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## Potential of green bael leaves powder and its quality characteristics for the development of novel food products

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### Abstract

Bael (*Aegle marmelos*), commonly known as Bengal quince, is a traditional medicinal plant widely used in Ayurvedic medicine. The leaves of the plant are particularly noted for their therapeutic properties, including anti-diabetic, anti-inflammatory, and antioxidant effects. This study aims to explore the physico-chemical properties with micronutrients and antioxidant activity of green Bael leaves powder to evaluate its potential as a functional ingredient in the food industry. The analysis of green Bael leaves powder reveals a diverse range of essential macro and micro nutrients. Overall, green Bael leaves powder appears to have a moderate antioxidant activity, high in iron content.

**Keywords:** Antioxidant activity, bael leaves powder, human health, iron, traditional medicinal plant

### Introduction

Bael, also called *Aegle marmelos*, is a prickly tree in the Rutaceae family. This tree is native to Bangladesh, Pakistan, India, and Myanmar. Bael leaves is a traditional medicinal plant widely used in Ayurvedic medicine (Singanan *et al.*, 2007) <sup>[10]</sup>. Bael leaves are useful in treating a variety of conditions, including diabetes, asthmatic problems, diarrhoea, dysentery, ophthalmia, deafness, inflammations, and cataracts (Kirtikar and Basu, 1993) <sup>[5]</sup>. Bael leaves are also astringent, laxative, and expectorant. Fresh aqueous and alcoholic leaf extracts of Bael were reported to have a cardio tonic effect in mammals (Haravey, 1968; Nadkarni, 2000) <sup>[3, 7]</sup>. Bael leaf extract was found to be a potential antioxidant drug, which help to reduce the blood glucose level in alloxan induced diabetic rats (Sabu and Ramadasan, 2004) <sup>[8]</sup>. It was found to be as effective as insulin in the restoration of blood glucose and body weight to normal levels on hyperglycemic state (Seema *et al.*, 1996) <sup>[9]</sup>. Bael leaves can be used in high doses in conjunction with oral hypoglycemic medications to normalise blood glucose levels in people whose diabetes cannot be controlled with these medications or in patients whose medications have negative effects on dosage increases (Ismail, 2009) <sup>[4]</sup>. Bael leaves aid in controlling and preserving the body's homeostatic metabolism. It was discovered that extracts worked well as an anti-diabetic drug. To shed light on its potential anti-diabetic properties, a thorough investigation into the metabolites of plant extracts of Bael leaves on insulin release, glucose release, and glucose absorption is required (Muralidharan, 2014) <sup>[6]</sup>.

The use of natural ingredients in the development of novel food products has gained significant attention in recent years due to the growing demand for healthier and more sustainable food options (Chen *et al.*, 2023) <sup>[2]</sup>. The development of novel food products that utilize natural ingredients is not only important for meeting the growing demand for healthier food options, but it also has the potential to contribute to the sustainability of the food industry. Previous research has shown that natural ingredients, such as green tea leaves and spinach, have antioxidant and anti-inflammatory properties that make them suitable for use in the development of functional food products.

While there is a growing body of research on the use of natural ingredients in the development of functional food products, there is a lack of research specifically focused on the use of green Bael leaves. The aim of this research study is to investigate the potential of green Bael leaves powder as a natural ingredient in the development of novel food products.

## Materials and Methods

### Collection of Bael leaves

Fresh Bael leaves were procured from local market, Kolkata, West Bengal.

### Preparation of green Bael leaves powder (GBLP)

Fresh green Bael leaves chopped up into tiny bits, then these dehydrated at 40 °C for 4-6 hours in a hot air-circulating oven after being rinsed with tap water to discarded the unaccepted constituents. After properly removed free water from the sample, mixer grinder used to prepare powder of dehydrated Bael leaves, with the help of 40 mesh sized screen, fine powder developed and preserved in air tight plastic containers for further analysis.

### Proximate Composition Analysis

The proximate composition, including moisture, ash, protein, fat, and Fibre content, was determined using standard AOAC

methods.

### Mineral Content Analysis

The mineral content (calcium, potassium, magnesium, iron, and zinc) was analyzed using atomic absorption spectrophotometry (AOAC, 2016)<sup>[1]</sup>.

