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A Comparative Review of the Traditional Uses, Phytochemistry, and Pharmacological Activities of *Aegle marmelos* and *Madhuca longifolia*

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Abstract

Plant based medicines have a long history of usage as a primary source of traditional medicine, such as Ayurveda and ethno medicine and a broad spectrum of therapeutic effectiveness because of naturally occurring bioactive compounds. Two of them *Aegle marmelos* and *Madhuca longifolia* are especially significant medicinal plants with a wide pharmacological range and are extensively applied in the Indian traditional medicine. They are plants that have been cherished to be used in the management of many diseases, such as gastrointestinal diseases, inflammation, diabetes, and skin diseases. The two plants possess bioactive substances, including alkaloids, flavonoids, saponins, and terpenoids, which help in their antioxidant, anti-inflammatory, anti-microbial, and antidiabetic activities. Despite the fact that *Aegle marmelos* is particularly stated to have significant digestive and antidiabetic properties, *Madhuca longifolia* has significant anti-ulcer and analgesic potential. In general, the therapeutic potential of both plants is rather high, and additional clinical studies are required to determine the effectiveness of these plants and contribute to their safe introduction into the pharmacotherapy. In the current review, a comparison between the traditional applications, phytochemical composition, and pharmacological action of *Aegle marmelos* and Madhuca longifolia will be *given*.

Keywords: *Aegle marmelos*, *Madhuca longifolia*, Phytochemistry, Ethnomedicinal, Pharmacological Activity, Medicinal Plants

1. Introduction

1.1 Overview of Herbal Medicine and Global Reliance

The practice of herbal medicine has been an important part of healthcare in the world particularly in the developing world where other healthcare systems like Ayurveda continue to play a central role in healthcare. The number of individuals worldwide who depend on plant-based remedies as a source of preventive and curative treatments is an appreciable percentage because of the availability, cheapness, and social acceptability [1]. The rising popularity of natural products is also attributable to the fear of the side effects and resistance of the synthetic drugs [2, 3]. India is known worldly as the "botanical garden" of the world owing to its abundance in biodiversity and is the biggest manufacture of medicinal plants, which are very essential to human and animal health [4]. The traditional medicine systems that provide ready healthcare particularly in tribal and rural communities are based on most of these botanical resources [5]. Approximately 80 percent of the population worldwide has been known to rely on the traditional medicine, the most common by the extracts of plants, as their main medical care and India has one of the largest medical traditions grounded on plants [6]. Historical records dating back to 2600 BCE also support the historical use of medicinal plants in India and the use of these medicinal plants in health practices and modern pharmacological research [7]. Indian medicinal plants are deemed as enormous source of pharmacologically active principles and constituents which are usually employed in numerous remedies to a variety of ailments [8].

1.2 Application of Plant-Based Drugs in Contemporary Pharmacology

The contributions of plant-derived compounds to current pharmacology have played a major role in the discovery and development of drugs, serving as templates [9]. Alkaloids, flavonoids, and terpenoids, among other bioactive phytoconstituents, have several pharmacological properties such as antioxidant, anti-inflammatory, and antimicrobial activity [10, 11]. Combination of traditional knowledge on medicinal plants and the use of modern scientific validation has accelerated the discovery of new therapeutic agents [12].

1.3 Botanical Account of Selected Plants

Aegle marmelos (Rutaceae), also known as Bael, is a widespread Indian subcontinental tree, which is mostly used in the treatment of digestion, diabetes, and infections [13]. *Madhuca longifolia* (Sapotaceae), worldly known as Mahua is a tropical plant that has been found to possess three applications; as medicine, food, and economic application especially in the tribal society to cure inflammation, ulcer, and skin diseases [14].

1.4 Research Gap

Despite some studies documenting the pharmacological effect of *Aegle marmelos* such as antioxidant and wound healing, little research has been done on *Madhuca longifolia* and is mostly limited to initial studies [14, 15]. Moreover, the efficacy of these plants in wound healing, phytochemical standardization, and formulation has not been compared in a comparative study. Limited comparative studies have integrated their conventional, phytochemical, and pharmacological properties and, therefore, the comprehensive picture of therapeutic potentials is yet to be realized.

1.5 Aim and Objectives of the Review

This review aims to conduct a comparative analysis of *Aegle marmelos* and *Madhuca longifolia* based on their Ethnomedicinal uses, phytochemical composition, and pharmacological activities to determine their future use in drug development and clinical applications.

