

Aegle Marmelos: A Review on its Medicinal Properties

Mr. Gaikwad Rohit¹, Dr. Bavage. S. B², Dr. Lonikar N. B.³

B Pharmacy

Latur College of Pharmacy, Latur, Maharashtra, India

Abstract: *Plants and their products have been a major resource since time immemorial. Food and medicine for humanity. Egle marmelos, commonly known as Bael (or Bel), is a slender, fragrant, medium-sized tree belonging to the Rutaceae family. all Number of chemical components of Eglia leaves and various therapeutic effects marmelo has been reported by several researchers.[1]*

These phytochemicals include: Various compounds such as alkaloids, flavonoids and phenolic acids (protocatechuic acid) acids, gallic acid and ellagic acid). □ The current review focuses on nutritional and pharmacological activities. Fruit Bael [2].

The nutritional and phytochemical profiles are discussed below. In addition to reviewing, check the consistency of the fruit.Recent literature based on The nutritional and pharmacological values of Bael fruit have shown high potential for: Food and medicine.[4]

Keywords: Egle Marmelos (Bael); nutrition; Phytochemicals; pharmacological characteristics; Industrial applications.

I. INTRODUCTION

Aegle marmelos belonging to family Rutaceae, is commonly known as Bael in indigenous systems of medicine and has been regarded to possess various medicinal properties. The bael is one of the sacred trees of the Hindus. Leaves are offered in prayers to Shiva and Parvathi since ancient times. Bael is a deciduous sacred tree, associated with Gods having useful medicinal properties, especially as a cooling agent.[1]

Bael mentioned in the renowned book Charaka Samhita, a comprehensive compilation of all the essential ayurvedic information, which identified bael as a necessary item in ayurvedic medicine.[9]

The universal role of plants in the treatment of disease is exemplified by their employment in all the major system of medicine irrespective of the underlying philosophical premise Plants have at one time supplied virtually all cultures with food, clothing, shelter and medicine. It is estimated that approximately 10 to 15 percent of roughly 300,000 species of higher plant, have a history of use in traditional medicine[8]

The value of medicinal plant in today's world is that they become a potential source for bioactive compounds The chemicals obtained from medicinal plant are known as phytochemicals serve as lead compounds in drug discovery and design[7]

Phytochemicals such as carotenoids, terpenoids, flavonoids, polyphenols, alkaloids, tannins, saponins, pigments, enzymes, minerals and vitamins, possess different kind of therapeutic effects like antimicrobial and antioxidant activity.[6].

Although being a subtropical tree it can grow well in tropical climates too at an altitude of 1200 m. Bael is widespread and growing throughout the Indian peninsula. In most countries in Southeast Asia[3]

The fruit of Bael has been known since the Ramayana period, and records about the tree have also been passed down. It can be found in Panchvati and Chitrakuta hills. Medicinal properties of fruits The Bael tree is also described in the ancient treatises "Brihat Samhita" and "Charka". Samhita. According to ancient beliefs, the Bael tree acts as an indicator plant, allowing humans to track it. underground water. All parts of the plant are transported: root leaves, stems, seeds, fruits, etc. It has a variety of medicinal properties and is used to treat a variety of diseases. fetus . This plant is edible, abundant and mainly used for medicinal purposes. Vitamins, minerals, antioxidants [5].

Aegle marmelos L. (Family: Rutaceae) (Figure 1) is a plant widely used in various fields Places in India.[2].

II. PLANT PROFILE

Scientific classification[1] :-

- Kingdom- Plantae.
- Order – Sapindales.
- Rut and family.
- Aurantioideae subfamily.
- Genus - Aegle
- Example – EgleMarmelos
- Botanical name – Aegle marmelos.

