



REVIEW ARTICLE

A REVIEW ON *AEGLE MARMELOS*: PHYTO-PHARMACOLOGICAL PROSPECTIVE

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ABSTRACT:

Aegle marmelos Linn as locally known as bell belonging family Rutaceae. It is medium sized tree growing throughout the forest of India of altitude 1200 meter. A number of chemical constituents and various therapeutic effects of leaves of *Aegle marmelos* have been reported by different scientist. Extensive investigations have been carried out on different parts of *Aegle marmelos* and as a consequence, varied classes of compound viz., alkaloids, coumarins, terpenoids, fatty acids and amino acids have been isolated from its different parts. potential pharmacological activity of the leaves are hypoglycemic, anti-inflammatory, antimicrobial, anticancer, radioprotective, chemopreventive and anti-oxidative activity.

Keywords: *Aegle marmelos*, Bael, Phytochemical and Pharmacological.

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INTRODUCTION:

Bael known botanically as *Aegle marmelos* finds its mention in various relord Shiva and that place is known as Bilkeshwar temple. Bilva is a medium sized tree having white fragrant flowers. At the end of spring season its leaves start falliigious and Ayurvedic texts of India. It is also known by the name of bilva. Its leaves are used for worshiping Lord Shiva. It is believed that Pārbati ji worshiped under the *Bilva* tree for three thousand years in Haridwar to get married to Ling and in summer there are new leaves and flowers on it. The uniqueness of bael fruit lies that

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it is used in its raw form i.e. it is detached from the tree before it is ripened. *Shiva Purana* says that a person who serves and feed milk, ghee and cereals to a hungry devotee of Lord Shiva on roots of its tree, he never faces poverty in his life. these plants have been extensively studied by advanced scientific techniques and reported for various medicinal properties viz, anticancer activity, antibacterial activity, antifungal activity, antidiabetic activity, antioxidant activity, hepatoprotective activity, haemolytic activity, larvicidal activity and anti-inflammatory activity etc.¹

Botanical Name: *Aegle marmelos*

Common Name: bael



Figure of *Aegle marmelos*

Classification

Kingdom: Plantae

Subkingdom: Tracheobionta

Division: Magnoliophyta

Class: Magnoliopsida

Subclass: Rosidae

Order: Sapindales

Family: Rutaceae

Genus: *Aegle*

Species: *marmelos*

Different Names

English (Bael fruit, Indian bael, holy fruit, golden apple, elephant apple, Indian quince, stone apple); Burmese (Opesheet, ohshit, bel Indian); German (Belbaum, Schleimapfelbaum); French (Oranger du Malabar, cognassier du bengale, bel Indian); Gujrati (Billi); Hindi (baelputri, bela, sriphal, kooralam); Indonesian (maja batuh, maja); Japanese (modjo); Thai (matum, mapin, tum); Vietnames (tar imam, mbau nau) Arab (Bull, Quiththa el hind); Urdu (bel); Tamil (Vilvam); Sanskrit (Bilwa, sriphal); any few other names are there to identify bael tree in different parts of world. ^{2,3}

Habitat and Distribution

The bael tree has its origin from eastern ghat and central India. It is native to India and bael tree is usually available in the range of Himalaya to west Bengal, in central and south Asia. It grows around foot hill of Uttar Pradesh, Bihar, Chhattisgarh, Madhya Pradesh, Uttaranchal, Jharkhand, The Deccan Plateau, the East coast, Myanmar, srilank. ^{4,5}

Morphology

A small to medium-sized aromatic tree, deciduous; stem and branches, light brown to green; strong auxiliary spines present on the branches; the average height of tree, 8.5 meters.

Leaves

are alternate, pale green, trifoliate; terminal leaflet, 5.7 cm long, 2.8 cm broad, having a long petiole; the two lateral leaflets, almost sessile, 4.1 cm long, 2.2 cm wide, ovate to lanceolate having reticulate pinnate venation; petiole, 3.2 cm long.



Figure of leave

Leaflets

Are ovate or ovate-lanceolate, margins crenate, apex acuminate, glabrous and densely minutely glandular-punctuate on both surfaces; lateral leaflets to 7 cm long and 4.2 cm wide, petiolules 0-3cm long.

Flower

Greenish white, sweetly scented, bisexual, actinomorphic, ebracteate. hypogynous, stalked; stalk, 8 mm long; diameter of a fully open flower, 1.8 cal; flowers, borne in lateral panicles of about 10 flowers, arising from the leaf axil; calyx, gamosepalous, five-lobed, pubescent, light green, very small in comparison with petals; corolla polypetalous, with 5 petals, imbricate, leathery, pale yellow from above and green from beneath, length 4 mm; androecium, polyandrous, numerous, basifixed, 4 mm long, dehiscing longitudinally; gynoecium, light green, 7 mm long, having capitate stigma and terminal style.



