



PHYTOCHEMICAL SCREENING AND ANTIMICROBIAL ACTIVITY OF *AEGLE MARMELOS*: A REVIEW

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Communicated :16.10.2024

Revision: 11.11.2024 & 21.11.2024

Published: 30.01.2025

Accepted: 07.12.2024

ABSTRACT:

Aegle marmelos (bael) has attracted considerable interest due to its wide range of pharmacological properties. This review compiles findings from several studies highlighting the medicinal benefits of various plant parts of *Aegle marmelos*. It focuses on the phytochemical constituents, particularly in methanolic extracts, which demonstrate significant antioxidant activity. The antimicrobial potential of *Aegle marmelos* is well-established, showing strong activity against both gram-positive and gram-negative bacteria. Additionally, the plant has been explored for its inclusion in formulations like natural toothpaste to enhance oral hygiene. *Aegle marmelos* also shows promise in the management of skin infections and possesses antifungal, antidiabetic, and antioxidant properties. In conclusion, *Aegle marmelos* holds great potential as a therapeutic agent against clinical pathogens and warrants further research to explore its broader applications in healthcare.

Keywords: - *Aegle marmelos*, antifungal, antidiabetic, antioxidant, therapeutic agent.

INTRODUCTION:

Traditional medicines are widely used in India because of their broad pharmacological effects. Both developed and developing countries continue to rely on traditional plant-based remedies as a primary means of managing infections. Many people believe that herbal medicines, often referred to as "green medicines," are healthier and safer than synthetic pharmaceuticals [1]. Approximately 80% of the global population relies on plants for their primary healthcare needs. Plants are a significant source of commercially available drugs, with many synthetic medications being derived from natural plant-based compounds. The use of natural products has grown in recent years, and active plant extracts are regularly screened for potential new drug discoveries [2]. *Aegle marmelos* is an important medicinal plant found throughout India, known for its wide range of medicinal properties [3]. *Aegle marmelos* belongs to the Rutaceae family. It is a medium-sized deciduous tree with strong axillary thorns and compound leaves consisting of three leaflets. Bael

leaves are highly beneficial in treating various ailments, including diabetes, jaundice, cholera, and asthma. A poultice made from bael leaves is used to treat ophthalmic conditions and is also applied to inflamed areas, often in combination with black pepper, to reduce edema. Additionally, bael is used to treat constipation and jaundice. Extracts of this plant have demonstrated a wide range of therapeutic properties, including antioxidant, anti-ulcer, anti-diabetic, anti-cancer, anti-hyperlipidemic, anti-inflammatory, anti-bacterial, and anti-spermatogenic effects [1,6].

The juice of *Aegle marmelos* leaves, when mixed with honey, is commonly used to treat fever and can also help in the management of tuberculosis. Rich in antioxidants, this combination supports insulin secretion, which in turn helps in lowering blood sugar levels [4]. *Aegle marmelos* has been reported to contain various bioactive compounds, including alkaloids, cardiac glycosides, terpenoids, saponins, tannins, flavonoids, and steroids. It is traditionally used in the treatment of diarrhea and dysentery. Additionally, the

leaves of this plant have been used for inducing infertility or abortion in women [5]. Hence, looking at so many benefits of *Aegle marmelos* plant, this review was carried out to know the current status of this plant extract against present day multidrug resistant pathogens.

THE REVIEW :

Md. Tajminur Rahman et al. (2024) conducted a study to analyze the phytochemical content and antioxidant activities of Bael powder and its products using methanol and ethanol extracts. Their findings revealed that the powdered fruit pulp of Bael contains significant amounts of total phenols, flavonoids, tannins, and other phytochemicals, making it a rich source of antioxidants. The methanolic extracts were found to contain significantly higher levels of total phenols, flavonoids, and tannins compared to the ethanolic extracts, although both extracts exhibited comparable antioxidant activity.

Payal Pilaaji et al. (2023) conducted a study on the formulation and evaluation of toothpaste prepared with *Aegle marmelos*. They compared this natural toothpaste with a chemically formulated artificial toothpaste by performing antimicrobial activity tests. The study found that the natural toothpaste plays a significant role in maintaining dental cleanliness, promoting oral hygiene, and preventing dental cavities. Additionally, it was found to be safer with fewer adverse effects compared to conventional chemical-based toothpaste.

Purushoth Prabhu et al. (2021) conducted a study on the antibacterial potency of a combination of extracts from *Tridax procumbens*, *Aegle marmelos*, and *Acalypha indica* against *E. coli*, *B. subtilis*, *S. aureus*, and other *Streptococcus* species. Their findings revealed that methanol, ethyl acetate, and hexane extracts of *Tridax procumbens* and *Acalypha indica*, along with the oil of *Aegle marmelos*, exhibited antibacterial activity against the bacteria responsible for infections. Based on these results, the extracts

were formulated into an ointment with a suitable base for the treatment of skin infections.

Shailja Choudhary et al. (2021) conducted a literature study and concluded that *Aegle marmelos* is associated with significant medicinal properties, making it one of the most important medicinal herbs.