Genus name [1] :-

- English: Bengal quince, Beel Fruit, Golden Apple, Indian.
- Quince, stone apple tree
- Tamil: Aluvigam, Iyalbudi, Kuvilam, Mavilangai, Vilvam, Villuvam.
- Telugu: Bilvama, Maluramu, Maredu; Mabilangai, Vilwam, Viluvam.
- Telugu: Bilvama, Maluramu, Maredu, Sailusham, Sandilyam, Srifhalam.
- Hindi: Bel, Bili, Sirfal and Bela;
- Sanskrit: Adhararutha, Asholam, Atimangalia, Bilva. · Bengal: Bael, Bel,
- Gujarat: Billy;
- Kannada: Bela, Bilva
- Malayalam: Koovalam, Vlvam. ·
- Orisa: Bello.



III. PLANT DESCRIPTION

Marmelos belongs to the Rutaceae family. It is a small to medium-sized, slow-growing tree reaching a height of 25 to 30 feet. The stem is smooth and thick with several thorny branches. Complete botanical description of A. Marmelos [2].

Leaf

The leaves of A. marmelos are alternate, trifoliate, aromatic, deciduous borne as single or compound and comprises of 3 to 5 oval, pointed shallowly, thin toothed leaflets with length 4-10 cm and 2-5 cm in width, terminal one have long petiole while the lateral one is without a petiole. [5].

Fruit

Fruits have a hard, smooth woody shell (i.e., pericarp), a soft rind at immature stages crust is gray-green at early stages, turns yellowish or orange at the ripening stage and becomes very hard and orange-red when dried [9].



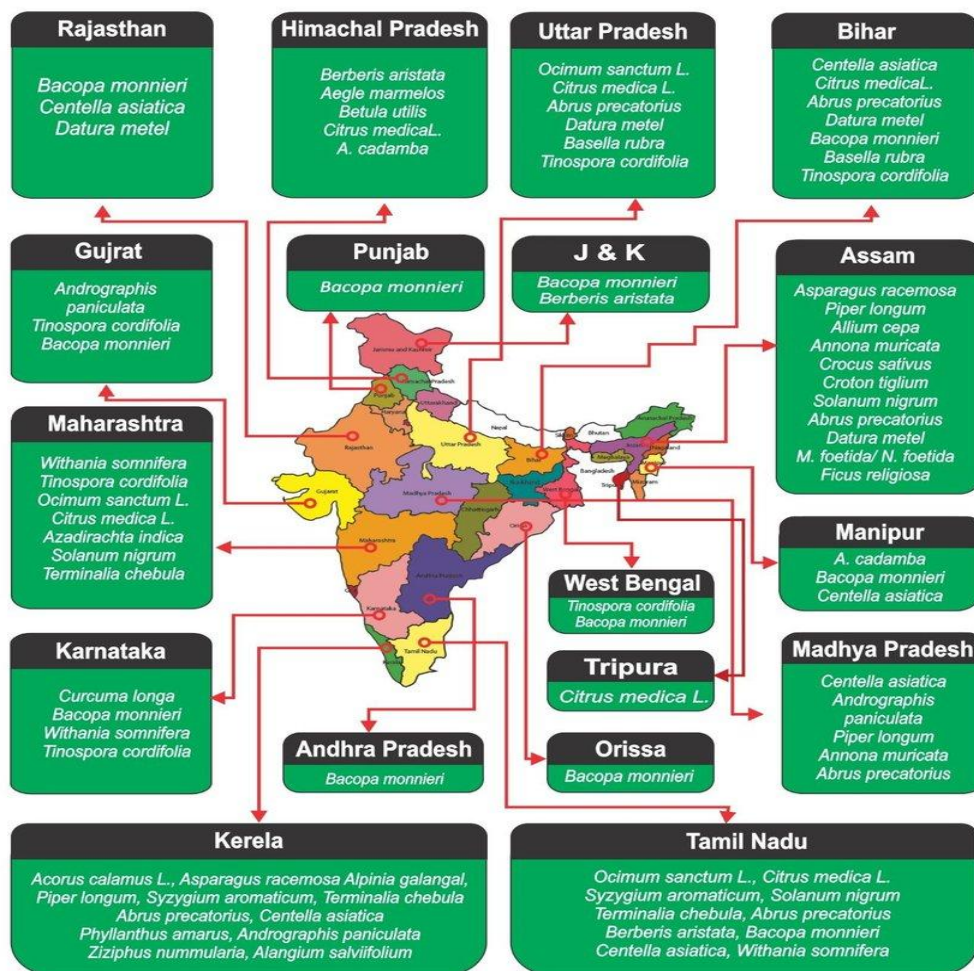
Flower

Flowers are fragrant, 2 cm wide, erect, stalked, sweet-scented and formed a cluster of about 4 to 7 flowers, 4 to 5 recurved fleshy petals, yellowish from inside and greenish from outside with 50 or more greenish stamens. The calyx is shallow with five short broad teeth, capitate stigma ovary is oblong-ovoid and has slightly tapering thick short style [5].



