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Phytochemical Screening and Pharmacological Study of Aegle Marmelos : A Review

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ABSTRACT

Aegle marmelos, commonly called "Bael," is a native Indian herb. The Bael tree—also referred to as the golden apple or Bengal quince—belongs to the Rutaceae family of medium-sized deciduous trees. Traditional medicine has traditionally utilized all portions of the sapling, including the fruit, woof, roots, leaves, and stems because they all have medicinal properties. Regardless of how old the fruit is, this is accurate. The composition of *Aegle marmelos* has been found to include flavonoids, fatty acids, carbohydrates, tannins, alkaloids, terpenoids, vitamins, and essential oils, among other things. The plant has pharmacological properties that can modulate the immune system, relieve pain, reduce inflammation, treat arthritis, lower blood cholesterol, fight cancer, fight viruses, treat ulcers, and promote wound healing. Its other properties include anti-proliferative, hepatoprotective, antidiabetic, antibacterial, and antifungal properties. Therefore, those who are keen to carry out further research on.

Keywords: - *Aegle Marmelos,* Phytochemical, Pharmacological Activity, Traditional use.

I. INTRODUCTION

Medicinal plants are a significant component of the nation's natural resources. They contribute significantly to the rural population's access to primary healthcare services. They work as both a healing agent and a crucial raw element in producing traditional medicines.[1] One of India's best medicinal plants is the Bael tree. The historic Sanskrit medical text "Charka Samhita" has a description of its therapeutic powers. Ripe fruit has several medicinal uses, include bowel movements, cooling, astringent, and fragrant properties. The berry, whether it is fully ripe or still green, has gastrointestinal, stomachic, or antiscorbutic properties[2]. The Rutaceae family includes Aegle marmelos, occasionally referred to as wood apples or Bael/Bilva. This plant has profound mystical, religious, and medicinal value. Its fruit and leaves are revered and offered to Hindu deities such as Lord Shiva. The ancient writings refer to it as the Shiva tree, or "Shiva druma" for this reason. The Indian traditional medical system, Ayurveda, and numerous folk medicines employ leaves, bark, roots, fruit, and seeds widely to treat a wide range of

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illnesses. Despite being native the the northern part of India, the plant is extensively distributed across the Indian peninsula, as well as in Indochina, Ceylon, Burma and Thailand [3,4]. These herbs have been the subject of in-depth research using cutting-edge scientific methods, and findings have indicated that they have a variety of therapeutic benefits, including the ability to fight off cancer, fight off infection, fight off fungal growth, fight diabetes, fight inflammation, safeguard the liver, fight haemolysis, fight larvicidal activity, and more [5,14] .The alternately double or complex leaves have one or rarely two pairs of opposing leaves with short stems. The leaf structures might be complicated entities solitary, or alternate. A prospectus is 4–10 cm long and 2–5 cm broad. Looking below, the thin leaflets' midribs are readily visible. The final segment of the leaflet has a longer petiole. A new leaf looks shiny and has a pink or burgundy colour after going through an inactivity or regenerative period.[15]



Figure 1: - *Aegle marmelos* Plant



Figure 2:- *Aegle marmelos* Leaves

Table 1 : Taxonomy of Aegle marmelos

Kingdom	Plantae
Order	Sapindales
Family	Rutaceae
Genus	Aegle
Species	Aegle marmelos

Phytochemical Constituents of *Aegle marmelos*

Alkaloids, tannins, essential oils, gums, resins, coumarin, and polysaccharides are just a few of the phytochemicals that make Bael effective for treating various illnesses. In comparison to other fruits, its nutritional value is much more substantial. The environment also values it greatly.[16] Different portions of the tree have been used to isolate and identify chemical components like alkaloids, coumarin, and considerable. [17]Aegeline was also isolated from the leaves of *Aegle marmelos* an alkaloidal-amide. [18]

