



Effect of Sodium Benzoate Concentrations and Storage Conditions on Sensory Evaluation and Microbial Count of Jamun Juice during Storage

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Microbiological assessment of preservative method and storage conditions for Jamun juice was carried out. The juice samples were subjected to chemical treatment using sodium benzoate (250, 500, 750, 1000 ppm and control). All samples were stored in ambient ($28 \pm 2^\circ\text{C}$) and cold storage condition (12°C) for six months to determine the effect of treatments on microbial count. Microbiological criteria are intended to give some degree of assurance that juice is safe and of suitable quality, and that it will remain so to the end of its shelf life. The use of sodium benzoate and juice stored at cold storage temperature gave the best storage stability and was best for consumption upto 4 months.

(Key words: Jamun juice, Microbial count, Sensory, Sodium benzoate, Storage condition)

Fruits are considered as the important protective foods of mankind as they not only meet the quantitative needs to some extent but also supply vitamins and minerals. It is therefore, necessary to make them available for consumption throughout the year in fresh or processed form. Jamun (*Syzygium cumini*) fruit is an important member of the family Myrtaceae. It is considered to be indigenous to India and the West Indies, being cultivated in the Philippines, West Indies and Africa. The Jamun tree is tall, evergreen and is generally grown as avenue or as wind breaks on the boundary of the orchard. The fruits are good source of iron and are used as an effective medicine against diabetes, heart and liver trouble. The most common type grown in north India is known as Rajamun. Due to perishable nature of jamun, the commercial utilization for processing is still limited in India.

However, the juice extracted from the jamun could be utilised for preparation of value added products such as nector, squash, syrup, jamun powder, etc. So, to preserve juice at farm level with minimum processing is important. The jamun fruit has excellent processing qualities for pulp and seed. Fruits are extensively used for the preparation of preserves, squashes, jellies, wine, vinegar, juice etc. Preservation of fruit juice is very important so that the preserved juice can be further used for preparation of juice based beverages. The fruit juice is rich source of sugars, minerals, vitamins, organic acids

etc., which act as a good source of food for spoilage micro organisms. The enzymes present in juice are also responsible for deterioration of the quality. Thus, study on preservation method, with different sodium benzoate concentrations and storage conditions on the sensory quality and shelf life of fruit juice is essential.

MATERIALS AND METHODS

The jamun fruits were washed, wiped dry and juice was extracted mechanically with the help of jamun pulper. Initially pulp was separated from seed with the help of jamun pulper. Then juice was extracted by pressing pulp in muslin cloth. The juice was then pasteurized at 80°C for 20 minutes. After pasteurization, juice was treated with sodium benzoate at concentrations of 250 (P_1), 500 (P_2), 750 (P_3), 1000 (P_4) ppm and control, respectively. Then treated hot juice was immediately placed in 1 lit. HDPE cans and stored at two different storage conditions, viz. ambient temperature ($28 \pm 2^\circ\text{C}$) and cold storage ($12 \pm 1^\circ\text{C}$) up to six months. The experiment was laid out in factorial completely randomized block design with three replications. The sensory evaluation and microbial count of juice was done immediately after preparation and 6 months after storage.

The sensory quality of jamun juice was studied by preparing a RTS (10 per cent juice, 12 per cent TSS and 0.25 per cent acidity and remaining water) from various treatments. The sensory evaluation was done by using 9

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point Hedonic scale. The bacterial growth in juice was estimated by serial dilution and plate technique using nutrient agar medium. For estimation of yeast growth, MGY medium was used with serial dilution technique. The shelf life of jamun juice was decided on the basis of sensory evaluation (overall acceptability). The jamun juice which recorded sensory score below 5.5 in 9 point Hedonic scale was rated as unacceptable and shelf life of this juice was considered to be over.

RESULTS AND DISCUSSIONS

Effect of sodium benzoate concentrations on microbial count of jamun juice during storage

The data regarding effect of sodium benzoate concentrations on yeast and bacterial count in jamun juice under different storage conditions are presented in Table 1 and 2. Results revealed that, yeast and bacterial count of jamun juice increased throughout the storage period in both ambient (S_1) and cold storage conditions (S_2). However, result also indicated that yeast and bacterial load was maximum in S_1 as compared to S_2 storage condition.

Considering sodium benzoate concentrations it was observed that, the results were significant throughout the storage period with respect to yeast and bacterial count. From initial day of storage up to 2 month storage there was no growth of yeast and bacteria in treatment P_1 to P_4 .