IV. GEOGRAPHICAL DISTRIBUTION

Marmelos is a semitropical plant that flourish at an approximate altitude of 1200 meter from sea level. It is mainly obtained in hill areas and dry forests. It is found almost all states in India like Himachal Pradesh, Andhra Pradesh, Bihar, Jammu and Kashmir, Kerala, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Uttar Pradesh, Tamil Nadu and West Bengal. It is also cultivated in Nepal, Myanmar, Vietnam, Tibet, Ceylon, Laos, Cambodia, Malayasia, Sri Lanka, Bangladesh, Thailand, Indonesia, the dried areas of Java, Fiji and some parts of Philippine Islands.[2].



V. PHYTOCHEMISTRY

Several research works have been done to identify active chemical constituents from various parts of bael plant. Extensive studies have been conducted on different parts of *A. marmelos* and as a result, different types of compounds such as alkaloids, coumarins, terpenoids, fatty acids and amino acids have been isolated from different parts.[2]

Soil Type:

-Bael is said to grow best in fertile, well-drained soil. However, it grew well and bore fruit on oolitic limestone. South Florida. It also grows well in wet, alkaline or rocky soils with a pH of 5 to 8. In India, it is famous for growing well in places where other fruit trees cannot survive [1].

Chemical composition

1 Alkaloid

- Alkaloids constitute the largest class of secondary plant substances. A new alkaloid has been reported from the leaves of *Aegle marmelos*. That is, ethylcinnamamide, O-3,3-(dimethylallyl)poledinol, N-2-methoxy-2-[4(3',3)dimethylallyloxy] phenyl] ethylcinnamamide,

Coumarins

-Coumarinsextracted from the fruit part of the plant include 6-(2-hydroxy-3-hydroxymethyl--3-butenyl)-7-hydroxycoumarin, (6-formyl umbilliferone, 6-(4-acetoxy-3-methyl-2-butenyl)-7-hydroxyl coumarinhydroxysmyrindiol,

Copyright to IJARSCT

DOI: 10.48175/568

www.ijarsct.co.in

8-[(3-methyl-2-oxo-3-buten-1-yl)oxy]7Hfuro[3,2g]benzopyran2one) isofraxidin, isogosferol,alloimperatorin, decursinol, demethylsuberosin,marmelosin, isophellodenolpsoralen, marmelonine, umbelliferone, scoparone, scopoletin, xanthotoxin, xanthoarnol and xanthotoxol[5]

Tannins:

The maximum tannin content in bael fruit was recorded in the month of 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 as 4, 7, 8 - trimethoxyfuro- quinoline[1].

Carbohydrates:- Arabinose, fructose, galactose, sucrose and glucose .[1]

Organic acids :- Malic acid, tartaric acid and oxalic acid.[1]

Phenolic acids and Flavonoids

Phenolic acids and flavonoids extracted from the fruit part include ellagic acid, quercetin, chlorogenic acid, gallic acid, ferulic acid, and kaempferol and protocatechuic acid [5]

Phenylpropanoids:

These are naturally occurring phenolic compounds, which have an aromatic ring to which three- carbon side chain is attached. Among the phenylpropanoids are included hydroxycoumarins, phenylpropenes and lignans. The most widespread plant coumarin is the parent compound, coumarin itself, which occurs in over twenty-seven plant families. Marmesin was created as a new compound in the leaves, which is also found in the pith and roots [1].

Bark

- Coumarins include aegelinol, mermesin, marmesin and Umbelliferone and alkaloids include skimmianine, gamma. pagarin [5].

