A review on phytochemical and pharmacological values of Aegle marmelos

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INTRODUCTION:

Bael produces numerous phytochemicals that make it helpful in several illnesses, such as alkaloids, tannins, essential oils, gums, resins, coumarin, polysaccharide. The nutritional aspect, compared to other fruits, is much more essential. It is also of great significance to the environment. It serves as a climate purifier; in contrast to other plants, it releases a greater percentage of oxygen. It has various primary therapeutic applications such as antifungal, analgesic, anti-inflammatory, antipyretic, hypoglycemic, anti-lipidemic, and resistant, anti-proliferative, wound, anti-fertility and insecticidal healing. With the aid of various post-harvest technologies, the fruits are also used to make a variety of items such as candy, toffee, jelly, juice, and so on. These innovations aid in the reduction of post-harvest losses, extending the shelf life of Bael products. It is therefore a good source of income for a needy farmer.1 The purpose of this analysis is to understand the phytochemical parameters, conventional uses and creative Bael fruit applications.

Botanical Description

Species: Aegle marmelos

Aegle marmelos is a medium-sized, slow-growing tree with a short trunk, dense, fuzzy, flaking bark, up to 12-15 m tall, and spreading with spiny branches. A clear, gummy sap, similar to arabic gum, exudes from wounded branches and hangs in

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long threads, eventually becoming solid. At first taste, it is sweet and then unpleasant to the mouth.4

**Leaves:** The deciduous, alternating leaves, single or 2’s or 3’s, are composed of 3 to 5 oval, pointed, shallowly toothed leaflets, 4-10cm long, 2-5cm thick, long-petiole terminal one. When bruised, mature leaves emit a disagreeable odour.5

**Flowers:** Flowering occurs shortly after the new vacation in April and May. Fragrant flowers have 4 curved, fleshy petals, green outside, yellowish within, and 50 or more greenish-yellow stamens in clusters of 4 to 7 along a young branch.4

**Fruits:** The fruit, which is round, pyriform, oval, or oblong in shape and has a diameter of 5-20 cm, may have a thin, rough, woody shell or a gray-green rind that is more or less soft until fully ripe and becomes yellowish when fully ripe. It’s lined with aromatic, minute oil glands. There’s a hard central core inside, as well as 8 to 20 faintly shaped triangular segments with thin, dark-orange walls and aromatic, pale orange, pasty, sweet, resinous pulp that’s more or less astringent. The fruit takes 10 to 11 months to mature from bloom to ripening. Fruits contain 61.5 g of water, 1.8 g of protein, 0.39 g of fat, 1.7 g of minerals, 31.8 g of carbohydrates, 55 mg of carotene, 0.13 mg of thiamine, 1.19 mg of riboflavin, 1.1 mg of niacin and 8 mg of vitamin C per 100 g of food. The Bael fruit, with its richest source of riboflavin, is highly nutritious.1

**Seeds:** 10 to 15 flattened-oblong seeds are contained in the pulp. The seeds are about 1 cm long, with woolly hair and each enclosed in a sack of clear, sticky mucilage that solidifies when dried.7

**Chemical composition:**

*Aegle marmelos* have a number of compound groups, such as alkaloids, cardiac glycosides, saponin, hormones, coumarins (marmelosin, marmesin, marmin, imperatorin, scopoletin), terpenoids, phenylpropenoids, tannins, flavonoids, and polysaccharides. There are γ-sitosterol, aegelin, lupeol, rutin, marmesinin, β-sitosterol, flavone, glycoside and phenylethyl cinnamides in the leaves of *Aegle marmelos*. Shahidine, an alkaloid with an oxazoline centre, was isolated from the fresh leaves of *Aegle marmelos* as a major component and demonstrated activity against a few Gram-positive bacteria.8
Halfordino, ethylcinnamade, and marmelin are new alkaloids discovered in the leaves of *Aegle marmelos*. *Aegle marmelos* leaves have recently yielded a number of phenylethyl cinnamides, including new compounds called anhydromarmelaine, agelinosides A and B, which are -glucosidase inhibitors. The common component of the essential oil from leaves, twigs and fruits was found to be al-Phellandrene, which is terpenoid. Leaf oil registered alpha-phellandrene (56%) and p-cymene (17%). The main constituent of bael leaves that are characteristic markers for the identification of *Aegle marmelos* oil samples was confirmed to be Limonene (82.4%). Approx there is. In contrast to the cultivated form, 9% tannin in the pulp of wild fruits. Like skimmianine, also known as 4, 7, 8-trimethoxyfuro-quinolone, tannin is also found in leaves. Hydroxycoumarins, phenylpropanes and lignans were contained in the phenylpropanoids. It's lined with aromatic, minute oil glands. There's a hard central core inside, as well as 8 to 20 faintly shaped triangular segments with thin, dark-orange walls and aromatic, pale orange, pasty, sweet, resinous pulp that's more or less astringent. The fruit takes 10 to 11 months to mature from bloom to ripening.9

