



## A REVIEW ON PHYSIOCHEMICAL PROPERTIES AND MEDICINAL USES OF AEGLE MARMELLOS (INDIAN BAEI).

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### ABSTRACT :

It notes that India has a rich diversity of medicinal plants and the forest is the major source of raw materials for drugs and perfumes. Each plant or herb has a specific quality and is intentionally used for maintaining health and various diseases. The Food and Agriculture Organization estimated in 2002 that over 50,000 medicinal plants are used across the world. The literature review article included each part of the plant with their medicinal uses. *Aegle marmelos* (L.) Correa (Family : Rutaceae) is a broad leaf tree of height 6 - 10 m and width 0.9 - 1.2 m with straight, sharp and axillary thorns and trifoliate aromatic leaves. The medicinal properties of this plant represent it as a valuable source of medicinal compounds.

**Keywords:** Bael, *Aegle marmelos*, Bael pulp, Medicinal plant, Traditional plant.

### INTRODUCTION :

*Aegle marmelos*, commonly known as bael is a species of tree native to the Indian subcontinent and Southeast Asia. It is present in India, Pakistan, Bangladesh, Sri Lanka, and Nepal as a naturalized species. The tree is considered to be sacred by Hindus and Buddhists. *Bael* (*Aegle marmelos* L.) considered being a pack house of nutrients and medicine, is one of the most ignored and underutilized fruit crops [1]. The bael tree is believed to have originated in India and spread to nearby countries in prehistoric times. It is now grown in many parts of Southeast Asia, including India, Pakistan, Bangladesh, Sri Lanka, Burma, and Thailand. The bael tree is considered a medicinally valuable species. It's used in herbal compositions to treat gastric, bladder, and pulmonary cancers, and is effective against cancer cells. The tree is aromatic, and all the parts are medicinally important [2]. Fruits, leaves, bark, roots, and seeds are used in ayurvedic and folk medicine systems to treat various ailments [2]. Bael plant acts as a 'Sink' for chemical pollutants as it absorbs poisonous gases from atmosphere and makes them inert or neutral [3]. Bael contains various phytochemicals like alkaloids, tannins, essential oils, gums, resins, coumarin, polysaccharide that makes it useful in many ailments [4].



**Figure 1.- Phytoconstituents present in the part of plant of *Aegle Marmelos***

Part of the Plant	Bael Compound	Biological Activity
Leaf	Skimmianine, Aegelin, Lupeol, Cineol, Citral, Citronellal, Cuminaldehyde, Eugenol, Marmesinin	Anti-cancer, Cardioactive, Anti-ulcer, Anti-allergic, Antiseptic, Antibacterial

		Antioxidant
Bark	Skimmianine, Fagarine, Marmin	Sedative Hypnotic
Fruit	Marmelosin, Luvangetin, Auraptin, Psoralen	Anti-bacterial, Anti-ulcer, Antispasmodic

### Uses of Parts of Aegle Marmelos for Medicinal purpose :

Bael leaves also known as Bel Patra called Bilva Patra in Sanskrit is a favourite of lord Shiva and is considered very auspicious for home inviting positivity and offering health benefits. The plant aids in balancing All three doshas Vata, Pitta, and Kapha. It can be consumed in daily, which will help you to control lifestyle diseases such as hypertension, heart problems and cholesterol.

