agric.,* **9**(2):128-134.

Chauhan, S.K., Joshi, V.K. and Lal, B.B. (1997). Preparation and evaluation of a refreshing sugarcane juice beverages. *J.Sci. Indian Res.,* **56**(4): 220-223.

Chauhan, O.P., Dhar Singh, S., Tyagi, M. and Balyan, D.K. (2002). Studies on preservation of sugarcane juice. *Internat. J. Food Properties,* **5**(1): 217-229.

Ghorai, K. and Khurdiya, D.S. (1998). Storage of heat processed kinnow mandarin juice. *Food.Sci.Tech.,* **35**(5): 422-424.

Kapur, K.L., Singh, V.P. and Garg, R.G. (1978). Preliminary studies on preservation of sugarcane juice. *Indian Fd. Packer,* **32**(2): 32-33.

Parvathy, K. (1983). Bottling of sugarcane juice. Proceedings of the scheme for studies on postharvest technology (ICAR), Coimbatore Centre. *Annual report,* 13-16.

Pushpha, Singh, Shashi, H.N., Archnna, Suman., Jain, P.C., Singh, P. and Suman, A. (2002). Sugarcane juice concentrates preparation, preservation and storage. *J.Food.Sci.Techno.,* **39** (1): 96-98.

Ranganna, S. (1977). *Manual of analysis of fruits and vegetables.* Tata-Mc-Grew Hill Publishing Co.Ltd. NEW DELHI, INDIA.

Ranganna, S. (1995). *Handbook of analysis and quality control for fruits and vegetables.* Tata-Mc-Grew Hill Publishing Co.Ltd. NEW DELHI, INDIA.

Swaminathan, V. (1995). *Food science, chemistry and experimental foods*. The Bangalore printing and Publishing Co.Ltd, Bengaluru (KARNATAKA) INDIA.

Yusuf, L.S., Shian, A. and Osman (2002). Changes in quality of sugarcane juice upon delayed extraction and storage. *Food Chem.,* **68**: 395-401.

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