

A Comprehensive Review on Medicinal Values of *Aegle marmelos* (Bael tree)

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Abstract

The modern generation is fast-paced, and allopathic treatment is undeniably successful at delivering results rapidly. The many adverse effects and contraindications of contemporary medicine, however, are its most worrisome feature. However, plants offer good substitutes for those drugs since they may address the problem at its root and have fewer or no side effects. The current study is based on the pharmacological activity of *Aegle marmelos*, which is sometimes called a bael in India. Numerous conditions have been linked to the great potential of this plant, including diabetes, cholesterol, peptic ulcers, inflammation, diarrhoea, dysentery, anticancer, cardioprotective, antibacterial, antifungal, radioprotective, antipyretic, analgesic, constipation, respiratory infections, antioxidant, hepatoprotective, wound healing, and many more. This review compiles the scientific literature on the *Aegle marmelos* plant, which is used in traditional medicine for a variety of purposes.

Keywords: *Aegle marmelos*, Bael tree, Medicinal values

INTRODUCTION

For more than 5,000 years, people have utilised plant-based items to cure diseases and restore bodily systems. The medical records of the Greek, Roman, Chinese, Indian, and Egyptian civilisations provide evidence of this [1]. In India, a wide variety of potentially medicinal plants are used by all social groups as traditional medicines in Siddha, Ayurvedic, and Unani systems as well as processed medicinal products [2]. Only between 250,000 and 500,000 of India's roughly 4.5 million plant species have undergone phytochemical studies conducted to determine their possible biological or pharmacological effects [3].

Indian medicinal plants are believed to contain a large number of pharmacologically active constituents and compounds that are commonly used in home treatments against a variety of diseases.[4]. Bael (*Aegle marmelos*.), another Indian medicinal plant, has produced a variety of bioactive compounds and has been demonstrated to have significant traditional benefits against a wide range of ailments.[5,6]

Plant Description:

The "Bale fruit tree," or Bael (*Aegle marmelos*), is a modestly sized, slender, aromatic tree that grows wild across India's deciduous forests. It belongs to the Rutaceae family. It is found on Andaman Island and in the western Himalayas, reaching elevations of 1200 meters. The tree is 90 to 120 cm in circumference and 6.0 to 7.5 meters tall.[7] The Hindu community generally regards this tree as sacred since its leaves are offered to Lord Shiva during worship. The tree is a distinct form of Lord Kailashnath in Hindu mythology.[8] The leaves, fruit, stem, and roots of this tree are used as traditional medicine to cure a range of human ailments at every stage of maturity.

Table 1: Vernacular names of *Aegle marmelos*

Language	Vernacular names of <i>A. marmelos</i>
English	Bael fruit, Bengal quince, Indian quince, Golden apple, Stone apple
Hindi	Sirphal, Bel, Bili, and Bela
Sanskrit	Asholam, Atimangaliya, Bilva, Adhararutha
Telugu	Maredu, Sailushamu, Bilvumu, Maluramu, Sandiliyamu, Sripthalmu
Gujrat	billi
Malayalam	Koovalam, Vilwam
Bengal	Bel, Bael
Kannad	Bilva, Bela
Orissa	belo

Table 2 : Taxonomical classification

Kingdom	Plantae
Sub-kingdom	Tracheobionta
Super division	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Rosidae
Order	Sapindales
Family	Rutaceae
Genus	<i>Aegle</i>
Species	<i>marmelos</i>

Table 3 : Phytoconstituents isolated from various parts of *Aegle marmelos* [11]

Sr. No	Part	Phytoconstituents
1.	Leaf	Skimmianine, Aegeline, Lupeol, Cineol, Citral, Citronella, Cuminaldehyde, Eugenol, Marmesinine
2.	Bark	Skimmianine, Fagarine, Marmin
3.	Fruit	Marmelosin, Luvangetin, Aurapten, Psoralen, Marmelide, Tannin
4.	Seed	Citral, A-D-phellandrene, Cineol, P-cymene, D-limonene, Cumin aldehyde, Citronellal
5.	Root	Alkaloid, Halopine, Coumarins, Terpinens.



