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Study on effect of different pre–treatments on physico-chemical properties and organoleptic quality of bael candy (*Aegle marmelos* Correa.) cv. Narendra Bael-6

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Abstract
The experiment work studies on preparation and preservation of bael candy was conducted in the laboratory of Horticulture SHIATS, Allahabad, during the year 2014 to prepare and evaluate for all the sensory parameters were as based on the overall acceptability which was depended on Color, Texture, Flavor and Taste. The bael candy was prepared from healthy and mature bael fruits (cv. NB-6). The experiment was laid out in Complete Randomized Design (C.R.D.) with three replication and ten treatments separately. Result shows that Total Soluble Solids (°Brix), acidity (%), reducing sugars (%), total sugars (%) and browning (O.D.) were continuously increased where as non-reducing sugars (%) and organoleptic quality decreased gradually and were statistically significant. Precisely, on the basis of results obtained it may be concluded that the sensory quality of Bael candy treatment T_4 (Dipping the Bael pieces in 2.25% Lime Water for overnight) can be used in commercialization of Bael candy preparation. This recipe may also be advocated for safe storage at ambient temperature up to 4 months.

Keywords: bael, candy, lime water, alum, organoleptic quality

Introduction
Bael (*Aegle marmelos* L.) is an important indigenous fruit of India, belonging to family Rutaceae. The bael is native of Indo-Malayan region and has been known in India from prehistoric times. The leaves of the tree are traditionally used as sacred offering to 'Lord Siva' according to Hindu custom. In the Epic Ages, such as those of the Ramayana bael fruit was known. The ripe fruit is sweet, aromatic, and cooling. The tree's wood is yellowish white and hard but not durable.

Bael is a very hardy, subtropical, deciduous tree and can thrive well in swampy, alkaline and stony soils having pH range from 5 to 10. The fruit is available in almost all the states of India but most abundantly available in Uttar Pradesh, Bihar, West Bengal and Orissa. The slow-growing trees bear strong spines and alternate compound leaves with three leaflets. The sweet-scented white flowers are borne in panicle clusters and are sometimes used in perfumes. The fruit is pyriform (pear-shaped) to oblong in shape and 5–25 cm (2–10 inches) in diameter. It has a very hard woody gray or yellow rind and sweet, thick, orange-coloured pulp.

The bael fruit is one of the most nutritious fruits. According to (Gehlot and Dhawan, 2005) [4] it contains 61.5 g water, 1.8 g protein, 31.8 g carbohydrates, 1.19 mg riboflavin and 8 mg vitamin C per 100 g of eadible portion. The ripe fruit and unripe fruit, as well as the roots, leaves and branches have all been used in traditional medicine. In Ayurveda, the ripe fruit has been used for chronic diarrhea and dysentery, as a tonic for the heart and brain, and as adjuvant treatment of dysentery. A decoction of the roots has been used to treat melancholia, intermittent fevers, and palpitations; the roots have mainly been used as an ingredient of the Ayurvedic medicine, *dashmool*. The leaves have been given as a febrifuge, and as a poultice for the treatment of eye disorders and ulcers; and administration of fresh leaves has been used for weakness of the heart, dropsy, and beriberi. It can be processed into delicious products like preserve, candy, squash, toffee, slab, pulp powder, and nectar (Kumari *et al.*, 2018) [5]. The experiment was conducted with aim to standardize the bael candy for preparation to assess the physico-chemical properties and shelf life the candy.

Materials and Methods
The experiment was carried out under Post Harvest Laboratory in Department of Horticulture, Allahabad School of Agriculture, SHIATS, Allahabad (U.P.) during the session 2013-14 under Complete Randomized Design with ten treatments and three replications in each.

Standardization for preparation of Bael Candy is mentioned in Table: 1. First of all 12 Kg. mature, healthy bael fruits (cultivar, NB-6) were taken and washed in tap water to wash out adhering dirt and dust particles. Fruits were cut in slices by wood cutter. Bark and seeds were removed. Then puncturing and cutting of pieces into desired shapes were done. Now, pre-soaking treatments were done for over night and following steps were used for preparation of bael candy.