### Antioxidant Activity

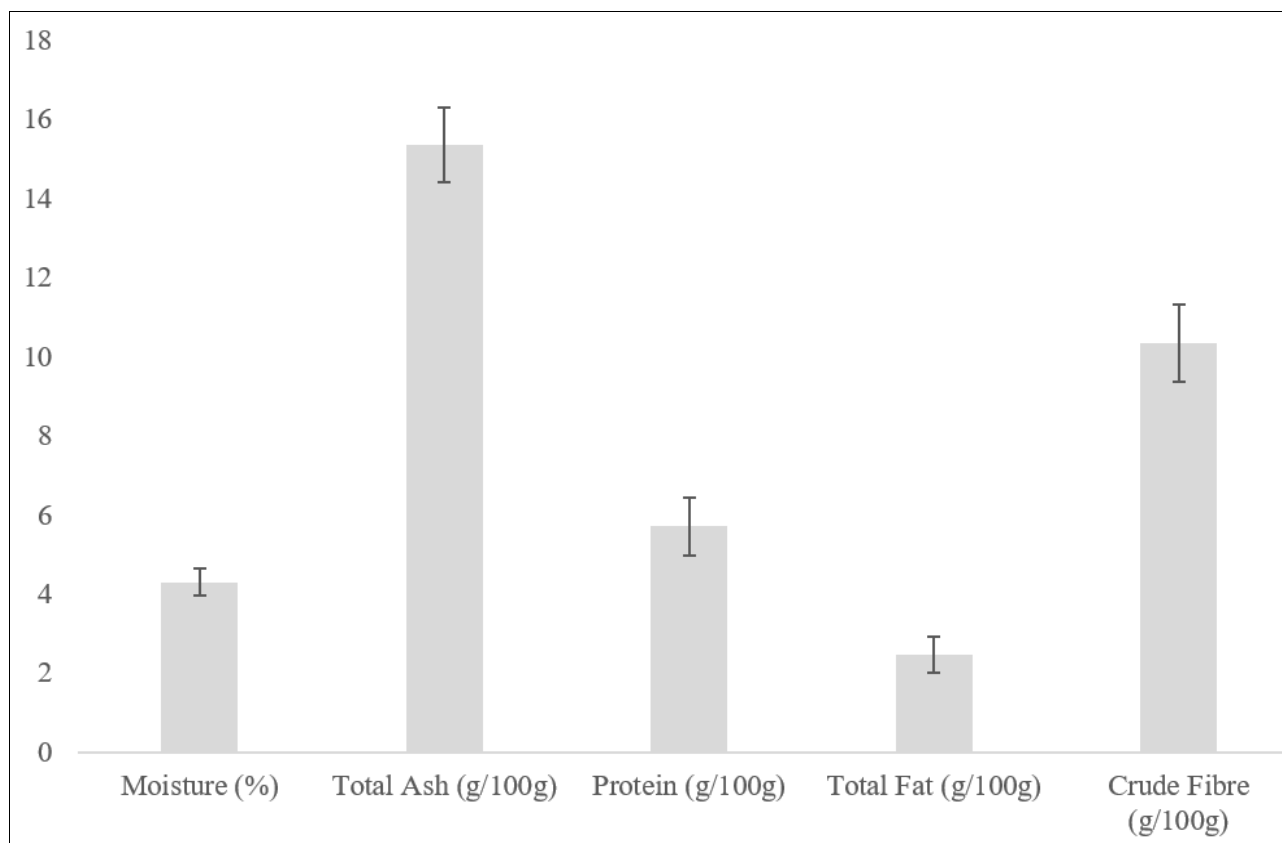
The antioxidant activity of the Bael leaves powder was assessed using the DPPH radical scavenging assay. The results were expressed as percentage inhibition of the DPPH radical (AOAC, 2016)<sup>[1]</sup>.