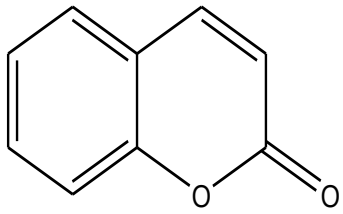
Some key phytochemicals found in *Aegle marmelos*, Alkaloids such as Aegeline, skimmianine, Tannins including marmelosin, and psoralen contain various phytochemical constituents. Coumarins, such as

imperatorin, marmelosin. Flavonoids including rutin and Scopoletin. Phenolic compounds like eugenol. Sterols such as β- sitosterol. Essential oils including limonene, and citronella.[19]

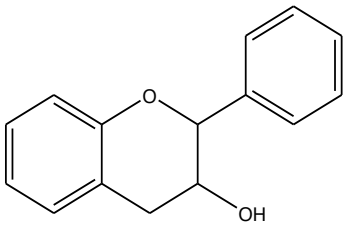
Table 2: Phytoconstituents present in different parts of the *Aegle marmelos*

S.no.	Plant part	Chemical phytoconstituents
1	Leaf	Skimmianine, Aegeline, Lupeol, Cineol, Citral, Citronella, Cuminaldehyde, Eugenol, Marmesinine.
2	Bark	Skimmianine, Fagarine, Marmin.
3	Fruit	Marmelosin, Luvangetin, Aurapten, Psoralen, Marmelide, Tannin.
4	Seed	d-Limonine, Cineole, Citral
5	Root	Psoralene, Xanthotoxin, Scopoletin, Tembamide 20

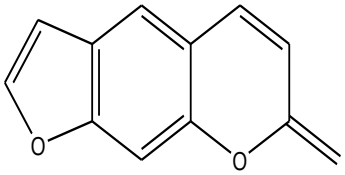
These compounds contribute to the medicinal properties of *Aegle marmelos*, such as antimicrobial, anti-inflammatory, antioxidant, and various other health benefits.