Whereas, in P_5 (control) bacterial growth was observed at initial day and 2 month storage. At 4 month storage the lowest yeast and bacterial growth was found in treatment P_4 which was significantly superior over rest of the treatments. While, highest yeast and bacterial load was recorded in P_5 . At 6 month storage, yeast and bacterial population was increased rapidly. Lowest growth was recorded in P_4 and highest in P_5 . From above findings it could be seen that, as the concentration of sodium benzoate increases, yeast and bacterial growth get decreased. Similar findings have been reported by, Oladipo *et al.* (2010) in some Nigerian fruit juices and Hussain *et al.* (2011) in apple and apricot blended juice.

With respect to effect of storage conditions on the yeast and bacterial growth, it was observed that, as the storage period increases the yeast and bacterial load get increased at faster rate in ambient temperature (S_1) as compared to cold storage (S_2). Similar findings have been reported by Emamifar (2010) in orange juice.

The interaction of sodium benzoate concentrations and storage conditions had significant effect on yeast and bacterial load in juice from 2 to 6 months storage period. At 4 month storage no yeast and bacterial growth was recorded in treatment combination P_4S_2 which was at par

Table 1. Effect of sodium benzoate concentrations on bacteria count (at 10^4 dilution mL^{-1}) of jamun juice under different storage condition

Sodium benzoate conc. (P)	Storage period (Month)											
	Initial			2 month			4 month			6 month		
	Storage condition			Storage condition			Storage condition			Storage condition		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
P_1	0.00	0.00	0.00	0.00	0.00	0.00	49.25	7.35	28.30	55.08	40.75	47.92
P_2	0.00	0.00	0.00	0.00	0.00	0.00	32.08	4.42	18.25	52.08	36.50	44.29
P_3	0.00	0.00	0.00	0.00	0.00	0.00	17.75	0.20	8.98	40.42	32.25	36.33
P_4	0.00	0.00	0.00	0.00	0.00	0.00	10.50	0.00	5.25	31.08	15.08	23.08
P_5	3.25	3.25	3.25	6.50	4.50	5.50	53.50	9.75	31.63	61.25	50.75	56.00
Mean	0.65	0.65	0.65	1.30	0.90	1.10	32.62	4.34	18.48	47.98	35.07	41.53
	SEm $\pm$		CD at 1%	SEm $\pm$		CD at 1%	SEm $\pm$		CD at 1%	SEm $\pm$		CD at 1%
Sodium benzoate conc. (P)	0.08		0.339	0.04		0.169	0.22		0.90	0.27		1.078
Storage condition (S)	0.05		NS	0.03		0.107	0.14		0.57	0.17		0.682
Interaction (PxS)	0.12		NS	0.06		0.240	0.32		1.28	0.38		1.525

P_1 - sodium benzoate 250 ppm, P_2 - sodium benzoate 500 ppm, P_3 - sodium benzoate 750 ppm, P_4 - sodium benzoate 1000 ppm, P_5 - Control
 S_1 -ambient temperature, S_2 -cold storage

Table 2. Effect of sodium benzoate concentrations on yeast count (at 10^4 dilution mL^{-1}) of jamun juice under different storage condition

Sodium benzoate conc. (P)	Storage period (Month)											
	Initial			2 month			4 month			6 month		
	Storage condition			Storage condition			Storage condition			Storage condition		
	S ₁	S ₂	Mean	S ₁	S ₂	Mean	S ₁	S ₂	Mean	S ₁	S ₂	Mean
P ₁	0.00	0.00	0.00	0.00	0.00	0.00	5.33	1.24	3.29	7.50	6.25	6.88
P ₂	0.00	0.00	0.00	0.00	0.00	0.00	4.50	1.10	2.80	5.50	5.25	5.38
P ₃	0.00	0.00	0.00	0.00	0.00	0.00	3.42	0.00	1.71	4.50	4.33	4.42
P ₄	0.00	0.00	0.00	0.00	0.00	0.00	2.50	0.00	1.25	3.50	2.33	2.92
P ₅	3.42	3.42	3.42	5.85	3.50	4.68	8.83	5.83	7.33	11.58	8.33	9.96
Mean	0.68	0.68	0.68	1.17	0.70	0.94	4.92	1.63	3.28	6.52	5.30	5.91
	SEm±		CD at 1%	SEm±		CD at 1%	SEm±		CD at 1%	SEm±		CD at 1%
Sodium benzoate conc.(P)	0.06		0.25	0.06		0.250	0.13		0.506	0.19		0.759
Storage condition (S)	0.04		NS	0.04		0.158	0.08		0.320	0.12		0.480
Interaction (PxS)	0.09		NS	0.09		0.353	0.18		0.715	0.27		1.073

