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Review Article

A review on pharmacological and phytochemical properties of *Aegle marmelos* plant

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ABSTRACT

Bael (*Aegle marmelos*) is an economically valuable tree species. Bael possesses many medicinal values and therefore used as an ingredient in ayurvedic herbal medical preparations. Aegle marmelos is one of the important plant with several medicinal and neutraceuticals properties. Traditional system of medicine consists large number medicinal plant, which conveyed their potential therapeutic utilities. Aegle marmelos is commonly known as bael. Its belong to the Rutaceae Family, widely grown in india, Tropical and subtropical countries.

Extensive investigation has been carried out on different parts of Aegle marmelos, varied classes of compound viz.., fatty acid, Terpenoids, amino acids, alkaloids, and Coumarins have been isolated from its different parts.

Keywords: - Bael, *Aegle marmelos*, Rutaceae, Phytochemistry

1.1 INTRODUCTION

Aegle marmelos belonging to family Rutaceae, is commonly known as Wood apple. The bael is one of the sacred trees of Hindus. Leaves are offered in prayers to Shiva and Parvathi since ancient times. [(1)] Plants have been utilized as a natural source of medicinal compounds since thousands of years. Human is using numerous plant and plant derived products to cures and relief from various physical and mental illness.

These plant are used in traditional Chinese, Ayurveda, Siddha, Unani, and Tibetan medicines. [(3)] In last five decades, these plants have been extensively studied by advanced scientific techniques and reported for various medicinal properties eg., anticancer activity, antibacterial activity, antifungal activity, antidiabetic activity, antioxidant activity, hepatoprotective activity, anti-inflammatory activity, etc. [(2-4)]

- **Plant Profile: -**

Aegle Marmelos.

Fig 1.1 Aegle marmelos plant

Plant description: -

Aegle marmelos could be a slow-growing, medium-sized tree, up to 13 m (43 feet) tall with short trunk, thick, soft, flaking bark, and spreading, sometimes spiny branches, the lower ones drooping. Young suckers bear many stuff, straight spines. The deciduous alternate leaves, borne singly or within the group, are composed of three to five oval, pointed one with a protracted petiole.

Plant being important sources of natural antioxidants, their importance for as food additives or nutritional supplements has already been established. [5] The search for safe and effective naturally occurring antioxidants is now focused on edible plants especially spices and herbs. The literature is replete with reports of extracts from natural sources like spices, herbs and hulls that have demonstrated strong antioxidants activity. The antioxidant activity of some medicinal plants in food and biological systems in poorly investigated. In the present review, an attempt has been made to gather information on the phytochemical and pharmacological activities of an important medicinal plant *Aegle marmelos.*

Leaves of *Aegle marmelos:* -

Bael has an important place in the traditional systems of medicine the Ayurveda. The leaves, roots, bark, fruits and the seeds are reported to possess diverse medicinal properties and to cure various human ailments and diseases. The leaves are supposed to be the most useful in the treatment of fever, to stop abdominal pain, intermittent fever, allay urinary troubles, palpitation of the heart, dysentery, stomachalgia, seminal weakness, vomiting, fever and swelling. Leaves are used as mild laxative or the inflammation of the mucous membrane having a free discharge and for asthma. A hot poultice of the leaves is applied in opthalmia or severe inflammation of conjunctiva with acute bronchitis and inflammation of the other body parts.

Fig 1.2 Leaves of *Aegle marmelos*

Fruits and Seeds of *Aegle marmelos: -*

Fruits, yellowish green, with small dots on the outer surface, oblong to globose, 5.3 cm to 7.2 cm in diameter; weight 77.2 g; volume, 73.7 ml; pulp, yellow and mucilaginous, the pulp of dried fruits retain its yellow, and also remains intact; rind woody, 4 to 5 mm thick [18].

Fig 1.3 Fruit and seeds of *Aegle marmelos*.

