

Studies on the Effect of Different Storage Techniques on Quality and Shelf Life of Jamun Juice

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Abstract: An experiment was conducted to investigate the quality and storage life of jamun juice in pasteurized and preservative form at ambient conditions during 2013-2014 in postharvest technology laboratory at College of Horticulture, Mojerla, Mahabubnagar District, Telangana State. The investigation comprised of five treatments i.e. jamun juice + 350 ppm sodium benzoate (T₁), jamun juice + 500 ppm sodium benzoate (T₂), pasteurization of jamun juice (at a temperature of 80 ± 5°C) (T₃), pasteurization of jamun juice (at a temperature of 80 ± 5°C) + 350 ppm sodium benzoate (T₄), pasteurization of jamun juice (at a temperature of 80 ± 5°C) + 500 ppm sodium benzoate (T₅) replicated four times in completely randomized design with factorial concept. The results revealed that, the Total Soluble solids, pH, ascorbic acid, total sugars increases and titrable acidity, anthocyanin content and total phenols gradually decreased during the storage period. The highest overall acceptability was recorded in the treatment T₅ (4.36). Among the treatments the highest total sugars was observed in T₅ (7.59) and lowest in T₃ (6.83). The highest anthocyanin content was recorded in T₅ (48.65) and lowest in T₃ (47.97). Whereas, the lowest microbial content was observed in T₅ (2.78) and highest in T₃ (3.42).

INTRODUCTION

Jamun (*Syzygium cumini* L. Skeels) is an evergreen tropical tree belongs to the family Myrtaceae. According to Hindu tradition, Rama subsisted on the fruit in the forest for 14 years during his exile from Ayodhya. Because of this, many Hindus regard jamun as a 'Fruit of the Gods'. It has recently attained major importance as an arid zone Horticultural crop because of its hardy nature and high yielding potential. It is known by several names, such as black plum, Indian black berry and java plum. The world production of jamun is estimated at 13.5 million tonnes out of which 15.4 per cent is contributed by India. In the world, India ranks second in production of jamun. Maharashtra state is the largest producer followed by Uttar Pradesh, Tamil Nadu, Gujarat, Assam and others (Anonymous, 2005).

The jamun fruits possess several medicinal and nutritive properties. The unripe fruit juice is stomachic, carminative and diuretic in nature and has cooling and digestive properties (Kirtikar and

Basu, 1975). The seeds contain about 19 per cent tannins. Powdered seeds are used to treat against diarrhoea, dysentery and for reducing the sugars in the urine. It is also used as lotion for curing ring worm (Dastur, 1952) and against bleeding piles, correcting liver disorders, jaundice, kidney stone, asthma, blood pressure etc (Joshi, 2001).

Jamun fruits are not only used for table purpose, but also used in processing, considering the unique blend of taste and nutrition of fruits. It could not be utilized for proper consumption or processed due to lack of processing techniques and technical knowhow. Jamun being a highly perishable with short shelf life of fruit, it deteriorates at very faster rate, if proper post-harvest handling practices and processing techniques are not adopted. The storage life of jamun fruit is restricted to only 24 hrs at room temperature and 12 days at 3 to 4°C and 85 to 95 per cent relative humidity (Ramanjeneya, 1999).

Since it is highly perishable, it has very short storage life and marketing of its fresh fruits to distant places is very difficult. Therefore, attempt has been

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Table 1
Changes in total soluble solids (Brix) of jamun juice as influenced by different treatment during storage period

Treatments	Days after storage							Mean
	0	15	30	45	60	75	90	
T ₁	8.45	8.60	8.70	8.85	8.92	9.10	9.17	8.82 ^c
T ₂	8.52	8.62	8.82	8.92	9.10	9.20	9.30	8.92 ^{bc}
T ₃	8.32	8.47	8.60	8.77	8.77	8.90	8.97	8.68 ^d
T ₄	8.70	8.85	8.97	9.10	9.20	9.35	9.42	9.08 ^a
T ₅	8.87	8.87	9.0	9.15	9.27	9.37	9.47	9.14 ^a
Mean	8.57 ^f	8.68 ^{ef}	8.82 ^{de}	8.96 ^{cd}	9.05 ^{bc}	9.19 ^{ab}	9.27 ^a	
			<i>F-test</i>		<i>S.Em±</i>		<i>CD at (0.05)</i>	
For treatments (T)			**		0.043		0.123	
For days (D)			**		0.520		0.145	
For D × T			NS		0.116		-	

**significant at $p = 0.01$ level of significance; NS-Non significant; Figures with same alphabet did not differ significantly.

made in this study to preserve jamun in the form of juice by adopting different storage techniques.

