



A REVIEW ON AEGLE MARMELOS (VILVAM)

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ABSTRACT

Aegle marmelos, also known as Bael tree, is a sacred and medicinally important plant in traditional Indian medicine. This review discusses its botanical characteristics, traditional uses, phytochemical composition, and pharmacological activities. The plant is rich in bioactive compounds like flavonoids, alkaloids, and coumarins, which contribute to its therapeutic effects such as anti-inflammatory, anti-diabetic, antioxidant, and anti-cancer properties. Modern research supports its traditional uses, showing potential in treating various health conditions like cancer, diabetes, and gastrointestinal disorders.

KEYWORDS: Aegle marmelos, bael, pharmacological activities.

INTRODUCTION

Hindi) and Golden apple (in English); is a sacred Indigenous tree; grows wild throughout India in any climate, is a very important plant described in Ayurveda (the Indigenous system of medicine) to treat various diseases conditions like Vatavyadhi (diseases caused by humor 'Vata'), Shotha (edema), Shula (pain), Mutra krichhra (dysuria), Amavata (rheumatoid arthritis), Aegle marmelos, commonly known as Bi Hindi) and Golden apple (in English); is a sacred Indigenous Aegle marmelos, commonly known as Bilva or Bael tree (in Hindi) and Golden apple (in English); is a sacred Indigenous tree; grows wild throughout India in any climate, is a very important plant described in Ayurveda (the Indigenous system of medicine) to treat various diseases conditions like Vedavathi (diseases caused by humor 'Vata'), Shota (edema), Shula (pain), Mutra krichhra (dysuria), Amavata (rheumatoid arthritis), etc.^[1] About 80% of the world's population depends wholly or partially on traditional medicine for its primary health care needs. These plants are used by Ayurveda, Siddha, Tibetan and all other system of medicines. Our ancient literature like Rigveda, Yajurveda, Atharvaveda, Charak Samhita and Sushrut Samhita also describes about their properties and uses for treatment of various diseases.^[2] Natural medicinal plant is pollution free, no side effect, no toxic effect. Bael is a one of medicinal tree in thousands of medicinal plants. Bael (*A. marmelos*) tree is a usually nearby temple of lord shiva, Bael is also a sacred tree to Lord Shiva. The bael fruit is recognized 'RAMAYAN' period. Bael tree in mention in book of

'CHARKA SAMHITA'.^[3] The plant is of medicinal as well as religious importance. In Hindu religion, the plant is considered very sacred and the leaves of this plant is being offered to Lord Shiva during worship. It believes that mighty is king, who is strong and thorny like the Bilva tree and peace – showering at the same time.^[4] Various studies on Bael reveal that it acquires a variety of nutritional elements like a large group of phytochemicals which includes phenolic acids, flavonoids, alkaloids, tannins, and coumarins. Other than these, amino acids, fatty acids, a wide range of organic acids, minerals, carbohydrates, vitamins, fibers make Bael a highly nutritious fruit with immense health benefits.^[5]



Figure 1: Bael.



Figure 2: Aegle marmelos Bale Tree.

Botanical Description

This slow-growing tree is found to have a medium height of nearly about 762 cm and plant parts include bark, leaf, flower, fruit, and seed. Spiny branches of stem are observed in the Bael tree.^[6] The flower of Bael is of a greenish-white color. Having a sweet scent, it also characterizes as having bisexual, hypogynous, actinomorphic stalk. The leaf axil holds some lateral panicles which contain ten flowers.^[7] Embedded in the pulp are 10 to 15 seeds, flattened-oblong, about 1 cm long, bearing woolly hairs and each enclosed in a sac of adhesive, transparent mucilage that solidifies on drying.^[8]

Taxonomy

Kingdom: Plantae

Order: Sapindales
Family: Rutaceae
Sub family: Aurantioideae
Genus: Aegle
Species: A. marmelos.

Traditional Uses

A. marmelos is extensively described in Vedic literature for the treatment of a variety of diseases. It has long been used to cure a range of ailments.^[9] The leaves, stems, fruit, and seeds have medicinal virtues. In India and Bangladesh, A. marmelos is widely used to treat diabetes (Lampronti et al., 2003). In addition to this, the analgesic, antipyretic, anti-inflammatory, antihepatotoxic, antibacterial, and anticancer activities of A. marmelos have been well documented (Sharma et al., 2011b). It is effective in hypochondriasis, melancholia, and palpitation (Mazumder et al., 2006; Maity et al., 2009).

Pharmacological Activities

A. marmelos is one of the most frequently utilized medicinal and nutritional plants in the Rutaceae family. The different parts of this plant extract possess pharmacological activities like anticonvulsant, antioxidant, anti-inflammatory, antidiabetic, antidiarrheal, antihyperglycemic, anxiolytic, antidepressant, antihistaminic, antimicrobial, Hepatol protective, analgesic, immune modulatory, cardio protective and antithyroid.

