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Development of value added product form bael fruit (*Aegle marmelos*) powder

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Abstract

The “miracle tree” Bael (*Aegle marmelos*) is native to India and a sacred tree to Hindus. It has got immense medicinal properties and one of the most neglected and underutilized tree. Bael fruit is high in nutrition and it exhibits antibacterial, antioxidant, antidiabetic, anti hyperlipidaemic, antihyperlipidemic, antidiarrhoeal, antidysenteric, anticancer, antiviral, antiulcer properties. Rajasthani local variety of ripe bael fruits were used for development of bael fruit powder with two standardized drying methods i.e. tray drying and green house drying. Bael powder enriched food product i.e. cookies were developed by replacing refined wheat flour with bael fruit powder at different levels. 7.5% level of incorporation of tray dried bael powder cookies and 5% level incorporation of green house dried bael powder cookies gave highest score.

Keywords: Bael, *Aegle marmelos*, medicinal plant, underutilized tree, value addition, cookies

1. Introduction

Aegle marmelos belonging to family Rutaceae, is commonly famous as Bael and has various therapeutic properties. It is native to India and found throughout South Asia. In India, this fruit is grown in Indo-Genetic plains and Sub-Himalayan zone, in North-East India and dry and deciduous forest of central and southern India. *Aegle marmelos* is a widely distributed plant and grown in India, Ceylon, China, Nepal, Sri Lanka, Myanmar, Pakistan, Bangladesh, Nepal, Vietnam, Laos, Cambodia, Thailand, Indonesia, Malaysia, Tibet, Sri Lanka, Java, Philippines and Fiji (Neeraj *et al.*, 2017) [6]. Annual Indian Production of bael in 2015-16 was only 85.83 tones. Among Indian states, Orissa leads in production (48.56 tones) followed by Jharkhand (35.59 tones), Madhya Pradesh (1.46 tones), Hariyana (0.19 tones) and Himachal Pradesh (0.03 tonnes) (NHB, 2016) [7].

The fruits are differ in height and size of the tree, fruit shape, average weight of fruit, fruit rind, fiber content, colour, TSS, Ascorbic acid, average fruit yield etc. as per the varieties of bael (Peter, 2008) [8].

Aegle marmelos tree is mostly valued for its valuable fruits, which is oval or round shaped with the size ranges from 5-25 cm in diameter. The bael fruit has a hard, woody outer shell and from inside it has sweet, thick and aromatic pulp. In the bael fruit pulp, the seeds are present in edges and seed is enclosed by thick greasy and clear mucilage. The pulp of the bael fruit is a natural source of essential antioxidants and bioactive compounds. The pulp has laxative properties and is even considered as the best laxatives known so far. The parts of bael plants are used in case of gastrointestinal related problems such as diarrhea, dysentery and diabetes. It has antibacterial and antifungal properties. Bael is well-known to have anticancer activity, pyretic and analgesic activities and also gives relief in constipation. Several phytochemicals have been isolated and recognized from various parts of *A. marmelos*, including alkaloids, phenols, glycoside coumarins, steroids, tannins and carotenoids (Sharma *et al.*, 2007) [10].

Bael fruit pulp powder can be used to make innumerable value added products. The bael is still being used only by unrecognized sector and is not being given much emphasis for its commercial utilization in terms of value added products. The selected pharmacological studies have been conducted on different parts and the literature supports potential of bael fruit to be processed and formulated to prepare number of products. The focused investigation is required in the field to examine the unexplored and idle potential of bael fruit on the marketable scale.

2. Material and Methods**2.1 Bael Fruit Powder**

Rajasthani local variety of ripe bael fruits were procured from ICAR-Directorate of Medicinal

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and Aromatic Plants Research, Boriavi farm, Anand. The bael fruits were sorted and washed thoroughly under tap water and used for the experiments. Physico-chemical characteristics of bael fruit (*Aegle marmelos*) and pulp was evaluated by Anadani *et al.* (2021) [1]. The average mass, average length, average diameter, volume, density, pulp yield and pulp to seed ratio of the ripe bael fruits were found to be 1642.25±574.76 g, 15.3±1.96 cm, 14.5±1.69 cm, 1431.25±723.82 cc, 1.22± 0.19 g/cc, 49.27±1.12% and 13.21±0.83, respectively. This variety is rich in crude fiber (4.33±0.47%), ascorbic acid (19.53±0.55 mg/100 g) and minerals i.e. Calcium (192.5 mg/100 g), phosphorus (252.2 mg/100 g) and potassium (2543.4 mg/100 g).