Figure 1: Leaves & Fruit of *Aegle marmelos*

Traditional Uses of Bael Tree Parts for Medical Purposes:

Asthma, anaemia, fractures, wound healing, swollen joints, high blood pressure, jaundice, diarrhoea, healthy minds and brains, and typhoid issues during pregnancy are just a few of the medical disorders that can be addressed with the many elements of Bael. [12] *Aegle marmelos* has been used as a herbal treatment for diabetes mellitus in Ayurvedic, Unani, and Siddha medicinal systems in India [13], Bangladesh [14], and Sri Lanka.[15] The majority of this tree's parts are utilised medicinally. The unripe dried fruit is used to cure diarrhoea and dysentery because of its stomachic, astringent, and digestive qualities.[16] For those who have just recovered from bacillary dysentery, a sweet fruit pulp beverage offers a soothing effect.[17]

The proven medicinal benefits of *Aegle marmelos* include:

1. Anti diabetic Activity:

Upadhya S et al. (2004) evaluated the hypoglycemic and antioxidant effects of an aqueous extract of *Aegle marmelos* leaves in male albino rats with alloxan-induced diabetes. They came to the conclusion that AML would assist manage diabetes in the long run.[18] Similar to this, P.S. Marinzene et al. (2005) demonstrated the anti-hyperlipidaemic activity of the aqueous extract of *Aegle marmelos* fruits using streptozotocin IJCPR February-April 2011; 2(1) 14 Sharma et al. / Medicinal Values of Bael (*Aegle marmelos*) induced diabetic wistar rats.[19] Sunderam et al. (2009) examined the effects of individual alcoholic extracts of *Momordica Charantia*, *Eugenia Jambolana*, and *Aegle marmelos* against streptozotocine-induced diabetic rats and confirmed the extracts' ability to prevent laboratory-induced cell necrosis. [20]

However, in their study of *Aegle marmelos* leaf extract in alloxan-induced diabetes, Kuttan and Sabu (2004) found that the extract decreased oxidative stress by eliminating lipid peroxides and raising the levels of specific antioxidants, which in turn decreased sugar and hyperglycaemic levels. [21] In addition to the aforementioned research, Hema and Lalitakumari (1999) reported unexpected findings about *Aegle marmelos* and detailed its molecular-level pharmacological activity, including hypoglycemic effects. [22]

2. Hepatoprotective activity:

Singanan et al. (2007) found that *Aegle marmelos* os leaf extract had good hepatoprotective properties when used to identify alcoholic liver damage in albino rats. [23] Likewise, it was shown by Ramnik S. (2008) that aqueous extracts of bael fruit pulp and seeds can effectively treat and prevent hepatotoxicity brought on by CCl₄. [24]

3. Antibacterial activity:

Kaur et al. (2009) used *E. coli* treatment to confirm the antibacterial activity of ethnic extracts of dried pulp of *Aegle marmelos* against a variety of enteric pathogens, including *Shigella boydii*, *S. sonnei*, and *S. flexneri*. Maheshwari et al. (2009) found that certain phytochemicals, such as phenols, tannins, and flavonoids, were effective against all of these pathogens. Coli with fruit extract from *Aegle marmelos*. [26] Citarasu et al. (2003) have conducted experiments using *Aegle marmelos* s on certain pathogenic bacteria, including *Vibrio sp.*, *Salmonella typhi*, *Pseudomonas aeruginosa*, and *Aeromonas hydrophyla*. [27]

4. Analgesic, anti-inflammatory and antipyretic effects:

Commercial *Aegle marmelos* leaf extracts were shown to have anti-inflammatory, antipyretic, and analgesic activities by Arul et al. (2005). They also found that the majority of the extracts significantly inhibited the effects of carrageenan. Rats with cotton ball granuloma and paw oedema. In the restaurant, the extract also had a notable analgesic effect and caused the latter stage to lick mouse feet. The extract is primarily responsible for the notable reduction in rats' excessive breeding. [28] Using a rat paw oedema paradigm, An research G. R. (2008) also assessed the anti-inflammatory properties of an aqueous extract of *Aegle marmelos* and concluded that it did.[29] Shankharananth V. (2007) showed that 200 IJCPR Feb-Apr 2011; 2(1) 15 methanolic extract of *Aegle marmelos* leaves Sharma et al. Values of Medicine Bael and mice's tail-wrinking and tail-flicking tests, which are caused by acetic acid, show notable analgesic effect at 300 mg/kg.[30]

