Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(4): 408-410
Received: 07-05-2019
Accepted: 09-06-2019

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Changes in chemical constituents and overall acceptability of bael-mango jam during storage

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Abstract
Jam prepared from bael-mango blends was analyzed for changes in chemical constituents and overall acceptability at monthly intervals for three months storage period. Total sugars, reducing sugars, acidity and browning increased, while total carotenoids and total phenols decreased significantly in the blended product during storage. Jam prepared with 0 bael: 100 mango pulp ratio was most acceptable. The overall acceptability of bael-mango jam decreased significantly during three months storage period.

Keywords: Bael, mango, blends, jam, chemical constituents, overall acceptability, storage

Introduction
The demand for value added food products is increasing in India as well as in other foreign countries due to increasing trend towards fast foods. The natural fruit products have high nutritional, medicinal and calorific values, which can further be improved by blending pulp or juice of two or more fruits having excellent colour and appearance, refreshing flavour, delicious taste, and high nutritive and therapeutic values.

Bael (*Aegle marmelos* Correa.) is one of the important fruit trees of Indian origin and is known for its medicinal properties. It is one of the most nutritious fruits. It contains 61.5 g of water, 1.8 g of protein, 1.7 g of minerals, 31.8 g of carbohydrates and 1.19 mg of riboflavin/100 g edible portion. Its food value is 88 calories/100 g. Thus, it is richer than most of the reputed fruits like apple, guava and mango, which have calorific values of only 64, 59 and 36, respectively. They are useful in curing dyspepsia, dysentery, diarrhoea, vitiated condition of vata, vomiting, cardiopalmus, stomachalgia, intermittent fever, seminal weakness, swelling, uropathy and gastric irritability in infants. Its pulp can be used for the preparation of various fruit products *viz.*, preserve, candy, jam, RTS drink, nectar, squash/leather/slab, powder, etc., which can be commercially exploited (Singh & Chaurasiya, 2014) [7].

Mango (*Magnifera indica* L.) belongs to family Anacardiaceae. It is national fruit of India, Pakistan, Philippines and Bangladesh. Although, India is the home of about 1000 varieties but mainly Dashehari, Langra, Chausa, Safeda, Totapuri, Fazli, Alphonso, Bombay Green, Banganpalli, Neelam, etc. are grown commercially. Its pulp contains phytochemicals and nutrients. The fruit contains antioxidants vitamin A, C, B_6 (pyridoxine) and essential nutrients such as potassium, copper and amino acids. Pulp of mango can be incorporated into ready-to-serve drink, nectar, squash, syrup, cheese, toffee, pickles, ice-cream and desserts.

Blending of pulp/juice from two or more fruits could be an economic requisite to utilize profitably some fruits for processing, which may not otherwise have favourable characteristics like colour, flavour, aroma, taste, mouthfeel including overall cost and nutrition for the preparation of processed products. People have less preference for bael fruits due to its peculiar taste and flavour. However, blending of mango pulp with bael pulp may improve colour and appearance, taste, flavour, mouthfeel, texture, nutrition and overall acceptability of its blended products. These blended value added fruit products, being highly nutritive and therapeutically important, can be popularized very easily in the domestic as well as in the export markets.

Keeping all these aspects in view, the present research work was planned to standardize appropriate combination of Bael-Mango blends for preparation of jam and to evaluate storage quality of blended products.

Materials and Methods
The present investigation was carried out in Centre of Food Science and Technology, CCS Haryana Agricultural University, Hisar during the year 2015-16. Uniformly ripe bael and mango fruits were procured from local market of Hisar. Bael fruits were washed thoroughly in running water and broken by striking against hard surface.

The fruit pulp along with its seeds and fibres was scooped with the help of a stainless steel spoon. An equal amount of water to the weight of pulp was mixed with the pulp. The mixture of pulp and water was kneaded, heated at 80^0C and passed through fruit pulper to obtain homogeneous pulp free from seeds and fibres. Sodium benzoate @ 1 g/kg pulp was mixed with the pulp. The pulp was then packed in polypropylene jars and stored in deep freezer (Fig.1).