Flower of *Aegle Marmelos: -*

Flowers are greenish white in colour and sweetly scented in nature and have bisexual, actinomorphic, ebracteate, hypogynous stalk. The stalk is about 8 mm long and has a diameter of a fully open flower of about 1.8 calyx. The flowers are born in lateral panicles of about 10 flowers, arising from the leaf axil. The calyx is gamosepalous, five-lobed, pubescent, light green, very small in comparison with petals. The corolla is polypetalous, with 5 petals, imbricate, leathery and has pale yellow colour from above and green colour from beneath and length is about 4 mm. The androecium is polyandrous, numerous, basified and 4 mm long, dehiscing longitudinally. The gynoecium is light green in colour and about 7 mm long, having capitate sigma and terminal style.

Fig 1.4 Flower of *Aegle Marmelos*

Soil type: -Bael is claimed to try and do best on rich, well-drained soil, but its grown well and fruited on the oolitic limestone of southern Florida. It also grows well in swampy, alkaline or stony soils having pH range from 5 to 8. In india, it's the reputation of thriving where other fruit trees cannot survive.

Tree management: - The tree has no exacting cultural requirements, doing well with a minimum of fertilizer and irrigation, The spacing in orchards 6-9 m between trees. Seedlings begin in touch in 6 to 7 years, vegetatively propagated tress in 5 years. Full production in reached in 15 years. Normally, the fruit is harvested when yellowish-green and kept for 8 days while it loses its green tint.

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Table no. 1 Different name of *Aegle marmelos*

Language	Vernacular name
English	Bengal quince, Bael fruit, Golden apple, Indian quince, stone apple.
Tamil	Aluvigam lyalbudi, Kuvilam, Mavilangai, Vilwam, Villuvam
Telugu	Bilvamu, Maluramu, Maredu
Hindi	Bael, Bili, Sirphal and Bela
Sanskrit	Adhararutha, Asholam, Bilva, Atimangaliya.
Bengal	Bael, Bel

Gujarat	Billi,
Kannada	Bela, Bilva
Malayalam	Koovalam, vilwam
Orissa	Belo

Traditional use of *Aegle marmelos:* -

- **Leaves [7]:** -Leaves are used as mild laxative or the inflammation of the mucous membrane having a free discharge and for asthma. The decoction of the leaves is febrifuge, or help in eliminating fever and is an expectorant, or promotes the removal of mucous secretion from the bronchial tubes. The leaf juice is given in dropsy or the abnormal accumulation of liquid in the cellular tissue accompanied with constipation and jaundice.
- **Roots [8]:** -The decoction of the root and sometimes the stem bark is useful in intermittent fever, also in hypochondriasis and palpitation of the heart. The decoction of root is given with sugar and fried rice for checking diarrhea and gastric irritability in children.
- **Fruit [9] [10]:** -Fruit is eaten during convalescence after diarrhea. It is valid for its mild astringency and as remedy for dysentery. The traditional healers of southern Chhattisgarh use dry powder of fruit with mustard oil for the treatment of burn cases. One part of powder and two part of mustard oil are mixed and are applied externally. Fruit are also used in gastric troubles, constipation, laxative, tonic, digestive, brain and heart tonic ulcer, antiviral.
- **Ripe fruit [9] [11]:** -The ripe fruit promotes digestion and helpful in treating inflammation of rectum. The ripe fruit extract showed antiviral activity against ranikhet disease virus.
- **Unripe fruit [8] [10]:** -Fine powder of unripe fruit showed significant effect on intestinal parasite and also effective against *Entamoeba histolytica* and *Ascaris lumbricoides.*
- **Flower [11]:** -Distillation of flowers yielded a drug used as tonic for stomach and intestine, anti-dysenteric, antidiabetic, and also local anaesthetic.

Chemical constituents: - [12]

- **Alkaloids:** - The alkaloids comprise the largest single class of secondary plant substances. new alkaloids from the leaves of aegle Marmelos were reported via, ethyl cinnamamide, O-3,3-(dimethylallyl) halfordinol, N-2-methoxy-2 - [4- (3,3- dimethyl allyl) phenyl] ethyl cinnamamide etc.
- **Terpenoids:** - The essential oil of aegle Marmelos correa leaves were studied very much extensively in india by various workers since 1950. A-Phellandrene was found to be the common constituent to the essential oil from leaves, twigs and fruits.
- **Tannins:** - The extreme tannin content in bael fruit was recorded in January. There is as much as 9% tannin in the pulp of wild fruits. Less in cultivated type. Tannin is also present in leaves as skimmianine, it is also named at 4, 7, 8, - trimethoxyfuro-quinoline.
- **Coumarins:** - Marmelosin, marmesin, Imperatorin, marmin, alloimperatorin, methyl ether, xanthotoxol, scopoletin, scoparone, umbelliferone, psoralen, and marmelide have also been reported.

