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Quality Improvement of Bael (*Aegle marmelos* Corr.) Candy and Storage Studies

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ABSTRACT

The research was done with two cultivars of bael like Local cultivar of West Bengal and NB-5 with a large fruit size and having a greenish yellow to yellowish green colour, average fruit weight (723.50 and 1212.50 gram), pulp per cent (75.40 and 79.62), TSS (12.2 and 14.4 °Brix), ascorbic acid (13.12 and 27.36 mg/100 g pulp) and β-carotene (1868.01 and 1155.37 IU) were analyzed in the fresh fruits. The product of bael candy was prepared by using of sugar, acid, water and preservatives. The slices were dipped in different concentration of alum solution for two hours and blanched. The best recipe of bael candy was found 2 per cent alum concentration and the standardized processed product was stored at room (25 – 37 °C) and refrigerated temperatures (8 -10 °C) up to 8 and 12 months and with organoleptic score 4.66 and 4.94 was found best among all treatments of local and NB-5 cultivar respectively. The economic analysis of the standardized products revealed that the income per rupee investment of bael candy was ₹ 0.79 and ₹ 1.16 for local and NB-5 respectively.

Keywords: Bael, candy, alum treated, quality, storage

Bael (*Aegle marmelos* Corr.) is an indigenous fruit of India belongs to family Rutaceae and it is commonly known as Bengal quince, Stone apple, Maredo, Indian quince, golden apple in English, holy fruit, bel, belwa, Sriphal in Hindi in India (John and Stevenson, 1979). It contains 28-39 per cent total soluble solids, 19-21 per cent carbohydrates, 11-17 per cent sugar, 1 per cent protein, 0.2 per cent fat, 7-21 mg/100g vitamin C. In addition, it is rich in vitamin A (186 IU/100g pulp); volatile oils and marmlosines. Its food value is 88 calories/100gm. Thus, it is richer than most of the reputed fruits like apple, guava and mango which have a calorific value of only 64, 59 and 36 respectively (Jauhari and Singh, 1971). Bael is considered to be one of the richest sources of riboflavin (Mukharjee and Ahmad, 1957) and provides lots of minerals and vitamins to diet (Barthakur and Arnolds, 1989).

The fruit's medicinal value is very high when it just begins to ripen. In Ayurvedic system of medicine, bael fruits are considered as an excellent remedy for diarrhea (Das and Das, 1995). The fruit is aromatic, cooling and laxative. It is useful in preventing or curing of scurvy, strengthens the stomach, promotes its action and it's also used as an anticancer and chemopreventive agent (Baliga *et al.,* 2011). The pulp also contains a balsam-like substance, and 2 furocoumarins-psoralen and marmelosin ($C_{13}H_{12}O_3$), highest in the pulp of the large, cultivated forms. It can be processed into delicious products like candy, squash, toffee, slab, pulp powder, and nectar (Jauhari *et al.,* 1969). This paper reports on the feasibility for the development of value added product (bael candy) from local cultivar of West Bengal and Cv. NB-5 in order to minimize the wastage, to promote the product as export item and to uplift the nutritional and socio-economic status of vulnerable commodities of West Bengal.

MATERIALS AND METHODS

The experiments were carried out in the Laboratory of Post Harvest Technology, Research Complex, Kalyani, BCKV, West Bengal during the year 2008-2010 with a view to analyze the physico-chemical characteristics and sensory attributes of fresh fruit and its processed product. The two cultivars of bael fruit were procurement from the NDUAT, Faizabad Cv. NB-5 and one of the Local cultivar from BCKV Campus, Kalyani. Climatically the region comes under tropical humid with rainfall of 0.00 to 241.2 mm, temperature maximum 37.58 °C and minimum 9.26 °C along with RH (%) 93.25 to 57.5 (Annual average) by *AICRP on Agricultural Meteorology*, BCKV, Kalyani (2008-2010).

Standardization of bael candy

Fully matured and turn up of pulp colour (light yellow colour of pulp) of bael fruits were used for processed product and washed with tap water and make into half horizontally. The half cut fruits along with seeds were sliced into suitable size of pieces (2.5 × 6.0 × 0.3cm) for preparing product with the help of a cutter machine. The pieces were treated by alum at different concentration (0.0, 1.0, 1.5, 2.0 and 2.5%) and blanched (28 minutes at 7kg/cm^2). The product was prepared with the combination of sugar syrup, citric acid and fruit slices were dipped into 40 °Brix sugar syrup and kept overnight, same process repeated for three times and added citric acid (0.6%). The different formulations were used to prepare the bael candy and coded as BCL_1, BCL_2, BCL_3, BCL_4, BCL_5 and BCL_6 for local cultivar and NBC_1, NBC_2, NBC_3, NBC_4, NBC_5 and NBC_6 for cultivar NB- 5. The TSS was raised to 40 to 65 °Brix or above and added the potassium meta-bisulphite (KMS) 100 ppm as preservative. Sieved the slices with muslin cloth and washed in hot water for a minute and spread on the tray. The prepared product was dried at 55 °C for 3 hours and packed in polyethylene packet with the capacity of 100g and immediately closed air tight with help of sealing machine. The product was stored at room (25-37 °C) and refrigerated temperature (8-10 °C).

