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STUDIES ON PHYSICO-CHEMICAL COMPOSITION OF JAMUN AND CHANGES IN CHEMICAL COMPOSITION OF RTS BEVERAGE DURING STORAGE

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ABSTRACT

The investigation on studies on physico-chemical composition of jamun and changes in chemical composition of RTS beverage during storage was conducted in the Horticulture Processing Laboratory, Department of Horticulture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.). The experiment comprised of 10 treatments including one control recipe (varying level of juice 10% to 15%, TSS 10% to 15% and acidity 0.3 per cent) in Completely Randomized Design (CRD) with 3 replications. The recipes were analysed for chemical composition at 0, 30, 60 and 90 days of storage in ambient conditions. The recipe with 15% juice, 15% TSS and 0.3% acidity (T_5) recorded highest ascorbic acid (12.50mg/100ml), pH (3.70), reducing sugar (2.93%), non-reducing sugar (11.35%) and total sugar (14.28%), whereas the highest TSS (15.11°B) and acidity (0.45%) were recorded with the recipe containing 13% juice, 15% TSS and 0.3% acidity (T_3) and 10% juice, 10% TSS and 0.3% acidity (T_6), respectively. During storage period, the TSS, acidity, reducing sugars were increased, while pH, total sugars, non-reducing sugars and ascorbic acid were decreased.

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INTRODUCTION

Jamun [*Syzygium cumini* (L.) Skeels] is an evergreen tropical tree in the flowering plant family Myrtaceae, native to India and Indonesia. The tree is tall, evergreen, also grown for shade and windbreak. It is gaining popularity among the consumers due to its high neutroclinical values, in rural as well as urban masses. Different parts of the tree such as bark, fruit and seed posses medicinal and therapeutic values (Kirtikar *et al.*, 1990; Noomirio and Dahot, 1996). It is a good source of iron and pectin, apart from the usual contents, e.g., minerals, protein etc. It is also used in making beverages, jellies, jam, squash, wine, vinegar and pickles. Jamun fruits are universally accepted to be very good for medicinal purposes especially for curing diabetes because of its effect on the pancreas. The fruit juice and seed contain a biochemical called 'jamboline' which is believed to check the pathological conversion of starch into sugar in case of increased production of glucose. The fruit is highly perishable and can be stored only upto 2-3 days under ambient temperature. However, in cold storage (3-4°C and 85-90% RH) it can be stored for only 12 days (Sharma, 2014).

India is a country, well-known for its tradition and culture. Syrup or Sharbet are offered to guests and is an important homemade soft drink. Similarly, fruit juice and beverages also hold an important position due to their richness in essential minerals, vitamins and other nutritive constituents. Synthetic drinks which are more popular commercially are not so healthy or nutritive compared to natural once. Hence, if natural drinks could substitute synthetic drinks, it would provide numerous benefits to consumers as well as farmers. In view of the rising demands for natural and organic products, fruit juice and other fruit-based beverages have great scope.

India is second largest producer of fruits and vegetables in the world after china, the present quantity of fruit and vegetable processing is very meager (around 2.2%) as compared to 80% in USA, 70% France, 80% Malaysia and 30% Thailand (Singh *et al.*, 2014). Though, there is a maximum availability of raw material or jamun fruits harvested, it can not be fully utilized, consumed or processed due to lack of processing techniques and technical know-how. Being highly perishable fruit and its short life, it deteriorates at a very faster rate if proper post harvest handling practices and processing techniques are not adopted. Hence, an attempt was made to preserve the jamun juice in the form of RTS to make them available in off season as it has lot of medicinal properties.

MATERIALS AND METHODS

The present investigation was carried out at the Department of Horticulture, College of Agriculture, IGKV, Raipur (CG). The fruits of jamun used for experimentation were procured from the local market. The jamun fruits were washed crushed for the extraction of pulp. The extracted pulp without seeds was heated to 50°C and passed through a fine muslin cloth. After extraction of juice, various required amount of juice for RTS were taken. The volume of the final product was maintained by adding water to each recipe combination. A calculated amount of sugar was added in the pulp to adjust the total soluble solids as 10, 11, 12, 13, 14 and 15 per cent in the recipe for RTS. The acidity was maintained to 0.3 per cent in the final product

by addition of required amount of citric acid.

The prepared RTS with the different recipe was bottled (200 ml capacity) by leaving 2 cm head space and pasteurized. These bottles were stored at ambient temperature for further studies. Observations were taken just after preparation of the product and therefore, one month till 3 months of storage.