The processed and extracted pulp was used for drying purpose. The drying techniques employed to dry the bael fruit pulp were Open sun drying, Solar drying, Green house drying and Hot air drying (50, 60, 70 and 80°C) with three levels of thicknesses of pulp i.e. 2, 4 and 6 mm. Standardization of drying parameters was done by two ways; natural drying method and mechanical drying method (Anadani *et al.*, 2023) [2].

2.2 Value added Product from Bael Powder

There is a great scope for the value addition of bael pulp powder and development of value added products. From bael fruit powder, one can make number of value added products. The bael fruit pulp powder was utilized to prepare one of the bakery product (Cookies). The level of addition was decided on the basis of preliminary trials. The aim was to increase the sensory properties. The level of incorporation was optimized on the basis of overall acceptability (sensory).

Cookies were prepared in two stages. First stage the cookies were prepared by replacing refined wheat flour with bael fruit powder with different levels (5, 10, 15 and 20%) and standardized based on sensory parameters and in second stage, the optimized concentration of bael fruit powder for preparation of cookies by replacing refined wheat flour was evaluated to ± 2.5% of standardized concentration to narrate the optimized concentration at precise level of incorporation.

2.2.1 Cookies methodology

2.2.1.2 Ingredients

Table 1: Ingredients for Bael fruit powder cookies

Ingredient	Quantity	Percentage
Refined wheat flour	1 kg	100
Shortening (Vegetable Ghee)	600 g	60-65
Sugar powder	500 g	50
Ammonium bi-carbonate	1 tsp	0.5
Sodium bi-carbonate	1 tsp	0.5
Milk/water	50 ml	5-10

Bael fruit powder with different levels (5, 10, 15 and 20%) by replacing refined wheat flour

2.2.1.2 Process for preparation of Bael fruit powder cookies

Mix shortening (vegetable ghee) and sugar and whipped it together. Then, add ammonium bi-carbonate and sodium bi-carbonate and mix it with shortening sugar mixture. Now, add milk/water and mix it properly. Sieve the refined wheat flour for two times, mix it and make soft dough. Divide the dough into small balls of about 8 g and place in the baking tray and bake the cookies at 170 to 175 °C for 15-20 mins as shown in

Fig 1 (Kamaliya and Kamaliya, 2001) [4]



Fig 1: Cookies incorporated @ 0, 5, 10, 15 and 20% bael fruit powder

2.2.2 Analysis of bael fruit powder cookies

2.2.2.1 Sensory characteristic

Panels were asked to score the samples for colour, texture, taste and overall acceptability based on 9-point hedonic scale. The score-card suggested by Lawless and Haymann, (2010) [5] was used for judging.

3. Results and Discussion

3.1 Value Added Product from Bael Fruit Powder

Cookies were prepared as per the procedure explained in section 2.2.1. The aim was to increase the sensory properties and consumer acceptability. The level of incorporation of bael pulp powder was optimized on the basis of overall acceptability score.

Bael fruit powder was produced by two standardized methods that were by green house drying and 2 mm thickness of bael fruit pulp and hot air drying and 2 mm thickness of pulp (Anadani *et al.*, 2023) [2]. Cookies with different levels of bael fruit powders were prepared. The cookies were evaluated for sensory attributes and the results are presented in Table 2 and 3 for tray died bael powder and Table 4 and 5 for green house dried bael powder incorporation.