Physico-chemical analysis

The physiochemical properties of fresh and processed product of bael fruit were analyzed by standard methods like TSS from Hand Refractometer, sugars by Lane and Eynon (1923), titrable acidity by AOAC (1984), ascorbic acid by 2, 6-dichlorophenol indophenols (Dye) titration method and β-carotene analyzed with the help of spectrophotometer at 452 nm by Ranganna (2000). The protein was estimated by Lowry's method (1951) and also the stored product was analyzed at monthly intervals. Organoleptic test of freshly prepared product and stored product was evaluated by method of a 5 -Point Hedonic Scale (Amerine *et al.,* 1965) and benefit: cost ratio was calculated after estimation of the cost involved including the operational as well as 10% overhead charges incurred during the preservation of bael candy. The data obtained were subjected to Complete Randomized Design (CRD) with critical difference (CD) value at 5% level of probability and each treatment replicated for three times as suggested by Raghuramula *et al.* (1983).

RESULTS AND DISCUSSION

The physico-chemical composition of fresh bael fruit is presented in Table 1. The local cultivar and NB-5 were observed its shape, colour of fruit and pulp colour was roundish and oblong, light green and greenish yellow, yellow and light yellow respectively. Average fruit weight of NB-5 (1212.50g) was higher than the local cultivar (723.50g). Similarly, other physical parameter particularly pulp recovery and pulp per cent were also observed higher in NB-5 cultivar, among different chemical parameters was found that the content of TSS (14.4 °Brix), total sugar (8.89%), acidity (0.67%), ascorbic acid (27.36 mg/100g) and protein (8.77%) was higher except only reducing sugar (2.05%) and β-carotene (1155.37 IU). The results are in agreement with the findings (Kanghe, 2008).

TSS, TS, Reducing sugar and Acidity content of alum treated bael both cv. were found an increasing trend during storage at room and refrigerated temperatures shown in Table 2 and 3. The increase in TSS might be due to depletion of moisture in the form of water vapour from the packaging material through the sealing points and total sugar increased due to breakdown of complex sugars is reported by Sogi and Singh, 2001 in Kinnow candy. The conversion was due to the breakdown of sugars and more inversion of sucrose (Rani and Bhatia, 1985) and a similar result was found in bael products (Chand and Gehlot, 2006; Kenghe, 2008). Similarly,

Table 1: Physical and biochemical characteristics of Bael fruit

Physical characters	Local cultivar of W.B.	Cv. NB- 5
Fruit shape	Roundish	Oblong
Fruit colour	Light Greenish	Greenish yellow
Fruit weight (g)	723.5	1212.5
Rind weight (g)	154.7	231.2
Pulp colour	Yellowish	Light yellow
Pulp + seed weight (g)	568.8	981.2
Pulp recovery (g)	545.5	965.4
Pulp per cent	75.40	79.6
Rind per cent	21.4	19.1
T.S.S. (°Brix)	12.2	14.4
Total Sugar (%)	6.4	8.9
Reducing sugar (%)	2.11	2.0
Acidity (%)	0.3	0.6
Ascorbic Acid (mg/100 g)	13.1	27.3
Protein (%)	3.6	8.8
β-carotene (IU)	1868.0	1155.4

Table 2: Storage study of Alum treated bael candy (Local cultivar of W. B.)