Figure of flower

Stamens

Numerous- another elongate, apiculate- filaments free or fascicled, inserted round an inconspicuous disk. Ovary ovoid, cells 10-20; style terminal, short, deciduous; stigma capitate; ovules numerous, 2-seriate.

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 retains its yellow, and also remains intact; rind woody, 4 to 5 mm thick.



Figure of fruits

Seeds

numerous, embedded in the pulp, oblong, compressed, white, having cotton-like hairs on their outer surface. seeds numerous, oblong, compressed, embedded in sacs covered with thick, orange coloured sweet pulp root bark is 3 to 5 cm thick covered, with creamy yellowish surface. It has a firm leathery texture, a sweet taste and fracture is fibrous. Stream bark is extremely gray and internally cream in colour. The outer surface is rough warty due to a number of lenticels, ridges and furrows. It is 4-8 mm thick, film in texture and occurs as flat or channeled pieces⁶. The fracture is tough and gritty in outer region and fibrous in the inner.⁵The taste is sweet and there is no characteristic odour.



Figure of seed

Chemical constituents

Various chemical constituents were found in bael like alkaloids, coumarins, steroids, polysaccharides, tannins, carotenoids etc.

Alkaloid: Agelin, aegelenine, marmeline, dictamine, fragrine, O-methylhalfordinine, O-isopentanylhalford iniol, N-4-methoxy styryl cinnamide.

Coumarin: Marmelosin, marmesin, imperatorin, marmin, alloimperatorin, methylether, xanthotoxol, scoparone, scopoletin, umbelliferone, psoralen and marmelide.

Polysaccharide: Galactose, arabinose, uronic acid and L-rhamnose was obtained on hydrolysis.

Tannin: Tannin was also present in leaves and fruit as skimmianine. Carotenoids were also reported, which impart pale colour to fruit

Seed oil: Composed of palmitic, Stearic, oleic, linoleic and linolenic acid. The fruit pulp contains 60.7 per cent moisture. The pulp contains 0.46 per cent acidity, 8.36 per cent total sugars, 6.21 per cent reducing sugars, 2.04 per cent non-reducing sugars and 0.21 per cent tannins. The pectin content is 2.52 per cent, which is quite high. The fruit pulp, however, is not a good source of vitamin C which is only 920 mg per 100 g of pulp⁴. This fruit is a very good source of protein which is 5.12 per cent of the edible portion. The total mineral content of the edible portion, as represented by ash, is 2.663 per cent. The percentage content of some of the minerals, viz. phosphorus, potassium, calcium, magnesium and iron is 0.137, 0.746, 0.188, 0.127 and 0.007 respectively.

Nutritional value of *Aegle marmelos*

The fruit of *A. marmelos* possess high nutritional value. The fruit is used to make juice, jam, sirup, jelly, toffee and other products. The pulp is reported to contain water, sugars, protein, fiber, fat, calcium, phosphorus, potassium, Iron, minerals and vitamins (Vitamin A, Vitamin B1, Vitamin C and Riboflavin). The leaves and the shoot of the plant are used as green vegetable in Indonesia.^{6,7}

Pharmacological uses of different parts of *Aegle marmelos*⁸

Leaves: Anti-inflammatory, Ulcer, Cause Sterility, or abortion, laxative, asthma, Ophthalmia and eye affection, expectorant, cold and respiratory infection, backache, abdominal disorder, vomiting, cut and wounds, dropsy, beriberi, weakness of heart, cholera, diarrhea, cardiac tonic, control blood sugar, nervous disorders, hair tonic, acute bronchitis, veterinary medicine for wound healing, anti worms, stimulation of respiration. **Root:** Bark Intermittent fever and fish poison, palpitation, melancholia, anti dog bite, gastric troubles, heart disorders, fever, antiamoebic, hypoglycemic, rheumatism. **Flower:** Stomach tonic, anti dysenteric, Antidiabetic, diaphoretic and as a local

anesthetic, epilepsy and as an expectorant. **Fruit:** Dysentery, diarrhea, gastric troubles, constipation, laxative, tonic, digestive, stomachic, brain and heart tonic, ulcer, antiviral Ripe Treatment of rectum inflammation, antiviral, sweet, cooling, aromatic, nutritive, dysentery. **Unripe:** Astringent, dysentery, stomachache in diarrhea, tonic, digestive, demulcent, treatment of piles. **Seed:** antibacterial, antifungal.

Medicinal Properties

Antibilious, antiparasitical, antipyretic, aphrodisiac, aromatic, alternative, astringent, digestive stimulant, febrifuge, hemostatic, laxative, nutritive, stomachic, stimulant, tonic. Fruits: cooling and laxative.