MATERIALS AND METHODS

The locally available jamun fruits were collected from a single tree, located in farmer field, near to College of Horticulture, Mojerla, Mahabubnagar District. Unblemished, riped and good quality jamun fruits were washed thoroughly with clean tap water, hand crushed, destined and pulp was heated up to 70°C for two minutes. It is useful for easy separation of the seeds from pulp. The juice was extracted by squeezing pulp and then straining through muslin cloth. Then the juice was heated till it reaches 90°C temperatures.

In case of T₁ (Jamun juice + 350 ppm Sodium benzoate) and T₂ (Jamun juice + 500 ppm Sodium benzoate), 350 ppm and 500 ppm of sodium benzoate was added respectively to the heated juice. In T₃ jamun juice was pasteurized at a temperature of 80 ± 5°C, without adding the preservative, and then filled into sterilized bottles. In treatment T₄ and T₅ jamun juice was pasteurization at a temperature of 80 ± 5°C for 10 minutes, cooled and added with 350 ppm and 500 ppm sodium benzoate respectively. After imposition of treatments, the juices were filled into clean, sterilized crown bottles of 200 ml capacity and sealed with crown caps by using crown corking machine and then stored at ambient conditions for further evaluation.

The study was carried for three months and analysis was carried in an interval of 15 days, all the treatments were replicated four times in completely randomized design with factorial concept. Total soluble solids (TSS) were determined with a digital refractometer by placing a drop of the filtered juice

in the prism of the refractometer and results were recorded. The pH of the products was determined by using pH meter. Ascorbic acid was estimated by Indophenol method, total sugars by Lane and Eynon method and acidity was estimated by adopting the procedure described by Ranganna (1986). Anthocyanins were estimated by adopting the procedure bisulphate bleaching method (Ribereau-Gayon and Stonestreet, 1965) and phenols as per the Folin Ciocalteu Reagent method (Bray and Thorpe, 1954). For estimating the microbial population in different sample products, dilution plate method was followed (Cruick Shank *et al.*, 1975). Organoleptic evaluation was done by a panel of 5 members using a Hedonic scale (Peryam and Pilgrim, 1957). It was taken based on the organoleptic scores given by panelists. Interpretation of the data was carried out in accordance with Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Total Soluble Solids

Increasing trend of total soluble solids content was noticed during storage period presented table in Table 1. The highest total soluble solids were observed in T₅ (9.14). The increase in TSS of jamun juice during storage period might be due to slow hydrolysis of polysaccharides, acids and pectin substances to simple substances like sugars. Similar results have been reported by Madan lal choudary *et al.* (2006) in guava RTS beverage.

pH

There was significant difference in pH among different days of storage period. During the storage

Table 2
Changes in pH of jamun juice as influenced by different treatments during storage period

Treatments	Days after storage							Mean
	0	15	30	45	60	75	90	
T ₁	3.49	3.52	3.56	3.60	3.63	3.67	3.71	3.60 ^c
T ₂	3.58	3.62	3.65	3.68	3.72	3.76	3.80	3.69 ^b
T ₃	3.43	3.47	3.50	3.53	3.57	3.61	3.64	3.53 ^d
T ₄	3.59	3.62	3.66	3.69	3.73	3.77	3.81	3.69 ^b
T ₅	3.54	3.86	3.91	3.94	3.99	4.03	4.07	3.95 ^a
Mean	3.59 ^g	3.26 ^f	3.65 ^e	3.69 ^d	3.73 ^c	3.77 ^b	3.81 ^a	
			<i>F-test</i>		<i>S.Em±</i>		<i>CD at (0.05)</i>	
For treatments (T)			**		0.005		0.016	
For days (D)			**		0.006		0.018	
For D × T			NS		0.015		-	

**significant at p = 0.01 level of significance; NS---Non significant; Figures with same alphabet did not differ significantly.

period, the pH gradually increased from initial day to end of storage period. Among the treatments the highest pH was recorded in T₅ (3.95) followed by T₄ (3.69). Significant increase of pH during storage could be attributed to the simultaneous decrease in titrable acidity of juice.

Ascorbic Acid

The data in the Fig. 1 revealed that, there were significant differences among treatments with respect to the ascorbic acid, the highest ascorbic acid was recorded in treatment T₅ (17.36) followed by T₄ (16.64). This is might be due to thermal degradation during processing and subsequent oxidation effect of light and storage temperature. Degradation of ascorbic acid into dehydro ascorbic acid furfural and hydroxyl furfural is a common phenomena observed during storage. Similar decline in ascorbic acid have been reported by Upale (2005) in storage of jamun juice.

