The Pharma Innovation Journal 2021; 10(8): 1282-1284

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(8): 1282-1284

www.thepharmajournal.com
Received: 03-05-2021
Accepted: 17-07-2021

SV Anadani
College of Food Processing Technology and Bio-energy, Anand Agricultural University, Anand, Gujarat, India

SH Akbari
College of Food Processing Technology and Bio-energy, Anand Agricultural University, Anand, Gujarat, India

Amee Ravani
College of Food Processing Technology and Bio-energy, Anand Agricultural University, Anand, Gujarat, India

Anurag Nema
College of Food Processing Technology and Bio-energy, Anand Agricultural University, Anand, Gujarat, India

Corresponding Author:
SV Anadani
College of Food Processing Technology and Bio-energy, Anand Agricultural University, Anand, Gujarat, India

Physico-chemical characteristics of bael (*Aegle marmelos*) fruit and pulp

SV Anadani, SH Akbari, Amee Ravani and Anurag Nema

Abstract
Aegle marmelos belonging to family Rutaceae, is commonly famous as Bael in indigenous system of medicine and has various medicinal properties specially as a cooling agent. It is native to India and found throughout South Asia. Bael is considered to be a pack house of nutrients and remedy and is one of the most ignored and underutilized medicinal fruit crops. The different parts of bael tree are used for various medicinal purposes, such as for treatment of asthma, anemia, fractures, wounds healing, swollen in joints, high blood pressure, jaundice, diarrhea, healthy mind and brain typhoid troubles during pregnancy. 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*. The products obtained from bael fruit, being highly nutritive and therapeutic are getting popularized in India as well as in international market.

Keywords: Bael, bael pulp, *Aegle marmelos*, medicinal plant, underutilized tree

1. Introduction
Aegle marmelos belonging to family Rutaceae, is commonly known as Bael in indigenous system of medicine and has been regarded to possess various medicinal 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 up to a height of 500 m, in North-East India and dry and deciduous forest of central and southern India. (Neeraj *et al.*, 2017) [7]. 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) [6].
The bael is one of the sacred trees of the Hindus. Leaves are offered in prayers to Shiva and Parvathi since ancient times. Bael is a deciduous sacred tree, related with Gods having useful medicinal properties, especially as a cooling agent (Patkar *et al.*, 2012) [8]. There are no standard cultivars of bael till now; they are generally named after the locality, where they are easily available (Peter, 2008) [9].
The *marmelos* tree is mostly valued for its beneficial fruit, which is oval or round shaped and the size ranges from 5-25 cm (2-10 inches) in diameter. The bael fruit has a hard, woody outer shell and inside is present a sweet, thick and aromatic pulp. In the pulp, the seeds are present in ridges and seed is surrounded by thick slimy and transparent mucilage. The colour of the fruit pulp may vary from bright orange to sunset yellow. The pulp of the bael fruit is a natural source of natural antioxidants and bioactive compounds. 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 known to have anticancer activity, pyretic and analgesic activities and also provides relief in constipation. Numerous phytochemicals have been isolated and identified from various parts of *A. marmelos*, including alkaloids, phenols, glycoside coumarins, steroids, tannins and carotenoids (Sharma *et al.*, 2007) [12].
Bael (*Aegle marmelos* L.) considered being a pack house of nutrients and medicine, is one of the most ignored and underutilized fruit crops. The products from the bael fruit pulp are highly nutritive as well as remedial. Bael fruit pulp has a lot of potential to be processed in 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.

2. Materials and Methods
Rajasthani local variety of ripe bael fruits were procured from ICAR-Directorate of Medicinal

and Aromatic Plants Research, Boriavi farm, Anand (Gujarat) in the month of April (Fig 1 and 2). The bael fruits were sorted first and removed diseased, damaged and broken fruits.

Fig 1: Harvesting of bael Fruit

Fig 2: Bael fruit (Rajasthani local Variety)

2.1 Physical Properties

Physical properties of bael fruit *viz*. average mass, average length, average diameter, volume, density, pulp yield, pulp to seed ratio, thickness of rind, waste index and number of seeds per fruit were measured as per the standard procedure mentioned below.

2.1.1 Average mass (g)

Twenty bael fruits were selected randomly and weighed their mass individually on an electronic weighing balance. Then, average mass of fruit was calculated and expressed in grams (Mohsenin, 1986; Sharma *et al*., 2019) [5, 13].

2.1.2 Average length and diameter (cm)

The length and diameter of the same twenty fruits were measured with help of Vernier Caliper and calculated average values and expressed in cm (Sawale *et al*. 2018; Mohsenin, 1986) [11, 5].

