

A Review on Phytochemistry and Pharmacology of *Macaranga Peltata*

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Abstract

Macaranga peltata, categorized within the Euphorbiaceae family, represents a prevalent pioneer arboreal species across Southeast Asia, specifically in regions, such as India and Sri Lanka. This review scrutinizes the phytochemical properties and pharmacological profiles of *Macaranga peltata*, underscoring both its historical medicinal applications and prospective therapeutic roles. The plant exhibits a rich composition of secondary metabolites, encompassing flavonoids, stilbenes, tannins, and terpenes, with the majority of these compounds being extracted from its foliar structures. Pharmacological investigations have substantiated a myriad of biological activities attributed to extracts of *Macaranga peltata*, which include antimicrobial, antioxidant, anti-inflammatory, anticancer, antifungal, wound healing, and hepatoprotective effects. Traditional applications of *Macaranga peltata* within indigenous medicinal frameworks involve the treatment of febrile conditions, dermatological ailments, gastrointestinal disorders, and lacerations. The multifaceted nature of the plant is further exemplified by its utilization as green manure and in the manufacturing of matchboxes and pencils. This review aggregates pertinent information regarding the distribution, morphological characteristics, phytochemical composition, and pharmacological efficacy of *Macaranga peltata*, thereby offering a thorough examination of its potential as a reservoir of bioactive compounds for therapeutic endeavors. Additional research is essential to isolate bioactive constituents and clarify their mechanisms of action, particularly in the context of oncological treatment.

Keywords: *Macaranga peltata*, phytochemistry, pharmacology, traditional medicine, bioactive compounds

INTRODUCTION

Macaranga, a prominent genus within the family Euphorbiaceae, comprises over 300 species, widely distributed across tropical and subtropical regions, such as Africa, Asia, numerous Pacific islands, and Australia [1]. These plants can either grow as shrubs or trees, reaching heights of up to

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15 m, showing significant variability in growth patterns. Notably, members of this genus are known for their intricate symbiotic relationships with ants, which protect the plants by attacking or consuming herbivorous insects [2]. Phytochemical research has shown that species within the *Macaranga* genus are rich in bioactive compounds, including terpenoids, flavonoids, tannins, and phenolic derivatives, attracting attention in natural product chemistry research [3]. These plants are also widely used in traditional medicine to treat various ailments, such as swellings, cuts, diarrhea, coughs, stomachaches, hypertension, boils, furuncles, and bruises, demonstrating their broad therapeutic potential [4].

One key species, *Macaranga peltata*, is particularly prevalent in the Western Ghats of India, thriving in various ecological settings. This species, as part of the Euphorbiaceae family, plays a crucial role in the biodiversity of Southeast Asia, where it is commonly found [5]. The distribution of *M. peltata* spans Southern China, the Indo-China Peninsula, Indonesian islands like Sumatra and Java, the Malay Peninsula, Thailand, Laos, Cambodia, Myanmar, Sri Lanka, and parts of Northeastern India, highlighting its ecological significance [6]. Plants, including those from the *Macaranga* genus, have long been integral to traditional medicine across various cultures, offering remedies for physical and mental health conditions [7]. Historically, the bark of *M. peltata* has been used in traditional Chinese medicine to treat fever and skin diseases, while its leaves have been recognized for their analgesic properties [8]. Other species in the genus have been employed to treat fungal infections, stomach aches, and symptoms like fever, cough, and tonsillitis [9]. Fresh and dried leaves of *Macaranga* species have also been used for treating sores, boils, cuts, and swellings, and the natural products isolated from these plants have shown antitumor, antioxidant, and antimicrobial activities, furthering their pharmacological relevance [10].

The purpose of this comprehensive review is to critically evaluate and synthesize the current body of knowledge surrounding *M. peltata*, with a particular focus on its phytochemical constituents and pharmacological properties. This review aims to provide a detailed analysis of the diverse bioactive compounds found in *M. peltata*, elucidating their chemical structures and potential biological roles, while critically assessing the pharmacological activities attributed to its extracts and isolated compounds. By exploring the potential therapeutic applications of *M. peltata* in modern medicine and drawing parallels with its traditional uses, we seek to bridge the gap between traditional knowledge and modern scientific inquiry. Furthermore, this review endeavors to identify significant knowledge gaps in the current research landscape, propose specific directions for future investigations, and evaluate the potential of *M. peltata* as a source of novel pharmaceutical agents, considering both its promise and limitations. Through this multifaceted approach, we aim to offer a comprehensive understanding of *M. peltata*'s potential in pharmacology and drug discovery, providing insights that could guide future research and development efforts while contextualizing its importance within the broader framework of natural product research and medicinal plant studies.

