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Nutritional and Antioxidant Activities of Value Added Products Prepared from *Syzygium cuminii* L.

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Considering the seasonal abundance and already recognized nutritional and medicinal values of jamun fruit (*Syzygium cuminii* L.), three different types of value added products of jamun namely, jamun juice, jamun squash prepared using stevia (*Stevia rebaudiana*) and jamun squash prepared using sugar were made. After 1 week of the preparation of]products, the total soluble sugar content was found to be the highest (47.38 g/100 mL) in jamun squash prepared using sugar and the lowest (9.60 g/100 mL) in jamun squash prepared using stevia. The nitrogen content (0.136 g/100 mL), calcium content (10.96 mg/100 mL), the potassium content (38 mg/100 mL) and iron content (0.45 mg/100 mL) were found to be the highest in jamun squash prepared using stevia. The phosphorus content was found to be the highest (10.49 mg/100 mL) in jamun juice and the lowest (6.017 mg/100 mL) in jamun squash prepared using sugar. The antioxidant activity measured in terms of DPPH (1,1-diphenyl-2-picrylhydrazyl) inhibition was found to be the highest for jamun juice and the lowest for jamun squash prepared using sugar. The microbial analysis of jamun products during the different periods of storage revealed that the growth of *Lactobacillus* species was prominent as compared to other microbes. The data showed a decreasing trend of the values as the duration of storage increased.

Keywords: *Syzygium cuminii* L., Value added products, Nutritional, Antioxidant, Microbial and Sensory qualities.

INTRODUCTION

Jamun (*Syzygium cumunii*) is an important minor fruit crop of Indian origin. It is an evergreen tropical tree in the flowering plant family Myrtaceae, native to India and Indonesia. Jamun fruit is universally accepted to be very good for medicinal purposes especially for curing diabetes because of its effect on the pancreas[1]. Since, the fruit is rich in anthocyanin, it imparts antioxidant properties too. There are few reports available on production of different value added products of jamun. Chowdhury and Ray[2] produced red wine by fermentation of jamun fruit. Shahnawaz *et al.*[3] reported the carbohydrate content and protein content of fresh and stored jamun juice and squash.

In view of different medicinal and therapeutic properties of the jamun fruit and because of its short availability period, an attempt has been made in this study on three different types of value added products from jamun fruit, *viz.*, jamun juice, jamun squash prepared using stevia and jamun squash prepared using sugar. So far, no report could be traced on preparation of jamun beverage using the natural zero calorie sweetener *Stevia rebaudiana*.

EXPERIMENTAL

Preparation of jamun juice: The jamun juice was prepared according to method given by Srivastava and Kumar[4]. The fresh jamun fruit was weighed on a weighing balance (weight recorded was 2500 g) followed by addition of water (amount of water added was 1250 mL) and then boiled at 70 °C for 5 min. The jamun was crushed to detach each seed and then sieved. The pulp was re extracted after adding water and the previous extract in the ratio 3:2. This was boiled just to reach 70 °C, crushed and then sieved as mentioned before. The entire extract was passed through three layers of muslin cloth. The total volume recorded was 2500 mL. The total soluble solid found was 5 % and pH recorded was 3. Sodium benzoate, as chemical preservative was then added at the rate of 0.05 % to the 2500 mL extract and was stored closed inside food grade plastic bottles in dark at room temperature (average temperature 25 °C).

Preparation of jamun squash with stevia: 30 g dry stevia leaves (9 % stevioside) with 5 % moisture was boiled to 100 °C in 1 L water for 5 min, strained and then the extract was collected. This extract was added at the rate of 10 % to the 1:1

juice and then chemical preservative sodium benzoate was added at the rate of 0.05 % to the jamun juice. The product was stored closed inside food grade plastic bottles in dark at room temperature (average temperature 25 °C).