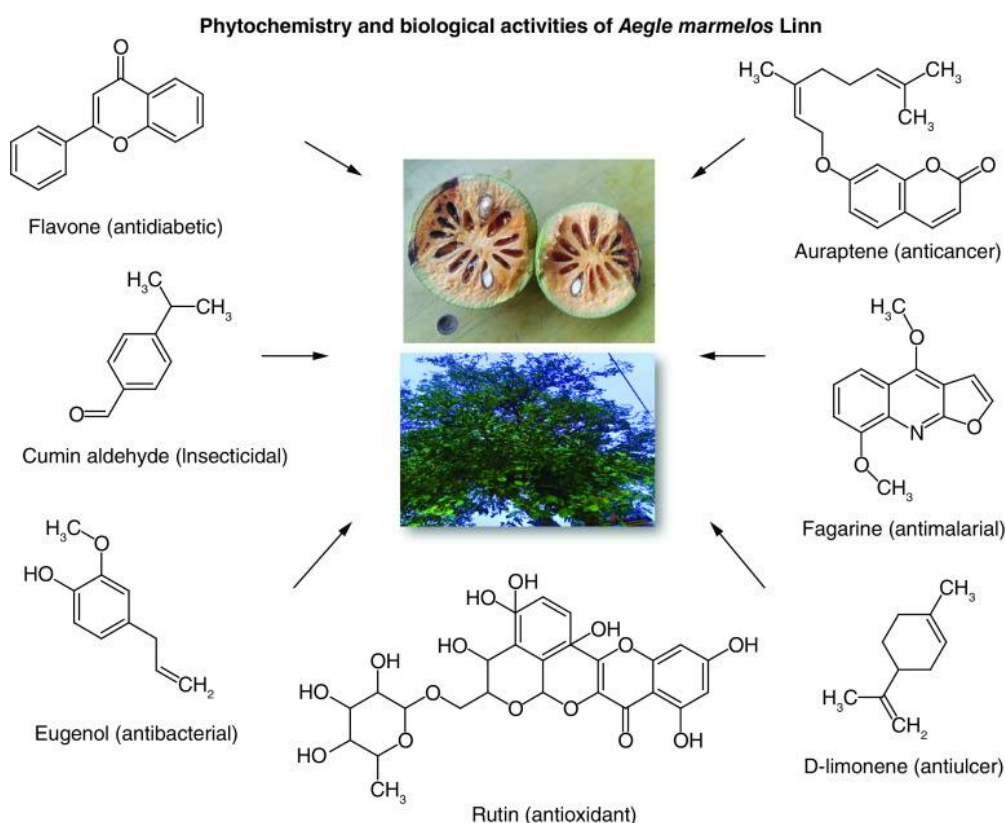


Figure 3: Phytochemistry and biological activities of Aegle marmelos Linn.

Anti-Cancer Activity

The *A. marmelos* of methanol and acetone extract of cytotoxicity against HEP-2, MDA-MB-231, and Vero cells were investigated. The IC₅₀ for the methanol extract of *A. marmelos* was 47.08 g/ml, whereas the IC₅₀ for the acetone extract of *A. marmelos* was 79.62 g/ml, making HEP-2 cells more sensitive to it. Both extracts of *A. marmelos* are toxic to cancer cells; however, Vero cells can survive 24 hours.^[10] In an *in-vivo* study, Swiss albino mice with Ehrlich ascites carcinoma received an intraperitoneal injection of a 400 mg/kg hydroalcoholic extract of *A. marmelos*. That significantly increased median survival time up to 28 days after tumor inoculation compared with the saline-injected control group.^[11] The rats were given Aegle marmelos ethanolic fruit pulp extract (200 mg/kg b.w./day) orally for 5 weeks after developing breast tumors (approximately 0.5 cm) and the amount of tumor was assessed. Treatment with Aegle marmelos resulted in a substantial reduction in breast tumor volume (P 0.05), as well as a substantial drop (P 0.0001) in serum biomarkers such as TNF-, serum malondialdehyde (MDA), and glucose levels. In a rat model, the ethanolic fruit pulp extract has anti-proliferative effect by slowing the progression of breast cancers.^[12]