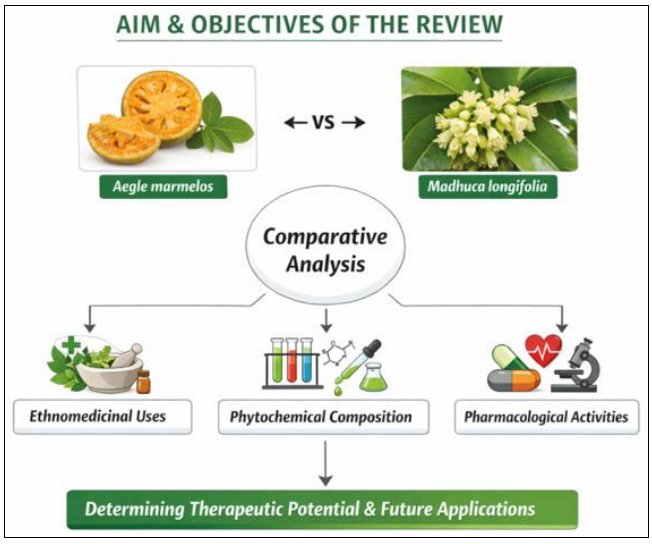

Fig 1: Schematic overview of the Aim & Objectives of the review for comparative evaluation of *Aegle marmelos* and *Madhuca longifolia*

2. Botanical Description and Distribution

2.1 *Aegle marmelos*

Aegle marmelos (Rutaceae), also called Bael, is a medium-sized deciduous tree with a hard woody trunk, trifoliate aromatic leaves and round or oval fruits that have a hard shell and mucilaginous pulp [16]. The plant usually grows to 10-15 meters tall and is highly adaptive to various climatic conditions [17]. It can survive drought and poor soils, which are found in dry forests, plains, and other hilly areas. *Aegle marmelos* is also commonly found in the sub-Himalayan tract, central India, and southern states, and is often planted around temples in India due to its religious value [18].

2.2 *Madhuca longifolia*

Madhuca longifolia (family Sapotaceae, also spelt Mahua) is a large, evergreen or semi-evergreen tree species, growing up to 18 meters [19]. It has thick bark and foliage and flowers that are fleshy, cream in color [20, 21] and abundant in sugars [19, 20]. It is an ecologically important tree prevalent in tropical and subtropical areas [22] and specifically in dry deciduous forests [23]. It is primarily found in central, western, and peninsular India and serves a significant purpose in the life of the tribal people because of its many secondary applications [24, 25].

Table 1: Plants description including family and parts used

Feature	*Aegle marmelos*	*Madhuca longifolia*	References
Family	Rutaceae	Sapotaceae	[16,19]
Common name	Beal, Bilva	Mahua, Mahva	[17,20]
Part used	Fruit, leaf, bark	Flower, seed, bark, leaf	[16,20]

Overall, while *Aegle marmelos*in primarily adapted to arid and semi-arid regions with medicinally valuable fruits, *Madhuca longifolia* is ecologically dominant in forest ecosystems and valued for its flowers and seeds, highlighting their complementary ethnobotanical importance [25, 27].

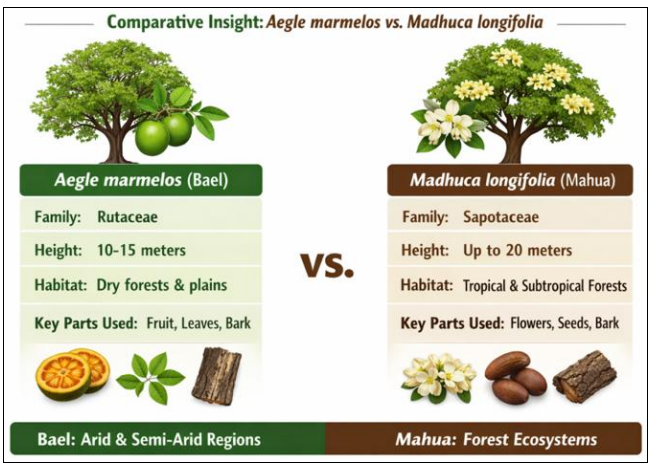

Fig 2: Ethnobotanical Comparative insights of *Aegle marmelos* vs. *Madhuca longifolia*

3. Traditional and Ethnomedicinal Uses

3.1 *Aegle marmelos*

Aegle marmelos an Ayurvedic medicine has been widely applied in the treatment of gastrointestinal diseases such as diarrhea, dysentery, and irritable bowel syndrome. The unripe fruit is especially appreciated as an astringent, and the ripe one is a digestive tonic [28, 29]. The plant achieves its

diabetes-reducing properties through its hypoglycemic effects, and it also has anti-inflammatory and antimicrobial effects in its leaves [30, 31]. Furthermore, the various parts of the plant are administered in the treatment of fever and respiratory infections in traditional systems [28, 29].

3.2 *Madhuca longifolia*

Madhuca longifolia is commonly used as a tribal and folk medicine because of its various medicinal uses [32, 34]. It is also utilized in the treatment of cough, bronchitis, and general debilitation because of such nutritive and demulcent properties [20]. the leaves and the tree bark have powerful anti-ulcer and analgesic properties that are applied in treating skin ailments, swellings, and wounds [35]. The oil and seeds derived from it are also used traditionally in rheumatism and skin infections, which emphasizes the multifunctional use of the plant as a medicine [32, 34].

3.3 Ethno medicine Analysis Comparison

Aegle marmelos is already well-documented, well-standardized in Ayurveda and is mostly applied in the management of the digestive system and metabolic disorders [36] since *Madhuca longifolia* is more commonly used in tribal medicine systems as the provider of symptomatic relief, nutritional supplementation, and topical agents [22, 37]. This opposition signifies a hierarchical pharmacological Ayurveda practice against a holistic and community-based use of ethno medicine.