5. Antifungal Activity :

According to Patil R. H. (2009), an ethanolic extract of *Aegle marmelos* leaves has antifungal, antidiarrheal, and antibacterial properties. [31] Using the spore germination assay, Rana B. K. (1997) assessed the antifungal properties of essential oils extracted from Bael leaves. The oil's effectiveness against various fungal isolates varied, and at 500 ppm, 100% inhibition of spore germination was seen for all tested fungus. They suggested that bael leaf essential oil might disrupt the Ca²⁺-dipicolonic acid metabolism pathway and potentially prevent the production of spores.[32] Pitre S. and Srivastava S.K. (1987) show that ethanolic root extract has antifungal properties against Trichophyton mentagrophytes and Aspergillus fumigatus.[33]

6. Anticancer Activity:

Leticia V. and Costa L. (2005) assessed the anticancer potential of traditional Bangladeshi medicine and employed extracts of *Aegle marmelos* for cytotoxic action utilising tumour cell lines, brine shrimp lethality assay, and sea urchin egg assay. It was discovered that the *Aegle marmelos* extract was poisonous in every test that was performed.[34] 30 In a similar vein, Gagetia G.C. et al. (2005) documented the anticancer properties of a hydroalcoholic extract of bael leaves in an animal model of Ehrlich ascites carcinoma and suggested that the extract's skimmianine content might be the cause of the induction of apoptosis.[35]

7. Radioprotective activity:

Jagethia G.S. and Venkatesh P. (2005) examined the radioprotective effects of *Aegle marmelos* extract by exposing mice to different doses of gamma radiation. They found that oral administration of the extract enhanced tolerance to 1.6 Gy radiation.[36] Again, Jagethia G.S. and colleagues (2006) examined the effects of a plant extract on the peripheral blood and small intestine of Swiss albino mice. They exposed animals to gamma radiation and recorded the effects of the radiation on the peripheral blood, splenic colony-forming units, and intestinal mucosa. *Aegle marmelos* extract has been shown to significantly reduce the harmful effects of radiation on the bone marrow and intestines of mice.

8. Antiulcer Activity:

According to Goel R.K. (1997), oral administration of pyranocoumarins derived from *Aegle marmelos* Correa seeds demonstrated a significant protective effect against gastric ulcers caused by stress and cold restriction in rats and guinea pigs, as well as pylorus ligation-associated gastric ulcers in rats. [38] According to Dury J. N. (2007), rats pretreated with unripe bael fruit extract showed a considerable reduction in the absolute stomach mucosal damage caused by ethanol. [39]

9. Antithyroid activity:

Scopoletin (7-hydroxy-6-methoxycoumarin) was extracted from *Aegle marmelos* leaves by Panda S. and Kar A. (2006), who also assessed the compound's possible potential for managing hyperthyroidism. In mice given levothyroxine, scopoletin (1.00 mg/kg, taken orally for 7 days) was found to lower serum thyroid hormone levels. Additionally, it has been demonstrated that scopoletin exhibits higher therapeutic activity than propylthiouracil, the conventional antithyroid medication.[40]

10. Toxicity Study:

Veerappan A et al. (2007) collected complete alcohol extract, total aqueous extract, total aqueous extract, and methanol extract from *Aegle marmelos* leaves and investigated their toxicity in lab rats. The use of bael did not result in any histological alterations. For 14 days in a row, 50 mg of the marmelos leaf extract per kg of body weight was given intraperitoneally. The information gathered indicates that a leaf extract of *Aegle marmelos* is a potent antioxidant. Gummy has an excellent drug safety profile.[41]

11. Other reported medicinal properties:

It has been demonstrated that gummy bear fruit aqueous extracts have antidiarrheal effects by selectively targeting the outer membrane protein C of enteropathogenic *Escherichia coli*. [42] Additionally, findings of insecticidal efficacy [43], antilipid peroxidative activity [44], and antioxidant properties [45] have been made in addition to these effects.

CONCLUSION

Several phytoconstituents found in *Aegle marmelos* are crucial for herbal medications. Nearly every part of this plant, including the roots, bark, seeds, fruits, and seats, is used to treat different illnesses. Bael trees have a lot of potential, thus it should be grown or protected to increase the probability of developing novel, efficient herbal remedies. To create a more cost-effective product with therapeutic use, extensive research and development is needed.

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