### Results and discussion

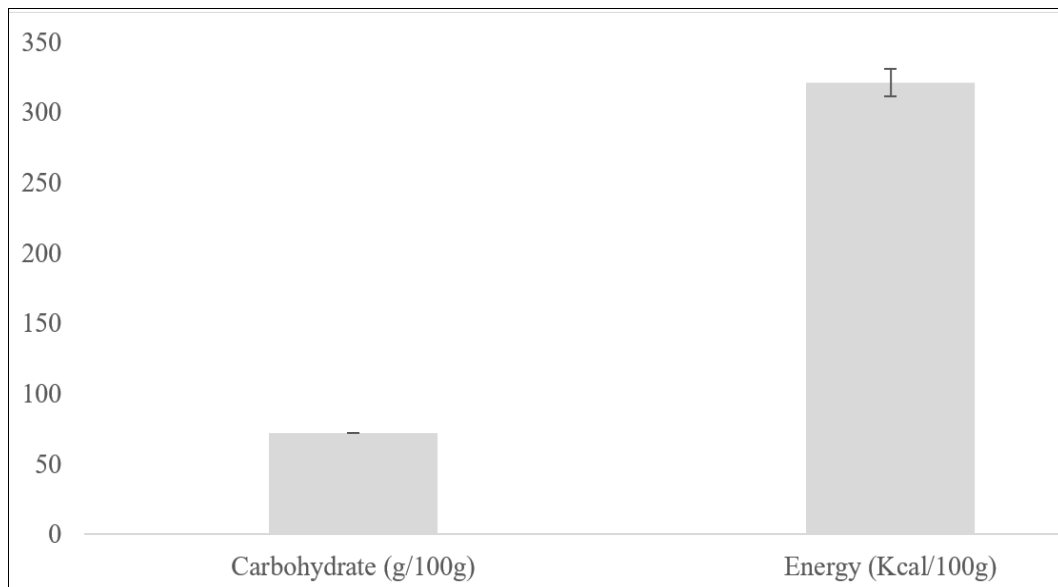
This analysis had done in the Food & Nutrition Laboratories of Swami Vivekananda University, Barrackpore, West Bengal, India.

**Table 1:** Proximate Composition of green Bael leaves powder

Parameter	Result
Moisture (%)	4.30±0.11
Total Ash (g/100g)	15.36±0.05
Protein (g/100g)	5.72±0.11
Carbohydrate (g/100g)	72.22±0.28
Total Fat (g/100g)	2.48±0.01
Energy (Kcal/100g)	318.27±0.06
Crude Fibre (g/100g)	10.35±0.01



**Fig 1:** Graphical representation of proximate Composition of green Bael leaves powder



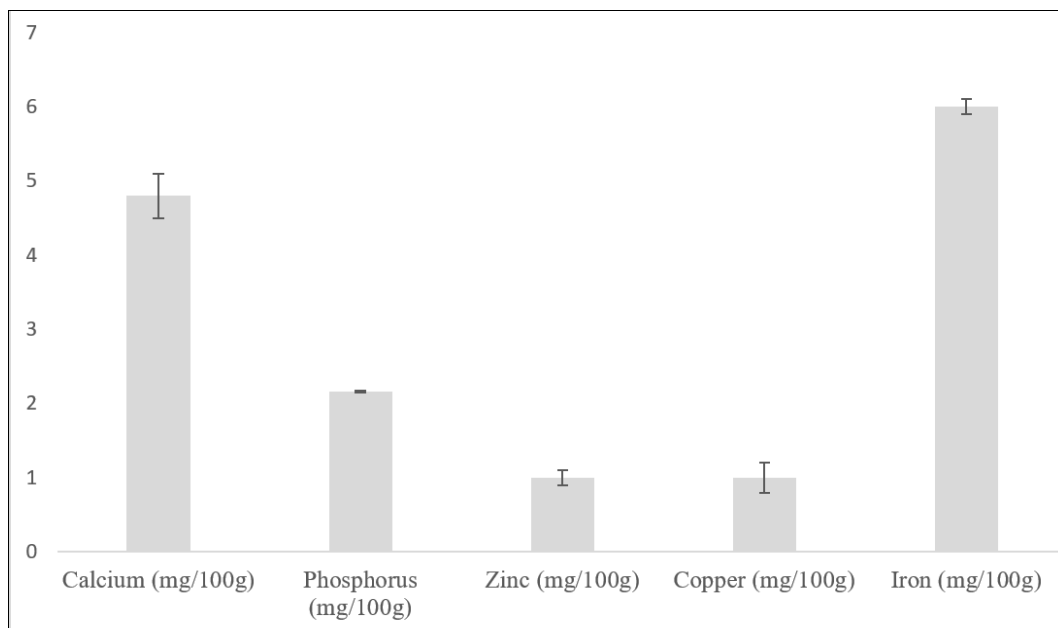
**Fig 2:** Graphical representation of carbohydrate and energy content of green Bael leaves powder