Taxonomical Classification [2]

- *Kingdom*: Plantae.
- *Division*: Magnoliophyta.
- *Class*: Magnoliopsida.
- *Order*: Malpighiales.
- *Family*: Euphorbiaceae.
- *Subfamily*: Acalyphoides.
- *Tribe*: Acalypheae.
- *Subtribe*: Macaranginae.
- *Genus*: *Macaranga*.
- *Species*: *peltata*.

Synonyms [11]

The plant *M. peltata* is known by several names. The synonyms are given below:

- *English*: Shield-leaf tree.
- *Hindi*: Chand kal.
- *Kannada*: Chandakala, Chandakanni.
- *Tulu*: Uppolige.
- *Malayalam*: Vatta.
- *Tamil*: Vattikanni.

DISTRIBUTION OF THE PLANT [2, 12]

M. peltata, a prominent member of the Euphorbiaceae family, exhibits a widespread distribution across various tropical regions of Southeast Asia. Its range extends from the Indian subcontinent through parts of Indo-China, encompassing a diverse array of ecosystems and climatic zones. The species is particularly abundant in northern Thailand, Sri Lanka, and India, where it plays a crucial role in forest ecology and succession. In Sri Lanka, *M. peltata* is one of the most prevalent early successional woody plants, especially in the low country wet zones. These areas are characterized by high annual rainfall and relatively stable temperatures, providing ideal conditions for the species' rapid growth and establishment. The plant's ability to thrive in these environments underscores its importance in the island's biodiversity and forest dynamics.

Within India, *M. peltata* is notably common in the Western Ghats, a biodiversity hotspot known for its rich and unique flora. The species' presence extends from the southern tip of the Western Ghats northward, adapting to various altitudinal gradients and microclimates along this mountain range. In northeastern India, *M. peltata* also finds suitable habitats, contributing to the region's complex forest ecosystems.

The distribution of *M. peltata* is not limited to these areas; it extends to other parts of Southeast Asia, including southern China, the Malay Peninsula, and Indonesian islands, such as Sumatra and Java. This broad geographical range demonstrates the species' remarkable adaptability to diverse environmental conditions, from coastal areas to inland forests and from lowlands to mid-elevation mountain slopes.

M. peltata is known by various vernacular names across its range, reflecting its cultural and ecological significance in different regions. In Sri Lanka, it is commonly referred to as "Kenda" or "Kanda," while in India, it is known as "Chandada" among other local names. These appellations not only indicate the plant's recognition in traditional knowledge systems but also hint at its potential uses and importance in local ecosystems.

One of the most notable ecological attributes of *M. peltata* is its role as a pioneer species in disturbed habitats. The plant readily colonizes areas that have undergone natural or anthropogenic disturbances, such as forest clearings, landslides, or abandoned agricultural lands. This pioneering characteristic makes *M. peltata* an essential component in the process of forest regeneration and secondary succession. By quickly establishing itself in disturbed areas, it helps to stabilize soil, provide shade, and create conditions favorable for the establishment of later successional species.

The species' success in colonizing disturbed areas can be attributed to several factors. Its rapid growth rate allows it to outcompete other vegetation in the early stages of succession. Additionally, *M. peltata* produces large quantities of small, lightweight seeds that are easily dispersed by wind or animals, enabling it to quickly reach and establish in newly available habitats.

In the tropical forests of the Western Ghats, researchers have observed a significant presence of viable *M. peltata* seeds in the soil seed bank, particularly during October–December. This temporal pattern of seed viability coincides with the post-monsoon period in many parts of its range, suggesting an evolutionary adaptation to seasonal rainfall patterns. The abundance of germinable seeds during this period ensures that the species can rapidly respond to disturbance events, maintaining its ecological role in forest dynamics.

The adaptability of *M. peltata* to various environmental conditions is further evidenced by its presence in different forest types, including evergreen, semi-evergreen, and moist deciduous forests. This ecological plasticity allows the species to occupy diverse niches within its range, contributing to its widespread distribution and ecological success.

