J. Hortl. Sci.
Vol. 12(1) : 65-70, 2017

Original Research Paper

Changes in chemical constituents and overall acceptability of bael-guava nectar and crush during storage

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ABSTRACT

The bael-guava nectar and crush were analyzed for changes in chemical composition at monthly interval for three months storage period. There was a slight increase in total soluble solids of both the beverage blends. Total and reducing sugars, acidity and browning increased significantly, while ascorbic acid and total phenols decreased significantly during three months storage in both the blended beverages. Though, the overall acceptability of bael-guava beverages decreased significantly with the advancement in storage period, their overall rating remained above the acceptable level even after three months storage.

Keywords: Bael, guava, nectar, crush, chemical constituents, storage

INTRODUCTION

Aegle marmelos, commonly called as bael, is a tropical fruit native to Southeast Asia and is grown throughout India, Sri Lanka, Pakistan, Bangladesh, Burma, Thailand and most of the Southeast Asian countries. The tree belongs to the *Rutaceae* family and holds a sacred value among Hindus and is often worshipped or its leaves are presented to the deities. The pulp contains laxative properties and is used in treatment of gastrointestinal related problems such as diarrhoea, dysentery, constipation and diabetes. Bael fruit, because of its hard shell, mucilaginous texture and numerous seeds in its pulp is difficult to eat in raw form, hence, it is not popular as a dessert fruit. The fruit has a great potential for processing into several products like ready-to-serve drink, nectar, squash, crush, syrup, wine, cider, preserve, candy, jam, slab, bar, cheese, toffee and powder.

Guava (*Psidium guajava* L.) belongs to family *Myrtaceae* and is a native of tropical America. It is a rich source of ascorbic acid and other vitamins. Apart from vitamin C, it is also a rich source of minerals like calcium, phosphorus, iron. It is very much relished for its fleshy texture, appealing flavour and delicious taste. It contains appreciable quantities of antioxidants like polyphenols and ascorbic acid that help in reducing incidence of many degenerative diseases such as arthritis, arteriosclerosis, cancer, heart diseases, inflammation and brain dysfunction.

Fruit beverages are increasingly gaining popularity throughout the world due to nutritive and therapeutic value over synthetic beverages, which can further be improved by blending two or more fruit juices/pulps having excellent flavour, taste, nutritional and medicinal value. Consumers, generally, have less preference for bael beverages due to its peculiar taste. Guavas, on the other hand, are liked very much by majority of consumers. Thus, blending of guava pulp with bael pulp will supplement its blended beverages with vitamins, minerals, besides improving its overall acceptability. Keeping this aspect in view, the work was initiated to standardize appropriate combination of bael-guava blends for preparation of nectar and crush, and also to assess the changes in chemical constituents and overall acceptability of beverage blends during storage.

MATERIAL AND METHODS

The present investigation was carried out at Centre of Food Science and Technology, Chaudhary Charan Singh Haryana Agricultural University, Hisar during the year 2015. Uniformly ripe bael and guava fruits were procured from local market of Hisar. The bael and guava fruits were washed thoroughly and the pulp was extracted (Figs. 1 and 2).

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

Ripe bael fruits
↓
Washing
↓
Breaking of fruits
↓
Scooping out pulp
↓
Addition of water equal to weight of pulp
↓
Kneading
↓
Heating at 80^{0}C
↓
Passing through pulper
↓
Bael pulp

Fig. 2 Flow sheet for extraction of guava pulp

Ripe guava fruits
↓
Washing and cutting into slices
↓
Addition of water
(25% to weight of fruit slices)
↓
Blending in a mixer
↓
Straining through a stainless steel sieve
↓
Guava pulp

The extracted bael pulp was blended with guava pulp in 100:0, 80:20, 60:40, 40:60, 20:80, and 0:100 proportions. Nectar beverages with 20 and 25 per cent pulp, 14 per cent total soluble solids (TSS) and 0.24 per cent acidity were prepared from the above blends (Fig. 3). For this, total soluble solids (TSS) and acidity were first analyzed in bael-guava blends. On the basis of this analysis, requisite quantities of sugar and citric acid dissolved in water were added to bael-guava blends for the adjustment of required TSS and acidity in the beverage blends (as per recipes). Nectar blends were then filled in pre-sterilized glass bottles (200 ml capacity) leaving 1" headspace, sealed with crown corks and sterilized in boiling water for 25 to 30 minutes. The sterilized bottles were then cooled in air, labelled and stored at room temperature for three months.

Fig. 3 Flow sheet for preparation of Bael-Guava nectar

Bael-Guava blends
(as per recipe)
↓
Preparation of sugar syrup
(sugar + citric acid + water)
↓
Straining
↓
Cooling
↓
Mixing with blends
↓
Filtration
↓
Bottling
↓
Sealing
↓
Sterilization
↓
Cooling
↓
Labeling
↓
Storing at room temperature

Crush (Fig. 4) beverages having 40 and 50% pulp, 55% total soluble solids and 1.0% acidity were prepared from bael-guava blends in different ratios *i.e.*, 100:0, 80:20, 60:40, 40:60, 20:80 and 0:100, respectively. Sodium benzoate @ 1 g/L was mixed as a chemical preservative in the crush and filled in 200 ml capacity sterilized glass bottles leaving 2.5 to 3.0 cm headspace, sealed with crown corks, labelled and stored at room temperature.