Table 2: Traditional Uses of *Aegle marmelos* and *Madhuca longifolia*

Therapeutic use	*Aegle marmelos*	*Madhuca longifolia*	References
Digestive disorder	✓(diarrhea, dysentery)	Limited	[28, 32]
Antidiabetic	✓	Moderate	[28, 34]
Anti-inflammatory	✓	✓	[30, 35]
Anti-ulcer	Limited	✓	[29,32]
Analgesic	Moderate	✓	[29, 35]
Skin diseases	Moderate	✓	[31, 35]
Tribal use	Limited	Extensive	[29, 35]

In general, the two plants show remarkable Ethnomedicinal interest, and supplementary therapeutic value in the traditional healthcare systems.

4. Phytochemical Composition

4.1 Phytochemistry of *Aegle marmelos*

Aegle marmelos boasts of a large number of bioactive compounds that make it possess a medicinal value [38]. Alkaloids (e.g., aegeline, which is the best known among the key ingredients) are attributed to the antidiabetic and cardio-protective effects [39]. Coumarins, and in particular, marmelosin, play an important role in antimicrobial and anti-inflammatory responses [40]. Additionally, flavonoids and tannins are available in the plant, and these have high antioxidant properties and play a role in the therapeutic effect on metabolic and gastrointestinal disorders [41]. Such phytoconstituents are mainly present in the fruit, leaves and the bark [39, 40].

4.2 *Madhuca longifolia* Phytochemistry

Madhuca longifolia has a specific phytochemical profile, i.e., the presence of saponins and triterpenoids, which are the major contributors to its anti-inflammatory, anti-ulcer, or immunomodulatory effects [42, 43]. Flavonoids and glycosides are also present in the plant and exhibit antioxidant and antimicrobial activity [23]. These bioactive compounds are especially high in the seeds, flowers, and bark, which contribute to its extensive application in traditional medicine [44, 45].

The phytochemical profile of plants

A comparative study shows that *Aegle marmelos* tends to have more alkaloids and coumarins [46]. Whereas *Madhuca longifolia* has more saponins and triterpenoids [44]. They are both plants that contain flavonoids, which is the reason for the similarities in their antioxidative and anti-inflammatory actions [23, 44].

Table 3: Major Phytoconstituents of *Aegle marmelos* and *Madhuca longifolia*

Compound class	*Aegle marmelos*	*Madhuca longifolia*	References
Alkaloids	High	Low	[40, 42]
Flavonoids	High	High	[41, 44]
Saponins	Low	High	[41, 43]
Triterpenoid	Low	High	[40, 44]

5. Pharmacological Activities

5.1 *Aegle marmelos*

Aegle marmelos has a broad range of pharmacological activity in experimental research. The bioactive compounds, including aegeline and flavonoids, are responsible for its antidiabetic effect because they increase insulin release and glucose metabolism [47, 48]. The coumarins and tannins in the plant also exhibit significant antimicrobial activity against several bacterial and fungal pathogens [49]. It mediates anti-inflammatory action by inhibiting pro-inflammatory mediators, whereas studies have noted hepatoprotective effects, demonstrating protection against toxin-induced liver damage [50].

5.2 *Madhuca longifolia*

Madhuca longifolia is an active agent that is effective in treating ulcers and the saponins and triterpenoids present in the product help in enhancing the protective layer of the stomach mucosa [51]. The antioxidant capacity of the plant is high because it interacts with free radicals and reduces the oxidative stress levels [52]. It is also an analgesic and anti-inflammatory agent; therefore, it can be applied in the management of pain and inflammation [53]. Its extracts have also been discovered to have cytotoxic effects on certain cancer cell lines, which is giving rise to the anticancer potential [54].

5.3 Comparative Pharmacological Evaluation

The similarity in the presence of flavonoids in both plants coincides with their pharmacological effects, which are anti-inflammatory and antioxidant effects. However, Aegle marmelos is more actively applied as antidiabetic and hepatoprotective agent, and Madhuca longifolia is more effective as anti-ulcer agent and analgesic agent [48, 50, 51] this highlights its complementary treatment benefits in the traditional and modern medicine.

Table 4: Pharmacological Activities of *Aegle marmelos* and *Madhuca longifolia*

Pharmacological Activity	*Aegle marmelos*	*Madhuca longifolia*	References
Anti-diabetic	✓	Moderate	[47, 51]
Antimicrobial	✓	Moderate	[49, 52]
Anti-inflammatory	✓	✓	[50, 52]
Hepatoprotective	✓	Limited	[50, 51]
Antiulcer	Limited	✓	[49, 51]
Antioxidant	✓	✓	[49, 52]
Analgesic	Moderate	✓	[50, 53]
Anticancer	Limited	Emerging	[50,54]

6. Mechanisms of Action

6.1 Role of Flavonoids in Antioxidant Pathways

Flavonoids contained in *Aegle marmelos* and *Madhuca longifolia* are crucial for reducing oxidative stress through several biochemical pathways [55]. These substances are free radical scavengers, that is, they donate hydrogen atoms or electrons, neutralizing the activity of reactive oxygen species (ROS) and preventing cell damage [56]. Also, flavonoids increase endogenous antioxidant defense mechanisms by increasing the activities of superoxide dismutase (SOD), catalase, and glutathione peroxidase, which are involved in cytoprotection [57].