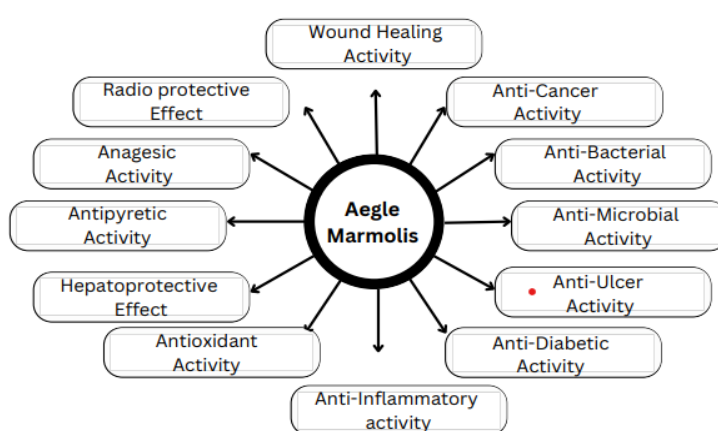


Figure : 2

#### **Anti-Cancer Activity :**

Aegle marmelos, commonly known as Bael, is a medicinal plant that has been extensively studied for its potential in inhibiting cancer growth. Several bioactive compounds present in the different parts of the plant, such as fruits, bark, leaves, seeds, and roots, have been identified to exhibit anti-cancer activity. Aegle marmelos, has anti-cancer Properties against several human cancer cell lines, including melanoma cells, hepatocellular carcinoma cells, human epidermoid carcinoma cells, pancreatic adeno-carcinoma cells and prostate cancer cell lines[6]. Extract of *A. marmelos* is an Antiproliferative but it produces effect on MCF-7 and MDA-MB-231 breast Cancer cell line when it is in high Concentration[3].

#### **Anti-Bacterial Activity**

The extracts from the leaves, bark, and fruit of Aegle marmelos have antibacterial activity against a range of bacteria, including *Escherichia coli*, *Proteus mirabilis*, *Salmonella paratyphi A and B*, and *Klebsiella pneumoniae* etc. The antibacterial property of *A. marmelos* crude methanolic and chloroform leaf extracts was evaluated through agar disc diffusion method. Two Gram-positive (*Bacillus subtilis*, *Staphylococcus aureus*) and three Gram-negative bacteria (*Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Escherichia coli*) were used for the study[2].

#### **Anti-Microbial Activity**

It has been stated that Aegle marmelos has been traditionally used to treat various infectious disorders by inhibiting a wide range of harmful microorganisms[8]. Ethanolic extract of dried fruit pulp of Aegle marmelos is effective against various intestinal pathogens[4].

#### **Anti-Ulcer Activity**

Aegle marmelos leaves extract have potential anti ulcer activity. This results may further suggests that aqueous extract was found to possess Antiulcerogenic as well as ulcer healing property, which might be anti secretory activity. Oral administration of pyranocoumarin isolated from the seeds of Aegle marmelos Correa, showed significant protection against pylorus-ligated and aspirin-induced gastric ulcers[4].

**Anti-Diabetic Activity**

Aegle Marmelos has an antidiabetic properties and widely used in Ayurvedic and Siddha medicines. An ethanol extract of Aegle marmelos leaves can reduce glucose absorption and inhibit intestinal disaccharidase enzyme and  $\alpha$ -amylase activities. It can also improve insulin-mediated glucose uptake by peripheral tissue. Administration of Aegle Marmelos fruit pulp powder daily for 60 days significantly affected blood glucose and lipid parameters. Aegle Marmelos leaf juice improved biochemical parameters of type 2 diabetes mellitus.

**Anti-Inflammatory Activity**

Aqueous extracts from the roots of Aegle marmelos have shown promising results in acute inflammation models, but were less effective in chronic models. The seeds of Aegle marmelos contain essential oils that have anti-inflammatory property.

**Antioxidant**

Antioxidant activity of these plants is due to the presence of flavones, isoflavones, flavonoids, anthocyanin, coumarin lignans, Catechins and isocatechins. Aegle marmelos is extensively reported to possess antioxidant activity against a variety of free radicals[5]. The aqueous extract of Aegle Marmelos fruit was screened for antioxidant activity by the DPPH radical scavenging. The extract showed efficient antioxidant activity[9].

**Hepatoprotective Activity**

Aqueous extract of Bael fruit pulp and seeds are Effective in the treatment and prevention of carbon tetrachloride induced hepatic toxicity[4]. Aqueous leaf extracts of Aegle marmelos have hepatoprotective effects in rats, including: Reducing elevated lipid peroxide levels increasing the activity of superoxide dismutase and catalase, reducing serum alanine aminotransferase, aspartate aminotransferase, and alkaline phosphatase levels.