Among these blends, one best blend (40 bael:60 guava) was selected on the basis of sensory evaluation along with 100 bael :0 guava and 0 bael:100 guava for storage study.

Fig. 4 Flow sheet for preparation of Bael-Guava crush

Bael-Guava blends
(as per recipe)
↓
Preparation of sugar syrup
(sugar + citric acid + water)
↓
Straining of syrup
↓
Cooling
↓
Mixing with blends
↓
Mixing of sodium benzoate
(1g/L crush)
↓
Straining
↓
Bottling
↓
Sealing
↓
Labeling
↓
Storing at room temperature

Nectar and crush were analyzed for changes in chemical composition during three months storage. Total soluble solids (TSS) were estimated at ambient temperature by hand refractometer (0-32% and 28-62%) and the values were expressed as per cent TSS. Total and reducing sugars were estimated by the method of Hulme and Narain (1931). Acidity, ascorbic acid and browning were analyzed by the methods of Ranganna (2014), while total phenols were estimated as per the method given by Amorium *et al.* (1997). Nectar and crush from bael-guava blends were subjected to by a panel of eight judges using 9-point hedonic scale as described by Ranganna (2014). The crush beverages were evaluated after diluting it 5 times (1:4) with water, whereas nectar beverages were served as such without dilution. The overall acceptability of nectar and crush was based on mean scores obtained from sensory scores of colour and appearance, flavour, taste, mouthfeel.

The treatments were replicated thrice, and the data were subjected to analysis of variance (ANOVA) using completely randomized design. The critical difference value at 5% level was used for making comparison among different treatments during storage period.

RESULTS AND DISCUSSION

There was a gradual increase in total soluble solids of bael-guava blended beverages. The increase in total soluble solids of nectar and crush might be due to hydrolysis of polysaccharides and solubilization of pulp constituents during storage. Total sugars and reducing sugars of bael-guava nectar and crush increased during three months storage. This might be due to hydrolysis of polysaccharides like pectin, starch, etc. into simple sugars and inversion of non-reducing into reducing sugars respectively. Similar observations were recorded by Patil *et al.* (2011) in rose apple and jamun blended nectar, Nagpal and Rajyalakshmi (2009) in bael-citrus blended beverages and Selvi *et al.* (2013) in guava-banana-mango mixed fruit squash. The increase in acidity during storage might be due to formation of organic acids by degradation of ascorbic acid. The results are in conformity with the earlier findings of Jakhar *et al.* (2013) in guava-barbados cherry blended RTS drink and Tiwari and Deen (2014) in bael-aloe vera squash.

Blending of bael pulp with guava pulp resulted in significant increase in ascorbic acid content in bael-guava nectar and crush. There was significant effect of different treatments and storage on ascorbic acid content of bael-guava nectar and crush. Ascorbic acid is sensitive to heat, light and is oxidized quickly in the presence of oxygen, hence, it might have been destroyed during processing and subsequently during storage period. Similar reduction in ascorbic acid content was also recorded by Kumar *et al.* (2009) in aonla-pineapple blended nectar and Hemalatha *et al.* (2014) in orange blended star gooseberry squash. A gradual loss in total phenols was recorded in both bael-guava beverage blends during three months storage.

Table 1. Changes in chemical constituents of bael-guava nectar during storage

Treatments* Bael:Guava	Storage period (months)	Total soluble solids (%)	Total sugars (%)	Reducing sugars (%)	Acidity (%)	Ascorbic acid (mg/100 ml)	Total phenols (mg/100 ml)	Browning (O.D. at 440 nm)	Overall acceptability (9 point hedonic scale)
20% Pulp									
100:0	0	14.00	10.82	5.41	0.24	0.46	1.37	0.171	8.40
	1	14.20	11.27	7.03	0.26	0.33	1.18	0.188	8.21
	2	14.27	11.81	8.25	0.27	0.25	1.01	0.222	8.17
	3	14.40	12.17	9.06	0.28	0.20	0.85	0.257	7.89
40:60	0	14.00	11.45	5.14	0.24	7.32	1.61	0.151	8.58
	1	14.07	11.90	6.67	0.25	4.63	1.36	0.169	8.45
	2	14.20	12.35	7.98	0.25	2.88	1.14	0.189	8.23
	3	14.33	12.71	8.70	0.26	1.94	1.00	0.217	7.94
0:100	0	14.00	11.72	4.69	0.24	10.64	2.18	0.050	8.28
	1	14.00	12.08	6.04	0.25	5.88	1.82	0.061	8.04
	2	14.20	12.53	7.21	0.26	3.30	1.51	0.073	7.85
	3	14.20	12.98	8.07	0.27	2.22	1.30	0.091	7.65
25% Pulp									
100:0	0	14.00	10.64	5.86	0.24	0.58	1.52	0.200	8.23
	1	14.20	11.18	7.39	0.25	0.45	1.31	0.225	8.02
	2	14.33	11.63	8.74	0.26	0.30	1.10	0.274	7.81
	3	14.47	12.08	9.82	0.27	0.25	0.94	0.315	7.66
40:60	0	14.00	11.00	5.50	0.24	8.70	1.86	0.172	8.32
	1	14.20	11.54	6.85	0.24	4.78	1.60	0.197	8.12
	2	14.33	11.90	8.16	0.25	2.98	1.35	0.217	7.93
	3	14.40	12.26	9.28	0.26	2.01	1.13	0.245	7.70
0:100	0	14.00	11.36	4.96	0.24	12.37	2.52	0.061	8.06
	1	14.00	11.72	6.22	0.25	7.09	2.02	0.070	7.87
	2	14.20	12.26	7.66	0.26	4.07	1.69	0.093	7.72
	3	14.27	12.62	8.52	0.27	2.44	1.45	0.111	7.54
CD (*P=0.05*)	Treatment	0.077	0.269	0.167	0.004	0.231	0.071	0.0052	0.049
	Storage	0.063	0.220	0.136	0.003	0.189	0.058	0.0043	0.040
Treatment x Storage		NS	NS	NS	NS	NS	0.143	0.010	NS