6.2 Saponins and Anti-Inflammatory mechanisms.

Madhuca longifolia contains saponins that have anti-inflammatory properties by affecting the main inflammatory mediators [42]. They also prevent the synthesis of pro-inflammatory cytokines (TNF-a, IL-1b, and IL-6) and the activation of signaling pathways (NF-kB) that are critical for regulating inflammation [58]. This leads to decreased tissue inflammation and enhanced healing processes [59].

Alkaloids contain a ring structure that, in pyridine, serves as the link connecting ring carboxyl groups. Alkaloids, such as pyridine, act as complexing agents for ring carboxyl groups [60].

Aegeline in *Aegle marmelos* is an alkaloid that regulates the metabolism of certain pathways specifically glucose metabolism. Its actions include insulin secretion, glucose uptake in peripheral tissues, and changes in the activity of important enzymes of carbohydrate metabolism, which contribute to antidiabetic effects [47, 59].

6.3 Signaling Pathways and Molecular Targets

The pharmacological action of these plants is associated with some important pathways, including the NF-kB inhibition and the oxidative stress regulation at the molecular level [61]. By lowering the concentration of ROS and suppressing the activity of inflammatory transcription factors, the phytoconstituents also prevent the cell damage and the progression of chronic diseases [62, 63]. The use of poly-pharmacological combinations to treat multifactorial diseases is the focus of this poly-pharmacological approach.

7. Toxicological Profile and Safety

7.1 Acute and Chronic Toxicity Studies

Toxicological appraisals of *Aegle marmelos* and *Madhuca longifolia* show that they have an overall good safety profile when applied within therapeutic scope. Toxicity tests done on *Aegle marmelos* extracts have shown that they were relatively safe and there were no reported cases of death or alteration in behavior when the extracts were subjected to the normal doses on the experimental animals [64]. Similarly, chronic toxicity testing shows that the whole treatment has no major organ toxicity particularly hepatic and renal toxicity [65, 66]. *Madhuca longifolia* has been reported to have low toxicity in both acute and sub-chronic toxicity studies although high doses of seed extracts may result in mild physiological effects, a circumstance explained by the existence of saponins [64, 65, 67].

7.2 Safe Dosage Ranges

The safe dosage of *Aegle marmelos* differs depending on the part of the plant and the formulation; moderate doses of fruit and leaf extracts are evaluated as safe for therapeutic application [65, 68]. For instance, while a 90-day oral toxicity study in rats showed no significant adverse effects at doses up to 2000 mg/kg/day, higher concentrations administered intravenously induced dose-dependent cardiotoxicity [69]. In the case of *Madhuca longifolia*, flower and leaf extracts and seed oil have been studied to be safe, especially through controlled consumption; For example, a study on the methanolic extract of *Madhuca longifolia* bark reported an LD50 greater than 2000 mg/kg in mice, classifying it as practically non-toxic [70]. nevertheless, it has been noted that its varied phytochemical composition may restrict dosage standardization [71, 72].

7.3 Adverse Effects

The negative impacts of the two plants are not severe when used in properly. A pronounced effect of *Aegle marmelos* could cause constipation because of excessive fruit intake [73]. In *Madhuca longifolia*, the toxicity or side effects may be mild gastrointestinal problems caused by excess seed extracts or oils, both of which can be toxic in their unprocessed forms [66, 72]. Overall, both plants can be regarded as comparatively safe, but additional clinical research is required to achieve standardized dosage and safety profiles for prolonged use.

8. Clinical Studies and Evidence Gap

8.1 Available Clinical Evidence

The clinical information about *Aegle marmelos* and *Madhuca longifolia* remains incomplete and the highest amount of researches is limited to *in vivo* and *in vitro* experimental models. Some of the clinical evidence is premature but it suggests that extracts of the *Aegle marmelos* leaf extract can be used in the glycemic regulation of diabetic patients, but again it is small-scale or non-standard trials [48]. Studies on *Madhuca longifolia* have primarily focused on pharmacological and in silico research, which has demonstrated the antioxidant, anti-inflammatory and Cytotoxicity.

8.2 Limitations of the Existing Research.

The current literature is not exhaustive because it contains the following problems: The lack of a single approach to extraction, the variability of phytochemical composition, and small sample sizes in the experimental studies. Most research studies have been founded on preclinical models that limit the direct extrapolation of results to the therapeutic application in human beings. Secondly, the dosage and duration of treatment is not in concurrence with each other, thereby making it difficult to compare findings of varying studies. No large-scale randomized controlled trials

evidence is available to further prove efficacy and safety profile validation.

8.3 Need for Human Studies

The clinical trials are supposed to be conducted in an appropriate manner to prove the therapeutic efficacy of such medicinal plants, the most appropriate dose and their safety over the long run. It ought to harmonize formulations and to determine active components so that formulations can be reproducible and acceptable by regulatory authorities. The combination of the traditional knowledge and the development of the evidence-based clinical research can help *Aegle marmelos* and *Madhuca longifolia* to become an effective therapeutic agent in the modern medicine.