Total Sugars

The data showed in the table 3 indicates that, there were significant differences among treatments with respect to the changes in total sugars of jamun juice, the highest total sugars was recorded in treatment, T₅ (7.59) followed by T₄ (7.37) and the lowest was recorded in T₃ (6.83). This might be attributed to slow hydrolysis of polysaccharides, acids and pectin substances to simple substances like reducing and non reducing sugars and from the present investigation, the increase in total sugars content coincided with the increase in Total Soluble Solids.

Titration Acidity

The titration acidity represented in Fig. 2 recorded significant differences among treatments, the highest titration acidity was recorded in treatment T₄ (0.29) followed by T₅ (0.25). The decrease in titration acidity content during storage period, might be due to

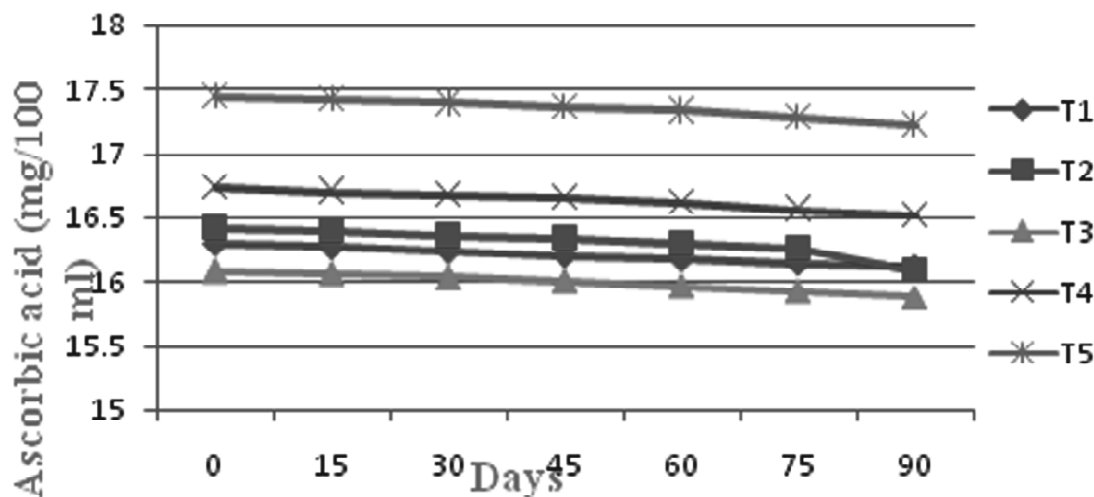


Figure 1: Changes in ascorbic acid (mg/100 ml) of jamun juice as influenced by different treatments during storage period

Table 3
Changes in total sugars (%) of jamun juice as influenced by different treatments during storage period

Treatments	Days after storage							Mean
	0	15	30	45	60	75	90	
T ₁	6.57	6.75	7.00	7.25	7.45	7.65	7.87	7.22 ^c
T ₂	6.67	6.90	7.12	7.35	7.55	7.72	8.00	7.33 ^b
T ₃	6.17	6.37	6.62	6.82	7.07	7.27	7.50	6.83 ^d
T ₄	6.65	6.90	7.15	7.40	7.62	7.85	8.05	7.37 ^b
T ₅	6.92	7.17	7.37	7.62	7.82	8.05	8.15	7.59 ^a
Mean	6.60 ^g	6.82 ^f	7.05 ^e	7.29 ^d	7.50 ^c	7.71 ^b	7.91 ^a	
			<i>F-test</i>		<i>S.Em±</i>		<i>CD at (0.05)</i>	
For treatments (T)			**		0.032		0.091	
For days (D)			**		0.038		0.108	
For D × T			NS		0.086		-	

**significant at p = 0.01 level of significance; NS--Non significant; Figures with same alphabet did not differ significantly.

conversion of acids into salts and sugars by enzymes particularly invertase. Gajanana (2000) reported that decrease in titrable acidity content during storage period might be due to acid hydrolysis of polysaccharides in amla juice.

Anthocyanins

The anthocyanin content gradually decreased during the storage period and among the treatments the anthocyanins in jamun juice registered significant results and the highest anthocyanins content was recorded in treatment T₅ (48.65) followed by T₄ (48.32) and lowest in T₃ (47.97). The decrease in anthocyanin content during storage of jamun juice might be due to hydrolysis of protopectic 3-glucoside linkage of anthocyanins. These results were conformity with that reports given Upale (2005) in storage of jamun juice.