- **Polysachharides:** -Galactose, arabinose, uronic acid and L-rhamanose are obtained from on hydrolysis.
- **Flavonoids:** - Mainly includes Rutin, Flavone, flavan-3-ols, flavone glycosides

Pharmacological Use: -

1) Chronic diarrhea
2) Dysentery and peptic ulcers
3) Cure for respiratory infections
4) Anti-inflammatory
5) Treat diabetes
6) Respiratory problem
7) Antioxidant
8) Anticancer
9) Antibacterial

Table no.2 Scientific classification [6]: -

Kingdom	Plantae
Clade	Tracheophytes
Clade	Angiosperms
Clade	Eudicots
Clade	Rosids
Order	Sapindales
Family	Rutaceae
Subfamily	Aurantioideae
Genus	Aegle
Species	Aegle Marmelos

Scientifically reported activities: -

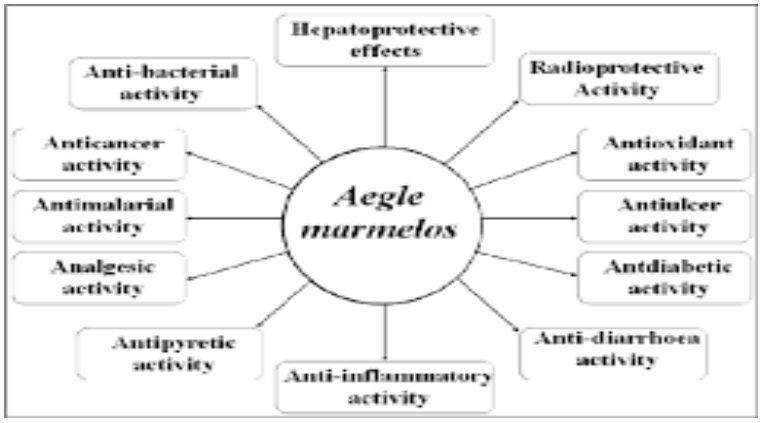

Fig 1.5 Scientifically reported activities of *Aegle marmelos*

- **Antibacterial activity [13]: -**Antimicrobial activity of different leaf extract such as petroleum ether, dichloromethane, chloroform, ethanol and Aqueous extract of aegle Marmelos leaves were tested against selected Gram positive and Gram negative bacteria. Result depict that phytochemical extracts of aegle Marmelos exhibited significant anti-bacterial activity. However, the inhibitory activity was found to be both organism and solvent dependent. Chloroform and ethanol leaf extract of aegle Marmelos was found to be more active towards the bacterial species tested. Further, the aqueous leaf extract was moderately active followed by dichloromethane extract. However, petroleum ether extract was not effective against any of the organisms tested. Growth of *Lactobacillus bulgaris* and *Bacillus cereus* was not inhibited by any of the tested leaf extracts of *Aegle Marmelos.*
- **Antimicrobial Activity [14]: -**Ethanolic extract of dried fruit pulp of aegle Marmelos against various intestinal pathogens i.e., *Shigella boydii, S, sonnei & S. Flexneri* and proposed that certain phytochemical including phenols. Tannins and Flavonoids were effective against all. It was also confirmed by *Kaur et al, (2009)* by getting treat *E. Coli* with Aegle Marmelos fruit extract. In consonance, *citarasu et al, (2003)* also experimented Aegle Marmelos on certain pathogenic bacteria like *Salmonella typhi, Pseudomonas aeruginosa, Aeromonas hydrophlya & Vibrio sp.., and* concluded its positive bacteriocidal effects.
- **Hepatoprotective activity: -***Singanan et al, (2007)* worked on Aegle Marmelos extract on alcohol induced liver injury in albino rats and presented data of excellent hepatoprotective effects. Similarly, Ramnik S (2008), also demonstrated that aqueous extract of bael fruit pulp and seeds are effective in the treatment and prevention of CCl4 induced hepatic activity.
- **Analgesic, Anti-inflammatory & antipyretic Activity: -**Arul et al, (2005) presented anti-inflammatory, antipyretic and analgesic properties of serial extract of Aegle Marmelos and presented that most of the extract cause a significant inhibition of the carrageenan-induced paw oedema and cotton-pellet granuloma in rats. The extracts also produced marked analgesic activity by reduction the early and late phases of paw licking in mice. A significant reduction in hyperpyrexia in rats was also produced by the most of the extracts. Similarly, Ghangale G. R (2008) also evaluated aqueous extract of Aegle Marmelos for anti-