9. Future Perspectives

9.1 Drug Development Potential

Both *Aegle marmelos* and *Madhuca longifolia* have been found to have a high potential for providing new therapeutic agents because of their high phytochemical content. Recently, some evidence shows that bioactive molecules in the *Aegle marmelos* may be used as lead molecules in drug discovery, especially in controlling chronic diseases like diabetes and inflammation [48]. Correspondingly, *Madhuca longifolia* also has shown promising pharmacological properties, which justifies its application as a phytotransformer [52, 54].

9.2 Nano-Formulation and Enhancement of Bioavailability

Poor bioavailability of the phytoconstituents is one of the biggest issues in the development of herbal drugs. Nanotechnology promises to provide solutions through the use of nanoparticles, liposomes and nanoemulsions which are various forms of nanoformulations. Research using *Madhuca longifolia* has demonstrated that the nanoparticle synthesis through *Madhuca longifolia* increases antimicrobial and anticancer effects, suggesting its use in nanomedicine. Similarly, *Aegle marmelos* formulations have been investigated as sustained-release drug delivery systems to enhance the therapeutic efficacy [10, 11].

9.3 Incorporation into Modern Medicine

Despite their therapeutic potential, they have not yet been incorporated into mainstream medicine because of inadequate clinical validation and regulatory standardization. The existing data indicate that the plants may be used in tandem with other conventional treatments provided they are reinforced by strict clinical research and pharmacokinetic investigations [74, 75].

9.4 Need for Standardization

To attain uniformity, safety, and effectiveness, the plant extracts should be standardized. A major issue is the phytochemical variation that varies based on the environmental and processing conditions. Therefore, to come up with evidence-based therapies it is necessary to establish quality control, dosage, and standardized extraction methods.

10. Conclusion

The current review shows the significant medicinal prospects of *Aegle marmelos* and *Madhuca longifolia* that are well-established in the traditional healthcare frameworks and have an emergent scientific rationale. *Aegle marmelos* has good efficacy in the control of gastrointestinal disorders, diabetes, and hepatic conditions and its efficacy is mainly due to its high levels of alkaloids, coumarins, and flavonoids [45, 48, 76]. Conversely, *Madhuca longifolia* exhibits strong anti-ulcer, analgesic, antioxidant and anti-inflammatory performance which is largely as a result of saponins, triterpenoids as well as glycosides [45, 53, 54].

The comparative analysis shows that the two plants possess overlapping pharmacological activities like antioxidant and anti-inflammatory activities and are different in their therapeutic specialization. Aegle marmelos is more effective in the treatment of metabolic and digestive disorders and Madhuca longifolia is more effective in the treatment of ulcerative diseases, pain and inflammation [47, 54]. This complementary profile shows the importance of the two medicines in both integrative and traditional medicine systems.

However, the use of this kind of results in clinical practice is low due to the unavailability of standard preparations, the unavailability of trials in human beings, and the non-homogeneous phytochemical composition even when the preclinical outcomes are promising. The disparity of the conventional knowledge and the modern therapeutics future research should, therefore, fill in this gap through clinical research, molecular mechanism validation and improved drug delivery procedures. To exploit the full therapeutic potential of these medicinal plants and combine it with safe and effective modern medical practice, it is important to pay attention to translational research.

11. References

1. World Health Organization. WHO global report on traditional, complementary and integrative medicine 2024. WHO, 2025.
2. Petrovska B. Historical review of medicinal plants' usage. Pharmacognosy Reviews/Bioinformatics Trends/Pharmacognosy review, Jan 1, 2012; 6(11):1.
3. Ekor M. The growing use of herbal medicines: Issues relating to adverse reactions and challenges in monitoring safety. Frontiers in Pharmacology, Jan 1, 2014; 4:177.
4. Ghosh S, Bishal A, Ghosh SK, Jana K, Gayen B, Sahu S, *et al*. Herbal Medicines: A Potent Approach to Human Diseases, Their Chief Compounds, Formulations, Present Status, and Future Aspects. International Journal of Membrane Science and Technology, Oct 11, 2023; 10(1):442.
5. Lambert J, Srivastava JP, Vietmeyer ND. Medicinal plants. World Bank technical paper, 1997.
6. Ralte L, Singh YT. Ethnobotanical survey of medicinal plants used by various ethnic tribes of Mizoram, India. PLoS ONE, May 10, 2024; 19(5).
7. Nandal K, Harshit, Nandal R, Rathee J, Dahiya P, Kaur M. The History of Medicinal Plants from Indian Ancient Remedies to Modern Pharmacology. European Journal of Medicinal Plants, Jun 16, 2025; 36(3):172.
8. Sulaksyani DrD. Herbal Wealth of India: An Insight into Medicinal Plants and their Clinical Efficacy. Zenodo (CERN European Organization for Nuclear Research), Dec 1, 2025.
9. Nasim N, Sandeep IS, Mohanty S. Plant-derived natural products for drug discovery: Current approaches and prospects. The Nucleus, Oct 18, 2022; 65(3):399.