Mukesh Pimpliskar et al. (2012) conducted a study on the antibacterial activity of *Aegle marmelos* stem, fruit, and leaf extracts against four standard pathogenic bacterial strains (*E. coli*, *B. subtilis*, *P. aeruginosa*, *S. aureus*) using the agar well diffusion method. The results showed that all the extracts exhibited significant antibacterial activity, effectively inhibiting both Gram-negative and Gram-positive bacteria.

Sonal Kumar Nagarkar (2021) conducted a study to evaluate the antimicrobial activity of methanolic and aqueous extracts of *Aegle marmelos* leaves against common human pathogens, including *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Streptococcus mutans*, and *Candida albicans*. The study found that the aqueous extract of *Aegle marmelos* was more effective in inhibiting all five test pathogens, with zones of inhibition ranging from 31 mm to 51 mm, compared to the methanolic extract, which showed zones of inhibition between 14 mm and 39 mm. The results suggest that both methanolic and aqueous leaf extracts of *Aegle marmelos* could be utilized as natural treatments for various infectious diseases caused by human pathogens.

Surender S. Yadav et al. (2015) conducted a study to investigate the antibacterial properties of methanolic and chloroform leaf extracts of *Aegle marmelos* against two Gram-positive bacteria (*Bacillus subtilis*, *Staphylococcus aureus*) and three Gram-negative bacteria (*Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Escherichia coli*) using the agar disc diffusion method. The study found that both methanolic and chloroform

leaf extracts exhibited maximum antibacterial activity, with a 15 mm zone of inhibition against *P. aeruginosa* and an 18 mm zone against *S. aureus*. The results suggest that *Aegle marmelos* extracts may serve as a potential antibacterial agent against both Gram-positive and Gram-negative bacteria, with methanolic leaf extract showing greater activity than the chloroform extract.

V.N. Ariharan and P. Nagendra Prasad (2014) conducted a study to evaluate the antibacterial activity of aqueous extracts from three morphological traits of *Aegle marmelos* leaves: Trait I (small leaves with 3 leaflets), Trait II (medium-sized leaves with 7 leaflets), and Trait III (large leaves with 3 leaflets). The extracts were tested against several human pathogenic bacteria, including *Bacillus subtilis*, *Enterococcus faecalis*, *Staphylococcus aureus*, *Escherichia coli*, *Vibrio cholerae*, and *Pseudomonas aeruginosa*. The study found that Gram-negative bacteria showed a larger inhibition zone compared to Gram-positive bacteria, with *E. coli* exhibiting the highest inhibition. Among the three leaf traits, Trait I showed the most significant inhibitory effect against all six bacterial strains. Trait II exhibited activity against four organisms (*Enterococcus faecalis*, *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*), while Trait III was effective against four others (*Bacillus subtilis*, *Enterococcus faecalis*, *Escherichia coli*, *Vibrio cholerae*). These results suggest that the active principles may be present in smaller quantities in Traits II and III. Overall, the study indicates that *Aegle marmelos* leaves can serve as a valuable natural antibiotic.

Neha Parihar et al. (2014) conducted a study to evaluate the antibacterial activity of *Aegle marmelos* fruit, leaf, and stem extracts in methanol, aqueous, and petroleum ether solvents against various test bacterial strains using the agar well diffusion method. The study found that the fruit extract in methanol was the most

effective, showing significant antibacterial activity against *Escherichia coli*, *Bacillus subtilis*, and *Salmonella typhi*. The results suggest that *Aegle marmelos* holds promise for the development of phytomedicines due to its antimicrobial properties.

Aarti Saxena et al. (2014) conducted a study to evaluate the antimicrobial activity of ethanolic and methanolic extracts of *Aegle marmelos* against human pathogens, including *Klebsiella aerogenes*, *Klebsiella pneumonia*, *Enterococcus faecalis*, *Escherichia coli*, *Bacillus subtilis*, *Pseudomonas aeruginosa*, *Streptococcus faecium*, *Staphylococcus aureus*, and *Proteus mirabilis*. The study found that *Aegle marmelos* exhibits broad-spectrum antimicrobial activity, highlighting its potential as a therapeutic agent against various bacterial infections.

Saroj Kothari et al. (2011) conducted a study to investigate the antimicrobial activity of serial petroleum ether, chloroform, and methanol extracts from the leaves of *Aegle marmelos* against various bacterial and fungal species. The study found that all the extracts exhibited broad-spectrum antimicrobial activity, effectively inhibiting bacteria such as *Staphylococcus aureus*, β *Streptococcus haemolyticus* group A, *Proteus mirabilis*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Escherichia coli*, and *Salmonella typhi*, as well as fungi like *Candida albicans*, *Candida tropicalis*, and *Aspergillus flavus*.