Medicinal Use

In Ayurvedic texts *Aegle marmelos* tree has been held in high esteem owing to its medicinal value. Though many inference has come to surface from the researches done in this field.

- Bael's fruit serves as stool binding. In fact it is used in condition like diarrhea, dysentery etc.
- Powder of bael leaves has anti diabetic effect.
- Juice of bael leaves with black pepper i.e. *kali marich* taken three times a day is helpful in jaundice.
- Syrup made of pulp of bael fruit, with tamarind is useful in burning sensation on skin, diarrhea, yellow coloration of skin, nausea etc.
- When there is pain and redness in eyes, poultice of bael leaves applied on eyes gives good result.
- Muarraba of bael gives appreciable result in diarrhea, especially when there is bleeding.
- Bael's pulp used with jaggery gives results in blood disorders.
- In excessive bleeding and problem of leucorrhoea, juice of *bael* leaves with cumin seed (jeera) and milk
- Local application of one part of dry powder of Bael fruit and two parts of mustard oil are useful in burn.
- Ripened fruit of bael is one of a good laxative. Pulp of ripened fruit or in the form of a sharbat /syrup is useful in constipation.

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- In stress, insomnia and feeling of nervousness milk boiled with bark of bael tree give good result.
- Oil prepared by boiling bael's soft leaves with cow urine, sesame oil and goat milk in the ratio of 1: 4:8 is useful in ear diseases.
- Bael leaves soaked overnight in water and strained water is drunk in the morning gives relief in pain and discomfort in peptic ulcers.
- Bilva fruit powder is useful in irritable bowel syndrome and it has stomachic.
- The extract of bael leaves is useful in conjunctivitis, deafness and leucorrhoea.
- The young leaves and shoots of bilva tree are used as food in Thailand. They have nutritional value.
- The leaf extract has been reported to have antispermatogenic effect and were used a fertility control in Bangladesh.
- Ayurvedic texts hold that *Aegle marmelos* pacifies vata, kafa and enhances jatharagni i.e. digestive fire.
- Ripened fruit of Bael is difficult to digest and is full of doshas, so its use if not specified should be avoided.
- Paste of bael with shunthi, pipali and marich (black pepper) is useful in jaundice.

Other activity of *Aegle marmelos*

S. N.	Topic	Author	Year	Worked done
1	Bio-Autography: An Efficient Method To Check The In Vitro Antimicrobial Activity Of Aegle Marmelos Against Enteric Pathogens ⁹	Phulan Rani, Karan Vasisht and Neeraj Khullar	2013	Worked on methanolic extract of fruit pulp of <i>Aegle marmelos</i> having antimicrobial effect against multi drug resistant clinical pathogens isolated from stool samples, by the bio-autography technique. Hence the method has potential in determining the efficacy of medicinal plants against other clinical pathogens as well.

- 2 Antimycobacterium Chinchansure 2015 Phytochemical investigation of n-butanol fraction of acetone extract of *Aegle marmelos* fruit has afforded four compounds coumarins marmelosin, marmin and xanthotoxol and flavonoid kaempferol 3*O*-rhamnoside, afzelin. All the isolated compounds were evaluated for their antimycobacterium activity against *Mycobacterium tuberculosis* H37Ra and *Mycobacterium bovis*.
- 3 Antigenotoxic Prabhjit Kaur, 2009 Antigenotoxic activity exhibited by the extracts of *A.marmelos* may be attributed in part to the polyphenolic constituents, which possess the potential to protect DNA from reactive oxygen species and S9 dependent mutagens. Further studies are required to isolate these constituents and decipher their mode of action for their eventual application in cancer chemoprevention.
- 4 Clinical Evaluation of Mohammad 2009 Worked on Clinical Evaluation of Antidiabetic Activity Yaheya of *Trigonella* Seeds Mohammad Ismail and *Aegle marmelos* Leaves ¹²

- NIDDM patients, whereas five patients were kept as control subjects. Inclusion and exclusion criteria were formed for the study. Written consent was taken from the patients. Initial postprandial blood glucose level (PPBGL) was estimated at the time of enrolment in the study and then after each week during the entire period of the study. At the end of the study, the initial and final readings were compared.
- 5 Anti-inflammatory Activity and Total Flavonoid Content of *Aegle Marmelos* Seeds¹³ Ganesh N. 2011 Worked on anti-inflammatory effect of aqueous and methanol extracts of *Aegle marmelos* seeds was using carrageenan induced paw edema and cotton pellets induced granuloma in rats. To prove the dependency of pharmacological activity on certain phytoconstituent, total flavonoid contents were estimated, using a spectrophotometric technique
- 6 Study of antimicrobial potential of *Aegle marmelos*¹⁴ S. K. Gangai 2014 Determined the antibacterial activity of three extracts of leaves of *Aegle marmelos* which was screened for its potential against five bacterial strains: *Lactobacillus*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Salmonella*
-