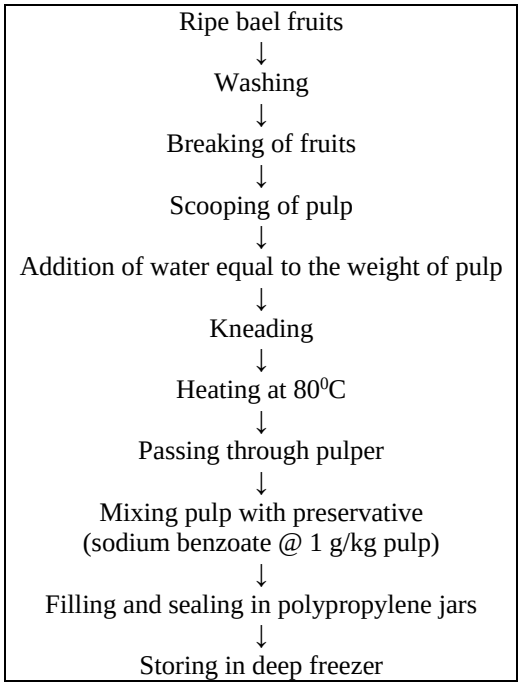

Fig 1: Flow sheet for extraction of pulp from bael fruits

Mango fruits were washed thoroughly in clean running water and peeled off. The pulp was separated from the stone with the help of a stainless steel knife and blended in a mixer to obtain fine pulp. Sodium benzoate @ 1 g/kg pulp was mixed with the pulp. The pulp was then packed in polypropylene jars and stored in deep freezer (Fig. 2).

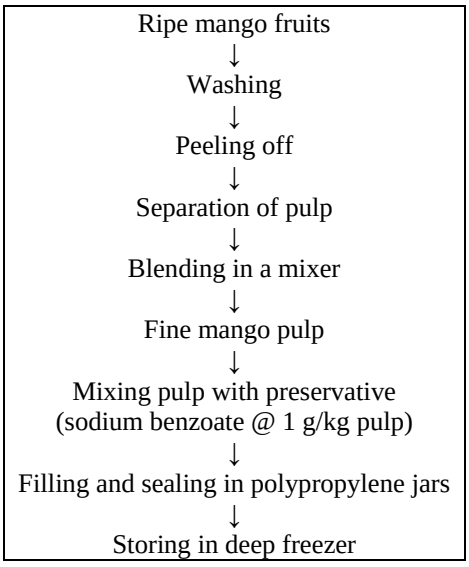

Fig 2: Flow sheet for collection of pulp from mango fruits

The bael and mango pulp were blended in ratio of 100:0, 60:40 and 0:100. For preparing jam, one kg blended pulp was cooked after mixing 700 g sugar, 5 g citric acid and 3 g pectin. Jam was filled hot in 150 g capacity sterilized glass bottles, screw capped properly, cooled in air, labelled and stored at room temperature for three months (Fig. 3).