Biochemical analysis

The total soluble solids (TSS, as expressed in ºB) and pH of extracted juice and RTS were determined using hand refractometer and digital pH meter, respectively. Acidity was determined by titrating the juice against N/10 NaOH and expressed as percent of citric acid, whereas ascorbic acid (mg/100mL) was determined by titrating the product against 2,6-dichlorophenol indophenol indicator (Ranganna, 1986). Sugars were estimated in terms of reducing, non-reducing and total sugars (Ranganna, 1986).

Statistical analysis

The analysis of variance of the data was done by using completely randomized design (CRD) for different treatments as per the methods given by Gomez and Gomez (1985). The analysis of variance revealed at significance of $P < 0.05$ level, S.E. and C.D. at 5 % level is mentioned wherever required.

The following recipes (Treatments) of jamun RTS were evaluated

Treatments	Details
T_0	10% juice + 15% TSS + 0.3% acidity
T_1	11% juice + 15% TSS + 0.3% acidity
T_2	12% juice + 15% TSS + 0.3% acidity
T_3	13% juice + 15% TSS + 0.3% acidity
T_4	14% juice + 15% TSS + 0.3% acidity
T_5	15% juice + 15% TSS + 0.3% acidity
T_6	10% juice + 10% TSS + 0.3% acidity
T_7	10% juice + 11% TSS + 0.3% acidity
T_8	10% juice + 12% TSS + 0.3% acidity
T_9	10% juice + 13% TSS + 0.3% acidity
T_{10}	10% juice + 14% TSS + 0.3% acidity

RESULTS AND DISCUSSION

The effect of storage period on TSS, acidity, ascorbic acid, pH, reducing sugar, non-reducing sugar and total sugar of jamun RTS were determined. The data obtained during course of investigation for development of jamun RTS beverage are given as follows:

Physico-chemical composition of Jamun fruit

Physical composition

Physical composition of jamun fruit under study is presented in Table 1. The average fruit weight and pulp weigh was recorded 10.55 g and 6.6 g, respectively, which was 62.55 per cent of the total fruit weight. The parameters seed weight and non-edible waste in jamun fruit were recorded 1.9g and 2.75g, respectively. The calculated value of these two parameters are 18.01 per cent and 26.06 per cent, respectively of total fruit weight, whereas pulp:seed ratio was calculated 3.47.

Chemical composition

Chemical composition of jamun fruit under study is presented in Table 1. Data with respect to chemical composition of fruits revealed that mean value of total soluble solids (TSS) was recorded 11.8°Brix. The mean value of total sugar, reducing sugar and non-reducing sugar content was recorded 8.06 per cent, 6.11 per cent, and 1.95 per cent, respectively in fruits of jamun. The mean value of ascorbic acid content was recorded 31.5 mg/100ml. Total titrable acidity was recorded 1.216 per cent whereas, pH value was also recorded 3.38 in the fruit sample.

The data recorded with respect to chemical parameters of jamun RTS are presented in Table 2 and Table 3.

TSS (°Brix)

Changes during storage of jamun RTS indicated that TSS increased slightly with the advancement of storage period. TSS was found significantly higher (15.11°Brix) with the treatment T_3 (13% juice + 15% TSS + 0.3% acidity). While, minimum TSS content was recorded (10.19°Brix) with the treatment T_6 (10% juice + 10% TSS + 0.3% acidity). Similar results were reported by Khurdiya and Roy (1985) in jamun juice, Kanan and Thirumaran (2002) in jamun products (RTS, Squash, syrup, jam) and Das (2009) in jamun RTS. An increase in TSS content of jamun RTS during storage may possible due to conversions of polysaccharides into sugars.

Acidity (%)

Acidity of jamun RTS showed an increasing trend with increasing period of storage (0 to 90 days). Highest acidity was

Table 1: Physico-chemical composition of jamun fruits

S.No.	Characters	Values	% of total fruit weight
A. Physical composition			
1.	Fruit weight (g)	10.55	-
2.	Seed weight (g)	1.90	18.01%
3.	Peel weight (g)	0.85	8.05%
4.	Pulp weight (g)	6.6	62.55%
5.	Wt. of non edible waste (g)	2.75	26.06%
6.	Pulp: Seed ratio	3.47	-
B. Chemical composition			
1.	Total Soluble Solids (°Brix)	11.8	
2.	Acidity (%)	1.216	
3.	Ascorbic acid (mg/100 ml)	31.5	
4.	pH	3.38	
5.	Reducing sugar (%)	6.11	
6.	Non-reducing sugar (%)	1.95	
7.	Total sugar (%)	8.06	