inflammatory activity by using rat paw oedema model and proposed that Aegle Marmelos posseses anti-inflammatory activity. Shankharananth v.., (2007) demonstrated that methanolic extract of Aegle Marmelos at a dose level of 200 and 300 mg/kg show significant analgesic activity on acetic acid induced writhing and tail flick test in mice.

- **Anticancer activity [15]:** -Leticia V and costa L.., (2005), evaluated the anticancer potential of folk medicine used in Bangladeshi and used extracts of aegle Marmelos for cytotoxic action using brine shrimp lethality assay; sea urchin egg assay, and MTT assay using tumor cell lines. The extract of Aegle Marmelos was found to exhibited toxicity on all used assays. Similarly, Gagetia G.C. et al (2005) reported the anticancer effect of hydroalcoholic extract of bael in the animal model of Ehrlich ascites carcinoma and proposed that induction of apoptosis may be due the presence of skimmianine in extract.
- **Radioprotective Activity [16]: -** Radioprotective effect of *Aegle Marmelos* extract was studied by Jagetia GC and Venkatesh P (2005) by exposing to different doses of gamma-radiation in mice and found that oral administration of extract resulted in an increase in radiation tolerance by 1.6 Gy. Again, Jagetia GC and coworkers (2006), studied effect of plant extracts on the peripheral blood and small intestine of Swiss albino mice. They exposed the animals to gamma radiation and data were collected against radiation-induced changes in the peripheral blood, spleen colony forming units, and intestinal mucosa, reported that Aegle Marmelos extract significantly reduces that deleterious effect of radiation in intestine and bone morrow of mouse.
- **Antifungal Activity:** -Patil R. H (2009) reported the antifungal activity of ethanolic extract of the Aegle Marmelos including antidiarrhoeal antimicrobial activities.
  Rana B. K. (1997) evaluated anti-fungal activity of essential oil isolated from the bael using spore germination of all the fungi tested was observed at 500ppm. They proposed that essential oil from bael may interfere with the Ca^{2+} dipicolonic acid metabolism pathway and possibly inhibit the spore formation.
- **Anti-ulcer Activity: -**Goel R. K (1997) reported that oral; administration of pyranocoumarin isolated from the seeds of Aegle Marmelos Correa, showed significant protection against pylorus-ligated and aspirin-induced gastric ulcers in rats and cold restraint stress-induced gastric ulcers in rats and guinea pigs. Dhuley J. N; (2007), reported that pretreatment of rats with unripe bael fruit extract produce a significant inhibition of absolute ethanol induced gastric mucosal damage.

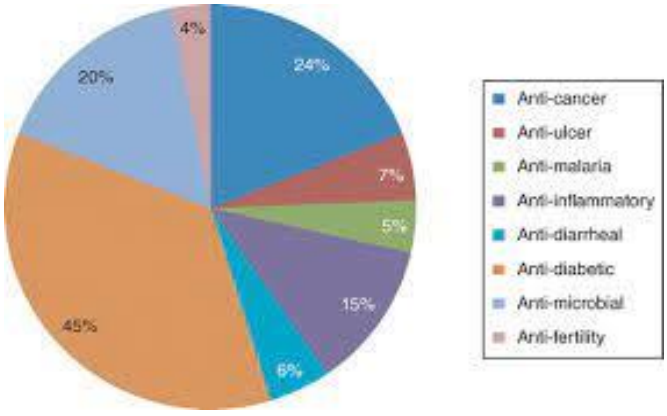

Fig 1.6

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