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Effect of some Indian herbs and chemical on shelf life of sugarcane juice

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ABSTRACT : The present study was carried out to provide hygienic, shelf-stable sugarcane juice to people and encourage the industrialists to start sugarcane juice production on commercial scale. Different lots of sugarcane juice were subjected to heat treatment at 75 °C for 15 minutes (T_1). Heat treatment after addition of lemon juice + ginger + Pudina extracts + black salt (T_2), heat treatment after addition of lemon juice + ginger + Tulsi extracts + black salt (T_3), heat treatment after addition of 0.04 per cent propyl parabens (T_4) and heat treatment after addition of 0.06 per cent propyl parabens (T_5). Fresh sugarcane juice was taken as control (T_0). All the treated juices were bottled and were pasteurized in hot water at 75 °C for 15 minutes. All the lots were stored for 30 days at room temperature (30 ± 5 °C).The prepared juice were observed for physico-chemical and microbiological aspects like T.S.S, pH, colour, total plate counts, yeast and mould growth along with sensory evaluation.The experiment was laid down using Completely Randomized Design.From the experiment it was clear that the overall performance of the above characteristics was found best when the juice was preserved by using heat treatment after addition of 0.04 per cent propyl parabens (T_4). However, the use of Pudina in the treatment T_3 and Tulsi in the treatment T_4 have shown the maximum values of sensory attributes upto the interval of 5 days as compared to others.

KEY WORDS : Sugarcane juice, Heat treatment, Storage, Sensory evaluation

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Sugarcane (*Saccharum officinarum*) is one of the most important agro-industrial crops in our country. India is the original home of sugarcane and second largest producer next to Brazil. Sugarcane has been used as a sweetening agent for millennia and today mainly in the form of refined sugar (Phanikumar, 2011). 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. It contains water (75%-85%), reducing sugar (0.3-3.0%), non-reducing sugar (10-21%) (Krishnakumar *et al*.,2013). Sugarcane juice is rich in enzyme and has many medicinal properties.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 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 (Khare *et al*., 2012). In general sugarcane juice is spoiled quickly (Sangeeta *et al*., 2013). Biodegradation is caused by micro-organisms mainly *Leuconostoc* sp. like *L. mesenteroides* and *L. dextranium* (Begum *et al*.,2015). These organisms convert sucrose into polysaccharides, such as dextran. Soon after the harvest of sugarcane;

endogenous invertase enzyme is activated and acts as a cause of deterioration. Extracted juice from the canes turns dark brown and marked sedimentation appears during storage.Conventional heating process imparts the taste of jaggery and delicate flavours of juice is adversally affected.The sugarcane juice can be introduced as delicious beverage by preventing the spoilage of juice with appropriate method.Main objective of this research work was to provide hygienic,shelf-stable sugarcane juice to people and encourage the industrialists to start sugarcane juice production on commercial scale.

RESEARCH METHODS

Sugarcane variety CoLk 94184 (Birendra) was collected from farms of Indian Institute of Sugarcane Research, Lucknow.The fully matured sugarcane stalks were harvested from the farms of Indian Institute of Sugarcane Research, Lucknow. The sugarcane stalks were peeled and scrubbed with the help of peeler and were cut into small pieces in order to make pre – treatment process convenient. The pieces of sugarcane stalk were then washed and blanched in hot water at a temperature of 80 °C for 15 minutes and then immediately cooled in the deep freezer in order to inactivate enzymatic activity during the processing of juice and also prevent the discolouration of sugarcane juice.Sugarcane juice were extracted by crusher and filtered through muslin cloth to remove the extraneous matter.The filtered juice was immediately kept for cooling in the refrigerator.

