DOI : 10.5958/0974-0112.2019.00060.4

Indian J. Hort. 76(2), June 2019: 373-376

Short communication

Quality retention of bael candy during storage

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ABSTRACT

Two bael cultivars, namely Local cultivar and NB-5 with a large fruit and having a greenish to yellowish green, average fruit weight (723.50 and 1212.50 g), pulp (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 used in the study. The bael candy was prepared by using of cane sugar, citric acid, water and preservatives. The slices were dipped into different concentrations of alum solution for two hours and blanched. The best recipe of bael candy was found 2 per cent alum concentration. Further, the product was stored at room (25-37°C) and refrigerated temperatures (8 -10°C) up to 8 and 12 months along with organoleptic score 4.66 and 4.94 was found best among all treatments of Local and NB-5 cultivars, respectively. Economic analysis revealed that the income per rupee investment of bael candy was Rs. 1.79 and Rs.2.01 for local and NB-5, respectively.

Key words: *Aegle marmelos*, alum, quality traits.

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 (Maity *et al.*, 8). 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. Bael is considered to be one of the richest sources of riboflavin and provides lots of minerals and vitamins to diet (Barthakur and Arnolds, 2).

The medicinal value of fruits 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, 5). The pulp 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. 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.

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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).

Fully matured and turn up of pulp colour (light yellow colour of pulp) were used for processed product and washed with tap water. The fruits were made into half horizontally along with suitable size of slice pieces (2.5 × 6.0 × 0.3 cm) 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 7 kg/cm^2). The product was prepared with the combination of sugar syrup, citric acid and then fruit pieces 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. Sieved the slices with muslin cloth and washed into hot water for a minute and spread

on tray. It was dried at 55° C for 3 hours and packed into 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). The quality characteristics of fresh and processed product of bael like TSS, sugars, titrable acidity, ascorbic acid and β carotene were determined according to the method described by Ranganna (11). The protein was estimated by Lowry's method (7) and simultaneously 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.*, 1) 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 obtained data 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.* (10).

The physico-chemical composition of fresh bael is presented in Table 1. The local cultivar and NB-5 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 like pulp recovery and pulp per cent

Table 1. Physical and biochemical characteristics of bael fruits.

Characters	Local	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
TSS (° 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 WB).

Bio-chemical parameters	Temp	Storage life (Month)								CD at 5%
		0	1	2	3	4	5	6	7	
TSS	T_1	38.33	38.47	39.00	39.20					NS
	T_2	38.33	38.47	38.47	38.47	39.00	39.20	39.60	39.67	NS
TS	T_1	34.34	35.35	36.56	37.57					NS
	T_2	34.34	34.34	34.34	34.34	35.35	36.56	37.78	38.99	NS
RS	T_1	6.56	7.43	8.16	9.54					0.69**
	T_2	6.56	6.90	7.24	7.80	8.22	9.68	10.70	11.55	0.69**
Acidity	T_1	0.15	0.17	0.19	0.20					0.08*
	T_2	0.15	0.15	0.17	0.19	0.21	0.23	0.24	0.24	0.07**
Ascorbic acid	T_1	9.13	7.38	6.18	5.17					NS
	T_2	9.13	8.95	7.81	7.44	6.92	5.50	4.71	3.18	1.16**
Protein	T_1	3.18	3.13	2.78	2.68					0.17**
	T_2	3.18	3.08	2.67	2.53	2.41	2.09	1.96	1.41	0.23**
Carotene	T_1	1148.09	941.83	660.84	483.35					193.05**
	T_2	1148.09	969.96	856.17	697.08	594.53	468.01	393.63	346.68	117.463**
Organoleptic score	T_1	4.60	4.56	4.02	3.48					0.39**
	T_2	4.60	4.58	4.24	4.14	3.86	3.04	2.78	2.44	0.54**

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 3 and 0to 7 month), r (Replication) – 3, T- Temperature, Samples acceptability scores of 2.5 and above were considered acceptable.

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

Bio-chemical parameters	Temp	Storage life (M)													CD at 5%		
		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			
Total Sugar (%)	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			
Reducing Sugar (%)	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 score	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 ^{O}C), T_2- Refrigerated Temperature (8 to 10 ^{O}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.

were also observed higher in NB-5, 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 similar patterns have been reported by (Kanghe, 6). TSS, TS, Reducing sugar and Acid content of alum treated bael candy of 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. The conversion of sugar was due to the breakdown of sugars and more inversion of sucrose (Rani and Bhatia, 12) and a similar result was found in bael products (Chand and Gehlot, 3; Kenghe, 6). Similarly, ascorbic acid, protein, β carotene and organoleptic value of alum treated bael candy of both cv. were showed a 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.,* 4. However, the rate of decrease showed more at room temperature and the retention of β carotene was noticed more at refrigerated temperature in both the cultivars. Because, it is light sensitive and more stable in neutral pH and decrease in β carotene was found during storage at both temperatures (Chaurasiya *et al.*, 4) in palm spread and palm toffee. The 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 from 2.5 and above by the panelist. A similar finding was observed in bael products by Prasad and Singh, 9.

Economic analysis of processed products for the preparation of 1 Kg bael candy for local and NB-5 cv. was Rs. 100.14 and Rs. 109, gross income Rs. 260 and Rs. 310 that means net income was Rs. 159.86 and Rs. 201 Respectively. Thus,the economic analysis revealed that the income per rupee investment of bael candy approximately Rs. 1.59 and Rs. 2.01 for local and NB-5, respectively. Thus, it could be assumed that NB-5 bael candy was more profitable than local cultivar.

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Received : February, 2018; Revised : May, 2019; Accepted : May, 2019