Bio-chemical parameters	Temp	Storage life Month (M-3- 7)								CD(0.05)	SEd
		0	1	2	3	4	5	6	7		
TSS	T_1	38.33	38.47	39.00	39.20					NS	0.41
	T_2	38.33	38.47	38.47	38.47	39.00	39.20	39.60	39.67	NS	0.49
TS	T_1	34.34	35.35	36.56	37.57					NS	1.90
	T_2	34.34	34.34	34.34	34.34	35.35	36.56	37.78	38.99	NS	3.00
RS	T_1	6.56	7.43	8.16	9.54					0.698**	0.30
	T_2	6.56	6.90	7.24	7.80	8.22	9.68	10.70	11.55	0.692**	0.33
Acidity	T_1	0.15	0.17	0.19	0.20					0.083*	0.04
	T_2	0.15	0.15	0.17	0.19	0.21	0.23	0.24	0.24	0.071**	0.03
Ascorbic acid	T_1	9.13	7.38	6.18	5.17					NS	1.32
	T_2	9.13	8.95	7.81	7.44	6.92	5.50	4.71	3.18	1.164**	0.55
Protein	T_1	3.18	3.13	2.78	2.68					0.169**	0.07
	T_2	3.18	3.08	2.67	2.53	2.41	2.09	1.96	1.41	0.227**	0.11
Carotene	T_1	1148.09	941.83	660.84	483.35					193.052**	83.72
	T_2	1148.09	969.96	856.17	697.08	594.53	468.01	393.63	346.68	117.463**	55.41
Organoleptic test	T_1	4.60	4.56	4.02	3.48					0.397**	0.17
	T_2	4.60	4.58	4.24	4.14	3.86	3.04	2.78	2.44	0.549**	0.26

*T_1- Room Temperature (25 to 37°C), T_2- Refrigerated Temperature (8 to 10°C), n- 10 (10 panelist), NS- Non Significant, **- Highly significant, * significant, M- Month (0 to 3 and 0to 7 month), r (Replication) – 3, T- Temperature, Samples acceptability scores of 2.5 and above were considered acceptable.*

ascorbic acid, protein, β-Carotene and organoleptic value of alum treated bael candy both cv. were found an decreasing trend during storage at room and refrigerated temperatures (Table 2 and 3). The decrease in protein content during storage of bael candy might be due the denaturation of protein caused by heat in presence of moisture was reported in palm spread and toffee by Chaurasiya *et al*., 2014.

However, the rate of decrease showed more at room temperature and the retention of β-Carotene was noticed more at refrigerated temperature in both cultivars. Because, it is light sensitive and more

Table 3: Changes in quality attributes of Alum treated bael candy (cv. NB 5) during storage

Bio-chemical parameters	Temp	Storage life Month (M-12)													CD(0.05)		
		0	1	2	3	4	5	6	7	8	9	10	11	12	M	T	MT
TSS(° Brix)	T_1	45.17	45.17	45.17	45.17	45.33	45.50	45.67	45.83	46.00	46.17	46.33	46.50	46.67	NS	NS	NS
	T_2	45.17	45.17	45.17	45.17	45.17	45.17	45.33	45.33	45.33	45.33	45.50	45.67	45.83			
TS (%)	T_1	27.85	28.34	29.23	30.75	32.93	33.70	34.78	35.83	36.47	38.62	39.05	40.81	42.52	2.189**	0.859**	3.096
	T_2	27.85	27.94	28.48	30.66	31.09	31.45	32.20	32.22	33.30	33.57	33.82	34.49	35.01			
RS (%)	T_1	8.65	9.86	10.77	11.66	12.55	13.24	14.03	14.46	14.92	15.94	16.46	17.18	17.90	1.103**	0.433**	NS
	T_2	8.65	8.70	9.26	9.73	10.44	10.62	11.31	12.10	12.53	12.99	13.28	14.01	15.25			
Acidity (%)	T_1	0.18	0.18	0.19	0.20	0.21	0.22	0.23	0.26	0.27	0.28	0.29	0.32	0.33	0.031**	0.0123**	NS
	T_2	0.18	0.18	0.18	0.18	0.19	0.20	0.21	0.21	0.22	0.23	0.24	0.26	0.28			
Ascorbic acid (mg/100g)	T_1	8.68	7.51	6.82	6.03	5.86	4.87	3.63	3.17	3.05	2.91	2.60	2.12	1.89	0.794**	0.311**	1.123
	T_2	8.68	8.15	7.32	7.15	6.16	5.84	5.23	4.93	4.35	4.20	3.89	3.18	2.47			
Protein (%)	T_1	7.73	6.91	6.57	5.90	5.16	4.76	4.24	3.78	3.08	2.95	2.39	2.06	1.73	0.729**	0.286**	NS
	T_2	7.73	7.33	6.68	6.12	5.54	5.01	4.92	4.56	3.85	3.73	3.47	3.17	2.84			
Carotene (IU)	T_1	458.65	389.43	357.30	341.95	321.67	303.86	291.27	268.91	233.36	212.60	199.59	175.82	126.38	52.866**	20.735**	NS
	T_2	458.65	457.60	402.04	386.69	366.41	348.60	327.13	313.65	278.10	244.33	219.53	196.74	171.12			
Organoleptic test	T_1	4.92	4.88	4.82	4.78	4.72	4.66	4.58	4.46	4.38	4.14	3.76	3.54	3.46	0.121**	0.047*	NS
	T_2	4.92	4.90	4.86	4.82	4.78	4.70	4.64	4.52	4.44	4.22	3.84	3.62	3.54			