Table 2: Sensory evaluation of tray dried bael pulp powder incorporated cookies

	Colour	Texture	Taste	OA
1-Control	7.78	8.06	7.83	7.72
2-5%	7.56	8.17	7.56	7.67
3-10%	8.11	8.33	8.33	8.39
4-15%	7.44	8.22	7.89	7.89
5-20%	7.22	7.61	7.44	7.33
SEm	0.238	0.267	0.263	0.224
CD	NS	NS	NS	0.639
CV (%)	9.38	9.92	10.09	8.60

Cookies were prepared by replacing refined wheat flour with tray dried bael fruit powder at the levels of 5, 10, 15 and 20% (Table 2). The effects of incorporation levels of bael pulp powder on colour, texture and taste were found non-significant and overall acceptability was found significant. From mean values for colour, texture, taste and overall acceptability, 10% incorporation of bael powder gave highest score (Fig. 2).

Now precise concentration of bael fruit powder, cookies were prepared again by replacing refined wheat flour with ±2.5% of optimized concentration i.e. 7.5, 10 and 12.5% (Table 2). From Table 3, mean values for colour, texture, taste and overall acceptability, 7.5% incorporation of bael powder gave the highest score and illustrated in Fig 3.

Table 3: Sensory evaluation of Tray dried bael pulp powder incorporated cookies with optimized levels

	Colour	Texture	Taste	OA
1-Control	8.22	7.78	7.92	7.86
2-7.5%	8.28	8.22	8.11	8.11
3-10%	7.42	8.11	7.83	7.78
4-12.5%	7.00	7.83	7.14	7.08
SEm	0.154	0.182	0.177	0.139
CD	0.445	NS	0.510	0.401
CV (%)	5.99	6.82	6.85	5.42

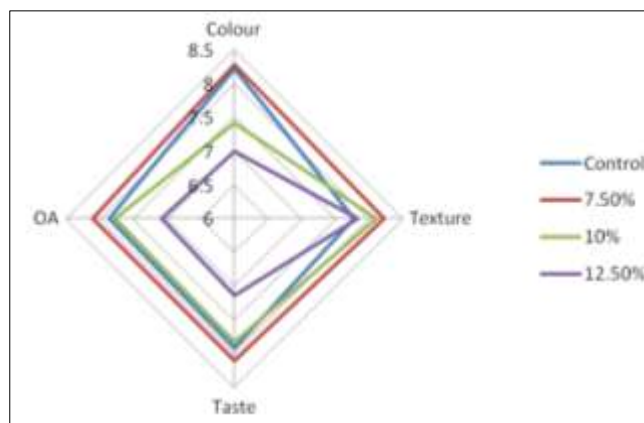


Fig 3: Sensory evaluation of tray dried bael pulp powder incorporated cookies at 7.5, 10 and 12.5% levels

Table 4: Sensory evaluation of Green house dried bael pulp powder incorporated cookies

	Colour	Texture	Taste	OA
1-Control	7.94	7.72	7.61	7.56
2-5%	8.11	8.17	7.97	8.17
3-10%	7.78	8.08	7.97	7.94
4-15%	7.56	8.06	7.94	8.00
5-20%	6.83	7.39	7.11	6.94
SEm	0.271	0.188	0.229	0.209
CD	0.774	0.536	0.655	0.596
CV (%)	10.63	7.14	8.90	8.11

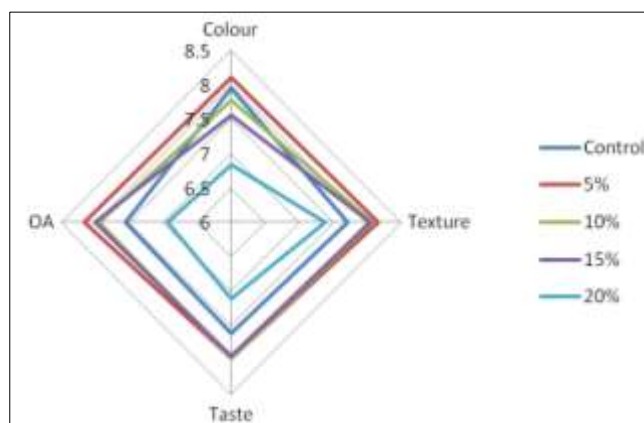


Fig 4: Sensory evaluation of green house dried bael pulp powder incorporated cookies at 5, 10, 15 and 20% levels

Cookies were prepared by replacing refined wheat flour with green house dried bael fruit powder at the levels of 5, 10, 15 and 20% (Table 4). The effects of incorporation of bael pulp powder on colour, texture, taste and overall acceptability are significant. From mean values for colour, texture, taste and overall acceptability, the 5% incorporation of bael powder gave highest score (Fig. 3).