Lemons were cut into two pieces with the help of sharp blade knife. Then lemon pieces were squeezed and lemon juice was filtered through the sieve and muslin cloth to remove the extraneous matter.Ginger juice was prepared by peeling the rhizomes with the help of sharp knife and therafter grinding them in the blender.The blended juice was filtered through muslin cloth.For the preparation of Tulsi extract 50 grams of Tulsi leaves were taken, 25 ml of water was added to it and grounded in the blender.After grinding the Tulsi 75 ml of water is added and the mixture is filtered through muslin cloth. The filtered juice was boiled for 2-3 minutes. For obtaining the Pudina extract 50 grams of pudina leaves were taken, 25 ml of water was added to it and grounded in the blender. After grinding the pudina leaves 75 ml of water was added into it and the mixture was filtered through muslin cloth. The filtered juice was boiled for 2-3 minutes.

Optimization of treatments :

Concentration of lemon (1.6 ml/ 100 ml juice), ginger (0.2 ml/ 100 ml juice), tulsi extract (12 ml/ 100 ml juice), Pudina extract (10 ml/ 100 ml juice), black salt (0.6 g/ 100 ml juice), propyl parabens (0.06% and 0.08%) and pasteurization treatment (75°C for 15) minutes were optimized on the basis of sensory evaluation. The sensory evaluation was based on three parameters namely flavour, appearance and overall acceptability.

Treatment :

Diffirent lots of sugarcane juice were subjected to heat treatment at 75°C for 15 minutes (T_1). Heat treatment after addition of lemon juice + ginger + Pudina extracts + black salt (T_2), heat treatment after addition of lemon juice + ginger + Tulsi extracts + black salt(T_3), heat treatment after addition of 0.04 per cent propyl parabens (T_4) and heat treatment after addition of 0.06 per cent propyl parabens (T_5). Fresh sugarcane juice was taken as control (T_0). All the treated juices were bottled and were pasteurized in hot water at 75 °C for 15 minutes. All the lots were stored for 30 days at room temperature (30 ± 5 °C).

Analysis:

The samples were drawn and analysed for physico-chemical and sensory attributes at the interval of 5 days for upto 30 days. T.S.S, pH, colour, total plate counts, yeast and mould growth were studied. The total soluble solids was measured by digital refratrometer Altago Pocket Refractrometer, pH by Hanna instruments HI2215 pH meter and colour by Color Reader CR-10 Konica Minota Sensing, Inc, Made in Japan. The microbial analysis were done according to the methods described by Ranganna (2007). 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 experiment was designed under Completely Randomized Design (CRD) with five treatments and three replications.

RESEARCH FINDINGS AND DISCUSSION

The findings of the present study as well as relevant discussion have been presented under following heads :

Changes during storage of sugarcane juice:

Fresh sugarcane juice sample spoiled within 3-4 h at room temperature, therefore results for control

couldnot be obtained. Simmilar results were obtained by Chauhan *et al*. (2002)

Physico – chemical changes during storage of sugarcane juice:

Results regarding changes in physico chemical properties are shown in Table 1. From the Table 1, it was clear that maximum T.S.S. was obtained in treatment T_5 (22.60 °B) while minimum T.S.S. (19.53) was observed in treatment T_2. Due to the addition of Pudina and Tulsi extract T_2 and T_3 have relative lower T.S.S. During the storage studies it was observed that T.S.S has declined in all the treatments, simmilar results were reported by Yasmin *et al.* (2010). The juice in which the herbs were added *i.e.* T_2 and T_3 have shown the simmilar trend with respect to their change in physico-chemical values.The maximum values of T.S.S. were observed at the interval of 0 days (T_1=22.10, T_2=19.53 and T_3=19.67) and the minimum in the 30 days (T_1=17.37, T_2=17.07 and T_3=17.28).

Table 1 also depicts that pH has decreased in all the treatments, at the interval of 30 days, the maximum pH (2.36) was observed at treatment T_5 followed by T_4 (2.32) while minimum at T_1 (2.14). Simmilar results were also reported by Chun *et al*. (2007). At 0 day interval T_2 and T_3 have shown lower values of pH (T_2=4.22 and T_3=4.14) compared to the other treatments.This was due to the addition of lemon juice. The gradual decrease in pH was observed in T_4 and T_5. This was probably due to the preservating effects of parabens.

