Development and sensory evaluation of unripe and ripe Bael fruit powder (Aegle marmelos)

Monika Bhanot

Abstract
The bael fruit is known for its medicinal properties and is one of the most nutritious fruits. In the present study unripe and ripe bael fruit pulp (Aegle marmelos) was used to develop powder in the laboratory. Purpose of this was to study the sensory evaluation of developed powder. There are four different techniques were used separately for drying unripe and ripe bael fruit pulp these were mechanical tray drier, solar try drier, open sun light and shade drying and developed powder after drying them properly. Results of the present study indicate that unripe and ripe bael fruit powder samples “liked very much” on six point hedonic scale. The highest score was achieved by shade dried powder as compared to other powders. Hence, it was selected for future research work.

Keywords: Bael, drying, unripe, ripe, fruit pulp, Aegle marmelos

Introduction
India has a rich source of plant as a natural or herbal medicine and it is being used from thousands of years ago. This is very true belief that natural plants are very healthier, energetic and mostly safer than synthetic drugs. (Modi and Patel, 2013) [3]. Among the natural herbs and plants, bael (Aegle marmelos) fruit is beneficial for the chronic dysentery, diarrhoea, anticaancer, cholesterol, peptic ulcer, inflammation and constipation. The most valuable part of the tree is fruit because it contains many vitamins like vitamin C, vitamin A, thiamine, riboflavin, niacin and minerals like calcium and phosphorus. The bael fruit pulp contains many functional and bioactive compounds such as carotenoids, phenolics, alkaloids, coumarins, flavonoids and terpenoids due to this reason bael has multiple therapeutic properties such as anti in inflammatory, antipyretic and anti diabetic (Sharma et al., 2006) [3]. Nigam and Nimbiar (2014) [4] revealed that bael is a fruit crop of sub tropical origin also can perform well in arid and semi arid regions. Fairly rich and well drained sandy loam soil is best. It tolerate harsh climate and also can withstand in 47 - 49 °C to -5 to -7 °C. In Rajasthan CISHB-1, CISHB-2 and pant aparna variety of fruit is grown which matures during April-May. Average weight of fruit is 1.0 kg. Fruit takes around 8-10 months to mature. At this stage colour of plant starts change from dark green to yellowish green. Yield of the plant of 300-400 fruits per tree per year. Storage life of fully matured fruit is 1 week and it can be kept for 3 months at 10 °C. Rani et al. (2009) [6] prepared bael fruit powder by drying the pulp to a thin sheet to below 4 per cent moisture level and then grinding to powder. Packed ground bael powder in polyethylene bags and stored in dry places after proper sealing for consumption in future. The colour of bael pulp powder was found golden poppy in direct sun drying, light brownish in hot water, orange in hot sand and orange/burnt orange and rust in oven. Before this, fruits were cracked and treated with hot water at 70 °C for 1 hour, hot sand for 2 hours at 70 °C, oven for 2 hours at 70 °C after that, rind of bael fruit was broken and removed the bael pulp and dried in direct sun light. The bael (Aegle marmelos) is an important indigenous fruit and has various nutritional and therapeutic properties. Five air-drying temperatures (60, 65, 70, 75 and 80 °C) and five thickness of pulp on the tray (2, 4, 6, 8 and 10 mm) were chosen to obtain the drying characteristics of bael fruit pulp. Moisture loss was recorded at every 5 min intervals during drying. The samples were also evaluated for variation in vitamin C and colour. The powder prepared from the pulp dried at 65 °C with a drying thickness of 2 mm was found optimum with respect to drying time, colour and ascorbic acid content. Two term model gave the best results for describing the drying kinetics of bael fruit pulp. Temperature at 65°C can be considered as the limiting temperature for drying of bael pulp to observe minimum reasonable change in colour and ascorbic acid content. Loss of vitamins was also more with increase in temperature and thickness of layer. (Singh et al. 2015) [8].