10. Newman D, Cragg GM. Natural Products as Sources of New Drugs over the Nearly Four Decades from 01/1981 to 09/2019. Journal of Natural Products, Mar 12, 2020; 83(3):770.
11. Atanasov AG, Zotchev SB, Dirsch VM, Taskforce the INPS, Orhan İE, Banach M, *et al*. Natural products in drug discovery: Advances and opportunities. Nature Reviews Drug Discovery, Jan 28, 2021; 20(3):200.
12. Chaachouay N, Zidane L. Plant-Derived Natural Products: A Source for Drug Discovery and Development. Drugs and Drug Candidates, Feb 19, 2024; 3(1):184.
13. Manandhar B, Paudel KR, Sharma B, Karki R. Phytochemical profile and pharmacological activity of *Aegle marmelos Linn*. Journal of Integrative Medicine, Apr 21, 2018; 16(3):153.
14. Yasmin S, Nayak R, Al-Salam FM, Diwan A, Mansuri R, Ashique S, *et al*. A comprehensive review of the bioactive compounds and the various pharmacological activities of Mahua *(Madhuca longifolia*) plant. Pharmacological Research - Modern Chinese Medicine, Dec 24, 2025; 18:100746.
15. Bhar K, Mondal S, Suresh P. An Eye-Catching Review of *Aegle marmelos L.* (Golden Apple). Pharmacognosy Journal, Feb 18, 2019; 11(2):207.
16. Savita S, Singh A, Singh AP. *Aegle marmelos (L.)* (Bael): A Systematic Review. Journal of Drug Delivery and Therapeutics. Society of Pharmaceutical Tecnocrats, Jun 15, 2021; 11:131.
17. Nair R, Barche S. Medicinal value of Bael, *Aegle marmelos*. International Journal of Farm Sciences, Jan 19, 2016; 6(1):307.
18. Jagetia GC, Ponemone V, Baliga MS. *Aegle marmelos (L.) CORREA* Inhibits the Proliferation of Transplanted Ehrlich Ascites Carcinoma in Mice. Biological and Pharmaceutical Bulletin, Jan 1, 2005; 28(1):58.
19. Kundu M, Schmidt LH, Jørgensen ME. *Madhuca longifolia (Koenig) J. F. Macb.* Research Portal Denmark, Jan 1, 2012; (156).
20. A BM, Usha T. A Study on Estimation of Phytochemical, Nutrition and the Antioxidant Activity of Dried *Madhuca longifolia* Flowers. International Journal for Research in Applied Science and Engineering Technology, Jan 21, 2024; 12(1):1023.
21. Mahajan R, Amarshettiwar S, Gajbe N, Wagh S, Tayade R. Madhuka: Promising millennium plant. International Journal of Chemical Studies, Jan 1, 2021; 9(1):3224.
22. Uppalwar BP Lokesh Vyas, Dr Sonali. A Comprehensive Review on *Madhuca longifolia*. Zenodo (CERN European Organization for Nuclear Research), Nov 5, 2025.
23. Saif Mohd, Varma R, Kant R, Gupta RK. *Madhuca longifolia* (Mahua): A comprehensive ethno pharmacological review. International Journal of Chemical Studies, Mar 1, 2020; 8(2):172.
24. Sinha J, Singh V, Singh J, Ak R. Phytochemistry, Ethnomedical Uses and Future Prospects of Mahua *(Madhuca longifolia)* as a Food: A Review. Journal of Nutrition & Food Sciences, Jan 1, 2017; 7(1).
25. Yadav S, Suneja P, Hussain Z, Abraham Z, Mishra S. Genetic variability in *Madhuca longifolia.* Biomass Bioenergy. 2011; 35(5):1773.
26. Chanchal DK, Sharma SK. Exploring the therapeutic potential of *Madhuca longifolia* in traditional Chinese medicine for the management of kidney stones and various diseases: A review. Pharmacological Research Modern Chinese Medicine, May 29, 2024; 11:100452.
27. Nagar S, Kumar M, Kumatkar R, Sharma J, Singh S. Evaluation of bael *(Aegle marmelos)* germplasms under semi-arid conditions. Int J Pure Appl Biosci. 2017; 5:436.
28. Sharma GN, Dubey SK, Sharma P, Sati N. Medicinal Values of Bael *(Aegle marmelos*) (L.) Corr.: A Review. Zenodo (CERN European Organization for Nuclear Research), Apr 1, 2011.
29. Bhattacherjee AK, Dikshit AK, Kumar P, Pandey DK, Tandon DK. Profiling nutraceuticals in bael [*Aegle marmelos(L.) Correa*] at various stages of fruit development. The Journal of Horticultural Science and Biotechnology, Mar 3, 2016; 91(2):169.
30. 1849-1917 K Kanhoba Ranchoddas,, 1867-1930 B Baman Das,. Indian medicinal plants. Biodiversity Heritage Library (Smithsonian Institution), Jan 1, 1918.
31. Bhardwaj R, Nandal U. Nutritional and therapeutic potential ofbael*(Aegle marmelosCorr.)* fruit juice: A review. Nutrition & Food Science, Nov 9, 2015; 45(6):895.
32. Thas JJ. Siddha Medicine background and principles and the application for skin diseases. Clinics in Dermatology, Jan 1, 2008; 26(1):62.
33. Ayyanar M, Ignacimuthu S. Traditional knowledge of Kani tribals in Kouthalai of Tirunelveli hills, Tamil Nadu, India. Journal of Ethnopharmacology, Jul 29, 2005; 102(2):246.
34. Das P, Ghosh S, Ghosh R, Dam S, Baskey M. *Madhuca longifolia* plant mediated green synthesis of cupric oxide nanoparticles: A promising environmentally sustainable material for waste water treatment and efficient antibacterial agent. Journal of Photochemistry and Photobiology B Biology, Oct 3, 2018; 189:66.
35. Kendre N, Wakte P. A review on Phytochemicals and biological attributes of *Madhuca longifolia*. Asian Journal of Pharmacy and Pharmacology, Jan 1, 2021; 7(2):74.
36. Kushawaha H, Singhai AK. *Aegle Marmelos*: A Medicinal Plant From A Traditional Indian Perspective. African Journal of Biomedical Research, Jan 1, 2024; 27.
37. Mazumder PM, Jha D. Biological, chemical and pharmacological aspects of *Madhuca longifolia*. Asian Pacific Journal of Tropical Medicine, Jan 1, 2018; 11(1):9.
38. Ghosh S, Kumar A, Sachan N, Chandra P. Bioactive Compounds and Distinctive Pharmacological Activity Guided Review of *Aegle marmelos*: A Miraculous Plant of Indigenous Medicine System. Current Bioactive Compounds, Nov, 2019; 16(7):965.
39. Sahoo L, Nayak Y, Mohanty SK. Exploring the phytochemical constituents of *Aegle marmelos* (bael) and their therapeutic potential against chronic diseases. International Journal of Basic & Clinical Pharmacology, Feb 25, 2025; 14(2):316.
40. Venthodika A, Chhikara N, Mann S, Garg M, Sofi SA, Panghal A. Bioactive compounds of *Aegle marmelos L.*, medicinal values and its food applications: A critical