Table 2: Effect of different recipe treatment on TSS, acidity, ascorbic acid and pH of stored jamun RTS

Treatments	Sorage period (days)															
	TSS (°Brix)				Acidity (%)				Ascorbic acid (mg/100ml)				pH			
	0	30	60	90	0	30	60	90	0	30	60	90	0	30	60	90
T0	15.07	15.07	15.24	15.33	0.32	0.33	0.42	0.55	12.20	12.12	11.90	11.59	3.47	3.23	2.93	2.69
T1	15.06	15.07	15.20	15.29	0.32	0.32	0.39	0.43	12.30	12.20	12.08	11.76	3.54	3.32	3.03	2.86
T2	15.06	15.06	15.16	15.24	0.31	0.32	0.36	0.40	12.42	12.32	12.20	11.95	3.63	3.46	3.14	3.04
T3	15.11	15.12	15.27	15.36	0.31	0.32	0.36	0.40	12.38	12.26	12.15	11.90	3.62	3.44	3.10	2.98
T4	15.03	15.03	15.13	15.20	0.31	0.31	0.35	0.38	12.46	12.35	12.24	12.10	3.67	3.49	3.18	3.08
T5	15.00	15.00	15.10	15.15	0.30	0.30	0.32	0.35	12.50	12.48	12.38	12.26	3.70	3.58	3.23	3.12
T6	10.19	10.20	10.31	10.38	0.35	0.36	0.45	0.58	12.16	12.05	11.83	11.55	3.43	3.20	2.88	2.66
T7	11.00	11.01	11.13	11.21	0.32	0.33	0.41	0.52	12.24	12.13	11.94	11.63	3.50	3.26	2.96	2.73
T8	12.10	12.10	12.22	12.28	0.32	0.33	0.40	0.49	12.25	12.14	12.00	11.69	3.51	3.29	2.99	2.78
T9	12.98	12.99	13.12	13.18	0.32	0.33	0.39	0.46	12.26	12.17	12.04	11.72	3.51	3.29	3.00	2.83
T10	14.00	14.01	14.11	14.19	0.31	0.32	0.38	0.41	12.30	12.21	12.12	11.80	3.58	3.36	3.08	2.90
SEm	0.010	0.014	0.007	0.010	0.009	0.01	0.008	0.008	0.007	0.007	0.010	0.010	0.010	0.010	0.014	0.007
CD at 5%	0.03	0.04	0.02	0.03	NS	NS	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.04	0.02

Table 3: Effect of different recipe treatment on Reducing sugar, non-reducing sugar and total sugar of stored jamun RTS

Treatments	Storage period (days)											
	Reducing sugar (%)				Non-reducing sugar (%)				Total Sugar (%)			
	0	30	60	90	0	30	60	90	0	30	60	90
T0	2.66	2.86	3.39	3.80	10.54	10.44	10.03	09.73	13.20	13.30	13.42	13.53
T1	2.83	3.04	3.41	3.84	11.17	11.08	10.82	10.46	14.00	14.12	14.23	14.30
T2	2.85	3.06	3.44	3.89	11.29	11.16	10.87	10.51	14.14	14.20	14.31	14.40
T3	2.86	3.07	3.45	3.92	11.30	11.17	10.91	10.54	14.16	14.24	14.36	14.46
T4	2.90	3.10	3.48	3.95	11.32	11.20	10.94	10.57	14.22	14.30	14.42	14.52
T5	2.93	3.13	3.51	3.98	11.35	11.23	10.97	10.60	14.28	14.36	14.48	14.58
T6	2.50	2.71	3.20	3.64	05.00	04.90	04.54	04.22	07.50	07.61	07.74	07.86
T7	2.54	2.75	3.26	3.67	05.76	05.63	05.23	04.93	08.30	08.38	08.49	08.60
T8	2.58	2.78	3.29	3.71	06.66	06.57	06.19	05.88	09.24	09.35	09.48	09.59
T9	2.59	2.82	3.35	3.74	07.69	07.54	07.10	06.83	10.28	10.36	10.45	10.57
T10	2.63	2.85	3.37	3.77	08.63	08.50	08.10	07.80	11.26	11.35	11.35	11.57
SEm	0.010	0.010	0.007	0.007	0.010	0.010	0.007	0.007	0.014	0.007	0.010	0.007
CD at 5%	0.03	0.03	0.02	0.02	0.03	0.03	0.02	0.02	0.04	0.02	0.03	0.02

found (0.45%) with the treatment T_6 (10% juice + 10% TSS + 0.3% acidity). While, minimum acidity was observed (0.32%) with T_5 (15% juice + 15% TSS + 0.3% acidity). The present findings are also in conformity with the reported works of Byanna and Gowda (2012) in sweet orange beverages, Yadav *et al.* (2013) in Banana RTS, Khurdiya and Roy (1985) and Das (2009) in jamun beverages. The increase in acidity in RTS during 90 days of storage may be due to formation of organic acids by ascorbic acid degradation as well as progressive decrease in the pectin content.