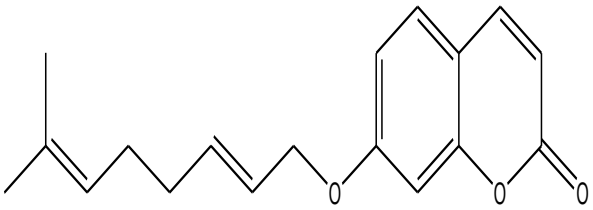
Coumarin



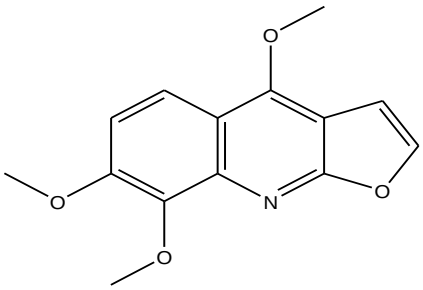
Tannins



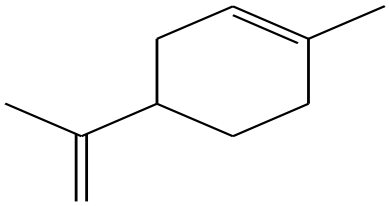
Psoralen



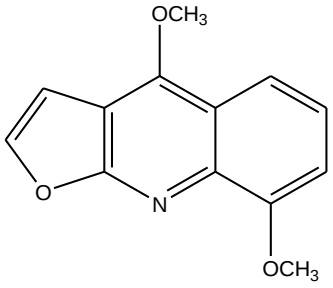
Auraptene



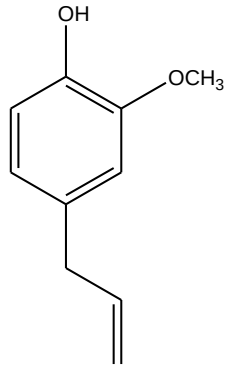
Skimmianine



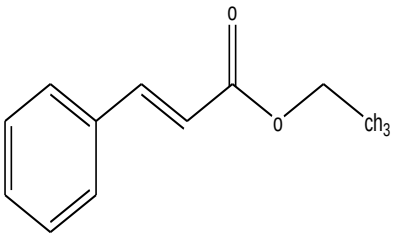
Limonene



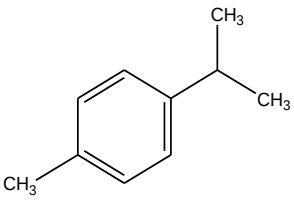
Fagarine



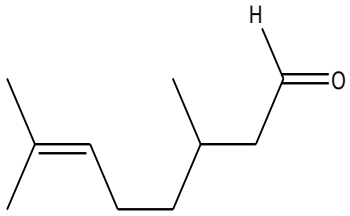
Eugenol



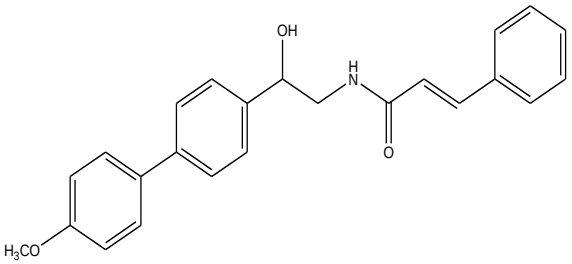
Ethyl cinnamate



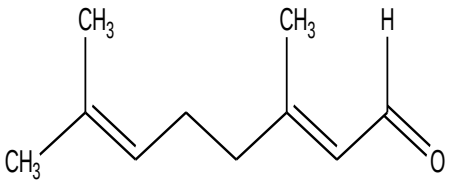
P-cymene



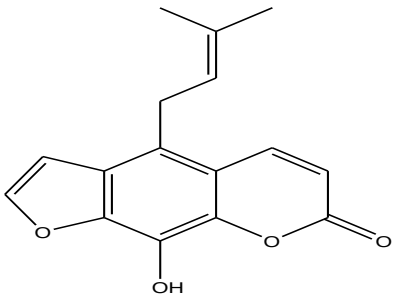
Citronellal



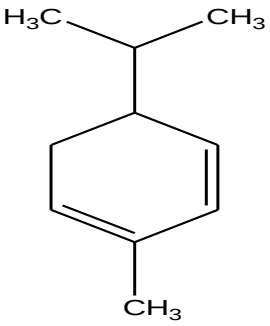
Aegeline



Citral



Alloimperatorin

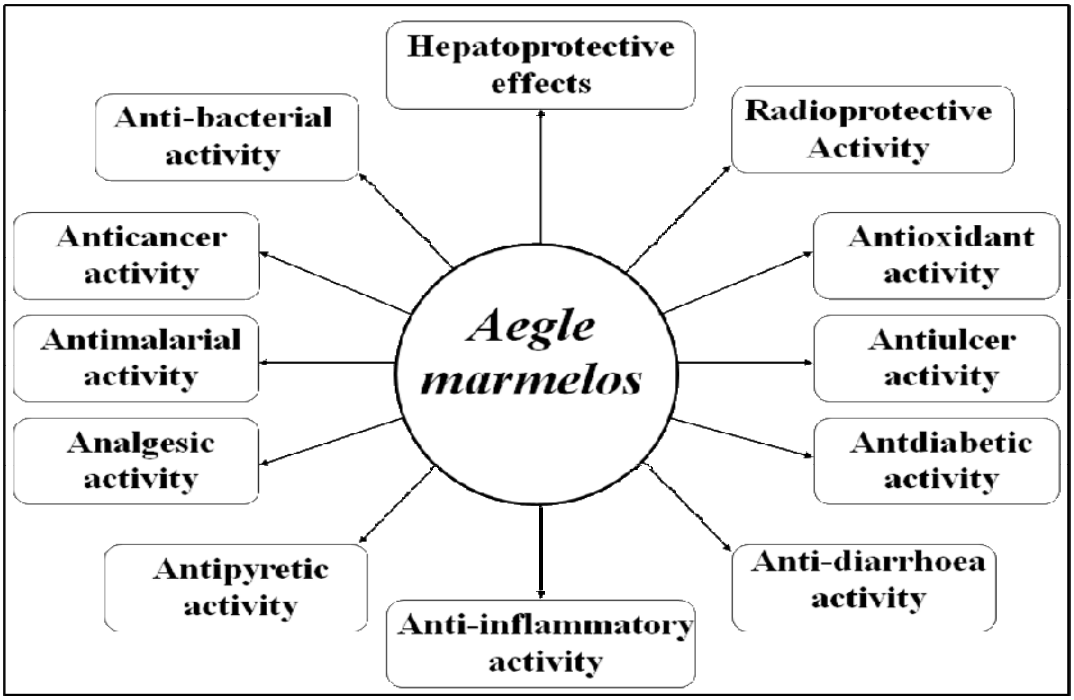


a-Phellandrene

Structures of some phytochemical constituents reported from Aegle marmelos.

Pharmacological Activities : -

Figure: 4 Pharmacological Activities



Hepatoprotective Properties

In this research, Rathee *et al.* performed the albino rats that had liver damage brought on by CCL4, and assessed the hepatoprotective potential of an ethanolic extract of *Aegle marmelos* leaves extract. The study's findings showed that 50 mg/kg (p.o.) of *Aegle marmelos* leaf extract possesses. [20] Singh *et al.* in this research hydroalcoholic extract of *Aegle marmelos* was tested for its hepatoprotective properties in contradiction to paracetamol-induced liver damage in rats. The animals with hepatotoxicity caused by paracetamol (3gm/kg) were given the methanolic extract orally at a dose of 500 mg/kg. Rats' livers were successfully shielded by the plant extract from the damage caused by paracetamol. A notable decrease in the serum enzymes haematoidin, alkaline phosphatase, aspartate transaminase, and alanine aminotransferase indicated this. The outcome specified that the methanolic extract had hepatoprotective properties against the hepatotoxicity that paracetamol causes in rats.[21]

Anti-diabetic Activity

Sabu and Kuttan in this research the anti-diabetic effect of *Aegle marmelos* leaves was found in rats with diabetes caused by alloxan. Blood sugar is lowered by the methanolic extract of *Aegle marmelos* leaves (120 mg/kg for weight, i.p.). After taking the extract continuously for six days, there was a noticeable drop in blood sugar levels. By the twelfth day, the levels had dropped by 54%.[22]