Terpenoids

Essential oil of Aegle marmelos (L.) Correa. The leaves have been studied very extensively by various scholars in India. Workers since 1950. α -Phellandrene was discovered. Common ingredients of essential oils extracted from leaves and twigs And fruit. α -Phellandrene (56%) and p-cymene (17%) are It has been reported in leaf oil. A similar report was later posted on the website. Many workers use leaf essential oil. P-ment-1-en-3,5-diol . It was isolated and characterized from the leaves of Aegle marmelos. Limonene (82.4%) was listed as the main ingredient. Eglamarmelos has leaves that appear to be limonene. Characteristic markers to identify Aegle marmelos oil Sample.[1].

Trade Products [1]:-

1-food:

- Aegle marmelos fruits can be cut in half, cracked for soft varieties, and the pulp, -flavored with palm sugar, eaten for breakfast, as is customary in Indonesia. The pulp is often processed into honey. The pulp and seeds are combined with milk and sugar to create a popular drink in India called sherbet.

2- B-Gum or chewing gum:

- The resin that coats the seeds is most abundant in wild fruits, especially unripe ones. It is commonly used as a household adhesive and is also used as an adhesive in jewelers. It is sometimes used as a substitute for soap. It is mixed with lime plaster to waterproof wells and added to cement when building walls. Artists may add it to watercolors and apply it as a protective coating to their paintings.

3- Tannins or dyes:

- The flesh of wild fruits contains up to 9% tannin, while cultivated fruits contain less tannin. The peel contains up to 20%. Tannin is also present in leaves. The skin of the unripe fruit is used for tanning and produces a yellow dye for calico and silk fabrics.

4-Essential oils:

- The essential oil of the leaves contains d-limonene, 56% ad-phellandrene, cineole, citronellal, citral, 17% pcirnene, and 5% cuminaldehyde. The limonene-rich oil is obtained from the bark and is used to scent hair oil.

5- Other products:

- The pulp of the fruit has a cleaning effect and is used to wash clothes. The hard fruit's skin is used to make pill boxes and snuff boxes, sometimes decorated with gold and silver. Cologne is obtained by distilling flowers. In Hindu culture, leaves are an essential offering to Lord Shiva.

Pharmacological activity

A-Anti-cancer activity

-Gastric ulcers occur due to constant erosion and damage to the stomach wall, which inhibits the synthesis of mucus, bicarbonate and prostaglandins, which can lead to perforation and develop into peritonitis and massive hemorrhage. Bael inhibits in vitro proliferation of human tumor cell lines, including lecuquin K562 and T lymphocytes [8].

-The plant extract was tested for the anticancer activity against tumor cell lines by using sea urchin egg assay, brine shrimp lethality assay and MTT assay method.[5]

-Researchers were evaluated the anticancer potential of folk medicine used in Bangladesh, India. Aegle marmelos for cytotoxic action using brine shrimp lethality assay. The extract of Aegle marmelos was found to be exhibited toxicity on all used assay.[8]

-Research proved that extracts from Aegle marmelos are able to inhibit the in vitro proliferation of human tumor cells,erythroleukemic HEL, melanoma colo38,MDAMB- 231 and breast cancer MCF7 celllines (Lampronti et al., 2003)[6]

-Anticancer activity was due toleaves and fruit of bael which contain lupeol, eugenol, citral, and marmelinskimianine (Asha and Krishan, 2016). It has been observed that ethanolic leaves extract of A.marmelos showed antiproliferative activity against ascites tumor in swiss albino mice (Chockalingam et al., 2012).[6]

B- Anti-diabetic activity:-

- Diabetes is a common metabolic disease worldwide. A significant portion of the world'spopulation suffers from the same problem.[8]

- Modern lifestyle factors such as stress, eating fast food, and drinking alcohol are the causes.[8]

-All A. marmelos leaf extracts were tested for hypoglycemic activity in various animal models. [5].

- The hydroalcoholic extract of the fruit parts showed hyperglycemic activity in rabbits at a dose of 500 mg/kg body weight. Plant fruit extracts had a protective effect on pancreatic tissue in diabetic rats [5].