Anti-Diabetic Activity

The lectin extract of *A. marmelos* fruit at a dose of 5 µg/mL enhanced glucose uptake through diffusion by 71.1% in yeast cells (Saha et al., 2016). Extract of *A. marmelos* leaf exhibited a significant reduction in oxidative stress by scavenging free radicals, preventing lipid peroxidation, and subsequently lowering elevated blood sugar in alloxan-induced diabetic rats (Sabu and Kuttan, 2004). Kamalakkannan and Prince (2003) studied the effect of oral administration of an aqueous extract of *A. marmelos* fruit in STZ-induced diabetic rats. The fruit extract (125 and 250 mg/kg p.o.), given twice daily for 4 days, led to a marked reduction of blood glucose (BG), thiobarbituric acid, hydroperoxide, ceruloplasmin, glycosylated hemoglobin, and alpha-tocopherol in blood. There was a substantial spike in reduced glutathione, liver glycogen, and vitamin C. Ethanol and water extracts of *A. marmelos* leaves administered for 28 days showed a 54% fall in BG and oxidative stress in alloxan-induced diabetic rats (Bhavani, 2014). The antidiabetic effect of water extracts of *A. marmelos* (75 mg/kg) plus *Withania coagulans* (100 mg/kg) was found to be higher than that of the individual extracts or even the standard drug glibenclamide indicating synergistic effects of these two extracts (Pande et al., 2014).

Anti-Diarrhoeal activity

Mazumder et al. performed *in vitro* and *in vivo* anti-diarrheal potential of chloroform extract of the root of *A. marmelos*. *In vitro* study was found that the extract was comparable to that of ciprofloxacin and mostly active against the strains of *Vibrio cholerae*, followed by *Escherichia coli* (*E. coli*) and *Shigella* spp.^[13] Also, it

was found that methanol extract of the fruits of *A. marmelos* decreased the intestinal propulsion in rats.^[14]

The unripe fruit pulp of *A. marmelos* affected the bacterial colonization to gut epithelium and production and action of certain enterotoxins. These suggest the varied possible modes of action of *A. marmelos* in infectious forms of diarrhoea thereby validating its mention in the ancient Indian texts and continued use by local communities for the treatment of diarrhoeal diseases.^[15,16]

Anti-inflammatory activity

Different organic extracts of the *A. marmelos* leaves possess highly significant acute and subacute anti-inflammatory activity.^[17] In acute and chronic inflammatory animal models, *A. marmelos* showed significant anti-inflammatory activity and it can be a promising anti-inflammatory agent.^[18] These activities may be due to the presence of lupeol and skimmianine in the leaves because both the compounds have shown the same potentialities in pure form. Activation of histamine receptor is essential for allergic and asthmatic manifestation. The alcoholic extract of *A. marmelos* leaves antagonized the histamine induced contractions and demonstrated positive relaxant effect in isolated guinea pig ileum and tracheal chain, suggesting inhibition of H1 receptor activity this extract may underlie these effects.

Anti-bacterial activity

Various extracts of *A. marmelos* leaves, roots and fruits have been reported to be active against many bacterial strains. There are several reports in the literature regarding the antimicrobial activity of crude extracts prepared from plants.^[19,21] In 2009, Venkatesan et al. showed that aqueous and ethanolic extract has activity against *E. coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Bacillus subtilis*. The ethanolic extract showed considerably more activity than the aqueous extract. Maximum antibacterial activity was shown against *Bacillus subtilis* followed by *Staphylococcus aureus*, *E. coli* and *Pseudomonas aeruginosa*.^[22] Jyothi and Rao showed that hexane, cold methanol and hot methanol extracts have inhibited *Klebsiella pneumoniae*, *Micrococcus luteus*, *Enterococcus faecalis* and *Streptococcus faecalis* growth *in vitro*. They also found that these three extracts have no effect on *E. coli* and *Proteus vulgaris*.^[23]

Anti-malarial activity

The alcoholic extracts of the *A. marmelos* seeds and leaves have been tested *in vivo* and *in vitro* for antimalarial activity against the NK65 strain of *Plasmodium berghei*. The seeds have shown schizontocidal activity in both the system, whereas, the leaves have shown activity only in the *in vitro* system.^[24]

CONCLUSION

Aegle marmelos (Bael tree) is a significant medicinal plant deeply rooted in traditional Indian medicine and culture. It possesses a wide range of therapeutic properties, including anti-inflammatory, anti-diabetic, antioxidant, and anti-cancer activities. The plant's various parts, such as the leaves, fruit, and bark, are rich in phytochemicals like flavonoids, alkaloids, and coumarins, which contribute to its extensive medicinal uses. Traditionally revered in Ayurveda and Hindu practices, *Aegle marmelos* is not only valued for its spiritual significance but also for its proven pharmacological benefits. Modern scientific studies support its traditional uses, demonstrating the plant's potential in treating conditions like cancer, diabetes, and gastrointestinal disorders. Despite these promising findings, further research is necessary to fully understand its mechanisms and to establish standardized therapeutic protocols. The Bael tree, therefore, represents a powerful example of how ancient wisdom and modern science can converge to enhance health and well-being.

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