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REVIEW ARTICLE

Phytochemistry, Pharmacological Activities, and Ethnomedical Significance of *Mimosa pudica* L

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Abstract: *Mimosa pudica L.*, a neotropical native plant, is now a pantropical species renowned for its rapid thigmonastic (touch-induced) leaf movement. Beyond this well-known curiosity, it possesses a deep-rooted history in traditional medicine systems, including Ayurveda and Unani, where it is utilized for a spectrum of ailments such as gastrointestinal disorders, cutaneous wounds, inflammation, and urogenital complaints. The ethnomedical applications of the plant are supported by its complex phytochemical profile, which is rich in secondary metabolites. The main constituents include the toxic non-protein amino acid mimosine, various C-glycosylflavonoids, tannins, terpenoids, and other phenolic compounds. These bioactive molecules are correlated with a wide array of scientifically validated pharmacological properties. Preclinical investigations have demonstrated significant antimicrobial, antioxidant, anti-inflammatory, wound healing, antidiabetic, hepatoprotective, and diuretic activities. For example, extracts have shown efficacy in alloxan-induced diabetic models and protection against carbon tetrachloride-induced hepatotoxicity. The dual identity of this plant as a valuable medicinal resource and a problematic invasive weed in agricultural regions presents a complex ecological profile. This review correlates the current scientific knowledge on *M. pudica*, linking its traditional uses to its characterized phytochemicals and documented biological activities.

Keywords: *Mimosa pudica*; Phytochemistry; Pharmacology; Ethnomedicine; Mimosine

1. Introduction

Mimosa pudica L., commonly known as the "sensitive plant" or "touch-me-not," is a species recognized globally for its remarkable physiological response to mechanical stimuli [1]. This seismonastic movement, where the bipinnate leaves rapidly fold inward upon being touched, is a classic example of turgor-mediated plant motor function [2]. While often cultivated as a curiosity, its significance extends far beyond this trait, representing a biological paradox as both a noxious weed and a plant of profound medicinal value.

Taxonomically, *M. pudica* belongs to the genus *Mimosa*, a large group within the subfamily Mimosoideae of the legume family, Fabaceae [3]. Although native to the neotropics (South and Central America), its high adaptability and effective seed dispersal have led to its naturalization across the world's tropical and subtropical regions. In many areas, it is considered a problematic invasive weed, colonizing disturbed soils, roadsides, and agricultural fields, where it competes with crops [4].

Figure 1. Leaves and Flowers of *Mimosa pudica*

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Despite its invasive status, *M. pudica* holds a place of high esteem in various traditional medicine systems. In Ayurvedic, Unani, and other folk traditions, different parts of the plant—including the roots, leaves, and stems—are employed to treat a wide array of conditions [5]. Its uses are extensive, ranging from the management of digestive issues like dysentery and diarrhea to the treatment of piles (hemorrhoids), skin diseases, leprosy, and urogenital disorders [6]. The plant's juice or paste is also a common topical remedy for wounds, ulcers, and scorpion stings [7].

The widespread ethnomedinal reliance on this plant has prompted significant scientific investigation into its chemical composition and biological properties, providing a roadmap for modern pharmacological validation. These studies have revealed a rich arsenal of phytochemicals, including alkaloids, C-glycosylflavonoids, tannins, and terpenoids, which are believed to be responsible for its therapeutic effects [8]. This review collates the current scientific literature on the botany, ecological status, phytochemistry, and pharmacological properties of *M. pudica*, providing a detailed perspective on its potential as a source for modern therapeutic agents.

Table 1. Selected Ethnomedinal Applications of *Mimosa pudica*

Plant Part Used	Traditional Indication / Ailment Treated	Medicinal System / Region
Root	Piles (Hemorrhoids), Fistula, Urinary complaints, Jaundice	Ayurveda, Traditional Indian Medicine
	Urogenital disorders, Leprosy	Siddha, Unani
	Snake bites, Scorpion stings (as paste)	Folk medicine (Various)
Leaves	Wounds, Cuts, Sores (as paste or juice)	Traditional Indian & Southeast Asian Medicine
	Diarrhea, Dysentery (as decoction)	Ayurveda, Philippines
	Insomnia, Anxiety (as infusion)	Traditional American & Indian Medicine
	Cough, Bronchitis	Folk medicine (Various)
Whole Plant	Diarrhea, Dysentery, Piles, Skin diseases	Ayurveda
	Rheumatism, Edema	Folk medicine (Various)
	Uterine problems	Traditional Indian Medicine

2. Botanical Profile

2.1. Taxonomy

The formal classification of *Mimosa pudica* L. places it firmly within the Fabaceae (legume) family, a vast and economically important group. The Mimosoideae subfamily is characterized by its actinomorphic (radially symmetrical) flowers arranged in dense, showy capitula, with numerous, conspicuous stamens [3]. Its detailed classification is as follows:

- Kingdom: Plantae
- Order: Fabales
- Family: Fabaceae
- Subfamily: Mimosoideae
- Genus: *Mimosa*
- Species: *Mimosa pudica*

The species was first formally described by Carl Linnaeus in his 1753 publication, *Species Plantarum* [3]. The genus name *Mimosa* is derived from the Greek "mimos" (mimic), and the species epithet "pudica" is Latin for "shy," "bashful," or "shrinking," alluding to its sensitive leaf movement.