*T_1- Room Temperature (25 to 37°C), T_2- Refrigerated Temperature (8 to 10°C), n- 10 (10 panelist), NS- Non Significant, **- Highly significant, * significant, M- Month (0 to 12 month), r (Replication) – 3, T- Temperature, Samples acceptability scores of 2.5 and above were considered acceptable.*

stable in neutral pH and decrease in β-Carotene was found during storage at both temperatures (Chaurasiya *et al.,* 2014) in palm spread and palm toffee. Organoleptic scores were judged on the basis of 5 point Hedonic Scale. In this study was considered slightly acceptable on the basis of organoleptic rating of 2.5 and above by the panelist. A similar finding was observed in pear candy by Rani and Bhatia, 1985 and Prasad and Singh, 2001 in bael products.

Economic analysis of processed products

For the preparation of 1 Kg bael candy for local and NB-5 Cv. was ₹ 100.14 and ₹ 109, gross income ₹ 180 and ₹ 235 that means net income was ₹ 79.86 and ₹ 126 respectively. Thus, the economic analysis revealed that the income per rupee investment of bael candy approximately ₹ 0.79 and ₹ 1.16 for local and NB-5 respectively. Hence, it could be assumed that NB-5 bael candy was more profitable than local cultivar.

REFERENCES

Amerine, M.A., Pangborn, R.M. and Roessler, E.B. 1965. *Principle of Sensory Evaluation of Food,* Academic Press Inc, New York.

AOAC. 1984. *Official methods of analysis,* 15th edn (Association of Official Analytical Chemists, Washington DC).

Baliga, M.S., Bhat, H.P., Joseph, N. and Fazal, F. 2011. Phytochemistry and medicinal uses of the bael fruit (*Aegle marmelos* Correa). A concise review. *Food Research International*, **44**: 1768-1775.

Barthakur, N.N. and Arnolds, N.P. 1989. Certain organic and inorganic constituents in bael (*Aegle marmelos* Correa) fruits. *Tropical Agriculture,* **66**: 65-68.

Chand, T. and Gehlot, R. 2006. Utilization of bael (*Aegle marmelos* Correa.) for preparation of pulp. *Research Crops,* **7**: 887-890.

Chaurasiya, A.K., Chakraborty, I. and Saha, J. 2014. Value Addition of Palmyra Palm and Studies On The Storage Life. *J. Food Sci. & Technol.,* **51**(4): 768-773.

Das, B. and Das, R. 1995. Medicinal properties and chemical constituents of Aegle marmelos Correa. *Indian Drugs.* **32**: 93-99.

Jauhari, O.S. and Singh, R.D. 1971. Bael a valuable fruit. *Indian Horticulture,* **16**: 48-53.

Jauhari, O.S., Singh, R.D. and Awasthi, R.K. 1969. Survey of some important varieties of bael (*Aegle mormelos* Correa.). *Punjab Journal of Horticulture,* 9: 48-53.

John, L. and Stevenson, V. 1979. T*he complete book of fruit.*Angus and Robertson Publishers Sydney.

Kanghe, R.N. 2008. Bael fruit processing for value addition and employment generation. *Food Pack Com.,* **2**: 10-12.

Lane, J.H. and Eynon, L. 1923. Determination of reducing sugar by Fehling's solution with methylene blue as indicator. *Journal Society of Chemical Industry,* **42**: 32.

Lowry, D.H., Rosebrough, N.J., Farr, A.L. and Randa, U.R.J. 1951. Protein measurements with Folin phenol reagent. *Journal of Biological Chemistry,* **103**: 625-628.

Mukharjee, B. and Ahmad, K. 1957. Riboflavin. *Pakistan Journal of Biological and Agriculture Science,* **4**: 47-51.

Prasad, Y. and Singh, R.P. 2001. Evaluation of bael (*Aegle marmelos* Correa.) in Uttar Pradesh and Bihar areas. *Haryana Journal of Horticulture Science*, **30**: 70-71.

Raghuramula, H., Madhavan, N.K. and Sundaram, K. 1983. *A Manual of Laboratory Technology, National Institute of Nutrition,* Indian Council of Medical Research, Hyderabad.

Ranganna, S. 2000. *Handbook of analysis and quality control for fruit and vegetable products,* 2nd edn., Tata and McGraw-Hill, New Delhi.

Rani, U. and Bhatia, B.S. 1985. Studies on Pear Candy Processing, *Indian Food Pack.*, **39**: 40-46.

Sogi, S.D. and Singh, S. 2001. Studies on bitterness development in kinnow juice, ready-to-serve beverage, squash, jam and candy. *Journal of Food Science and Technology,* **38**: 433-438.