RESULT :

Methanolic extract of *Aegle marmelos* contain higher levels of phenol, flavonoids, and tannins with notable antioxidant properties [7]. Natural toothpaste with *Aegle marmelos* promotes oral health and prevents cavities more safely than chemical alternatives [6]. *Aegle marmelos* when combined with other plant extracts it shows antibacterial activity against several pathogens, and it is useful for skin infections [5]. *Aegle*

marmelos is a highly valuable medicinal plant with diverse applications in both traditional and modern medicine [8]. All parts of *Aegle marmelos*—including the stem, fruit, and leaves—exhibit antibacterial properties against both Gram-positive and Gram-negative bacteria [1]. The aqueous leaf extract of *Aegle marmelos* is more effective against human pathogens than the methanolic extract [4]. Both methanolic and chloroform extract of *Aegle marmelos* leaves show antibacterial potential, with methanol extract being more effective [9]. Among different leaf traits of *Aegle marmelos*, Trait I exhibits the highest antibacterial activity [10]. The methanolic fruit extract of *Aegle marmelos* is highly effective against *E. coli*, *B. subtilis*, and *S. typhi* [11]. Both ethanolic and methanolic *Aegle marmelos* extract have broad-spectrum antimicrobial activity against multiple pathogens [3]. *Aegle marmelos* leaf extracts, including those in petroleum ether, chloroform, and methanol, demonstrate broad-spectrum antimicrobial activity against both bacteria and fungi [2].

DISCUSSION :

The results indicated that both aqueous and methanolic leaf extracts of *Aegle marmelos* could be utilized as natural remedies for treating various infectious diseases caused by these pathogens. The ability of *Aegle marmelos* extracts to inhibit the growth of bacteria and fungi highlights its broad-spectrum antimicrobial activity, making it a potential source for the development of new antimicrobial agents. Based on the findings of this study, it can be concluded that the methanolic leaf extract of *Aegle marmelos* demonstrates significant in vitro antimicrobial activity.

CONCLUSION :

The literature review concludes that *Aegle marmelos* is a highly valuable medicinal plant with significant therapeutic properties, including antifungal, antimalarial, antiviral, antioxidant, and antidiabetic effects. Based on research

findings, *Aegle marmelos* shows great potential as a source of valuable drugs. The plant's diverse compounds, essential for maintaining good health, can be utilized to treat various health conditions. Additionally, the study highlights that toothpaste made from *Aegle marmelos* can effectively maintain oral hygiene, prevent dental cavities, and offer a safer alternative with fewer negative effects compared to conventional chemical-based toothpaste.

REFERENCES:

- Pimpliskar, M., Shinde, P., Savakare, V., Jadhav, V., & Girkar, K. (2012). Antibacterial screening of stem, fruit and leaves of *A. marmelos*. *European Journal of Zoological Research*, 1(2), 60-64.
- Kothari, S., Mishra, V., Bharat, S., & Tonpay, S. D. (2011). Antimicrobial activity and phytochemical screening of serial extracts from leaves of *Aegle marmelos* (Linn.). *Acta Pol Pharm*, 68(5), 687-692.
- Saxena, A., Pal, A., & Pal, K. (2014). ANTIBACTERIAL ACTIVITY OF AEGLE MARMELOS AGAINST HUMAN PATHOGENIC MICROBIAL STRAINS.
- Nagarkar, S. S. (2021). Antimicrobial activity of aqueous and methanolic extracts of *Aegle marmelos*. *Int. J. of Life Sciences*, 9(3), 357-360.
- Nachiar, G. S., Prabhu, T. P., Kavitha, C., & Sheela, T. (2021). Review on antibacterial potency of combination of effective extract of *Tridax procumbens*, *Aegle marmelos*, and *Acalypha indica*.
- Pilaji, P., Malpure, M., Raidas, D., Kodag, P., More, V., More, R., & Naik, D. (2023). Formulation And Evaluation of Toothpaste Preparation Using *Aegle Marmelos*. *World Journal Pharmaceutical Research*, 12(15), 749-760.
- Rahman, M. T., Halim, M. A., Mozumder, N. R., Ove, T. A., & Khatun, A. A. (2024). Phytochemicals and antioxidant

- properties of bael (*Aegle marmelos* L.) pulp powder and its products. *Journal of Agriculture and Food Research*, 15, 100971.
- Choudhary, S., Chaudhary, G., & Kaurav, H. (2021). *Aegle marmelos* (bael patra): An ayurvedic plant with ethnomedicinal value. *International Journal of Research in Ayurveda and Pharmacy*, 12(3), 147-156.
- Yadav, S. S., Dahiya, K. U. L. D. E. E. P., Ganie, S. A., & Gulia, S. K. (2015). Antibacterial activity of *Aegle marmelos* (L) Correa. *Int J Pharm Pharm Sci*, 7(3), 462-4.
- Ariharan, V. N., & Prasad, P. N. (2014). ANTI-BACTERIAL ACTIVITY OF THREE MORPHOLOGICAL TRAITS OF AEGLE MARMELOS (LINN.) CORR.-'VILVAM'. *Rasayan Journal of Chemistry*, 7(3), 260-263.
- Parihar, N., & Kumar, S. (2014). Antibacterial activity of *Aegle marmelos* against bacterial strains. *Indian Journal of Life Sciences*, 4(1), 63.