Table 2. Common Vernacular Names of *Mimosa pudica*

Language / Region	Vernacular Name(s)
English	Sensitive plant, Touch-me-not, Humble plant, Shame plant
Sanskrit	Lajja, Lajjalu, Namaskari
Hindi	Laajvanti, Chhui-mui
Bengali	Lajjabati
Kannada	Lajja, Nachika, Mudugu-davare
Malayalam	Tintarmani
Tamil	Thottal-sinungi, Thottalvadi
Telugu	Attapatti
Philippines	Makahiya ("shy")

2.2. Morphological Description

M. pudica is a diffuse, creeping perennial herb, though it can also behave as an annual in certain climates. It is often suffrutescent, meaning it becomes woody at the base. It typically grows to a height of 50-70 cm [9]. The slender, branching stems are notably armed with sharp, recurved prickles, which are also present on the leaf petioles, serving as a physical defense.

The leaves are bipinnately compound, consisting of one or two pairs of pinnae, each bearing 15-25 pairs of small, oblong leaflets [10]. The plant's characteristic movements are controlled by specialized motor organs called pulvini, which are swollen structures located at the base of the petioles and leaflets. This movement is a sophisticated defense mechanism initiated by an action potential. This signal propagates to the motor cells of the pulvini, triggering a massive, rapid efflux of K^+ ions and water. This osmotic shift causes a sudden loss of turgor, collapsing the cells on one side of the pulvinus and folding the leaflets [2, 11].

The inflorescence consists of globose (globe-like) heads, or capitula, borne on axillary peduncles. These heads (1-1.5 cm in diameter) are composed of numerous small, pink-to-lilac flowers with prominent stamens, giving them a fluffy appearance [9]. The fruit is a loment—a type of legume that fragments at maturity into 2-5 one-seeded segments. These segments are bristly along the margins, which aids in their dispersal by adhering to animal fur or clothing [12].

2.3. Distribution

Originating in the American tropics, *M. pudica* has become a pantropical species. It thrives in humid, warm climates and is commonly found in areas of disturbed soil, such as roadsides, wastelands, pastures, and open plantations [4]. It tolerates a wide range of soil types, including acidic and low-nutrient soils, though it prefers well-drained substrates [13].

This adaptability contributes to its status as a significant environmental and agricultural weed. It forms dense, prickly mats that can outcompete native flora and interfere with crops such as sugarcane, coffee, corn, and soybeans [14]. Its success as an invader is also attributed to high seed production and the longevity of seeds in the soil seed bank. The bristly loments facilitate epizoochory (dispersal by animals), allowing it to colonize new areas rapidly, particularly overgrazed pastures and agricultural margins [14].

2.4. Phytochemical Constituents

The various therapeutic applications of *M. pudica* are directly related to its complex secondary metabolite profile. The plant is a veritable reservoir of bioactive compounds, with significant variations in concentration depending on geographic location, season, and plant part.

2.5. Mimosine and Alkaloids

The most widely studied and characteristic compound in *M. pudica* is mimosine, a non-protein amino acid (also classified as an alkaloid) [15]. Mimosine is structurally similar to tyrosine and is known for its antimitotic properties, which it achieves by chelating metal ions essential for enzymes like DNA polymerase [16]. This antimitotic action specifically arrests the cell cycle in the late G1 phase, preventing DNA replication. While this property is explored for anticancer research, it is also responsible for the plant's toxicity. In ruminants, mimosine can be degraded by rumen microbes, but in non-ruminants, it is a notable toxin, capable of inducing alopecia (hair loss), goitrogenic effects, and depressed growth [17].

2.6. Phenolics and Flavonoids

M. pudica is particularly rich in phenolic compounds and flavonoids, which are largely responsible for its potent antioxidant activity [8]. A significant number of C-glycosylflavones have been isolated, particularly from the leaves [18]. Key C-glycosylflavonoids identified include derivatives of apigenin and luteolin, such as vitexin, isovitexin, orientin, and isoorientin. The direct C-C bond between the sugar and the aglycone (flavonoid nucleus) in these compounds imparts significant stability against both enzymatic and acidic hydrolysis compared to more common O-glycosides. This enhanced stability may improve their bioavailability and persistence *in vivo*, contributing to the plant's sustained anti-inflammatory and hepatoprotective effects [19].