*Bael-Guava nectar with 20 and 25 per cent pulp, 14 per cent TSS and 0.24 per cent acidity

Table 2. Changes in chemical constituents of bael-guava crush during storage

Treatments* Bael:Guava	Storage period (months)	Total soluble solids (%)	Total sugars (%)	Reducing sugars (%)	Acidity (%)	Ascorbic acid (mg/100 ml)	Total phenols (mg/100 ml)	Browning (O.D. at 440 nm)	Overall acceptability (9 point hedonic scale)
40% Pulp									
100:0	0	55.00	43.26	13.97	1.00	0.85	2.71	0.339	7.82
	1	55.60	43.71	16.45	1.03	0.67	2.61	0.382	7.69
	2	56.07	44.39	18.48	1.05	0.51	2.49	0.438	7.58
	3	56.47	44.84	21.18	1.09	0.44	2.41	0.501	7.51
40:60	0	55.00	44.17	13.63	1.00	16.60	3.10	0.220	7.86
	1	55.20	44.84	16.00	1.02	12.30	2.97	0.274	7.86
	2	55.93	45.52	18.59	1.04	9.44	2.86	0.337	7.68
	3	56.27	45.97	20.73	1.07	7.36	2.74	0.402	7.44
0:100	0	55.00	45.07	13.07	1.00	22.40	4.13	0.075	7.62
	1	55.20	45.52	15.32	1.02	16.26	3.91	0.089	7.56
	2	56.00	46.19	17.58	1.05	12.33	3.75	0.107	7.40
	3	56.07	46.87	19.83	1.08	9.20	3.58	0.129	7.11
50% Pulp									
100:0	0	55.00	41.91	14.65	1.00	1.12	2.98	0.362	8.14
	1	55.60	42.36	17.35	1.03	0.87	2.87	0.407	7.94
	2	56.27	43.04	19.38	1.05	0.70	2.74	0.478	7.72
	3	56.40	43.49	22.31	1.08	0.56	2.64	0.554	7.58
40:60	0	55.00	42.81	14.20	1.00	18.80	3.25	0.264	8.16
	1	55.40	43.26	16.67	1.03	13.88	3.13	0.322	7.97
	2	56.20	43.94	19.15	1.05	10.32	3.02	0.404	7.87
	3	56.33	44.61	21.63	1.07	8.04	2.87	0.484	7.62
0:100	0	55.00	43.71	13.52	1.00	27.40	4.23	0.097	7.89
	1	55.20	44.39	15.89	1.03	19.64	4.00	0.126	7.73
	2	56.07	45.07	18.03	1.06	14.22	3.83	0.159	7.44
	3	56.13	45.52	20.51	1.08	10.60	3.63	0.184	7.29
CD (P=0.05)	Treatment	0.116	0.717	0.319	0.006	0.341	0.044	0.0072	0.051
	Storage	0.095	0.585	0.260	0.005	0.279	0.036	0.0058	0.042
Treatment x Storage		NS	NS	NS	NS	NS	0.682	0.088	0.102

*Bael-Guava crush with 40 and 50 per cent pulp, 55 per cent TSS and 1.0 per cent acidity

The phenolic compounds are highly volatile and are easily oxidized. Similar findings were also recorded by Nidhi *et al*. (2008) in bael-guava blended beverages and Selvamuthukumaran and Khanum (2013) in spiced seabuckthorn mixed fruit squash. A gradual increase in browning of bael-guava nectar and crush was observed throughout the storage period of three months. There was significant effect of different treatments and storage period on browning of bael-guava nectar and crush.

The overall acceptability of bael-guava beverages decreased significantly with the advancement in storage period, however, their overall rating remained above the acceptable level even after three months storage.

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(*MS Received 22 October 2016, Revised 12 March 2017, Accepted 04 April 2017)*