P₁- sodium benzoate 250 ppm, P₂- sodium benzoate 500 ppm, P₃- sodium benzoate 750 ppm, P₄- sodium benzoate 1000 ppm, P₅- Control
 S₁-ambient temperature, S₂-cold storage

Table 3. Effect of sodium benzoate concentrations on colour of jamun juice under different storage condition

Sodium benzoate conc. (P)	Storage period (Month)											
	Initial			2 month			4 month			6 month		
	Storage condition			Storage condition			Storage condition			Storage condition		
	S ₁	S ₂	Mean	S ₁	S ₂	Mean	S ₁	S ₂	Mean	S ₁	S ₂	Mean
P ₁	8.70	8.70	8.70	7.70	7.80	7.75	4.73	5.97	5.35	3.47	4.00	3.73
P ₂	8.77	8.77	8.77	7.73	8.00	7.87	5.23	6.10	5.67	3.77	4.13	3.95
P ₃	8.93	8.93	8.93	8.00	8.30	8.15	5.37	6.20	5.78	4.00	4.40	4.20
P ₄	9.03	9.03	9.03	8.10	8.40	8.25	5.53	6.57	6.05	4.17	4.47	4.32
P ₅	8.60	8.60	8.60	7.20	7.40	7.30	4.57	5.50	5.03	2.97	3.17	3.07
Mean	8.81	8.81	8.81	7.75	7.98	7.86	5.09	6.07	5.58	3.67	4.03	3.85
	SEm±		CD at 1%	SEm±		CD at 1%	SEm±		CD at 1%	SEm±		CD at 1%
Sodium benzoate conc. (P)	0.03		0.111	0.04		0.162	0.09		0.368	0.07		0.270
Storage condition (S)	0.02		NS	0.03		0.102	0.06		0.233	0.04		0.170
Interaction (PxS)	0.04		NS	0.06		NS	0.13		NS	0.09		NS

P₁- sodium benzoate 250 ppm, P₂- sodium benzoate 500 ppm, P₃- sodium benzoate 750 ppm, P₄- sodium benzoate 1000 ppm, P₅- Control
 S₁-ambient temperature, S₂-cold storage

with P_3S_2 and significantly superior over other treatments. Highest yeast and bacterial growth was recorded in treatment combination P_5S_1 at 4 month storage. However, at 6 month storage the yeast and bacterial count was increased in all the interactions as compared to 4 months count. Similar findings have been reported by Chukwumalume (2012) in African star apple juice.

Effect of sodium benzoate concentrations on sensory evaluation of jamun juice during storage

The jamun juice was examined for its sensory qualities by preparing a RTS with recipe of 10 per cent juice, 12 per cent TSS and 0.25 per cent acidity. The organoleptic qualities in terms of colour and flavour and overall acceptability were done at initial and end of storage (6 month) by panel of 10 judges with 9 point Hedonic scale. Data regarding the effect of storage conditions, treatments and their combination on sensory score are presented below.

The sensory score for changes in colour, flavour and overall acceptability of jamun juice during storage are presented in Table 3 to 5. From the table it was observed that, mean score of colour, flavour and overall acceptability of jamun juice decreased with increased in storage period. Decrease in juice colour, flavour and

overall acceptability with increased in storage period may be due to slight browning and loss of acids or may be due to effect of temperature on storage quality of juice, micro fermentation process at the end of storage. Similar findings have been reported by Khurdiya and Roy (1985), Bhandari (2004) in jamun juice, Shakoor *et al.*, (2013) in strawberry juice

The score for colour, flavour and overall acceptability of jamun juice was found to be increased with increase in sodium benzoate concentrations. Significantly highest colour, flavour and overall acceptability score was recorded in treatment P_4 and P_3 throughout the storage period. The treatment P_5 (control) recorded lowest colour, flavour and overall acceptability score for jamun juice throughout the storage period.

Results were significant throughout the storage period as far as storage condition is concerned, except initial day of storage. The treatment S_2 recorded significantly highest score for colour, flavour and overall acceptability irrespective of sodium benzoate concentrations throughout the storage period. The highest score recorded by treatment S_2 (cold storage) may be due to the less deterioration of quality of juice during storage due to effect of low temperature.