Keywords: Bael, drying, unripe, ripe, fruit pulp, Aegle marmelos
Materials and Methods

1. Procurement of unripe and ripe bael fruit

1.1 Selection of unripe and ripe bael fruit
Unripe and ripe bael were purchased from orchard of Swami Keshwanand Rajasthan Agricultural University, Bikaner for present investigation.

1.2 Cleaning and sorting of unripe and ripe bael fruit
Damaged and non-edible portion were discarded. Bael fruit was first washed with tap water for few minutes and then rinsed with distilled water to remove the dust, dirt and other adhering impurities.

2.1 Pulping: Pulp was removed from the fruit after applying the force to crack fruit.

2.2 Destoning: Removed seeds & other non-edible part manually from pulp.

2.3 Drying: Drying the fruit pulp under different methods of drying.

3. Dehydration of fruit pulp
Standardization of drying method for unripe and ripe bael fruit pulp was carried out using standard methods of drying (CFTRI, 1996) [1].

3.1 Method used for drying
Unripe and ripe bael fruit pulp were dried using different methods i.e. sun drying, shade drying, solar tray drying and oven drying. Method of drying conditions was standardized before conducting the experiment.

3.2 Organoleptic evaluation of developed powders
Standardization of the developed powders (Sun, Shade, Solar and Oven) was carried out thorough organoleptic evaluation. The developed powders evaluated for their sensory characteristics like colour, aroma, texture and overall acceptability by selected panel of ten semi trained panel members.

Selection of panel members for evaluation of developed powders
Threshold test was used for selection of the panel member as given by Potter, 1987. Convenience, experience, knowledge, willingness, interest and sincerity were the criteria for consideration of panel members. Ten members were enlisted in the panel comprise of staff members of the college of Home Science, SKRAU, Bikaner, Rajasthan.

Preparation of score card
Six- point hedonic rating scale suggested by Ranganna (1986) [5] was provided to the judges for scoring acceptability of powders on the basis of certain qualities such as appearance, colour, aroma, texture and overall acceptability.

The aim of standardization of powders
To obtain consistently good quality outcome which means that every repetition of procedure will result in a standard quality powder. Standardization is must for introducing any product for circulation in market as a standard quality and to ensure that product is acceptable to the consumer. The shade dried powder from unripe and ripe bael fruit were selected by the panelist for conducting the present study.

Organoleptic evaluation of developed powders
Standardization of the developed powders were carried out thorough organoleptic evaluation. At the interval of 15 days for a period of two months of storage the developed powders were evaluated for their sensory characteristics like colour, aroma, texture and overall acceptability by selected panel of ten semi trained panel members.

Shelf life study
The shelf life study of any powder determined its wholesomeness during the definite period of time. Therefore, the quality of developed powders during storage for 60 days was evaluated for its organoleptic characteristics.

Statistical analysis
The data of the organoleptic acceptability, nutritional assessment and shelf life study were statistically analyzed to find out significance of the results (Chandel, 1997) [2]. The results are expressed as mean ± SD. The obtained data statistically analyzed by using SPSS statistics (Ver. 20)

Results and Discussion

1. Organoleptic evaluation of developed bael fruit powder
Selected bael fruit pulp was dried using sun drying, shade drying, solar drying and oven drying. The developed powders were evaluated for sensory characteristics by a panel of 10 semi-trained judges using six- point hedonic rating scale. Score awarded to the individual sensory attributes by panelists are presented in Table 1

1.1 Colour
Colour is the first parameter by which a consumer judges a product before purchase. Mean scores for colour of shade
dried powder both ripe and unripe bael fruit was found superior (6.9 each) when compared to sun dried (5.6 and 5.4), oven dried (6.1 and 6.0) and solar dried (5.5 and 5.4) powders respectively (Table 1). The colour of powder obtained by shade and oven drying method were found in the category of “liked very much” whereas sun and solar dried powder “liked moderately”.