Preperation of squash with sugar: The jamun squash with sugar was prepared according to method given by Srivastava and Kumar[4]. Water and sugar in ratio of 1:3 (150 mL of water was mixed with 450 g sugar) were mixed and boiled which was added separately to 500 mL 1:1 juice. Then the volume was made up to 1 L, sodium benzoate, as chemical preservative was added at the rate of 0.05 % and stored closed inside food grade plastic bottles in dark at room temperature (average temperature 25 °C).

Analytical methods: The total soluble sugar content was determined by Anthrone method as mentioned by Trevelyan and Harrison[5]. A measured volume of jamun beverage was taken and diluted to 200 times as it was intensely coloured. From this diluted solution, an aliquot of 0.2 mL was taken to determine the total soluble sugar content. The nitrogen was determined by Micro Kjeldahl method[6]. The ash content was also determined by the method of A.O.A.C.[6]. For this, 20 mL of the jamun beverage was weighed and dried in the water bath at 100 °C to have a paste like appearance and then put in the muffle furnace at 550 °C for 6 h. The calcium and the potassium were determined flame photometrically. Iron was determined spectrophotometrically according to the method of Wong[7]. Phosphorus content was determined spectrophotometrically according to the method of Fiske and Subba Row[8]. All the estimations were replicated four times and their mean was expressed. Antioxidant activity was determined by the method of Molyneux[9]. Free radical scavenging activity of DPPH (1,1-diphenyl-2-picrylhydrazyl) was determined on methanolic extracts of products of jamun. Antioxidant activity of L-ascorbic acid and quercetin were also assayed as standard.

Microbial analysis: The microbial analysis was done using standard method. For jamun products, 1 mL of the sample was blended in 9 mL sterile water (0.85 % w/v NaCl in water) in a stomacher lab-blender (400, Seward, UK) for 2 min. A serial dilution of the same diluents was made. Microbial enumeration was done with the following selective media. MRS (de man, Rogosa and Sharpe) for lactic acid bacteria, PDA (Potato Dextrose Agar) for molds, PCA (Plate Count Agar) for bacteria, YEA (Yeast extract Agar) for yeasts and Rose Bengal agar for yeast and mold. All media were obtained from HiMEDIA. All enumerations were done by colony counting after an incubation period of 48 h at 27 °C.

Sensory evaluation of two jamun products (squash with sugar and squash with stevia) were done by a panel of semi-skilled persons after diluting the products with refrigerated drinking water in the ratio 1:3. Sensory attributes (taste, flavour, colour, consistency, overall acceptance and sugar-acid blending) was evaluated using 9 point Hedonic scale (where 1 = dislike extremely and 9 = like extremely) by 5 semi-skilled panellists, in accordance with the method described by Amerin *et al.*[10].

RESULTS AND DISCUSSION

Data on different biochemical parameters for the jamun juice, jamun squash prepared using stevia and jamun squash prepared using sugar during different periods of storage are presented in Table-1. In present study, the higher values for most of the parameters observed for jamun juice and jamun squash prepared using stevia than the squash prepared using sugar might be due to the fact that in the later, half of the volume was made up by jamun juice and the rest was made up by sugar syrup.

Total soluble sugar and nitrogen content: The total soluble sugar content was found to be the highest in jamun squash prepared using sugar and the lowest in jamun squash made using stevia. Gopalan *et al.*[11] reported carbohydrate content to be 14 g/100 g of edible portion in jamun fruit. In the present investigation, the total soluble sugar content in 100 g of edible portion of jamun fruit, after 1 week of storage was calculated out to be 16.17 g, as 100 mL jamun juice was extracted from 64 g of edible portion of jamun fruit. However, Noomrio and Dahot [12] reported a total sugar of 9.40 mg/mL in fresh jamun fruit. Khurdiya *et al.*[13] reported total sugar content to be 8.40 % to 9.68 % in jamun fruit. Singh *et al.*[14] reported carbohydrate in jamun fruit to be 19.7 % and Shahnawaz *et al.*[15] reported 2.31 and 5.88 % carbohydrate in fresh and stored jamun squash, respectively. Hussain *et al.*[16] also reported a decrease (33.92 to 17.00 %) in non-reducing sugars during