The proximate composition of green Bael leaves powder is summarized in Table 1. The results indicate that the powder has a moisture content of 4.30 (%), which is relatively low and suggests good shelf stability. The high total ash content 15.36 g/100g indicates a significant presence of minerals. The protein content is moderate at 5.72 g/100g, contributing to the nutritional value of the powder. Carbohydrates are the major component, constituting 72.22g/100g, which provides a good source of energy. The total fat content is low at 2.48 g/100g, which is beneficial for low-fat diet formulations. The energy value of the powder is 318.27 Kcal/100g, making it a

substantial energy source. The crude Fibre content is 10.35 g/100g, indicating potential benefits for digestive health.

**Table 2:** Mineral Content of green Bael leaves powder

Mineral	Result
Calcium (mg/100g)	4.8±0.17
Phosphorus (mg/100g)	2.16±0.01
Zinc (mg/100g)	1.0±0.05
Copper (mg/100g)	1.0±0.11
Iron (mg/100g)	6.0±0.05



**Fig 3:** Graphical representation of mineral Content of green Bael leaves powder

The analysis of green Bael leaves powder reveals a diverse range of essential minerals. Comparing the calcium content to other leafy greens like spinach, which are considered to have higher levels of the mineral, it is quite low at 4.8±0.17 mg/100g. However, it still contributes to the dietary intake of calcium, which is crucial for bone health and various metabolic functions. The phosphorus content at 2.16±0.01 mg/100g indicates a modest presence of this mineral. Phosphorus is essential for the formation of bones and teeth,

and it plays a vital role in the body's utilization of carbohydrates and fats. With a content of 1.0±0.05 mg/100g, zinc is present in moderate amounts. Zinc is crucial for immune function, DNA synthesis, and cell division. The level found in Green Bael Leaves Powder can help meet daily dietary requirements, especially in populations where zinc deficiency is a concern. The copper content is 1.0±0.11 mg/100g. Copper is important for maintaining healthy bones, blood vessels, nerves, and immune function, and it helps the

body form collagen and absorb iron. Iron content is notably high at  $6.0 \pm 0.05$  mg/100g. This is significant as iron is essential for the production of haemoglobin, which carries oxygen in the blood. The high iron content suggests that Green Bael Leaves Powder could be a valuable dietary supplement for preventing iron deficiency anaemia. Overall, Green Bael Leaves Powder appears to be a good source of essential minerals, particularly iron. The presence of these minerals supports the potential health benefits of incorporating this powder into the diet. However, the bioavailability of these minerals and the overall dietary context should be considered to fully understand the nutritional impact. Further studies could explore the synergistic effects of these minerals when consumed as part of a balanced diet.

**Table 3:** DPPH (%) content of Green Bael Leaves Powder

Parameter	Result
DPPH (%)	$17.47 \pm 0.40$

The DPPH assay is a widely used method to evaluate the free radical scavenging ability of antioxidants in a sample. The result of  $17.47 \pm 0.40$  indicates the percentage inhibition of the DPPH radical by Green Bael Leaves Powder. The DPPH value of 17.47% suggests that Green Bael Leaves Powder has moderate antioxidant activity. This level of activity indicates that the powder contains compounds capable of neutralizing free radicals, which can help in reducing oxidative stress in the body.

### Conclusion

Overall, green Bael leaves powder is a nutritionally rich ingredient with a balanced profile of macronutrients and significant mineral content. Its low moisture content ensures good shelf stability, while its high carbohydrate and energy values make it a valuable addition to the diet. The moderate protein and high fibre contents further enhance its nutritional benefits, supporting overall health and well-being. The DPPH assay results demonstrate that Green Bael Leaves Powder exhibits moderate antioxidant activity, with a percentage inhibition of  $17.47 \pm 0.40\%$ . This finding indicates that the powder contains compounds effective in neutralizing free radicals, which can contribute to reducing oxidative stress in the body. While the antioxidant activity is moderate compared to other high-antioxidant foods, Green Bael Leaves Powder still offers beneficial properties that support overall health and well-being by helping to protect cells from oxidative damage. Thus, the powdered Bael leaves may be used for developing innovative food products.

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### Conflict of Interest

The authors declare no conflict of interest.

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