Total Phenols

There were significant differences among treatments with respect to total phenols and highest phenols was recorded in treatment T₅ (335.94). The decrease in phenols during storage of jamun juice might be due to their oxidation and condensation into brown pigments. Analogous results were reported by Sarolia and Mukherjee (2002) in lime juice and Upale (2005) in storage of jamun juice.

Microbial Count

There was significant difference in microbial count among different days of storage period. During the storage period, the microbial count gradually increased from initial day to end of storage period. The significantly lowest microbial counts were recorded at initial day (2.77) while highest at 90 days

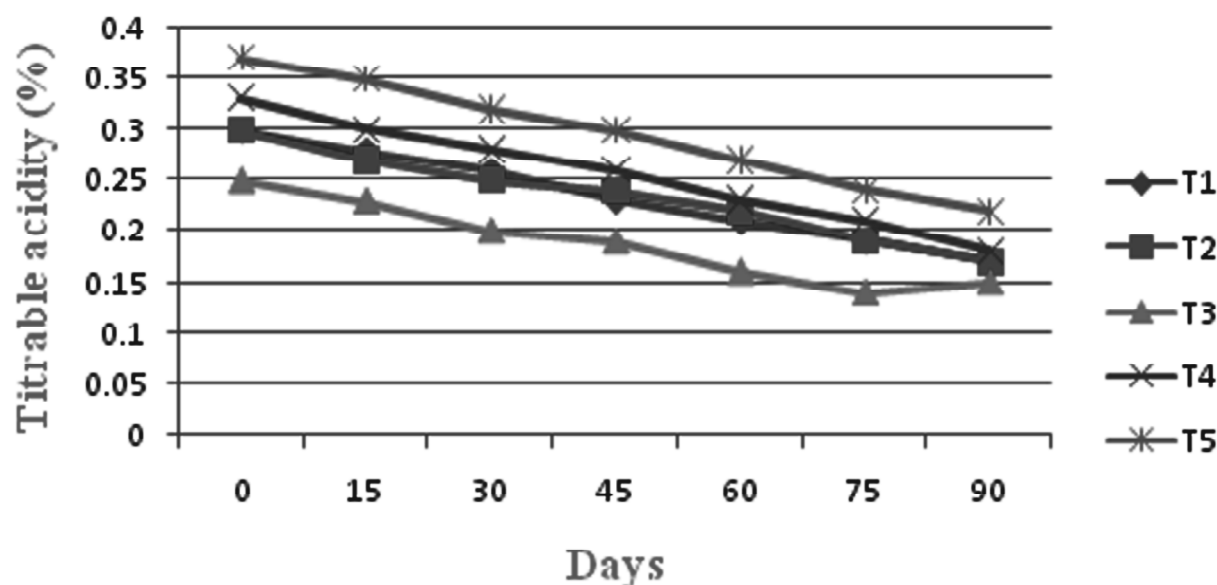


Figure 2: Changes in titrable acidity (%) of jamun juice as influenced by different treatments during storage period

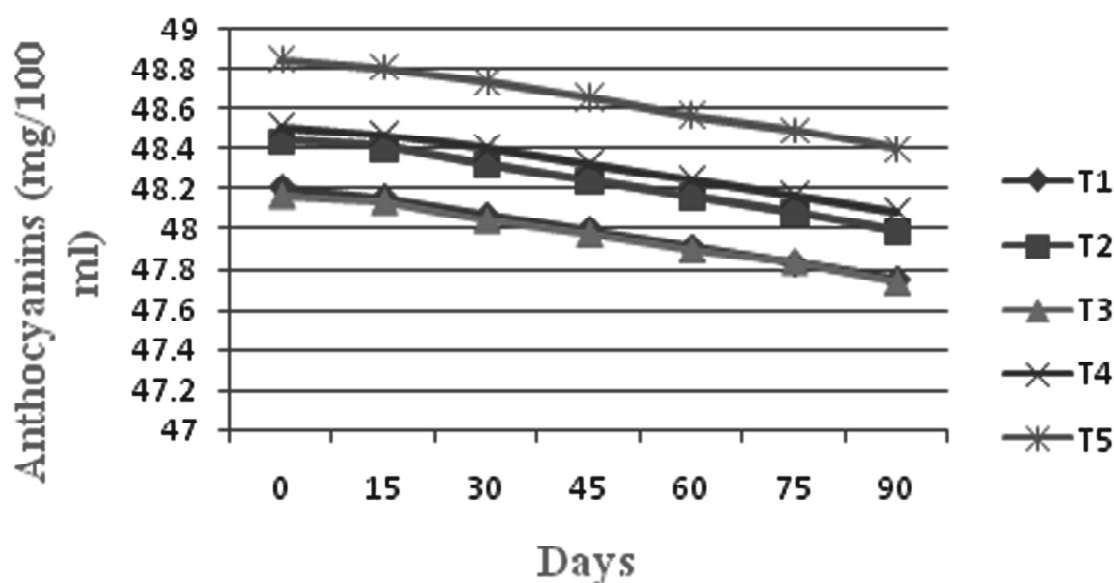


Figure 3: Changes in anthocyanins (mg/100 ml) of jamun juice as influenced by different treatments during storage period