TABLE -1
BIOCHEMICAL COMPOSITION OF JAMUN JUICE AND SQUASH PREPARED USING STEVIA AND SUGAR AT DIFFERENT PERIODS OF STORAGE

Storage time	Total soluble sugar (g/100 mL)			N (g/100 mL)			Ca (mg/100 mL)		
	Jamun juice	Squash with stevia	Squash with sugar	Jamun juice	Squash with stevia	Squash with sugar	Jamun juice	Squash with stevia	Squash with sugar
1 week	10.350	9.600	47.375	0.120	0.136	0.056	10.580	10.96	7.120
2 months	9.070	8.050	45.92	0.102	0.116	0.050	9.560	9.95	6.080
4 months	7.500	6.600	42.70	0.081	0.102	0.033	8.340	8.62	5.260
6 months	6.100	5.360	40.00	0.062	0.078	0.0197	7.400	8.15	4.230
CD at 5 %	0.355	0.126	0.600	0.005	0.005	0.003	0.202	0.207	0.339
Storage time	K (mg/100 mL)			P (mg/100 mL)			Fe (mg/100 mL)		
	Jamun juice	Squash with stevia	Squash with sugar	Jamun juice	Squash with stevia	Squash with sugar	Jamun juice	Squash with stevia	Squash with sugar
1 week	36.120	38.00	19.640	10.490	9.33	6.017	0.322	0.450	0.175
2 months	34.870	34.87	18.000	9.260	8.30	4.910	0.208	0.306	0.175
4 months	32.800	34.06	16.310	7.780	6.98	3.750	0.125	0.219	0.078
6 months	31.120	32.66	14.710	6.780	5.70	3.050	0.026	0.116	0.0139
CD at 5 %	0.395	0.586	0.565	0.589	0.290	0.177	0.003	0.007	0.009

storage of apple juice, apricot juice and their blend in refrigeration temperature for a period of 3 months.

The nitrogen content in the present investigation, in 100 g of edible portion of jamun fruit was calculated out to be 0.187 % as 100 mL jamun juice was extracted from 64g edible portion of jamun fruit. Singh *et al*.[14] and Gopalan *et al*.[11] observed protein content of jamun fruit to be 0.7 % on fresh weight basis, which represented nitrogen content of the same was 0.112 %. Progressive decrease in protein, ash and fat content of preserved mango pulp was observed over the entire storage period of 90 days[17]. Decrease in protein content supported the decrease in nitrogen content.

Calcium, potassium, iron and phosphorus content: The calcium content in the present investigation, in 100 g of edible portion of jamun fruit, after 1 week of storage was calculated out to be 16.53 mg, as 100 mL jamun juice was extracted from 64g of edible portion of jamun fruit. Singh *et al*.[14] and Gopalan *et al*.[11] reported the calcium content in jamun fruit to be 0.02 % and 15 mg/100 g, respectively.

Singh *et al*.[14] and Gopalan *et al*.[11] reported the iron content to be 0.1 % and 0.43 mg/100 g of edible portion in jamun fruit. The iron content in the present investigation, in 100 g of edible portion of jamun fruit was calculated out to be 0.50 mg, 1 week after storage, as 100 mL jamun juice was extracted from 64 g of edible portion of jamun fruit. In present investigation, the phosphorus content was found to be 16.39 mg/100 g of edible portion of jamun fruit. Gopalan *et al*.[11] and Singh *et al*.[14] reported the phosphorus content to be 15 mg/100 g (0.015 %) and 0.01 % of edible portion in jamun fruit.