Table 4. Effect of sodium benzoate concentrations on flavour of jamun juice under different storage condition

Sodium benzoate conc. (P)	Storage period (Month)											
	Initial			2 month			4 month			6 month		
	Storage condition			Storage condition			Storage condition			Storage condition		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
P_1	8.57	8.57	8.57	6.23	7.60	6.92	4.93	6.23	5.58	3.10	3.90	3.50
P_2	8.67	8.67	8.67	6.40	7.90	7.15	5.17	6.70	5.93	3.43	4.03	3.73
P_3	8.77	8.77	8.77	7.20	8.30	7.75	5.30	7.17	6.23	3.73	4.27	4.00
P_4	8.90	8.90	8.90	7.50	8.50	8.00	5.40	7.50	6.45	4.47	4.77	4.62
P_5	7.90	7.90	7.90	5.33	6.47	5.90	4.53	5.33	4.93	2.47	3.03	2.75
Mean	8.56	8.56	8.56	6.53	7.75	7.14	5.07	6.59	5.83	3.44	4.00	3.72
	SEm±		CD at 1%	SEm±		CD at 1%	SEm±		CD at 1%	SEm±		CD at 1%
Sodium benzoate conc. (P)	0.05		0.195	0.06		0.225	0.08		0.30	0.14		0.583
Storage condition (S)	0.03		NS	0.04		0.142	0.05		0.19	0.09		0.369
Interaction (PxS)	0.07		NS	0.08		NS	0.11		0.43	0.20		NS

P_1 - sodium benzoate 250 ppm, P_2 - sodium benzoate 500 ppm, P_3 - sodium benzoate 750 ppm, P_4 - sodium benzoate 1000 ppm, P_5 - Control
 S_1 -ambient temperature, S_2 -cold storage

Table 5. Effect of sodium benzoate concentrations on overall acceptability of jamun juice under different storage condition

Sodium benzoate conc. (P)	Storage period (Month)											
	Initial			2 month			4 month			6 month		
	Storage condition			Storage condition			Storage condition			Storage condition		
	S ₁	S ₂	Mean	S ₁	S ₂	Mean	S ₁	S ₂	Mean	S ₁	S ₂	Mean
P ₁	8.57	8.57	8.57	6.97	7.70	7.33	4.83	6.10	5.47	3.28	3.95	3.62
P ₂	8.68	8.68	8.68	7.07	7.95	7.51	5.20	6.40	5.80	3.60	4.08	3.84
P ₃	8.85	8.85	8.85	7.60	8.30	7.95	5.33	6.68	6.01	3.87	4.33	4.10
P ₄	8.97	8.97	8.97	7.80	8.48	8.14	5.47	7.03	6.25	4.32	4.62	4.47
P ₅	8.25	8.25	8.25	6.27	6.93	6.60	4.55	5.42	4.98	2.87	3.10	2.98
Mean	8.66	8.66	8.66	7.14	7.87	7.51	5.08	6.33	5.70	3.59	4.02	3.80
	SEm±		CD at 1%	SEm±		CD at 1%	SEm±		CD at 1%	SEm±		CD at 1%
Sodium benzoate conc. (P)	0.03		0.112	0.03		0.105	0.06		0.22	0.09		0.373
Storage condition (S)	0.02		NS	0.02		0.067	0.03		0.14	0.06		0.236
Interaction (PxS)	0.04		NS	0.04		NS	0.08		0.31	0.13		NS

P₁- sodium benzoate 250 ppm, P₂- sodium benzoate 500 ppm, P₃- sodium benzoate 750 ppm, P₄- sodium benzoate 1000 ppm, P₅- Control
 S₁-ambient temperature, S₂-cold storage

Table 6. Shelf life of Jamun juice

Interaction	Shelf life (months)
P ₁ S ₁	2
P ₁ S ₂	4
P ₂ S ₁	2
P ₂ S ₂	4
P ₃ S ₁	2
P ₃ S ₂	4
P ₄ S ₁	2
P ₄ S ₂	4
P ₅ S ₁	2
P ₅ S ₂	4

Shelf life of jamun juice

Shelf life of stored jamun juice was decided on the basis of sensory evaluation score of the juice (Table 6). The jamun juice which recorded sensory score below 5.5 in 9 point hedonic scale was rated as unacceptable and the shelf life of this juice was considered to be over. The shelf life of jamun juice was only 2 months, as the sensory score at 4 month storage was below 5.5 at ambient temperature. At cold storage, the shelf life of jamun juice was 4 month, as it recorded sensory score below 5.5 at 6 month storage and shelf life of jamun juice as stated

below. Similar findings have been reported by Khurdiya and Roy (1984) in jamun syrup and Sowjanya (2012) in pomegranate juice.

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