2.1.3 Volume (cc)

Volume of same twenty bael fruits was measured using water displacement method based on the Archimedes principle. Each bael fruit was submerged in a 10000 cm^3 eureka container and the volume of water displaced was measured using graduated cylinder. Water temperature during measurements was kept at 25 °C (Khan *et al*, 2019) [3].

2.1.4 Density (g/cc)

The density of the fruit was calculated by applying the formula as given below (Kaur and Kalia, 2017; Sawale *et al.* 2018) [2, 11].

$$\text{Density (g/cc)} = \frac{\text{Mass of Fruit (g)}}{\text{Volume of displaced water (cc)}}$$

After finding physical properties of the twenty bael fruits, the same bael fruits were cut and the pulp with seeds and fibres were scooped out using stainless steel knife. Then, the pulp, seeds and fibres were separated manually and measured the weight of each fractions and pulp yield, pulp to seed ratio, thickness of rind waste index and number of seeds were calculated.

2.1.5 Pulp yield (%)

It is ratio of edible part of fruit i.e., pulp to total weight of fruit multiplied by 100. Pulp yield was calculated and expressed in percent (Sawale *et al.*, 2018) [11].

$$\text{Percent edible index (\%)} = \frac{\text{Pulp weight (g)}}{\text{Total weight of fruit (g)}} \times 100$$

2.1.6 Pulp to seed ratio

The bael fruits were cut and the pulp and seed were separated using stainless steel knife. The content of pulp and seed from the individual fruit was determined by measuring the weight of each fraction. The weight was measured with an electronic balance. The average of twenty fruits was taken.

$$\text{Pulp to Seed ratio} = \frac{\text{Pulp percent of bael fruit (\%)}}{\text{Seed percent of bael fruit (\%)}}$$

2.1.7 Thickness of rind (mm)

The thickness of rind of the fruits was measured at various places of outer shell of bael with help of digital Vernier Caliper and calculated average value of twenty bael fruits expressed in mm (Sawale *et al.*, 2018) [11].

2.1.8 Waste index (%)

It is the ratio of waste part of fruit i.e. rind, seed and fibre to the total weight of fruit multiplied by 100 and expressed in percentage (Sawale *et al*., 2018) [11].

$$\text{Waste index (\%)} = \frac{\text{Weight of waste (g)}}{\text{Total weight of fruit (g)}} \times 100$$

2.1.9 Number of seeds

Number of seeds per fruit of twenty fruits was counted manually then average was calculated and expressed in number.

2.2 Chemical characteristics

The chemical characteristics namely, moisture content, crude fat, total ash, acidity, ascorbic acid, total fiber, calcium, phosphorus, iron, potassium and zinc of bael fruit pulp were analyzed as per AOAC, 2012 and Ranganna, 2007 [1, 10].

3. Results and Discussion

3.1 Physical Characteristics of Bael fruit

The physical characteristics of bael fruit and pulp were given in Table 1. The average mass, length, diameter, volume and density of bael fruits were found to be 1642.25 g, 15.3 cm, 14.5 cm, 1454.25 cc and 1.22 g/cc, respectively. The size of the bael fruit (Rajasthani local variety) used in present investigation is much larger than the other investigations reported by Sawale *et al.*, (2018) [11], Kumar *et al*. (2018) [4] and Sharma *et al.* (2019) [13].

Table 1: Physical Properties of Bael Fruit

Parameters	Mean value ± S. D.
Average mass (g)	1642.25± 574.76
Average length (cm)	15.3± 1.96
Average diameter (cm)	14.5 ±1.69
Volume (cc)	1431.25± 723.82
density (g/cc)	1.22± 0.19
Pulp yield (%)	49.27±1.12
Pulp to seed ratio	13.21±0.83
Thickness of rind (mm)	3.11±0.32
Waste index (%)	50.73±1.12
Number of seeds per fruit	210 ±20

The bael fruits were cut and the pulp with seeds and fibres were scooped out and separated the pulp, seeds and fibres. Based on the weight of each fraction the pulp yield, pulp to seed ratio, thickness of rind, waste index and number of seeds were found to be 49.27%, 13.21, 3.11 mm, 50.73% and 210, respectively. The results of the present investigation are in good accordance with the results reported by Kaur and Kalia, (2017) [2].

3.2 Chemical properties of Bael fruit pulp

Chemical properties *viz.* moisture content, crude fat, total ash, crude fiber, crude protein, carbohydrate, acidity, ascorbic acid and TSS of bael fruit pulp were given in Table 2. The results of moisture, crude fat, crude fibre and total ash were found to be 69%, 0.33%, 4.33% and 3.03%, respectively which are in good accordance with the results obtained by Singh *et al.* (2012) [14] and Kaur and Kalia (2017) [2] while ascorbic acid found to be 19.53 mg/g was in good agreement with the investigation by Sawale *et al.* (2018) [11]. The TSS and crude protein content were found to be 33°Brix and 3.37%, respectively which were near to the investigated value by Kaur and Kalia (2017) [2] and Sharma *et al.* (2019) [13].