**Antipyretic Activity**

The antipyretic effects of Aegle marmelos is due to the presence of skimmianine, an alkaloid compound. The leaves of Aegle marmelos are considered the most effective part of the plant for treating fever. Extracts from the leaves of Aegle Marmelos shown antipyretic activity in mice that were made Hyperthermic by an injection of dried yeast and this response of these was comparable to that of paracetamol.

**Analgesic Activity**

Ethanol extracts of the leaves and fruit pulp of Aegle marmelos showed a significant increase in mean latency time in the Eddy's hot plate method. The analgesic activity of stem bark of Aegle marmelos was comparable to that of tramadol and aspirin. The leaves of Aegle marmelos (bael) have been shown to have analgesic activity in mice. The methanolic extract of Aegle marmelos leaves was given to the mice at doses of 200 and 300 mg/kg. The results showed significant analgesic activity in the acetic acid-induced writhing and tail flick tests.

**Radio protective Effect**

In case of haemorrhoids, a decoction of an unripe fruit of Aegle Marmelos with fennel and ginger is prescribed. It is also reported that the pulp increases tolerance of sunlight and aids in maintaining the normal skin color. It is also used in treatment of luecoderma[4]. Leaf extract of Aegle marmelos showed significant radioprotection in cultured human peripheral blood lymphocytes at a concentration of 5  $\mu$ g/ml.

**Wound Healing Properties**

The 50% ethanol extract of Aegle marmelos fruit pulp promotes collagen deposition, reduce inflammation and decrease free radicals which help wounds heal faster. Paste of leaves of Aegle Marmelos is used in cut and wounds and injuries. It is also used in veterinary medicines for wound healing properties[10].

**PHYSICOCHEMICAL PROPERTIES OF BAELE FRUIT :**

In the Ayurvedic system of medicine, bael fruits are considered as an excellent remedy for diarrhea (Das & Das, 1995). The unripe fruits are bitter, acrid, sour, and astringent, and aids digestion and stomach Irritation[11].

**Figure 3 : Phytochemicals present in fruits of Aegle**

Test	Petroleum Ether Extract	Ethanol Extract	Aqueous Extract
Alkaloids	-	+	-
Carbohydrates	-	+	-

Glucosides	-	+	+
Flavonoids	-	+	+
Polyphenols	-	+	+
Saponins	-	+	+
Steroids	+	-	-
Triterpeoids	+	-	-

From the above table it is observed that ethanol extract shows By all positive tests for the presence of different phytochemicals Except steroids and triterpeoids which was followed by Aqueous extract where most of tests were detective positive While as in petroleum ether extracts there were hardly any Positive test for any phytochemical compound which shows There inertness related these solvents [12].

### Physical Properties of *Aegle Marmelos* (Bael Fruit).

#### 1. Fruit Length (cm)

The length of a bael fruit can vary depending on the variety, but some bael fruits can be as long as 28.57 cm. A significant variation in fruit length was observed in all genotypes [13].

#### 2. Fruit Width (cm)

The width of a bael fruit can range from 5–25 cm (2–10 inches) in diameter. The fruit is typically globose or slightly pear-shaped, and has a thick, hard rind that doesn't split when ripe.

#### 3. Some morphological characteristics of bael fruit

##### • Fruit colour

The fruit is mainly yellowish green, and the woody peel turns pale yellow when ripe.

##### • Pulp

The pulp is thick, orange-colored, and mucilaginous.

##### • Seed

The fruit contains numerous hard seeds with white thread-like hairs on their outer surface. The number of seeds per fruit of five fruit was measured manually then average was calculated and expressed in number.

##### • Rind

The rind is very hard and woody, and is gray or yellow in color. Thickness of rind of five fruits was measured by Vernier Caliper and then average was calculated and expressed in mm.

##### • Ripening

The fruit takes about 11 months to ripen on the tree, reaching maturity in December.

##### • Size

The wild forms of the bael fruit are smaller, with a diameter of 5 to 7.5 cm, while cultivated forms can be as large as 12.5 to 17.5 cm in diameter.