- Hyperglycaemia or high blood sugar level is typical complication of uncontrolled diabetes, leading to serious body damage, mainly affecting nerves and blood vessels .[3]

- Recently, fruit of A. marmelos has attracted much attention due to its uses in traditional medicinal system, but there are very limited studies related to its biological properties. In a study, fruit extract of A. marmelos was studied for its antidiabetic effect.[3]

C-Antiulcer activity:-

- The polyherbal formulation prepared from the leaf part of A. marmelos, rhizome of Glycyrrhizaglabra (200 mg), the root part of Hemidesmusindicus and fruit part of Cuminumcyminum was investigated for antiulcer activity against ethanol-induced gastric ulcer model in Wistar rats. [5]

- The oral administration of the polyherbal formulation at the dosage of 500 mg/kg produces moderate inhibition of gastric lesions in the rat model concerning the standard 20 mg/kg omeprazole administration. It was found that the polyherbal formulation can be useful to treat severe gastric ulcers and produces a non-toxic effect seven at highconcentration.[5]

- Methanolic extract of unripe fruit of Aegle marmelos reduced gastric ulceration and prevent the oxidative stress caused by Helicobacter pylori-Lipopolysaccharide in rats (Ramakrishna et al., 2015). Gastro protective effect of extract

was due to the presence of luvangetin which lowers oxidative stress in the gastro duodenal mucosa (Asha and Krishan, 2016).[6].

- An ulcer is a result of the defensive failure of mucosal layer of the GIT, it is due to imbalance between defensive and attacking factor like acid. There are several factors which induced peptic ulcer like H.pylori bacteria, acid secretion, drinking of alcohol, smoking and many more. Moreover the recurrence of ulcer after stopping medicine is high. About 70% of ulcer could recur. [1]

D-Antiviral activity:-

- The ethanolic Bael fruit extract have shown antiviral activity against virus of Ranikhet disease. Bael fruit contain marmilide which is the most effective viricidal agent which interferes with early events of replicating cycle (Maity et al., 2009)[6]

- The hydro alcoholic extract of the fruit of the Bael plant showed significant antiviral activity when tested against Ranikhet disease virus[5].

E-Antioxidant Activity:-

- Antioxidants protect the body against the side effects of free radicals, which are responsible for number of health-related disorders such as heart disorders, high blood pressure, cancer, and diabetes. In one study, it was observed that Bael fruit (pulp) extract has high antioxidant potential [3].

- Antioxidants have free radical scavenging activity and the ability to protect cells during oxidative stress. The antioxidant activity of this plant is due to the presence of flavones, isoflavones, flavonoids, anthocyanins, coumarins, lignans, catechins and isocatechins. [6].

- A. marmelos is widely known to have antioxidant activity against various free radicals (Sekar et al., 2011).[6]

- Methanol and ethanol extracts of A. marmelos plant fruit pulp were tested for antioxidant activity in a rat model using DPPH radical scavenging assay, nitric oxide scavenging assay, reducing power assay, H₂O₂ radical scavenging assay, ABTS radical scavenging assay, and ABTS radical scavenging assay. Superoxide radical scavenging analysis. Purification analysis.[5]

- Free radical inhibition was observed using methanol and alcohol extracts of the plant, which indicated excellent antioxidant activity of the plant. The inhibitory activity of unripe fruits is higher than that of mature fruits [5].

F- antibacterial activity :-

- A. marmelos has been reported to be traditionally used in the treatment of various infectious diseases to suppress a wide range of pathogenic microorganisms. Meena et al. (2016) evaluated the antibacterial activity of A. marmelos leaf and fruit extracts. Inhibition zones of 11 mm and 9 mm were observed using leaf and fruit extracts against *Rouletellaplantikola*. The plant extract provided the maximum area of inhibition (18 mm) against fungal strains, namely *Penicilliumchrysogenum* and the minimum area (7 mm) against *Candida albicans* [6].