**Therapeutic Uses and Pharmacology**

**Anti-cancer Activity:**

Breast cancer is among the world’s most common types of cancer. It is also the leading cause of death in female cancer patients around the world. Despite multiple clinical approaches, it is nevertheless related to a high mortality rate. *Aegle marmelos* (L.) Correa is widely used in the Indian Ayurveda medicine system due to its unique medicinal properties. However, there are few reports on its efficacy in the fight against cancer. The aim of this study was to see if in rats induced by 7,12-dimethylbenz(a)anthracene, *Aegle marmelos* fruit extract could prevent breast cancer (DMBA). The rats were female Charles Foster rats, aged 55-60 days and weighing around (150 ± 10) g, and they were given DMBA (20 mg/mL dissolved in olive oil) orally. The rats were given *Aegle marmelos* ethanolic fruit pulp extract (200 mg/kg b.w./day) orally for 5 weeks after developing breast tumors (about 0.5 cm), and the tumor volume was assessed. The volume of mammary tumors was significantly reduced (P<0.05) after treatment with *Aegle marmelos*, as were various serum biomarkers such as TNF, serum malondialdehyde (MDA), and glucose levels (P<0.0001). After treatment with *Aegle marmelos* ethanolic fruit pulp extract, both kidney and liver serum biomarker parameters improved significantly (P<0.0001). Taking all into account, the ethanolic fruit pulp extract of *Aegle marmelos* has anti-proliferative potency in the rat model, suppressing the growth of breast tumors. Hepatoprotection is another advantage of the plant extract. As a result, it may be used to treat breast cancer as a new and successful anti-cancer drug.11 Taking all into account, it can be concluded that *Aegle marmelos* ethanolic fruit pulp extract has anti-proliferative efficacy by suppressing the development of breast tumors in the rat model.12

**Antihyperglycemic activity:**

The author gave diabetic rats *Aegle marmelos* leaves extract @500 mg/kg to test hypoglycemic and antioxidant impact. Male albino rats were divided into three groups at random: Group I, Group II, and Group III, which included control, diabetic, and diabetic extract rats, as well as A extract rats. *A. Marmelos* they observed that there was a drop in blood glucose in group III animals at the end of four weeks relative to group I.13 *A. Marmelos*, like insulin, is effective in restoring normal blood glucose and body weight. According to new study, the leaf juice from *A. Marmelos* was effective in diabetes mellitus, which may be attributed to the presence of bioactive components such as agelin, scopoletin, and sitosterol in the leaves.14,15

**Anti-Diarrhoea and dysentery Activity:**

Half-mature or unripe fruit serves as a cure in the case of chronic diarrhoea and dysentery without fever. Half-ripe fruit is considered best for the task, but successful results have been shown by fully ripe fruits or even fruit powder. It is sliced, dried and ground into powder while the fruit is still unripe. By baking and then eating brown sugar or jaggery, the unripe fruit can also be eaten. The amount of blood passed into the faecal matter decreases after use of fruit, and the faecal matter gets a more stable form.16,17

**Anticonvulsant activity:**

Extract from the aqueous leaves of *A. marmelos* has anticonvulsant efficacy against seizures caused by pentyleneetetrazole in mice. The anticonvulsant function of the extract of a aqueous leaves *A. marmelos* was attributed to the existence of mass spectrometry detected by liquid chromatography of Lupeollinolate, Skimmianine, Eugenol. Ethanolic leaf extract from *A. marmelos* reveals anticonvulsant activity due to flavonoid presence and interferes with the anticonvulsant activity of the GABAergic mechanism.18,19

**Antimicrobial activity:**

It is confirmed that *A. marmelos* are traditionally used to inhibit a wide variety of pathogenic microorganisms for the treatment of different infectious diseases. Antibacterial activity of leaves and fruit extract A was evaluated by the reviewer. *A. marmelos*. Inhibition zones of 11 mm and 9 mm were observed when leaf and fruit extracts were used against *Routella plantikola*. The plant extract *Penicillium chrysogenum* provided the maximum inhibition zone (18 mm) activity against fungal strains and the minimum inhibition zone (10 mm) activity against Candida albicans (7mm).20

**Anxiolytic and antidepressant:**

Extract from the methanolic leaves of *A. marmelos* has anxiolytic and antidepressant activity, and imipramine and fluoxetine improve anxiolytic and antidepressant activity.21