Table 1: Standardization of Pre-Treatments for Preparation of Bael Candy:

Treatments	Treatment details
T_1	Dipping the Bael pieces in 1.5% Lime Water for over night
T_2	Dipping the Bael pieces in 1.75% Lime Water for over night
T_3	Dipping the Bael pieces in 2.0% Lime Water for over night
T_4	Dipping the Bael pieces in 2.25% Lime Water for over night
T_5	Dipping the Bael pieces in 2.5% Lime Water for over night
T_6	Dipping the Bael pieces in 1.5% Alum for over night
T_7	Dipping the Bael pieces in 1.75% Alum for over night
T_8	Dipping the Bael pieces in 2.0% Alum for over night
T_9	Dipping the Bael pieces in 2.25% Alum for over night
T_{10}	Dipping the Bael pieces in 2.5% Alum for over night

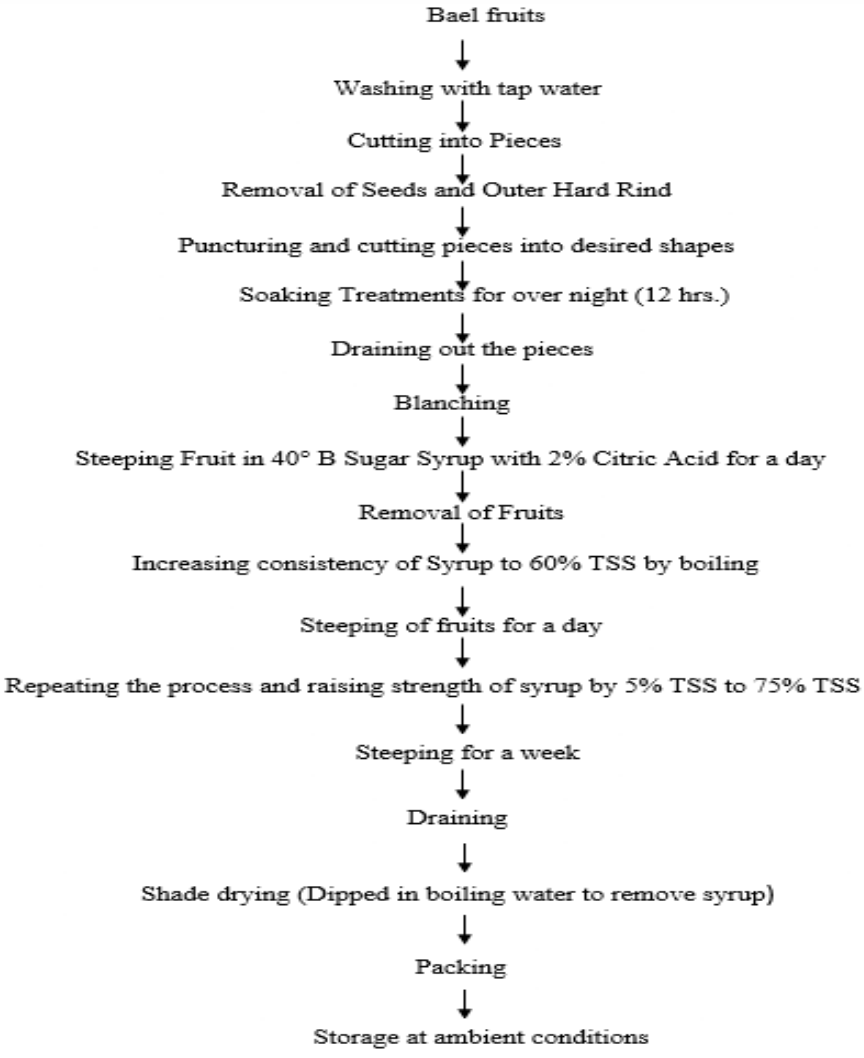
Note - TSS 75°Brix, Acidity 2% and preservative (KMS) 350 ppm were constantly used in all treatments.

First observation was recorded just after preparation of candy then after every 30 days intervals up to 120 days of storage. The physico-chemical composition *viz*., TSS was determined by Hand Refractrometer, while acidity, total sugar, reducing sugar, non-reducing sugar and browning were estimated through standard methods as suggested by (Ranganna, 2001) [6]. While shelf life of candy was determined by sensory evaluation (Singh *et al.,* 2017) [8]. Experiment was subjected to completely randomized design analysis.

Results and Discussion

As per the results recorded from the present investigation, revealed that the higher concentration of sugar in candy increased the TSS per cent at T_1 to T_{10} and this effect on TSS per cent persisted till 120 days of storage. It is obvious that the TSS per cent of candy was influenced by storage period and the TSS per cent increases continuously with the increase in storage period up to 120 days.