Ascorbic acid (mg/100mL)

Ascorbic acid content in jamun RTS of all the treatments showed a decreasing trend with increasing period of storage (0 to 90 days). The maximum ascorbic acid was observed (12.50 mg/100ml) with the treatment T_5 (15% juice + 15% TSS + 0.3% acidity). The minimum ascorbic acid content was recorded (12.16 mg/100 ml) with the treatment T_6 (10% juice + 10% TSS + 0.3% acidity). Similar reduction in ascorbic acid content have also been reported by Baramanray *et al.* (1995) in guava nectar, Saravanan *et al.* (2004) in papaya RTS, Das (2009) in jamun products and Sharma *et al.* (2009) in guava-jamun RTS. The decrease in ascorbic acid in RTS during storage might be due to oxidation or irreversible conversion of L-ascorbic acid into dehydro ascorbic acid in the presence of enzyme ascorbic acid oxidase (ascorbinase) caused by trapped or residual oxygen in the glass bottles.

pH

pH value in jamun RTS showed a decreasing trend with increasing period of storage (0-90 days). Maximum pH value was observed (3.70) with the treatment T_5 (15% juice + 15% TSS + 0.3% acidity). While, minimum pH was observed (3.43) with the treatment T_6 (10% juice + 10% TSS + 0.3% acidity). The present findings are in agreement with those of Krishnaveni *et al.* (2001) and Byanna and Gowda (2012) in jackfruit and sweet orange RTS, respectively. The increased acidity and TSS under all the cultivar and recipe treatments during storage had a corresponding decrease in pH. Hence, the reduction in pH could be attributed to simultaneous increase in acidity and TSS of RTS irrespective of their storage temperature.

Sugars

Reducing sugar (%)

The reducing sugar content of jamun RTS showed an increasing trend with increasing period of storage (0-90 days). The maximum (2.93%) reducing sugar was observed with the treatment T_5 (15% juice + 15% TSS + 0.3% acidity). The minimum reducing sugar was recorded (2.50%) with the treatment T_6 (10% juice + 10% TSS + 0.3% acidity). These results are in close conformity with the report of Patil (2001), who revealed that there was a significant increase in reducing sugars in jamun juice throughout the storage period.

Non-reducing sugar (%)

The non-reducing sugar in jamun RTS showed decreasing trend with increasing period of storage (0-90 days). Maximum non-reducing sugar was recorded (11.35%) with the treatment T_5 (15% juice + 15% TSS + 0.3% acidity). Whereas, the minimum (5.00%) non-reducing sugar was observed with the treatment T_6 (10% juice + 10% TSS + 0.3% acidity). Similar trend of decrease in non-reducing sugar content have also been reported by Saravanan *et al.* (2004) in papaya RTS, Phalke (2009) in sapota and lime blended RTS and Byanna and Gowda (2012) in sweet orange RTS beverages.

Total sugar (%)

The total sugar content in jamun RTS showed an increasing trend with increasing period of storage. The maximum total sugar content was observed (14.28%) with the treatment T_5 (15% juice + 15% TSS + 0.3% acidity). The minimum total sugar content was recorded (7.50%) with the treatment T_6 (10% juice + 10% TSS + 0.3% acidity). Similar findings were reported by Patil (2001), Kannan and Thirumaran (2002), Gehlot *et al.* (2010) in jamun juice and beverages, Verma and Gehlot (2006) in bael beverages and Patil *et al.* (2014) in rose apple jamun blended RTS. The increase in reducing sugar as well as total sugar corresponded to the increase in total soluble solids (TSS) and ultimate decrease in non-reducing sugar in both the beverages during storage period. The variation in different fractions of sugar might be due to hydrolysis of polysaccharides like starch, pectin and inversion of non-reducing sugar into reducing sugar, as increase in reducing sugar was correlated with the decrease in non-reducing sugar. The increased level of total sugar was probably due to conversion of starch and pectin into simple sugars.

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