Table 4
 Changes in phenols (mg/100 ml) of jamun juice as influenced by different treatments during storage period

Treatments	Days after storage								Mean
	0	15	30	45	60	75	90		
T ₁	336.07	335.98	335.90	335.79	335.71	335.62	335.54	335.80 ^c	
T ₂	336.09	335.99	335.91	335.84	335.75	335.68	335.60	335.83 ^{bc}	
T ₃	334.02	333.93	333.86	333.78	333.70	333.62	333.54	333.78 ^d	
T ₄	336.15	336.07	335.98	335.90	335.83	335.76	335.68	335.91 ^a	
T ₅	336.19	336.10	336.02	335.95	335.87	335.78	335.70	335.94 ^a	
Mean	335.70 ^a	335.62 ^b	335.53 ^c	335.45 ^d	335.37 ^e	335.29 ^f	335.21 ^g		
	<i>F-test</i>			<i>S.Em±</i>			<i>CD at (0.05)</i>		
For treatments (T)	**			0.010			0.029		
For days (D)	**			0.012			0.034		
For D × T	NS			0.027			-		

**significant at $p = 0.01$ level of significance; NS---Non significant; Figures with same alphabet did not differ significantly.

Table 5
 Changes in microbial count (cfu/ml) of jamun juice as influenced by different treatments during storage period

Treatments	(No. × 10 ⁵ CFU/ml)		
	Initial	90 DAS	Mean
T ₁	2.94	3.39	3.17 ^d
T ₂	2.85	3.30	3.07 ^c
T ₃	2.86	3.98	3.42 ^e
T ₄	2.64	3.09	2.86 ^b
T ₅	2.56	3.01	2.78 ^a
Mean	2.77 ^a	3.35 ^b	
	<i>F-test</i>	<i>S.Em±</i>	<i>CD at (0.05)</i>
For treatments (T)	**	0.006	0.019
For days (D)	**	0.004	0.012
For T × D	NS	0.009	

**significant at $p = 0.01$ level of significance; NS-Non significant; Figures with same alphabet did not differ significantly.

(3.35) of storage. The microbial population in jamun juice during storage was very low at the beginning of storage. It was found to increase marginally during the storage period upto three months storage. But, such marginal increase did not affect the product. This may be attributed to the effect of both heat treatment and chemical preservatives in checking the growth of microorganisms. These results were accordance Sowjanya (2007) in pomegranate juice.

SENSORY EVALUATION

There were significant differences among treatments with respect to appearance, aroma and flavour, taste and overall acceptability and highest was recorded in T₅ respectively (4.17), (4.33), (4.26), (4.36). Based on the organoleptic evaluation the treatment T₅ has

Table 6
Changes in organoleptic characteristics at 90 days of storage of jamun juice as influenced by different treatments.

Treatments	Appearance	Aroma and flavour	Taste	Overall acceptability
T ₁	3.25 ^c	3.37 ^c	3.89 ^c	4.04 ^c
T ₂	3.47 ^b	4.09 ^{ab}	3.97 ^{bc}	4.09 ^c
T ₃	2.05 ^d	2.15 ^d	2.10 ^d	2.47 ^d
T ₄	3.67 ^b	4.23 ^{ab}	4.10 ^{ab}	4.23 ^b
T ₅	4.17 ^a	4.33 ^a	4.26 ^a	4.36 ^a
F-test	**	**	**	**
S. Em±	0.071	0.102	0.078	0.034
CD at (0.05)	0.216	0.309	0.238	0.104

**significant at p = 0.01 level of significance; NS---Non significant; Figures with same alphabet did not differ significantly.

scored highest acceptability compared to the other treatments, which might be due to the appropriate maintenance of all chemical constituents, better consistency, sugar acid ratios and lowest microbial count.

Shelf Life (Days)

The scores for overall acceptability of treatment T₃-Pasteurization of jamun juice (at a temperature of 80 ± 5°C) was poorly acceptable compared to other treatments which scored more than 4. The treatment T₃ terminated by 90 days of storage and other treatments are acceptable at that stage. However, the T₅ has recorded highest acceptability and was considered as best treatment for storage of jamun juice for longer period of time.

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