MORPHOLOGY

M. peltata is a resinous tree species that typically reaches heights of up to 10 m, though exceptional specimens may grow taller. This medium-sized stature allows it to form a significant component of the sub-canopy layer in many forest ecosystems, playing a crucial role in forest structure and dynamics. The tree growth form is characterized by a relatively straight trunk with a spreading crown. The bark is typically smooth and light-colored in younger trees, gradually becoming rougher and darker with age. A notable feature of *M. peltata* is the presence of resinous exudates, which can be observed when the bark or leaves are damaged. This resin likely serves protective functions against herbivores and pathogens (Figure 1).



Figure 1. *M. peltata* leaves.

One of the most distinctive features of *M. peltata* is its foliage. The leaves are alternately arranged along the branches, a common characteristic in the Euphorbiaceae family. What sets *M. peltata* apart is the impressive size of its leaves, which measure between 20 and 50 cm in length and from 12 to 21 cm in width. This large leaf size is an adaptation that allows the plant to efficiently capture light in the often-shaded understory environments where it initially establishes.

The leaf shape of *M. peltata* is typically circular or broadly ovate, reminiscent of a shield, which is reflected in its specific epithet “*peltata*” (meaning shield-shaped in Latin). The leaf margins can vary from smooth (entire) to minutely toothed (dentate), sometimes even on the same plant, indicating some level of phenotypic plasticity. A key identifying feature is the palmately arranged venation, consisting of nine distinct primary nerves radiating from the point where the petiole attaches to the leaf blade. This venation pattern not only provides structural support for the large leaves but also ensures efficient distribution of water and nutrients throughout the leaf tissue.

Interestingly, the petiole (leaf stalk) of *M. peltata* attaches to the lower surface of the leaf blade rather than at its base. This *peltata* leaf attachment is relatively uncommon in plants and serves as a useful diagnostic feature for identifying the species. The petioles themselves are long and sturdy, allowing the large leaves to be held away from the branch, maximizing light interception and minimizing self-shading.

The juvenile parts of *M. peltata*, including young stems, petioles, and leaf undersides, are covered with a velvety-hairy texture. This pubescence serves multiple functions, including protection against herbivores, regulation of water loss, and possibly defense against fungal pathogens. As the plant parts mature, this hairiness often diminishes (Figure 2).



Figure 2. *M. peltata* tree.

The reproductive structures of *M. peltata* provide further distinguishing characteristics. The flowering period typically occurs from January to February, coinciding with the dry season in many parts of its range. The flowers are arranged in elongated panicles that develop within the leaf axils. These inflorescences are characterized by their yellow-green color, which may aid in attracting pollinators.

M. peltata is dioecious, meaning that male and female flowers are borne on separate trees. The male flowers are particularly small and numerous, clustered within large, conspicuous bracts. These bracts may serve to attract pollinators from a distance. The female flowers, while less numerous, are equally crucial for reproduction. Following successful pollination, the female flowers develop into fruits. The fruit of *M. peltata* is a capsule, measuring 4–5 mm in diameter. Each capsule contains a single spherical black seed. The small size and lightweight nature of these seeds facilitate their dispersal by wind and possibly by small animals, contributing to the species' colonizing ability. An important aspect of *M. peltata*'s reproductive strategy is the production of a large number of seeds, which form significant soil seed banks in its native habitats. In the tropical forests of the Western Ghats, researchers have observed a peak in germinable seed abundance during October–December. This timing coincides with the onset of the northeast monsoon in many parts of India, suggesting an evolutionary synchronization with seasonal rainfall patterns to maximize germination success.

The seeds of *M. peltata* possess several adaptations that enhance their survival and germination potential. The seed coat contains phenolic compounds, which are thought to protect against fungal attacks and parasites in the soil. This chemical defense, combined with the seeds' small size, allows them to persist in the soil for extended periods, forming a reservoir of regenerative potential that can rapidly respond to disturbance events [13].