- typhi, *Escherichia coli* and three fungal strains *Pestotlotia foedans*, *Paecilomyces variotii*, *Fusarium oxysporum*. Chloroform extract showed good antibacterial and antifungal against *E. coli* and *Fusarium oxysporum*.
- 7 Evaluation of Hari jagannadha 2012 Investigated the antidiarrhoeal
Antidiarrhoeal Rao G. and activity of the aqueous extract from
activity of extract Lakshmi P the leaves of *Aegle marmelos*.
from leaves of *Aegle* Preliminary phytochemical
*marmelos*¹⁵ screening, acute toxicity study and
antidiarrhoeal activity were studied
on castor induced diarrhea,
Magnesium sulphate induced
diarrhea, and gastric transit time at
50, 100 and 200 mg/kg body weight.
The preliminary phytochemical
screening of the extract results with
the presence of anthraquinone
glycosides, catechins, fixed oils and
saponins etc.
- 8 Hepatoprotective Hiral Modi, 2012 Worked on hepatoprotective
Activity of *Aegle* Vishnu Patel, activity of various extracts of *Aegle*
Marmelos Against Komal Patel *Marmelos*, belonging to the family
Ethanol Induced Rutaceae, in Wistar Female rats
Hepatotoxicity in with liver damage induced by
Rats¹⁶ ethanol. Herbal drugs play crucial
role in treatment of various diseases
due to its antioxidant property. It
was found that AMCL, AMAL &

- AMAQ, at a dose of 500 mg/kg body weight exhibited hepatoprotective effect by lowering the Serum Glutamate Pyruvate Transaminase (SGPT), Serum Glutamate Oxaloacetate Transaminase (SGOT), alkaline phosphate and total bilirubin to a significant extent.
- 9 Evaluation of Rama Dahiya, 2015
Antimicrobial Rajesh Singh
Potential of Aegle Tomar, Vikas
Marmelos Fruit Shrivastava
Extract against
Selected
Microorganisms¹⁷
- 10 Phytochemical and Mathew George, 2016
pharmacological Lincy Joseph and
screening of in vivo Sreelakshmi R
anti-inflammatory
activity of Aegle
- Evaluated the antimicrobial properties of *Aegle Marmelos*. In this study, antimicrobial activities of different extract of *AegleMarmelos* fruit were evaluated against different microbial strains like *Escherichia coli* (MTCC-443), *Bacillus subtilis* (MTCC-441), *Pseudomonas aeruginosa* (MTCC-4673), *Staphylococcus aureus* (MTCC-3160), *Aspergillus brasiliensis* (MTCC-1344) and *Candida albicans* (MTCC-227) by agar well diffusion method & MIC determination by broth dilution method.
- Evaluated anti-inflammatory activity and to determine phytochemical constituent of ethanolic leaf extract of *Aegle marmelos* (L.) Corr. Serr. Ethanolic

	marmelos (L.) Corr. Serr ¹⁸		extract was screened for different phytochemical constituents. Ethanolic extracts were screened for anti-inflammatory activity (induced by Carrageenan) in Wistar Albino rats.	
11	Evaluation of Antidepressant and Antianxiety activity of Ethanolic leaf extract of <i>Aegle marmelos</i> ¹⁹	Mathew George, Lincy Joseph, Sreelakshmi R	2016	Evaluated of Antidepressant and Antianxiety activity of Ethanolic leaf extract of <i>Aegle marmelos</i> . The result suggests that the ethanolic extract of <i>Aegle marmelos</i> contains some active principles which may be responsible for these activities.
12	Antibacterial activity of ethanolic leaf extracts of <i>aegle marmelos</i> (L) corr. ²⁰	Subramanian Ramya, Ramaraj Jayakumararaj, Gopinath Krishnasamy, Nagoorgani Periathambi, Aruna Devaraj	2012	Worked on antimicrobial activity of ethanolic leaf extracts of <i>Aegle marmelos</i> (L) Corr. on selected microbial strains. Phytochemicals present in the ethanolic leaf extracts of <i>A. marmelos</i> exhibit considerable antibacterial activity. Further, at concentration of 300µl and above, ethanolic leaf extracts of <i>A. marmelos</i> exhibited significant activity towards all the selected bacterial strains. However, <i>B. subtilis</i> and <i>E. coli</i> were more sensitive towards the treatment when compared to <i>S. aureus</i> , <i>P. aeruginosa</i> and <i>K. pneumonia</i> .

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