Flow sheet for preparation of bael candy



These findings are in confirmation with the findings of (Ullikashi *et al.,* 2017) [10] who reported increasing trend in TSS °Brix of Value Added Products from Bael Fruit during the storage period. (Bag *et al*., 2011) [2] reported that TSS of bael candy increases with the increasing storage period. Observations recorded for change in acidity were found highest in treatment T_4 (78.86 °Brix) and least in treatment T_1 (78.66 °Brix).Similar findings were reported by (Singh *et al*., 2016) [9]. Acidity of candy was observed to be increased gradually up to the end of experiment under ambient storage conditions. Changes in acidity were found statistically significant up to end of experiment in T_4 (2.05).

Reducing sugar of the candy was observed to be increased gradually up to the end of experiment in all treatments under ambient storage conditions. The minimum reducing sugar of the candy was observed in T_4 (27.74). Similar result was reported by (Bag *et al*., 2009) [1]. A sharp increase in reducing sugar of all treatments was found at later stage of the experiment (*i.e*. 90 and 120 days). Changes in reducing sugars were found statistically significant up to end of experiment. Non-reducing sugar of the candy was observed to be decreased gradually up to the end of experiment in all treatments under ambient storage conditions. Similar result was reported by Sheoran *et al*. (2007) [7]. A sharp decrease in non-reducing sugars of all treatments was found at 30 and 90 days of the experiment. Changes in non-reducing sugar were found statistically significant up to end of experiment. The maximum non-reducing sugar of the bael candy was observed in T_4 (37.18). Total sugar of the bael candy was observed to be increased gradually up to the end of experiment in all treatments under ambient storage conditions. The maximum total sugar of the bael candy was observed in T_4 (64.97). Similar result was reported by (Bhuiyan and Easdani, 2013) [3]. A sharp increase in total sugars of all treatments was found at 60, 90 and 120 days of the experiment. Changes in total sugar were found statistically significant up to end of experiment (Table 2).

Browning of bael candy was observed to be increased continuously up to the end of experiment under ambient storage conditions. Changes in browning of bael candy were found statistically significant up to end of experiment except at beginning of experiment. The minimum browning of bael candy was observed in T_4 (0.30 OD). Similar findings were reported by (Singh *et al.,* 2017) [8].

Score for over all acceptability of bael candy was observed to be decreased continuously up to the end of experiment under ambient storage conditions. Similar findings were reported by From over all acceptability point of view treatment T_4 {Dipping the Bael pieces in 2.25% Lime Water for overnight, had maximum Score in Color (8.52), Texture (7.89), Flavor (8.46) and Taste (8.56).

Table 2: Change in physico-chemical properties and organoleptic quality of Bael candy.

Treatments	TSS (°Brix)	Acidity	Reducing sugar	Non Reducing sugar	Total sugar	Browning (O.D.)	Colour	Texture	Flavor	Taste	Overall acceptability
T_1	78.66	2.08	27.81	37.11	64.81	0.34	7.00	6.67	7.67	7.33	6.30
T_2	78.76	2.07	27.76	37.15	64.90	0.33	7.03	7.21	8.01	7.67	6.67
T_3	78.84	2.09	27.80	37.12	64.93	0.32	8.00	7.67	8.33	7.92	7.82
T_4	78.86	2.05	27.74	37.18	64.97	0.30	8.52	7.89	8.46	8.56	7.49
T_5	78.76	2.07	27.78	37.14	64.92	0.31	7.00	6.64	8.31	7.00	6.89
T_6	78.66	2.09	27.76	37.13	64.89	0.35	6.67	6.33	7.26	7.21	5.67
T_7	78.63	2.08	27.74	37.17	64.91	0.34	7.71	7.47	7.33	8.00	7.00
T_8	78.70	2.10	27.80	37.08	64.88	0.34	7.33	7.67	7.20	7.80	7.53
T_9	78.83	2.10	27.75	37.15	64.93	0.36	7.67	7.00	7.87	7.67	6.89
T_{10}	78.84	2.11	27.76	37.18	64.94	0.38	7.00	6.76	7.47	7.64	5.67
F-test	S	S	S	S	S	S	S	S	S	S	S
S. Ed (±)	0.18	0.02	0.11	0.31	0.31	0.01	0.22	0.23	0.22	0.26	0.30
C.D. at 5%	0.45	0.08	0.32	1.23	1.02	0.10	0.56	0.55	0.58	0.54	0.50

Conclusion

It is concluded from the present investigation that treatment T_4 {Dipping the Bael pieces in 2.25% Lime Water for overnight, TSS (75°Brix), Acidity (2%) and KMS (350 ppm)} was found most suitable in terms of physico-chemical properties, sensory scores (7.49) and the quality was remained acceptable up to 4 months (120 days) under ambient storage conditions.

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