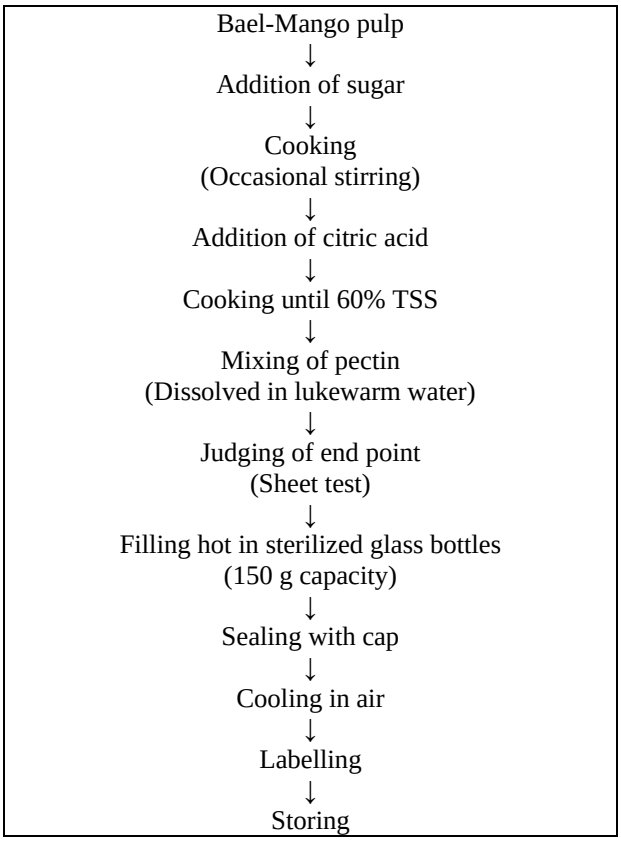

Fig 3: Flow sheet for preparation of bael-mango jam

Bael-Mango jam was analyzed for changes in chemical constituents and overall acceptability at monthly interval for three months. Total sugars and reducing sugars were estimated by the method of Hulme & Narain (1931) [3]. Acidity was determined by method of Ranganna (2014) [4]. Total carotenoids were analyzed by Rodriguez-Amaya method (1999) [5]. Total phenols were analysed by Amorium *et al.* (1997) [1] and browning was estimated by method of Ranganna (2014) [4]. The overall acceptability of bael-mango jam was based on mean scores obtained for all the sensory characters *i.e.*, colour and appearance, flavour, texture, taste and mouthfeel. The characters with mean scores of 6 and above out of 9 were considered acceptable (Ranganna, 2014) [4]. The treatments were replicated thrice and the data were analyzed statistically using completely randomized design. The critical difference value at 5 per cent level was used for making comparison among different treatments during storage.

Results and Discussion

There was a gradual and significant increase in total and reducing sugars of bael-mango jam with the advancement in storage period. The increase in level of sugars might be attributed to hydrolysis of polysachharides into sugars and inversion of sugars. The results are in conformity with those of Bafna & Manimehalai (2013) [2] in kokum fruit jam.

Acidity increased significantly in bael-mango jam during three months storage. This might be due to rise in the concentration of weakly ionized acids by degradation of polysaccharides and oxidation of reducing sugars or by break down of pectic substances and uronic acid. Similar observation was reported by Wani *et al.* (2013) [10] in karonda jam.

A significant decrease in total carotenoids of bael-mango jam was observed during storage. This might be due to auto-oxidation of β-carotene leading to loss of total carotenoids and also due to its highly unsaturated chemical structure, which made the constituent very susceptible to thermal degradation and oxidation. The results are in accordance with those of Teangpook & Paosantong (2013) [8] in low sucrose lime juice papaya jam.

There was also significant decrease in total phenols of bael-mango jam during storage. Total phenols are easily volatile and oxidized, hence, its content decreased in the samples regardless of exposure to light or darkness. Moreover, cell structure disrupted during processing and the materials became prone to non-enzymatic oxidation, which could be one of the major causes for loss in total phenols of the products. Similar decrease in total phenols was also reported by Shivani *et al.* (2008) [6] in jamun jam.

There was significant increase in browning of bael-mango jam during storage. This might be due to action of acidity, which enhanced hydrolytic reaction causing browning. Acids also enhanced maillard reaction and caramelization, which caused more browning in the products. Polyphenolic compounds present in fruit pulp also reacts with the enzymes to get discolouration. Similar increase in browning was also reported by Verma & Chopra (2010) [9] in aonla-mango mixed fruit slab.

Jam prepared with 0 bael 100 mango pulp ratio was most acceptable. The overall acceptability of bael-mango jam decreased significantly during three months storage period. Similar results were reported by Wani *et al.* (2013) [10] in karonda jam.

Table 1: Changes in chemical constituents and overall acceptability of bael-mango jam during storage

Treatments* Bael:Mango	Storage period (months)	Total sugars (%)	Reducing sugars (%)	Acidity (%)	Total carotenoids (mg/100 g)	Total phenols (mg/100 g)	Browning (440nm)	Overall acceptability (9 point hedonic scale)
100:0	0	55.88	31.09	0.65	1.02	18.67	0.51	7.87
	1	56.78	32.45	0.72	0.97	17.77	0.55	7.72
	2	57.68	33.24	0.76	0.91	16.26	0.60	7.30
	3	58.59	34.59	0.78	0.86	15.15	0.64	7.00
60:40	0	52.28	29.97	0.72	0.98	30.40	0.38	8.04
	1	53.18	30.42	0.74	0.84	29.12	0.45	7.68
	2	54.98	31.89	0.76	0.76	28.52	0.48	7.38
	3	55.88	32.11	0.83	0.67	27.44	0.52	7.28
0:100	0	50.47	26.59	0.74	0.92	40.16	0.21	8.34
	1	51.38	27.27	0.76	0.88	39.80	0.27	8.08
	2	52.28	28.50	0.78	0.84	39.32	0.30	7.86
	3	53.18	29.18	0.81	0.78	38.29	0.34	7.58
CD at 5%	Treatment	1.20	1.17	NS	0.08	1.34	0.03	0.15
	Storage	1.39	1.35	0.05	0.09	1.55	0.03	0.17
Treatment x Storage		NS	NS	NS	NS	NS	NS	NS

*Recipe - 1 kg blended pulp, 700 g sugar, 5 g citric acid and 3 g pectin; NS- Non-significant

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