Microbiological changes during storage of sugarcane juice :

From the Table 2, it was clear that the preservatvies had significant influence on the microbial spore load. At the end of storage studies the maximum total plate count was observed in T_1 (8.62 Log of Cfu/ml) and minimum in T_5 (2.747 Log of cfu/ml). Simmilar trend was observed for yeast and mould count, where the maximum yeast and mould count was observed in T_1 (3.60 Log of cfu/ml) and the minimum in T_5 (1.40 Log of cfu/ml). At the interval of 10 days the total plate count of T_1 was 2.91 Log of cfu/ml, T_2=2.89 Log of cfu/ml and T_3=2.82 Log of cfu/ml.The yeast and mould count at the interval of

Table 1 : Physico – chemical changes during storage of sugarcane juice

Treatments	Storage time (days)													
	Total soluble solids (°Brix)							pH						
	0	5	10	15	20	25	30	0	5	10	15	20	25	30
T_1	22.10	21.33	19.8	18.67	17.77	17.7	17.37	5.45	5.39	3.42	2.80	2.59	2.19	2.14
T_2	19.53	19.13	18.6	18.2	17.60	17.27	17.07	4.22	4.16	3.88	3.22	2.83	2.32	2.26
T_3	19.67	19.27	18.8	18.4	17.80	17.47	17.28	4.14	3.96	4.10	3.44	2.88	2.34	2.29
T_4	22.40	21.98	21.67	21.4	21.20	20.6	20.20	5.46	5.40	5.32	4.52	4.41	4.05	2.32
T_5	22.60	21.93	21.40	21.4	21.08	20.4	20.0	5.47	5.43	5.41	4.65	4.50	4.17	2.36
Mean	21.26	20.71	20.05	21.33	19.09	18.69	18.38	4.94	4.86	4.43	3.73	3.45	3.01	2.28
C.V.	1.02	1.69	0.93	0.90	0.93	0.81	1.31	0.44	2.76	4.82	5.71	6.45	4.68	2.48
S.E.±	0.12	0.20	0.10	0.10	0.10	0.08	0.13	0.01	0.07	0.12	0.12	0.12	0.08	0.03
C.D. (P=0.05)	0.40	0.64	0.34	0.32	0.33	0.29	0.44	0.04	0.24	0.39	0.39	0.41	0.26	0.10

Table 2 : Microbiological changes during storage of sugarcane juice

Treatments	Storage time (days)													
	Total plate count (Log of colony forming unit/10ml)							Yeast and mould count (Log of colony forming unit/10ml)						
	0	5	10	15	20	25	30	0	5	10	15	20	25	30
T_1	0.67	2.64	2.91	5.78	6.22	7.91	8.62	N.D.	0.56	0.67	1.76	2.40	3.80	3.59
T_2	0.62	2.52	2.89	5.59	6.15	7.88	8.54	N.D.	0.10	0.63	1.34	20.79	3.63	3.43
T_3	0.63	2.48	2.82	5.56	6.40	7.81	8.50	N.D.	0.10	0.25	1.56	2.68	3.25	3.36
T_4	0.61	0.88	1.85	2.21	2.73	2.81	2.83	N.D.	0.00	0.00	0.59	0.86	1.10	1.59
T_5	0.60	01.86	1.87	1.75	2.67	2.74	2.74	N.D.	0.00	0.00	0.10	0.92	1.36	1.40
Mean	0.62	1.87	2.47	4.18	4.84	5.83	6.25	N.D.	0.15	0.25	1.07	1.93	2.63	2.67
C.V.	2.25	0.583	1.14	7.32	7.51	0.44	0.57	N.D.	101.2	55.47	27.69	8.68	5.46	9.14
S.E. ±	0.08	0.006	0.016	0.177	0.218	0.015	0.021	N.D.	0.089	0.08	0.17	0.09	0.08	0.14
C.D. (P=0.05)	0.026	0.020	0.052	7.329	0.671	0.047	0.066	N.D.	0.28	0.26	0.54	0.30	0.26	0.45