#### 4. Volume

A xylometric method may be acceptable to measure the volume of fruits. In this method, the volume of an object is measured by submerging it in a container with water (A ml) and measuring the volume of the displaced water (B ml). The volume of water absorbed by the fruit is not considered significant. Volume displaced by fruits = (A - B) ml.

#### 5. Specific Gravity

The specific gravity of the fruits was calculated by applying the formula as given below.

Specific gravity (g/cc) = Weight of Fruit / Volume of water displaced.

Figure 4 : Physical parameters of Bael Fruit

Parameters	Values
External colour	Brownish yellow
Pulp colour	Bright yellow
Weight (g)	1120
Polar diameter (cm)	12.96
Transverse diameter (cm)	13.35
Specific Gravity (g/cc)	1.11
Volume (l)	1.01
Peel (%)	24
Pulp (%)	68
Seed (%)	1.3
Shape	Roundish oblong

### **Chemical Properties of Aegle Marmelos ( Bael Fruit )**

Bael contains compounds like coumarin, xanthotoxin, imperatorin, aegeline, and marmeline. These compounds may have antidiabetic, anticancer, antifertility, antimicrobial, immunogenic, and insecticidal properties.

#### **Moisture Content**

The reduction in moisture content of bael fruit pulp was recorded at an interval of 5 min for first 20 min, then at an interval of 10 min for next 80 min, then 15 min for next 60 min, 20 min for another 80 min and afterwards 60 min interval till the end of drying process [16].

$$\text{Moisture Content (db)} = \frac{W_0 - DM}{DM} \times 100$$

Where,

$W_0$  = Weight of sample at time  $\theta$  (g),

DM = Dry matter of the sample (g).

#### **pH**

The pH was measured with digital pH meter buffered with 4.0 and 7.0 and the values were recorded to be 4.95, 5.49 and 5.28 for pulp, seed and perfume respectively. The pH of bael fruit pulp can range from 4.70 to 5.30. Bael juice has a pH of around 4.3. Bael trees are known for their ability to grow in a wide range of soil conditions, including alkaline, stony, and shallow soils.

#### **Acidity**

The acid content of foods directly affects their flavour. The acids present are largely responsible for the sour taste. The acidity measured by titration method as % citric acid was 0.3 % in bael fruit pulp, while in seed and pericarp it was found to be 0.06 and 0.29%, respectively [13].

$$\text{Percent acidity as citric acid} = \frac{\text{Titer} \times \text{Normality of NaOH} \times \text{volume made up} \times 64 \times 100}{\text{Volume taken for} \times \text{Wt.} / \text{Volume of sample} \times 1000 \text{ Estimation taken}}$$

#### **Total Ash**

Total ash was determined according to Official method of analysis of the Association of Official Analytical Chemists [15].

$$\% \text{ASH} = \frac{[(\text{ashed wt.}) - (\text{crucible wt.})] \times 100}{[(\text{crucible and sample wt.}) - (\text{crucible wt.})]}$$

#### **Ascorbic Acid**

The ascorbic acid was determined by method of Ranganna (1986).

$$\text{Dye factor} = 0.5 \text{ Titer value} [15].$$

#### **Crude fat**

5 g sample was weighed accurately in thimble and defatted with petroleum ether in Soxhlet apparatus for 6-8 hrs. at 70°C. The resultant ether extract was evaporated and crude fat content was calculated [18].

#### **Dietary Fiber**

Total dietary fiber were analysed according to standard AOAC methods

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## **CONCLUSION :**

Bael fruit has high therapeutic and medicinal value. Bael has non-toxic nature due to this it gives immense advantages as it can be easily recommended for human trials and at lesser costs. The present review elaborates various therapeutic uses and physicochemical properties of Aegle Marmelos (Bael). Almost every part of this plant is used to cure a variety of illnesses, including the leaf, fruit, seed, bark, and root. The physical characteristics of fruit play a very important role in development of processing technology and on the quality of final products and chemical composition which is assessed the nutritional value.

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