Table 2: Chemical Properties of Bael Fruit Pulp

		Mean value ± S. D.
Chemical Parameters	Moisture (% wb)	69±1.91
	Crude fat (%)	0.33±0.035
	Total ash (%)	3.03±0.16
	Crude fiber (%)	4.33±0.47
	Crude protein (%)	3.37±0.18
	Carbohydrate (%)	19.93±2.20
	Acidity (% of CA)	0.5±0.1
	Ascorbic acid (mg/100g)	19.53±0.55
	TSS (°Brix)	33±0.57
Minerals	Calcium (mg/100g)	192.5
	Phosphorus (mg/100g)	252.2
	Iron (mg/100g)	4.391
	Potassium (mg/100g)	2543.4
	Zinc (mg/100g)	0.867

The results of Calcium, Phosphorus, Potassium and zinc in bael fruit used in present investigation i.e. Rajasthani local variety is very high than the other investigation reported by Kaur and Kalia (2017) [2].

4. Conclusions

The average mass, average length, average diameter, volume, density, pulp yield, pulp to seed ratio, thickness of rind, waste index and number of seeds 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%, 13.21±0.83, 3.11±0.32 mm, 50.73±1.12% and 210 ±20, respectively. The moisture, crude fat, total ash, crude fiber, crude protein, carbohydrate, acidity, ascorbic acid, TSS, calcium, phosphorus, iron and potassium of ripe bael fruit pulp were 69±1.91%, 0.33±0.035%, 3.03±0.16%, 4.33±0.47%, 3.37±0.18%, 19.93±2.20%, 0.5±0.1%, 19.53±0.55 mg/100g, 33±0.57 °Brix, 192.5 mg/100g, 252.2 mg/100g, 4.391 mg/100g and 2543.4 mg/100g respectively.

5. References

1. AOAC. Official methods of analysis. Association of Official Analytical Chemists, Washington D.C., USA 2012
2. Kaur A, Kalia M. Physico chemical analysis of bael (Aegle Marmelos) fruit pulp, seed and pericarp. Chemical Science Review and Letters 2017;6(22):1213-1218.
3. Khan MA, Singh K, Patel KK, Siddiqui M. Some Physical properties of wood apple (*Feronia Limonia L.*). Recent Advancement in Food Science and Nutrition 2019, 79-86.
4. Kumar A, Singh P, Singh M. Assessment of physicochemical properties of minor fruits (aonla, bael, ber, jackfruit and kaitha). Journal of Pharmacognosy and Phytochemistry 2018;SP2:05-09.
5. Mohsenin NN. Physical properties of plant & animal materials (3rd Ed.). Gordon and Breach Science Publishers, New York, 1986.
6. National Horticulture Board 2016
7. Neeraj, Bisht V, Johar V. Bael (*Aegle marmelos*), extraordinary species of India: A review. International Journal of Current Microbiology and Applied Sciences 2017;6(3):1870-1887.
8. Patkar A, Desai N, Ranage A, Kalekar K. A Review on Aegle Marmelos: A potential medicinal tree. International Research Journal of Pharmacy 2012;3(8):86-91.
9. Peter KV. Underutilized and underexploited horticultural crops, New India Publishing Agency, New Delhi 2008;3:201-222.
10. Rangana S. Handbook of analysis and quality control for fruit and vegetable products. 2nd Edn. *Tata McGraw Hill Publishing* Co. Ltd., New Delhi 2007
11. Sawale KR, Deshpande HW, Kulkarni DB. Study of physico-chemical characteristics of bael (*Aegle marmelos*) fruit. Journal of Pharmacognosy and Phytochemistry 2018;7(5):173-175.
12. Sharma PC, Bhatia V, Bansal N, Sharma A. A review on bael tree. Natural Product Radiance 2007;6(2):171-178.
13. Sharma S, Gehlot R, Singh R, Rekha, Sindhu R. Physico-chemical characteristics of fresh bael and mango fruits. International Journal of Chemical Studies 2019;7(3):5181-5182.
14. Singh U, Kochhar A, Boora R. Proximate composition, available carbohydrates, dietary fibres and anti-nutritional factors in Bael (*Aegle maemelos* L.) leaf, pulp and seed powder. International Journal of Scientific and Research Publications 2012;2(4):01-04