Table 5: Sensory evaluation of Green house dried bael pulp powder incorporated cookies with optimized levels

	Colour	Texture	Taste	OA
1-Control	7.50	7.61	7.56	7.61
2-2.5%	7.78	8.06	8.28	8.00
3-5%	8.00	8.33	8.50	8.33
4-7.5%	7.72	8.00	7.22	7.33
SEm	0.192	0.140	0.223	0.181
CD	NS	0.402	0.643	0.520
CV (%)	7.43	5.23	8.48	6.93

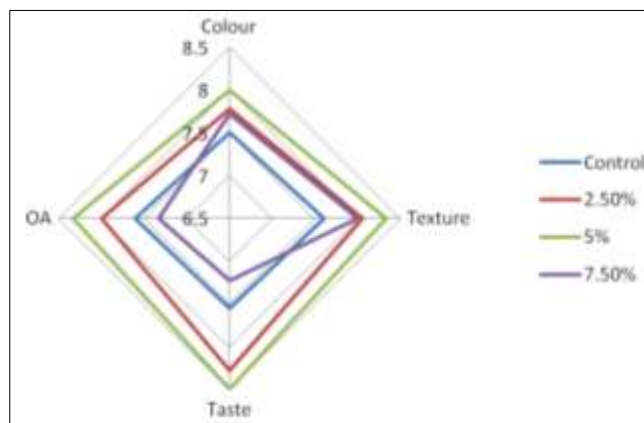


Fig 5: Sensory evaluation of green house dried bael pulp powder incorporated cookies at 2.5, 5 and 7.5% levels

For precise concentration of bael fruit powder, cookies were prepared again by replacing refined wheat flour with $\pm 2.5\%$ of optimized concentration i.e. 2.5, 5 and 7.5% (Table 4). From Table 5, mean values for colour, texture, taste and overall acceptability, 5% incorporation of bael powder gave the highest score and illustrated in Fig 4.

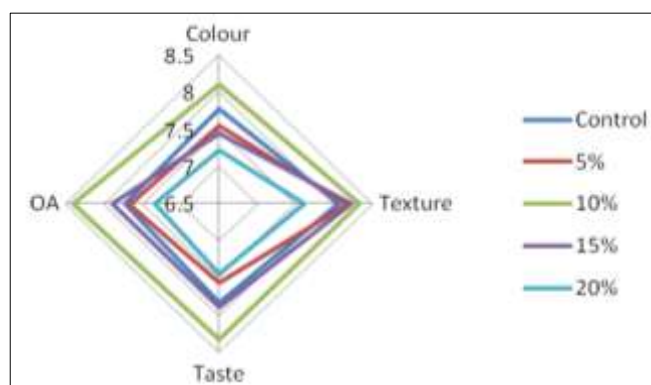


Fig 2: Sensory evaluation of tray dried bael pulp powder incorporated cookies at 5, 10, 15 and 20% levels

Sadal *et al.* (2018) [9] found that the biscuits with 10% pineapple pomace powder were most acceptable due to attractive appearance; and better taste and flavour. Hemalatha & Parameshwari (2019) [3] reported that wood apple dry powder incorporated cookies at a 30% level were most accepted by sensory evaluation.

4. Conclusion

The standardized bael powders were enriched in selected food product and evaluated for sensory characteristics. The food product i.e. cookies was enriched with bael pulp powder to improve functionality. The level of incorporation was

optimized on the basis of maximum overall acceptability. For tray dried powder 7.5% incorporation of bael powder cookies gave highest score in terms of colour (8.28), texture (8.22), taste (8.11) and overall acceptability (8.11). While in green house dried powder 5% incorporation of bael powder cookies gave highest score in terms of colour (8.00), texture (8.33), taste (8.50) and overall acceptability (8.33).

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