review. Phytotherapy Research, Nov 6, 2020; 35(4):1887.
41. Jain S, Kore DS, Luthra S, Mallesh Y, Dadheech S, Chandravanshi R, *et al*. Health Benefits and Therapeutic Potential of Bael (*Aegle marmelos L.):* A Comprehensive Review. Journal of Advances in Biology & Biotechnology, Nov 14, 2024; 27(11):776.
42. Khare P, Kishore K, Sharma DK. Medicinal uses, Phytochemistry and Pharmacological profile of *Madhuca longifolia*. Asian Journal of Pharmacy and Pharmacology, Sep 1, 2018; 4(5):570.
43. Yoshikawa K, Tanaka M, Arihara S, Pal BC, Roy SK, Matsumura E, *et al*. New Oleanene Triterpenoid Saponins from *Madhuca longifolia*. Journal of Natural Products, Oct 28, 2000; 63(12):1679.
44. Devi NK, Sangeetha R. *Madhuca Longifolia* (Sapotaceae): A Review of its Phytochemical and Pharmacological Profile. International Journal of Pharma and Bio Sciences, Oct 17, 2016; 7(4).
45. Roat P, Hada S, Chechani B, Yadav DK, Kumar S, Kumari N. *Madhuca indica*: A Review on the Phytochemical and Pharmacological Aspects. Pharmaceutical Chemistry Journal, May 1, 2023; 57(2):284.
46. Pisal P. A Review of the Phytochemical and Pharmacological Properties of *Aegle marmelos* Plants. International Journal for Research in Applied Science and Engineering Technology, Nov 12, 2024; 12(11):509.
47. Mujeeb F, Bajpai P, Pathak N. Phytochemical Evaluation, Antimicrobial Activity, and Determination of Bioactive Components from Leaves of*Aegle marmelos*. BioMed Research International, Jan 1, 2014; 2014:1.
48. Venkatesan S, Rajagopal A, Balasubramanyam M, Mohan V, Manickam N. Phytochemical Analysis and Evaluation of Antioxidant, Antidiabetic, and Anti-inflammatory Properties of *Aegle marmelos* and Its Validation in an *In-Vitro* Cell Model. Cureus, Sep 30, 2024; 16(9).
49. Saini P. Dynamic Bioactive Potentials of Endophytes Inherent to *Aegle marmelos*: A Review. Indian Journal of Pharmaceutical Sciences, Jan 1, 2024; 86(1).
50. Rathee D, Kamboj A, Sidhu S. Augmentation of hepatoprotective potential of *Aegle marmelos* in combination with piperine in carbon tetrachloride model in wistar rats. Chemistry Central Journal, Aug 20, 2018; 12(1):94.
51. Simon JP, Prince SE. Ameliorative activity of aqueous leaf extract from *Madhuca longifolia* against diclofenac-administered toxicity on rat stomach and intestine. Journal of Histotechnology, Mar 3, 2021; 44(3):114.
52. Agrawal S, Kulkarni GT, Sharma VN. A comparative study on the antioxidant activity of methanolic extracts of *Terminalia paniculata* and *Madhuca longifolia*. Free Radicals and Antioxidants, Oct 1, 2011; 1(4):62.
53. Simon JP, Prince ES. Hepatoprotective activity of *Madhuca longifolia*. J Cell Biochem. 2018; 119(7):6125.
54. Salve P, Vinchurkar A, Raut RW, Chondekar R, Lakkakula J, Roy A, *et al*. An Evaluation of Antimicrobial, Anticancer, Anti-Inflammatory and Antioxidant Activities of Silver Nanoparticles Synthesized from Leaf Extract of *Madhuca longifolia* Utilizing Quantitative and Qualitative Methods. Molecules, Sep 28, 2022; 27(19):6404.
55. Bhagyashri RSD Dashpute P, Bhalerao P, Bochare R, Talele. Evaluation of Anti-inflammatory, Analgesic and Anti Irritant Activity of *Aegle marmelos* Leaves Extract. Zenodo (CERN European Organization for Nuclear Research), Dec 4, 2025.
56. Lobo V, Patil A, Phatak A, Chandra N. Free radicals, antioxidants and functional foods: Impact on human health. Pharmacognosy Reviews/Bioinformatics Trends/Pharmacognosy review, Jan 1, 2010; 4(8):118.