The decrease of calcium, potassium, iron and phosphorous content in the jamun beverage during storage might be due to binding of the minerals with the other organic constituents (probably organic acids) of the jamun beverage. Jamun fruit contains many organic acids like oxalic acid, gallic acid, *etc*. Jamun also contains ascorbic acid, tartaric acid, tannins *etc*.[2]. The minerals might have bound to some of these forming complexes. In the form of complexes some amount of the minerals might have settled at the bottom of the storage bottle as precipitate, thus lowering the content of the minerals during storage. Kenawi *et al*.[18] reported 4 to 4.5 % decrease in calcium content in fortified and unfortified orange juice concentrate stored at room temperature for 10 weeks packed with three different packaging materials.

Antioxidant activity: Data on antioxidant activities for the value added products of jamun fruit are presented at Table-2. 50 % DPPH inhibition was observed for 57.840 µL of jamun juice and 90.504 µL jamun squash prepared using sugar at 1 week after storage. However, after 6 months of storage the 50 % DPPH inhibition was exhibited by 97.92 µL for jamun juice, 99.56 µL jamun juice prepared using stevia and 163.92 µL jamun juice prepared using sugar. The results revealed that the antioxidant activity decreased during storage, which might be due to the decrease in phenolic compounds. Khurdiya and Roy[13] reported the presence of phenolic compounds like anthocyanin (210-242.50mg/100g) and tannin (386.25-428.26 mg/100 g) in jamun fruit. Li *et al*.[19] reported that 1 mg concentrated extract of Chinese jujube produced 33.6 % to 98.6 % DPPH scavenging activity, just after harvest. However, Sanja *et al*.[20] and Gupta *et al*.[21] reported that 12.67 µg leaves of *Portulaca oleracea* and 4.391 µg roots of *Rhadiola imbricata* showed 50 % DPPH inhibition. The lower values observed by these workers might be due to higher antioxidant activity and/or utilization of dried alcoholic/aqueous extract samples for DPPH scavenging assay.

TABLE- 2
ANTIOXIDANT ACTIVITY OF THE VALUE ADDED PRODUCTS OF JAMUN FRUIT

Sample	50 % DPPH inhibition (1 week after storage)	50 % DPPH inhibition (6 months after storage)
Jamun juice (µL)	57.84	97.92
Jamun squash prepared using stevia (µL)	59.70	99.56
Jamun squash prepared using sugar (µL)	90.50	163.92
Ascorbic acid (µg)	22.32	22.32
Quercetin (µg)	21.34	21.34
CD at 5 %	63.79	121.141

Microbial evaluation: Data obtained on microbial analysis for jamun juice and two types of squashes during different periods of storage, *i.e.* 1 week, 2 months, 4 months and 6 months are presented in Table-3. The analysis revealed that the *Lactobacillus* species was prominent in all the three types of products of the jamun fruit during the different periods of storage. Yeast growth was found to be negligible compared to other microbes.

Microbial analysis revealed that fungus resistant to Rose Bengal Agar medium was not detected in all the forms of value added products and the microbial colonies were found to be within safer limit. There was a gradual decline in microbial population during storage which might be due to the increased action of chemical preservatives used in the products.

Detection of higher number of *Lactobacillus* sp. in comparison to total viable bacterial count might be due to selective growth of *Lactobacillus* sp. in MRS media. Detection of fungus in jamun products might be due to the use of filtered drinking water only, without being autoclaved. However, the present study revealed lesser number of microbial count in jamun beverages as compared to some other similar products. Ketema *et al*.[22] reported that mean aerobic mesophillic bacterial counts (cfu/mL) of avocado, papaya and pineapple juices to be 8.0×10^6, 3.1×10^7 and 7.9×10^6 cfu/mL, respectively. The counts of yeast were relatively higher in avocado (4.5×10^5 cfu/mL) and pineapple (5.0×10^6 cfu/mL) as compared to that of papaya (6.2×10^3 cfu/mL). Similarly, Patel and Patel [23] reported total microbial count to be between 1.4×10^6 cfu/g to 9.0×10^6 cfu/g in dried mango pulp, which was stored for 60 days using different packaging material. However, Elmahmood and Doughari[24] reported that the total bacterial counts in various *kunun-zaki* (indigenous Nigerian non-alcoholic beverage) samples ranged from 1.0×10^2 to 8.9×10^4 cfu/mL. Patel and Patel[23] also reported that there was no reduction of microbial load but observed that microbial count increased after each interval when the mango bar stored for 2 months at room temperature was withdrawn at an interval of 15 days. Kulkarni *et al.*[25] reported that *E. coli, S. aureus*, *P. aeruginosa*, *Salmonella* sp. and yeast and mould were present in commercial jamun juice and also some of the other herbal oral medicinal liquids.