PHYTOCHEMISTRY

From the various species belonging to the *Macaranga* genus of plants, a remarkable total of 190 distinct secondary metabolites have been successfully isolated and meticulously identified to date, showcasing the rich biochemical diversity present within these organisms. The isolated compounds encompass a wide array of chemical classes, which include but are not limited to flavonoids, which are numbered from 1 to 84; stilbenes, which are cataloged from 85 to 100; tannins, which range from 101 to 144; terpenes, which are identified from 145 to 156; coumarins, specifically numbered 157 and 158; steroids, which are classified between 159 and 161; alongside various other types of compounds that are documented from 162 to 190. It is particularly noteworthy that an astonishing 90% of these isolated compounds have been reported as deriving from the leaves of the *Macaranga* plants, while

the remaining 10% has been attributed to other anatomical parts of the plant, indicating a significant concentration of bioactive substances within the foliage. The analysis of the bark extract of *M. peltata* revealed compelling positive results, indicating the presence of a variety of important biomolecules, which include carbohydrates, glycosides, saponins, flavonoids, tannins, proteins, and amino acids, while conversely, the leaf extract demonstrated a slightly different profile, showing the existence of carbohydrates, steroids, and sterols, in addition to glycosides, flavonoids, tannins, proteins, and amino acids, thus highlighting the distinct phytochemical compositions found in different parts of this plant species (Table 1) [2, 14].

Table 1. Phytochemical constituents of *M. peltata*.

Compound Class	Isolated Compounds	Source	Description
Flavonoids	Quercetin, kaempferol, myricetin, rutin.	Leaves.	A diverse group of polyphenolic compounds known for their antioxidant properties, anti-inflammatory effects, and potential health benefits. Flavonoids contribute to the plant's color and flavor.
Stilbenes	Resveratrol, piceatannol.	Leaves.	Compounds that exhibit anti-cancer, anti-inflammatory, and antioxidant activities. Stilbenes are often found in fruits and are recognized for their role in plant defense.
Tannins	Ellagic acid, gallic acid.	Bark and leaves.	Polyphenolic compounds that provide astringency and have antimicrobial properties. Tannins are known for their role in plant defense against herbivores and pathogens.
Terpenes	Limonene, β -caryophyllene.	Bark and leaves.	A large class of organic compounds that play roles in plant metabolism and defense. Terpenes have been studied for their aromatic properties and potential therapeutic effects.
Coumarins	Umbelliferone, scopoletin.	Bark.	Aromatic compounds with anticoagulant properties. Coumarins are known for their fragrance and are used in perfumes and flavorings.
Steroids	β -Sitosterol, stigmasterol.	Leaf extract.	Organic compounds that serve as hormones in plants, influencing growth and development. Steroids can have various physiological effects on human health as well.
Sterols	Campesterol, sitosterol.	Leaf extract.	Plant sterols (phytosterols) that may help lower cholesterol levels in humans. They play a structural role in plant cell membranes.
Glycosides	Saponarin, rutinose.	Bark and leaves.	Compounds formed from a sugar moiety attached to a non-sugar component, which can have various biological activities, including anti-inflammatory effects.
Saponins	Diosgenin, glycyrrhizin.	Bark.	Glycoside compounds known for their foaming properties; they exhibit antimicrobial activity and can enhance the absorption of nutrients.
Proteins	Enzymes (e.g., amylase), storage proteins.	Bark and leaves.	Essential macromolecules involved in nearly all biological processes, including enzyme activity and structural functions within the plant.
Aminoacids	Glutamic acid, aspartic acid.	Bark and leaves.	The building blocks of proteins; amino acids play critical roles in metabolic

			pathways and can also have health benefits when consumed.
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TRADITIONAL USES