N.D. = Not detected

10 days was 0.67 Log of cfu/ml in T_1,0.63 Log of cfu/ml in T_2 and 0.25 Log of cfu/ml in T_3.The treatment of T_1 have shown greater values of total plate count and yeast and mould count compared to T_2 and T_3.These values indicate that T_1, T_2 and T_3 are microbiologically safe upto 10 days after storage, and the juice treated with preservative are safe for consumption throughout the storage period of 30 days.

Changes in the vales of colour (a and L) during storage of sugarcane juice :

"a" is a chromaticity designation of colour *i.e.* the value of 'a' measured redness when positive, grey when zero and greeness when negative.The L indicates intensity of colour *i.e.* lightness which varies from L=100 for perfect white to L=0 for black.

Table 3 clearly indicates that in the present experiment

Table 3 : Colour (a and L values) changes during storage of sugarcane juice

Treatments	Storage time (days)													
	a-value							L-value						
	0	5	10	15	20	25	30	0	5	10	15	20	25	30
T_1	-2.90	0.67	1	2.2	2.3	2.73	3.3	37.4	39.27	35.23	34.67	32.93	31.7	42.23
T_2	- 1.47	-0.73	0.43	-0.37	-2.7	-0.13	-0.06	47.77	48.5	50.53	52.1	53.17	55.23	56.73
T_3	-1.33	-0.57	-0.43	-0.33	-0.23	-0.13	-0.1	49.8	51.8	51.47	53.87	55.47	56.6	57.67
T_4	-2.93	-2.7	-2.5	-2.33	-2.03	-1.63	-1.2	36.47	38.5	40.9	42.73	45.67	47.00	49.3
T_5	-3.03	-2.97	-2.63	-2.57	-2.47	-2.0	-1.6	35.67	37.13	38.47	41.17	42.2	44.5	30.43
Mean	-2.33	-1.26	-1	-0.68	-0.54	-0.23	0.07	41.42	43.04	43.32	44.91	45.89	47	47.27
C.V.	-7.98	-8.93	12.649	-18.98	-17.24	-55.33	168.82	2.31	1.57	2.13	2.52	1.55	1.84	24.90
S.E. ±	0.107	0.065	0.073	0.075	0.054	0.075	0.065	0.553	0.39	0.534	0.654	0.410	0.499	6.797
C.D. (P=0.05)	0.343	0.207	0.233	0.238	0.172	0.238	0.207	1.764	1.246	1.704	2.089	1.309	1.592	NS

NS = Non significant

Table 4 : Changes in sensory scores (appearance and flavour) during storage of sugarcane juice

Treatments	Storage time (days)													
	Appearance							Flavour						
	0	5	10	15	20	25	30	0	5	10	15	20	25	30
T_1	8.23	7.70	5.10	4.70	4.40	4.20	4.13	7.97	7.67	5.33	4.60	4.2	3.8	3.47
T_2	8.56	8.03	6. 30	4.90	4.60	4.16	3.93	8.37	8.30	6.00	4.80	4.40	4.00	3.67
T_3	8.63	8.66	6.40	5.07	4.80	4.13	4.06	8.60	8.30	6.20	4.97	4.57	4.20	3.93
T_4	8.10	7.93	7.66	5.16	7.36	7.1	6.93	8.50	8.40	8.17	8.00	7.87	7.60	7.4
T_5	8.30	8.36	7.86	7.56	7.40	7.23	7.13.	8.30	8.00	8.03	7.80	7.70	7.50	7.2
Mean	8.36	8.14	6.66	5.48	5.71	5.36	5.24	8.35	8.13	5.75	6.03	5.75	5.42	5.13
C.V.	0.93	1.59	1.60	32.31	30.7	2.76	2.03	1.275	1.587	3.361	3.503	2.980	3.087	3.018
S.E. ±	0.045	0.075	0.061	1.022	0.101	0.086	0.061	0.061	0.075	0.141	0.122	0.099	0.097	0.089
C.D. (P=0.05)	0.143	0.238	0.196	NS	0.323	0.273	0.196	0.196	0.238	0.451	0.389	0.316	0.308	0.285