1.2 Aroma
Mean score of aroma of powders obtained through different treatments and found that maximum scores secured by unripe shade dried powder (6.7) followed by sun dried (5.7), oven dried (5.4) and solar dried (5.6) powders. Somewhat similar scores recorded for powder developed from ripe bael fruit i.e., 6.6, 5.8, 5.8 and 5.8 respectively for all treated powders (Table 1).

1.3 Texture
Unripe and ripe shade dried powder obtained 6.7 and 6.6 mean score for texture whereas sun, oven and solar dried powder obtained similar scores for powders developed from unripe and ripe bael fruit i.e. 5.6 & 5.7, 6.1 & 5.6 and 5.8 & 5.9 respectively. It was observed that shade dried powder secured higher mean score of texture followed by sun, solar and oven drying portrayed in Table 1.

1.4 Overall acceptability
Unripe bael fruit shade dried sample scored highest (6.7) as compare to oven drying (5.8), sun drying (5.6) and solar drying (5.3) respectively for overall acceptability. Similarly powder developed from ripe bael fruit observed somewhat similar pattern i.e. 6.5,5.8, 5.2 and 5.6 for shade drying, oven drying, sun drying and solar drying (Table 1). Mean overall acceptability score found in the category of “liked very much” by the panel members. Hence, among all dried powders the shade dried powder was selected for further study.

Table 1: Organoleptic acceptability of unripe and ripe bael fruit powder

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Powder</th>
<th>Fruit</th>
<th>Colour</th>
<th>Aroma</th>
<th>Texture</th>
<th>Overall Acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Sun Dried</td>
<td>U</td>
<td>5.6±0.51</td>
<td>5.7±0.82</td>
<td>5.6±0.96</td>
<td>5.6±0.51</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R</td>
<td>5.4±0.69</td>
<td>5.8±0.42</td>
<td>5.7±0.48</td>
<td>5.2±0.42</td>
</tr>
<tr>
<td>2.</td>
<td>Shade Dried</td>
<td>U</td>
<td>6.9±0.31</td>
<td>6.7±0.48</td>
<td>6.7±0.48</td>
<td>6.7±0.48</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R</td>
<td>6.9±0.31</td>
<td>6.6±0.51</td>
<td>6.6±0.51</td>
<td>6.5±0.52</td>
</tr>
<tr>
<td>3.</td>
<td>Oven Dried</td>
<td>U</td>
<td>6.1±0.73</td>
<td>5.4±0.57</td>
<td>6.1±0.73</td>
<td>5.8±0.78</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R</td>
<td>6.0±0.47</td>
<td>5.8±0.63</td>
<td>5.6±0.51</td>
<td>5.8±0.42</td>
</tr>
<tr>
<td>4.</td>
<td>Solar Dried</td>
<td>U</td>
<td>5.2±0.42</td>
<td>5.6±0.96</td>
<td>5.8±0.78</td>
<td>5.3±0.67</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R</td>
<td>5.4±0.51</td>
<td>5.8±0.42</td>
<td>5.9±0.31</td>
<td>5.6±0.51</td>
</tr>
</tbody>
</table>

Values are mean ±SD of ten panelists
U= Unripe, R= Ripe

Plate 1: Unripe bael: (A) Fruit pulp (B) Powder
Conclusion
Samples of unripe and ripe bael fruit were dried in oven drier, solar tray drier, sun and shade separately. Methods of drying for sample were standardized before conducting the experiment. Mean overall acceptability scores of unripe bael fruit shade dried sample scored highest i.e. 6.7 as compared to oven drying, sun drying and solar drying. i.e. 5.8, 5.6 and 5.3 respectively for overall acceptability. Similarly powder developed from ripe bael fruit observed similar pattern i.e.6.5, 5.8, 5.2 and 5.6 for shade drying, oven drying, sun drying and solar drying. Inclusion of these powders in the diet will definitely improving the nutritional value of the meals. In future the commercialization of unripe and ripe bael powder and its value added products.

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No potential conflict of interest was reported by the author.

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