Analgesic Activity

Shankarananth *et al.* assessed the methanolic extract of *Aegle marmelos* leaves (200 to 300 mg/kg body weight, p.o.) for its analgesic properties. *marmelos* in Swiss mice subjected to tail flick and writhing tests with acetic acid. The study's findings showed a considerable decrease in the writhing brought on by acetic acid. Methanol extract demonstrated a notable

analgesic effect even in the tail-flick test by prolonging the latency to the pain brought on by the strong light. [23] George *et al.* has report the *Aegle marmelos* (L.) Corr. Serr. leaf extract's anti-inflammatory qualities were evaluated, and the phytochemical components were determined by In. There was an ethanol extract screening. About different phytochemical constituents. Ethanolic extracts were examined in Wistar Albino rats to see if they may lessen inflammation brought on by carrageenan.[24] Ghangale *et al*. have reported the acetic acid-induced writhing and the tail flick test in mice be situated significantly alleviated by the methanol extract of *Aegle marmelos* (L.) plants on quantity stages of (200 and 300 mg/kg).[25]

Antioxidant Activity

In this research Rathee *et al.* have reported *the* albino rats that had liver damage brought on by CCL4, assessed the antioxidant activity of an ethanolic extract of *Aegle marmelos* leaf extract. According to the study's findings, DPPH radical scavenging was used to test a leaf of *Aegle marmelos* for antioxidant activity on a dosage of 50 mg/kg (p.o.). Effective antioxidant action was demonstrated by the extract.[26] Kumar *et al*. reported the antioxidant activity of *Aegle marmelos* leaf extract was investigated by (AME). AME was discovered to have high amounts of total flavonoid and phenolic content, which demonstrated antioxidant activity similar to that of vitamin C. When Pearson's correlation was used, a significant association was established between TPC, TFC, and the antioxidant activity of AME. This investigation demonstrated the significant antioxidant component of *Aegle marmelos* leaves.[27]