- Antibacterial agents are used in medical practice to treat food poisoning. Another way to kill these bacteria is to use medicinal plant extracts rich in antibacterial compounds. *Aegle marmelos* extract has antibacterial activity [8].

- It has been found to be active against various species such as *Staphylococcus aureus*, *S.epidermidis*, and *Proteus vulgaris*. It has also been used to treat Ranikhet disease virus and intestinal parasites.[8]

- Petroleum ether, ethanol and aqueous leaf extracts of the A. marmelos plant were tested for antibacterial activity using the agar diffusion method. The extract has been shown to be effective against *E. coli*, *Streptococcus pneumonia*, *Salmonella typhi*, *Proteus vulgaris* and *Klebsiella pneumonia*. [5].

- It was also observed that petroleum ether and aqueous extracts exhibited antibacterial activity against *Fusariumoxysporum*, whereas ethanol extracts exhibited activity against *Penicilliumchrysogenum*.

G-Diarrhea and dysentery

- Unripe and half-ripe bael fruits are the most effective remedy for diarrhea and dysentery. Ripe fruits are usually used for this purpose, but dried fruit powders are equally active. Gastrointestinal infections include a wide range of symptoms and known infectious agents.[8]

- Quince fruits are widely used to combat chronic diarrhea and dysentery. Due to the astringent properties of this fruit, unripe bael is most prized as a remedy for diarrhea and dysentery, common during the summer months in India.[2]
- Antidiarrheal activity has been demonstrated against several diarrheal pathogens using the MIC method. Alcohol extracts include *Shigella boydii*, *S. sonnei*, *S. flexneri*, moderate against *S. dysenteriae*. [2]

H-Radio-protective activity:-

- The hydro alcoholic extract of the fruit of the Bael plant was evaluated for the radio-protective activity against Swiss albino mice model that was exposed to several doses of gamma radiation.[5]
- The extract was administered through intra-peritoneal route for 5 days at the dosage of 5, 10, 15, 20 and 40 mg/kg before exposure to 10 Gy 60 Co gamma-radiations.[5].
- Now-a-days radiotherapy is one of the most important therapies for curing cancer especially for those suffering from vital visceral malignancies. Although it is very useful all over the world, however it has some side effects. Radioprotective effect has been studied with the use of bael fruit hydroalcoholic extract in mice that are exposed to several doses of gamma radiation.[2].
- Male albino Swiss rats were administered 5, 10, 15, 20, or 40 mg/kg intraperitoneally of *Aegle marmelos* extract daily for 5 days before exposure to 10 Gy of 60Co gamma radiation. The greatest number of survivors report maximum protection 30 days after exposure.[2]

REFERENCES

- [1]. Patkar Atul N. Desai Nilesh Vs. Akrotai Mountains A. Kalekar Comisker Rajasthan Shahu Chhatrapati Institute of Pharmaceutical Sciences, Kolhapur.
- [2]. Kaushik Bohr, Sumantha Mondal Padilapneumonia, India.
- [3]. Sharma, N., Palha Kumar, Zhang, B. Kumon, N. Sig Dishon D. koma. India.
- [4]. Kumori Anupama. Tivan RK, Sharma Ved Bhushan, Tim Shashikant Uttarakhand, India.
- [5]. Shoila Chaudhary, Geetika Chaudhary and Hemlata Kaunar Resort CEO remained silent. Ayurveda, Gina Sikho, Life Care, Zirkapur, Punjab, India .
- [6]. Rahul Savarkar. Devendra Singh Abhishek Choudhary.. Sheveta Anand, Anita Rathore and Hemant KoJediya, Novani, Indian College of Veterinary and Animal Sciences, Koj. Balavinagar (Udaipur), Rajasthan, India.
- [7]. Amit Pandey, Reshmi Mishra, MRD Life Sciences, Lucknow, ide CJSU universi SAFE ,India.
- [8]. Pushpendra k patel Jyoti Sahu, Lokesh Sahu, Narender Projapah, B.K. Dubey, Department of Gastroenterology, MP Nag Bhopal, India.
- [9]. Chamila Kumari Pathirana, Terrence Madhujit and Jonke Igwara (Sri Lanka).