NS=Non-significant

Table 5 : Changes in sensory scores (Overall acceptability) during storage of sugarcane juice

Treatments	Storage time (days)						
	Overall acceptability						
	0	5	10	15	20	25	30
T_1	7.83	7.50	5.40	4.60	4.53	4.33	4.13
T_2	7.93	7.60	5.50	4.70	4.63	4.43	4.26
T_3	8.20	7.70	5.60	4.80	4.76	4.53	4.30
T_4	8.10	7.50	7.30	7.20	7.16	7.10	6.93
T_5	7.93	7.40	7.13	7.10	6.87	6.80	6.73
Mean	8.00	7.54	6.19	5.69	5.59	5.44	5.27
C.V.	2.24	1.33	2.83	2.95	2.06	2.47	2.30
S.E. ±	0.103	0.058	0.101	0.097	0.067	0.077	0.070
C.D. (P=0.05)	NS	0.184	0.323	0.308	0.213	0.247	0.223

NS=Non-significant

treatment T_2, T_3, T_4 and T_5 remained green with negative 'a' values throughtout the storage period and the treatment T_1 showed positive values throughout the storage period. In the treatment of T_1 browning was observed with a rapid decrease of L-values. Afterwards juice colour became lighter with increasing L-values due to the sedimentation of browning compounds.Simmilar result was observed by Mao and Que (2007). Treatments of T_2 and T_3 showed relative higher values of 'a' compared to T_4 and T_5 throughout the storage studies.This was probably due to the addition of lemon juice which lowers the pH and causes degreening of juice.

Changes in sensory scores during storage of sugarcane juice :

Sensory evaluation regarding appearance, flavour and overall acceptability were carried out and mentioned in Tables 4 and 5.The treatment combination T_3 (prepared with the combination of Tulsi, ginger, lemon and salt) had shown the best results followed by T_2 (prepared with the combination of mint, ginger, lemon and salt) for upto the interval of 5 days.Simmilar trend was obtained for upto the interval of 5 days. Agarwal *et al*. (2015) have also observed that addition of flavouring like salt, ginger, lemon and mint to the sugarcane juice give better sensory attributes than normal juice.

The sensory scores reduced significantly with the advancement of storage was also reported by Singh *et al*. (2014). However, a significantly higher reduction in sensory scores of T_3, T_2 and T_1 (upto the interval of 10 days) was observed compared to T_4 and T_5. At the interval of 30 days the maximum score for appearance (7.13) was observed in T_5 and maximum score for flavour (7.4) and overall acceptability (6.8) was observed in T_4. Simmilar results were reported by Chun (2007).

Conclusion :

It can be concluded from the present investigation that the use of heat treatment along with preservatives had a significant impact on the shelf life of the sugarcane juice because the juice treated with preservatives could retain the characters like T.S.S., pH, total plate count, yeast and mould count and organoleptic characters for a longer duration than control.The use of herbs *i.e*. Tulsi and Pudina leaves have a significant impact on the sensory attributes of the sugarcane-juice with the maximum values for appearance,flavour and overall acceptability upto the interval of 5 days. At the end of storage studies T_5 was the best for retaining the various physico- chemical and microbiological characters followed by T_4. The organoleptic characters of T_4 were found to be better than T_5 during the storage studies.

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