57. Simopoulos AP. An Increase in the Omega-6/Omega-3 Fatty Acid Ratio Increases the Risk for Obesity. Nutrients, Mar 2, 2016; 8(3):128.
58. Sibille J, Duc KD, Holcman D, Rouach N. The Neuroglial Potassium Cycle during Neurotransmission: Role of Kir4.1 Channels. PLoS Computational Biology, Mar 31, 2015; 11(3).
59. Bernard Q, Wang Z, Nardo AD, Boulanger N. Interaction of primary mast cells with Borrelia burgdorferi (sensu stricto): Role in transmission and dissemination in C57BL/6 mice. Parasites & Vectors, Jun 27, 2017; 10(1):313.
60. Acharya A, Ghimire G, Shakya P. Medicinal Herbs. In: IntechOpen eBooks. IntechOpen, 2024.
61. Luo M, Zheng Y, Tang S, Gu L, Zhu Y, Ying R, *et al*. Radical oxygen species: An important breakthrough point for botanical drugs to regulate oxidative stress and treat the disorder of glycolipid metabolism. Frontiers in Pharmacology. Frontiers Media, May 12, 2023; 14.
62. Pham-Huy LA, He H, Pham-Huyc C. Free Radicals, Antioxidants in Disease and Health. International Journal of Biomedical Science, Jun 15, 2008; 4(2):89.
63. Hunter P. The inflammation theory of disease. EMBO Reports, Oct 9, 2012; 13(11):968.
64. Arul V, Miyazaki S, Dhananjayan R. Toxicity of Aegle marmelos. J Ethnopharmacol. 2005; 96:159.
65. Baliga MS, Bhat HP, Joseph N, Fazal F. Phytochemistry and medicinal uses of the bael fruit (*Aegle marmelos Correa*): A concise review. Food Research International, Mar 1, 2011; 44(7):1768.
66. Singh SK. *Aegle marmelos* protects hepatocytes from paracetamol induced hepatotoxicity. Indian Journal of Scientific Research, Jan 1, 2013; 4(1):53.
67. Singh S, More P, Mohan S. Hepatoprotective activity of *Aegle marmelos*. Int J Pharm Sci Res. 2013; 4(3):1158.
68. Raghu AV, Geetha RM, Gopalakrishnan VK. Antidiabetic activity of *Aegle marmelos*. J Clin Diagn Res. 2012; 6(8):1409.
69. Swarnkar R, Singh D, Choudhary A, Anand S, Rathore A, Jediya HK. Pharmacological Properties of *Aegle marmelos*: A Review. International Journal of Current Microbiology and Applied Sciences. Excellent Publishers, May 10, 2019; 8(5):1600.
70. Braga MA, Eleutério MW de F, César PHS, Konig IFM, Trento MVC, Marcussi S. Toxic or medicinal? New approach to the pharmacological and toxicological properties of *Echinodorus macrophyllus* leaves. Scientia Plena, Feb 21, 2024; 20(1).
71. Thakkar A, Patel D, Shah K. Pharmacological profile of *Madhuca longifolia*. Pharm Chem J. 2023; 57(4):512.
72. Simon L, Jayakumar R, Nair S. Toxicological evaluation of *Madhuca longifolia*. Biomed

Pharmacother. 2018; 101:1.
73. Lomate KA, Murthy K, Adak VS, Shete RV. A review on phytochemical and pharmacological values of *Aegle marmelos*. Journal of Drug Delivery and Therapeutics. Society of Pharmaceutical Tecnocrats, Apr 15, 2021; 11:162.
74. Salve PS, Kunjir SS, Pawar SB. Green synthesis of nanoparticles. Nanomaterials (Basel). 2022; 12(20):3568.
75. Patra JK, Das G, Fraceto LF, Campos EVR, Rodríguez-Torres M del P, Acosta-Torres LS, *et al*. Nano based drug delivery systems: Recent developments and future prospects. Journal of Nanobiotechnology, Sep 19, 2018; 16(1):71.
76. Ahmad W, Amir M, Ahmad A, Ali A, Ali A, Wahab S, *et al*. *Aegle marmelos* Leaf Extract Phytochemical Analysis, Cytotoxicity, *In Vitro* Antioxidant and Antidiabetic Activities. Plants, Nov 25, 2021; 10(12):2573.