M. peltata, a plant with a rich and extensive history of utilization within numerous ancient cultures, has played a significant role in traditional medicinal practices across various regions. Within the framework of traditional Chinese medicine, the leaves of *M. peltata* were historically believed to exhibit notable analgesic properties, serving as a natural pain reliever for various ailments. The bark of the plant, on the other hand, was primarily employed in the therapeutic management of fever and a wide array of skin diseases, showcasing its versatility in addressing both internal and external health concerns. In contrast, within the Indian subcontinent, *M. peltata* was prevalently utilized as an antiseptic agent, particularly valued for its ability to facilitate wound healing and address a range of digestive disorders. This diverse application across different cultural contexts underscores the plant's adaptability and perceived efficacy in treating a wide spectrum of health issues. In contemporary times, the applications of *M. peltata* remain prevalent and widely recognized, with the plant being utilized as an herbal remedy for a myriad of ailments, including but not limited to fever, headaches, stomach aches, and various skin issues. This continued use in modern traditional medicine practices speaks to the enduring belief in its therapeutic properties. Moreover, within the realm of traditional Chinese medicine, *M. peltata* has also garnered recognition for its roles as both an anti-inflammatory and antibacterial agent, further expanding its perceived medicinal value. Beyond its medicinal applications, *M. peltata* has been integrated into various aspects of daily life and industry. The wood derived from mature specimens of this tree species has been traditionally employed for construction purposes or as a reliable source of firewood, highlighting its practical value in communities where it grows. In certain regions, particularly in Nagaland, India, the leaves of *M. peltata* serve a unique purpose, being utilized for wrapping various items, thus demonstrating the plant's utility beyond its medicinal applications [4]. Specific traditional medicinal preparations involve the use of root extract, often in combination with warmed bark extract of *M. peltata*, which is traditionally utilized in the treatment of hemorrhoids, offering relief from this common and uncomfortable condition. Additionally, a decoction created by boiling the leaves and bark of the plant in water is traditionally used as a remedy for ulcers, both gastric and dermal, showcasing the plant's perceived efficacy in treating internal and external ailments. The versatility of *M. peltata* extends to agricultural applications as well, with its leaves being utilized as green manure, contributing to soil fertility enhancement and sustainable farming practices. In the realm of industry, the wood of *M. peltata* finds application in the manufacturing of matchboxes and pencils, while the tree itself serves an additional role as a shade tree within coffee plantations, illustrating its multifaceted applications across various sectors [14]. These diverse traditional uses of *M. peltata*, spanning medicinal, practical, and industrial applications, underscore its significant cultural and economic importance in the regions where it is found.

PHARMACOLOGICAL USES OF *M. PELTATA*

Antimicrobial Activity

The fruits of *M. peltata* have demonstrated significant antibacterial properties. In a comprehensive study, fruits were dried and extracted using petroleum ether and acetone to isolate bioactive compounds. The antibacterial efficacy of these extracts was assessed using the disc diffusion method against various Gram-negative bacterial strains, including *Escherichia coli*, *Proteus vulgaris*, and *Klebsiella pneumoniae*. Both petroleum ether and acetone extracts exhibited antibacterial activity, with the acetone extract demonstrating superior efficacy. Notably, the antibacterial activity increased in correlation with higher extract concentrations, indicating a dose-dependent response. The petroleum ether extract produced zones of inhibition measuring 0.5 mm, 0.4 mm, and 0.5 mm against *E. coli*, *P. vulgaris*, and *K. pneumoniae*, respectively at 10% concentration. In contrast, the acetone fruit extract yielded larger zones of inhibition: 0.7, 0.6, and 0.5 mm against the same bacterial strains.

These findings not only support the traditional use of *M. peltata* as an antimicrobial agent but also suggest its potential to develop new antibacterial treatments [15].

Antioxidant Properties

The antioxidant potential of *M. peltata* has been rigorously examined through various established methodologies. A study employing TLC bioautography and the DPPH assay revealed that the chloroform extract of *M. peltata* exhibited remarkable antioxidant activity, achieving an impressive 95% DPPH scavenging capability. Furthermore, the aqueous extract demonstrated significant antibacterial activity, highlighting the plant's multifaceted therapeutic potential. These findings provide a scientific basis for the traditional use of *M. peltata* in treating various ailments and suggest its potential to prevent oxidative stress-related disorders [16].

Anti-Inflammatory Effects

The anti-inflammatory properties of *M. peltata* Roxb. have been systematically investigated using the carrageenan-induced paw edema model in rats. The petroleum ether extract, administered at doses of 200 and 400 mg/kg, demonstrated a clear dose-dependent inhibition of paw edema. Importantly, acute toxicity assessments indicated no adverse signs of toxicity even at elevated doses up to 2000 mg/kg body weight, suggesting a favorable safety profile. These results not only corroborate the traditional use of *M. peltata* as an anti-inflammatory agent but also point to its potential to develop safer anti-inflammatory treatments [17].

Anti-Cancer Activity

In cancer research, *M. peltata* has shown promising results. An ethanolic extract prepared from shade-dried leaves of the plant demonstrated significant cytotoxic effects on oral cancer cell lines. Among various concentrations tested, 100 µg/ml of the ethanolic extract exhibited the most pronounced efficacy in producing significant growth inhibition. The cytotoxic effects were measured at a wavelength of 540 nm, and the concentration necessary to achieve a 50% reduction in cell viability was meticulously calculated. Notably, the genotoxic activity of the extract was markedly higher compared to both untreated cell lines and the standard chemotherapeutic agent, 5-fluorouracil. These findings highlight the potential of *M. peltata* in the development of novel anticancer therapies, particularly for oral cancers [18].