TABLE-3
GROWTH OF MICROORGANISM IN DIFFERENT JAMUN PRODUCTS

Microorganisms	Growth after 1 week of storage (cfu mL^{-1})			Growth after 2 months of storage (cfu mL^{-1})			Growth after 4 months of storage (cfu mL^{-1})			Growth after 6 months of storage (cfu mL^{-1})		
	Jamun juice	Squash with sugar	Squash with stevia	Jamun juice	Squash with sugar	Squash with stevia	Jamun juice	Squash with sugar	Squash with stevia	Jamun juice	Squash with sugar	Squash with stevia
Yeast	2×10^5	1×10^5	1×10^5	2×10^5	1×10^5	2×10^5	1×10^5	nil	1×10^5	1×10^5	nil	nil
Fungus	12×10^5	10×10^5	11×10^5	15×10^5	13×10^5	10×10^5	10×10^5	9×10^5	8×10^5	5×10^5	3×10^5	4×10^5
Lactobacillus species	42×10^5	41×10^5	45×10^5	40×10^5	44×10^5	43×10^5	30×10^5	30×10^5	30×10^5	22×10^5	28×10^5	31×10^5
Total viable bacterial count	26×10^5	23×10^5	22×10^5	23×10^5	24×10^5	18×10^5	18×10^5	18×10^5	11×10^5	9×10^5	10×10^5	8×10^5
Yeast and moulds	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil

(Each value is the mean of three replications)

In present study, the value added products exceeded the microbial count specified by 'Prevention of Food Adulteration Rules, 1956'. According to above rule[26] total plate count in ready-to-serve beverages including fruit beverages should not be more than 50 cfu/mL. The high counts observed in the present study may not necessarily pose hazard to the health of the consumers, provided that these are not potential pathogenic strains and the squash is consumed after diluting three times. However, the use of autoclaved water instead of filtered drinking water and/or increasing the strength of preservative within permissible limit from the present 0.05 to 0.1 % probably could have reduced the microbial load further.

Sensory evaluation: Data obtained on sensory evaluation for jamun squash prepared using sugar and stevia, after 1 week of storage and after 6 months of storage are presented in Table-4. The results revealed that the squash prepared with sugar was better than the same prepared with stevia, as the latter scored less for sugar acid blending, taste and overall acceptance.

TABLE-4
VALUES OF SENSORY EVALUATION OF
DIFFERENT VALUE ADDED PRODUCTS OF JAMUN

Parameters	Jamun squash with stevia		Jamun squash with sugar	
	After 1 week of storage	After 6 months of storage	After 1 week of storage	After 6 months of storage
Colour	9.0	7.0	9.0	8.0
Consistency	8.0	7.0	8.0	8.0
Sugar-acid blending	7.0	6.0	9.0	8.0
Taste	7.0	6.0	8.0	8.0
Overall acceptance	7.0	7.0	8.5	8.0

Each value is the mean of five replications

Conclusion

The nutritional analysis of three types of jamun beverages revealed that the nitrogen content and the minerals (calcium, potassium, iron and phosphorous) and antioxidant activity were higher in jamun juice and jamun squash made with stevia, in comparison to jamun squash made with sugar. Though, there was decrease in nitrogen, total soluble sugar and mineral content during storage, microbial and sensory qualities were not affected much. Although, in the sensory evaluation the jamun squash made with sugar was found to be more preferable to the same made with stevia, the latter is found to be more nutritious as revealed by nutritional analysis.