**Antioxidant activity**

Antioxidants have the potential to defend cells from oxidative stress through scavenging free radicals. Flavones, isoflavones, flavonoids, anthocyanins, coumarins, lignans, catechins, and isocatechins are all antioxidants found in these plants. Antioxidant activity against a variety of free radicals is well established in these plants. Antioxidant activity against a variety of free radicals is well established in *A. marmelos*. Another research found antioxidant activity in A. leaf extract. A marmelos was responsible for the high levels of total phenolic content (TPC) and total flavonoid content (TFC) in the extract.22,23

**Anti-inflammatory activity**

The author has tested the anti-inflammatory, antipyretic and analgesic efficacy of various extracts of *Aegle marmelos* leaves. The extracts provided a substantial inhibition of paw edema induced by carragenin and cotton pellet granuloma in rats. The leaves, due to the presence of luponed, skimmianine, displayed anti-inflammatory properties.24,25

**Analgesic activity**

At doses of 200 and 300 mg/kg, extract from the methanolic leaves of *A. marmelos* showed substantial analgesic activity...
in mice in acetic acid-induced writhing and tail flick studies.\textsuperscript{26}

**Antifungal activity**

According to research by Rana et al. (1997), essential oil from *Aegle marmelos* leaves can interfere with the metabolism pathway of Ca\textsuperscript{2+} dipicolonic acid and may inhibit the development of spores at a concentration of 500 ppm. Extract of A. ethanolic, methanolic and water leaves. *A. marmelos* has antifungal action against fungal dermatophytes.\textsuperscript{27}

**Neuroprotective activity**

In male rats, an extract of ethanolic leaves from *A. marmelos* displayed neuroprotective effects against streptozoxine-induced cognitive impairment. In addition, the extract inhibited acetylcholinesterase activity in the brain (AChE). AChE inhibition decreases the effects of cognitive deficits by increasing acetylcholine levels.\textsuperscript{28}

**Anti-ulcer activity**

Methanolic extract of *Aegle marmelos* unripe fruit decreased gastric ulceration and prevented oxidative stress in rats caused by Helicobacter pylori-Lipopolysaccharide. The presence of luvangetin, which reduces oxidative stress in the gastroduodenal mucosa, contributed to the extract’s gastroprotective impact. Some other research has indicated the ripe fruit of *A*. The antisecretory and cytoprotective property of *A. marmelos* protects gastric mucosa in NSAID induced ulceration in rats (Singh and Guha, 2012). Methanolic and aqueous extract of fruit seeds from *A. Marmelos* demonstrated antiluercer activity due to the presence of the compound quercetin.\textsuperscript{29,30}

**Antiviral activity**

Antiviral activity against the Randilhet disease virus was demonstrated by the ethanolic Bael fruit extract. Bael fruit produces marmilide, the most powerful viricidal agent that interferes with the replicating period of early events.\textsuperscript{31}

**Immunomodulatory activity**

Methanolic leaves have been found to extract *A*. In rats, *A. marmelos* activate cell-mediated and antibody-mediated immune responses, but the low dose of *Aegle marmelos* methanolic extract was found to be most effective in cell-mediated immune responses, whereas the high dose was the most effective in humoral immunity.\textsuperscript{32,33}

**Diuretic**

Sharma GN et al observed that, at a higher dose (500mg/kg), ethanolic extract induces a substantial increase in sodium excretion. An effective solvent is also present in petroleum ether, chloroform and ethyl acetate fractions.\textsuperscript{30}

**Antifertility**

Ethanolic leaf extracts from *A. marmelos*. The motility of the sperm had a major effect on *A. marmelos*. Increased concentration of extracts has also been suggested to reduce sperm motility.\textsuperscript{30}

**Toxicological studies**

From the leaves of *A*, complete alcoholic, total aqueous, whole aqueous and methanolic extracts were obtained. However, no adverse effects up to a maximum dose of 250 mg/kg body weight have been recorded with *marmelos*.\textsuperscript{34}

**Constipation**

As the best of all known laxatives, ripe fruit has been considered. The administration of ripe fruits cleans and tones the intestines in the event of constipation. Its daily usage for 2-3 months was successful in eliminating old and accumulated faecal matter from the intestines. The pulp of ripe fruit is crushed and created into a sherbet for the best results. To decrease the bitterness, seeds are omitted and sugar and/or milk can be added to make it more palatable.

**Conclusion:**

The therapeutic and medicinal value of the Bael fruit is high. Bael’s revolutionary commercial goods need to be exploited by preventing post-harvested fruit losses in order to process them into suitable products. These food products would benefit customers because of their nutritional value and their therapeutic significance. In order to find out the viewpoint on the globalisation of the Bael tree, the present analysis elaborates different therapeutic and creative approaches. For the betterment of the health care system, there is a need to create, preserve and encourage conventional medicines.

**References:**