Anti-Fungal Activity

The antifungal properties of *M. peltata* have been subject to scientific scrutiny. Various leaf extracts, including those derived from ethanol, chloroform, petroleum ether, ethyl acetate, and methanol, were evaluated for their antifungal activity, using fluconazole as a reference. The results indicated that the methanolic leaf extract, along with both the ethanolic and chloroform extracts, exhibited superior antifungal activity when compared to the predetermined standard concentration of fluconazole set at 10 µg/ml. These findings suggest the potential applicability of *M. peltata* extracts in antifungal therapies, offering a possible alternative or complement to existing treatments [19].

Wound Healing Activity

M. peltata has demonstrated significant efficacy in wound healing. A study using both excision and incision wound models in rats revealed that a gel formulation containing the methanolic extract of *M. peltata* bark significantly enhanced the wound healing process compared to the control group. In the excision wound model, the treatment resulted in an impressive 96.05% reduction in wound area by the 20th day, superior to the 89.61% reduction observed in the control group. It also contributed to a decreased epithelialization period, reducing it to an average of 22.67 days compared to 25 days for the control group. In the incision wound model, the skin-breaking strength exhibited a substantial increase in the treated group, measuring 508.17 g compared to only 406.50 g in the control group, with the differences being statistically significant ($p < 0.001$). These results strongly support the traditional use

of *M. peltata* in wound treatment and suggest its potential in developing advanced wound care products [20].

Hepatoprotective Activity

The hepatoprotective activity of *M. peltata* has been evaluated using a model of paracetamol-induced hepatotoxicity in rats. The methanolic extract significantly attenuated the levels of hepatic marker enzymes, demonstrating a notable hepatoprotective effect. At the same time, the standard reference compound silymarin was effective in restoring these enzyme activities to their normal physiological values. This finding suggests the potential of *M. peltata* in liver protection and treatment of liver disorders, opening up new avenues for research in hepatology [21].

KNOWLEDGE GAPS AND FUTURE RESEARCH FOR *M. PELTATA*

Despite the promising pharmacological activities demonstrated by *M. peltata*, several significant knowledge gaps persist, necessitating further research. Foremost among these is the need for comprehensive isolation and characterization of specific bioactive compounds responsible for the observed therapeutic effects. The molecular mechanisms underlying the plant's biological activities, particularly its anticancer and anti-inflammatory properties, remain largely unexplored and require in-depth investigation. There is a notable absence of well-designed clinical trials to evaluate the efficacy and safety of *M. peltata* extracts or isolated compounds in human subjects, which is crucial for translating preclinical findings into potential therapeutic applications. Future research should also focus on developing standardized extracts, exploring potential synergistic effects between compounds, and conducting thorough toxicological assessments. Investigating sustainable cultivation methods and the plant's ecological role in forest regeneration could provide valuable insights for pharmaceutical development and conservation efforts. Comparative analyses with related plant species and established pharmacological agents would further elucidate *M. peltata*'s unique therapeutic potential. Addressing these research gaps will be essential for fully understanding and harnessing the medicinal properties of *M. peltata*.

CONCLUSIONS

M. peltata, a prominent pioneer tree species in Southeast Asia, demonstrates significant potential as a source of bioactive compounds with diverse therapeutic applications. Its rich phytochemical profile, including flavonoids, stilbenes, tannins, and terpenes, contributes to its wide range of pharmacological activities. Scientific studies have validated its traditional medicinal uses, revealing antimicrobial, antioxidant, anti-inflammatory, anticancer, antifungal, wound healing, and hepatoprotective properties. The plant's versatility extends beyond medicine to agricultural and industrial applications, highlighting its economic importance. While current research provides a strong foundation for understanding *M. peltata*'s therapeutic potential, further investigations are necessary to isolate specific bioactive constituents, elucidate their mechanisms of action, and explore their potential in areas, such as cancer treatment. This comprehensive review underscores the significance of *M. peltata* in bridging traditional medicine with modern pharmacological research, paving the way for novel therapeutic developments.

CONFLICT OF INTEREST

None declared.

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ETHICAL STATEMENT

None declared.

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