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REFERENCES

1. S.G. Joshi, Medicinal Plants, Oxford & IBH Publishing Co. New Delhi, (2001).
2. P. Chowdhury and R.C. Ray, *Asian Food J.*, **14**, 15 (2007).
3. M. Shahnawaz, S.A. Sheikh and S.M. Nizamani, *Pakistan J. Nutr.*, **8**, 1275 (2009).
4. R.P. Sivastava and S. Kumar, Fruit and Vegetable Preservation Principles and Practices, International Book Distributing Company, Lucknow, India (2003).
5. W.E. Trevelyan and J.S. Harrison, *Biochem. J.*, **50**, 298 (1952).
6. AOAC, Official Method of Analysis, Association of Official Analytical Chemist, Washington DC, edn 14 (2005).
7. S.Y. Wong, *J. Biol. Chem.*, **55**, 421 (1923).
8. C.H. Fiske and Y.S. Row, in eds.: R.W. Cowgill and B. Pardec, Experimental Biochemical Research Techniques, p. 177 (1925).
9. P. Molyneux, *J. Songklanakarin Sci. Technol.*, **26**, 212 (2004).
10. M. Amerine, R.M. Pangborn and E. Roessler, Principles of Sensory Evaluation of Food, Academic Press, New York, p. 419 (1965).
11. C. Gopalan, B.V. Rama Sashtri and Balasubhramaniam, Nutritive Value of Indian Foods, National Institute of Nutrition, Indian Council of Medical Research, Hyderabad, India (1996).
12. M.H. Noomrio and M.U. Dahot, *Islamic Academy Sci.*, **9**, 9 (1996).
13. D.S. Khurdiya and S.K. Roy, *J. Food Sci. Technol.*, **22**, 27 (1985).
14. S. Singh, S. Krishnamurthi and S.L. Katyal, Fruit Culture in India. ICAR, New Delhi, p.55(1967).
15. M. Shahnawaz, S.A. Sheikh and S.M. Nizamani, *Pakistan J. Nutr.*, **8**, 1275 (2009).
16. I. Hussain, A. Zeb and M. Ayub, *World J Agric. Sci.*, **7**, 136 (2011).
17. S. Akhtar, M. Riaz, A. Ahmad and A. Nisar, *Pak. J. Bot.*, **42**, 853 (2010).
18. M.A. Kenawi, L.A. Shekib and N.A. El-Shimi, *Plants Food Human Nutr.*, **45**, 265 (1994).
19. J.W. Li, S. Ding and X. Ding, *Process Biochem.*, **40**, 3607 (2005).
20. S. Sanja, N.R. Seth, N.K. Patel, D. Patel and B. Patel, *Int. J. Pharmac. Sci.*, **1**, 74 (2009).
21. V. Gupta, S.S. Lahiri, S. Sultana, R. Tulsawani and R. Kumar, *J. Complemen. Integr. Med.*, **6**, 1 (2009).
22. T. Ketema, T. Gaddisa and K. Bacha, *Ethiop. J. Health Sci.*, **18**, 98 (2008).
23. V.T. Patel and H.R. Patel, *J. Agric. Eng.*, **41**, 55 (2004).
24. A.M. Elmahmood and J.H. Doughari, *Afr. J. Food Sci.,* **1**, 11 (2007).
25. C. Kulkarni, A. Deshpande and S. More, *Int. J. Pharm. Res. Dev.*, **2**, 191 (2010).
26. Prevention of Food Adulteration Act 1956. Microbial Food Safety-Indian Regulation, Retrieved from www.ilsi-india.org on 21st December 2011.