Diuretic Activity

Singh *et al*. have reported the research that *Aegle marmelos* fruit fractions and several organic extracts are evaluated by their diuretic properties. The extracts remained directed intraperitoneally to tentative rats at (dosages of 300, 400, and 500 mg/kg). They assessed the diuretic drug consequence in measuring the capacity of urine and the Na contented. They initiate that the higher dosage of ethanolic extract (500 mg/kg) dramatically raised the excretion of sodium. [28]

Antifertility Effect

Sekar *et al.* have the antifertility activity outcome of *Aegle marmelos* leaves on aqueous extract in male Albino rats was reported by. Rats are managed with *Aegle marmelos* (extract 250 mg/kg from weight intended for 45 days). Testicle, epididymis, and seminal vesicle weights decreased as a result of treatment. Additionally, the extract reduced the number of sperm in the testicles, the number of sperm in the epididymis, their motility, and the aberrant number of sperm.[29]

Antithyroid Activity

Panda and Kar have researched the antithyroid activity of *Aegle marmelos* leaves is evaluated by. Researchers found that giving rats treated with levothyroxine scopolamine (1.00 mg/kg, p.o. for 7 days) reduced the level of thyroid hormones in their serum. Furthermore, Scopoletin was shown to have a superior therapeutic effect than propylthiouracil and the popular antithyroid drug.[30]

Anti-arthritic Activity

Sekar *et al.* assessment, *Aegle marmelos* leaves shielded Wistar rats from collagen-induced arthritis. Rats given methanol extract showed a reduction in their arthritic index and paw edema. Additionally, radiological and histological changes were significantly diminished in rats given methanol extract treatment.[31]

Anticancer Activity

Seema *et al.* have researched the hydroalcoholic extract of Bael leaves had a positive effect on an

animal model of Ehrlich ascites cancer. The direction of 400 mg/kg of extract produced the greatest anticancer effect. The plant extract exhibits cytotoxicity against cancer cell lines, as demonstrated by the brine shrimp lethality assay and the MTT-based experiment.[32]

Antipyretic Activity

Shukla *et al.* examined to febrifuge effect of *Aegle marmelos* arranged albino rats that had pyrexia caused by Brewer's yeast. They demonstrate that the ethanolic extract suggestively (P<0.001) reduced high-form fever in a dose-dependent manner at (200 mg/kg to 400 mg/kg body weight). The extracts' antipyretic efficacy was found to be equivalent to that of paracetamol (100 mg/kg body weight).[33]

Antimicrobial Activity

K. V. Bhaskara Rao *et al. Aegle marmelos* has been known to inhibit a wide range of harmful bacteria and is usually used to treat numerous communicable disorders. The antibacterial ability of *Aegle marmelos* extracts against harmful microorganisms, such as bacteria and fungi, has been demonstrated by multiple in vitro investigations. The agar well diffusion method was used to test *Aegle marmelos* leaves' antibacterial properties. The aqueous, petroleum ether and ethanol extracts of *Aegle marmelos* plants against Salmonella typhi, Escherichia coli, Streptococcus pneumoniae, Klebsiella pneumonia, and Proteus vulgaris demonstrated effective antibacterial activity. Both the petroleum ether and aqueous extract and the ethanolic extract exhibit efficacy against Penicillium chromogenic and Fusarium exospore, respectively. [34] It has been documented that *Aegle marmelos* leaves possess antibacterial properties. The disc diffusion method was used to assess the antibacterial activity. A comparison was made between the petroleum ether extract of leaves and multi-resistant strains of Salmonella typhi, Bacillus subtilis, Escherichia coli, Proteus vulgaris, Pseudomonas aeruginosa, and Klebsiella pneumonia. Compared to gram-positive strains, gram-negative bacteria exhibited greater antimicrobial activity. [35] *Aegle marmelos* leaves have been shown to have antifungal efficacy against dermatophyte clinical isolates. Foliage abstracts then a portion of *Aegle marmelos* stayed reported to exhibit antifungal efficacy compared to Several solvent extracts of *Aegle marmelos* leaves were found to have antibacterial properties. A modified disc diffusion experiment was used to screen the different solvent extracts for antibacterial activity.[36] Various extracts showed antimicrobial efficacy against E. coli, Pseudomonas dentifrices, Bacillus stearothermophilus, Micrococcus luteus, Streptococcus faecalis, Staphylococcus aureus, and S. pyogenes. The extract of petroleum ether showed no activity, whereas the extracts of ethanol and chloroform showed the highest activity. [37]

Antidiarrheal Activity

One of the main therapeutic qualities of *Aegle marmelos* is its antidiarrheal action, which has historically been widely used to treat dysentery and chronic diarrhea. The antidiarrheal qualities of *Aegle marmelos* have recently been confirmed by several in vitro and in vivo investigations. It was reported that *Aegle marmelos* dried fruit pulps have antidiarrheal properties in vitro. The MIC technique was used to measure the antidiarrheal activity against the diarrhoea-causing pathogens. The ethanolic extract exhibited moderate action against S. dysenteries and good activity against S. flexneri, S. sonnei, and S. boydii.[38] An unripe *Aegle marmelos* fruit's crude aqueous extract was tested for diarrhoea-causing chemicals. Antibacterial, antiviral, and antiretroviral properties of the extract were examined. While none of the six examined bacterial strains showed any reduction in viability, the extract showed inhibitory efficacy against rotavirus and Giardia.[39]

Cytotoxicity Studies

Sharma *et al.* reported the toxicity of four different extracts—alcoholic, entire aqueous, methanolic, then aqueous—obtained from the leaves of *Aegle marmelos* were tested in experimental rats. A rat was given intraperitoneal *Aegle marmelos (*extracts at a dosage of 50 mg/kg body weight used for 14 days). did not exhibit at all important histological alterations. Based on available data, there is a significant margin of medication safety for *Aegle marmelos* leaf extracts.[40] Fruit is typically used as a nourishing food, while *Aegle marmelos* are commonly used in traditional medicinal systems. However, because *Aegle marmelos* leaves have historically been used to induce abortions and sterilize women, using them while pregnant or nursing is not advised.[41] *Aegle marmelos* leaves have recently been investigated for their acute and subacute toxicity characteristics. The LD50 values and acute and subacute toxicity effects of various *Aegle marmelos* leaf extracts were evaluated in Wistar albino rats.[42]

Traditional Use: -

The Ayurvedic literature talks a lot about using *Aegle marmelos* to treat a variety of illnesses. *Aegle marmelos* has been traditionally used to treat a variability of surroundings, such as tartness, dysentery, lasting looseness, infection, tenderness, severe bronchitis, snakebites, febrile delirium, dyspepsia, leprosy, myalgia, smallpox, spermatorrhea, leukoderma, appreciation illnesses, sores, sickness, sores, inflammation, dehydration, thyroid problems to ulcers.[43]

II. CONCLUSION

The results of this study clearly showed that *Aegle marmelos* is an important medicinal herb widely used in Ayurveda, Siddha, and other healing systems. This plant's almost whole morphology, including its leaves, fruits, seeds, bark, and roots, treats a wide range of ailments. Antioxidant, antibacterial, antifungal, anti-diarrheal, anti-diabetic, anti-proliferative, cytoprotective, hepatoprotective, anti-fertility, pain-relieving, anti-arthritis, anti-hyperlipidemic, cardioprotective, radioprotective, anti-cancer, anti-viral, anti-ulcer, immunomodulatory, and looped properties are a few of these. therapeutic qualities. A. melees can be marketed as a cutting-edge medication source for the treatment of numerous ailments since pharmacologists are eager to create novel pharmaceuticals from natural sources. Further studies are recommended to isolate specific compounds responsible for this activity and to better understand the underlying mechanisms, among their outcomes.

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