2.7. Tannins and Terpenoids

The presence of tannins, including both condensed (proanthocyanidins) and hydrolyzable types, explains the plant's traditional use as an astringent and for treating diarrhea, dysentery, and bleeding [6]. The astringent property results from the precipitation of salivary and mucosal proteins. This protein-binding capacity is also key to its wound-healing and antimicrobial effects, as tannins can form a protective, "leathery" layer over wounds and complex with microbial enzymes, inhibiting their function [20]. Additionally, various terpenoids and sterols, such as β-sitosterol, stigmasterol, and campesterol, have been identified, which are known for their anti-inflammatory, cholesterol-lowering, and other diverse biological activities [20].

Table 3. Major Phytochemical Constituents Isolated from *Mimosa pudica*

Chemical Class	Specific Compound(s)	Primary Plant Part(s)
Alkaloids / Non-protein Amino Acids	Mimosine	Leaves, Seeds
Flavonoids (C-Glycosides)	Vitexin, Isovitexin	Leaves
	Orientin, Isoorientin	Leaves
Other Phenolics	Gallic acid, Protocatechuic acid	Leaves, Stems
Tannins	Condensed tannins (Proanthocyanidins)	Whole plant, Bark
Terpenoids & Sterols	β-Sitosterol, Stigmasterol	Whole plant, Root
	Campesterol	Whole plant
Fatty Acids	Palmitic acid, Linoleic acid, Oleic acid	Seeds (Oil)

3. Pharmacological Activities

The rich ethnomedinal history of *M. pudica* is substantiated by numerous preclinical studies investigating its biological effects. These studies validate many of its traditional uses, providing a scientific basis for its therapeutic claims.

3.1. Wound Healing Activity

The application of *M. pudica* for cuts and wounds is supported by pharmacological studies. A methanolic extract of the roots, formulated as a 2% (w/w) ointment, demonstrated significant promotion of wound healing in rat excision wound models. This was evidenced by an accelerated rate of epithelialization and a higher percentage of wound contraction compared to control groups [21]. Furthermore, treatment was associated with increased levels of hydroxyproline, a key amino acid component of collagen, in the wound tissue. This finding confirms enhanced collagen synthesis and cross-linking, a critical step for restoring tensile strength to the repaired tissue [21].

3.2. Antidiabetic Activity

The plant's potential in managing hyperglycemia has been evaluated in rodent models. Ethanolic and petroleum ether extracts of *M. pudica* leaves were administered to alloxan-induced diabetic Wistar rats [22]. The alloxan model induces diabetes by selectively destroying pancreatic β-cells via the generation of reactive oxygen species. The ethanolic extract, in particular, produced a significant reduction in plasma glucose levels, with an efficacy profile that was comparable to the standard oral hypoglycemic agent, metformin [22]. This suggests the extract may have a protective effect on remaining β-cells, enhance peripheral glucose uptake, or inhibit carbohydrate-metabolizing enzymes like α-amylase and α-glucosidase.

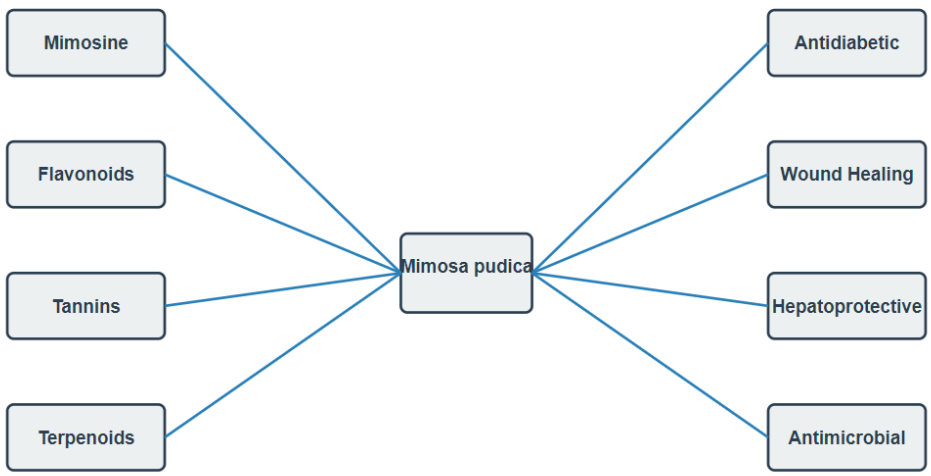

Figure 2. Phytochemical Constituents and Their Pharmacological Activities in Mimosa pudica

3.3. Hepatoprotective Activity

Traditional use in treating liver-related ailments is supported by hepatoprotective studies. A methanolic extract of *M. pudica* was shown to protect rats from liver damage induced by carbon tetrachloride (CCl_4), a well-known hepatotoxin [23]. CCl_4 induces

hepatotoxicity via bioactivation by CYP450 enzymes, leading to the formation of trichloromethyl free radicals, which initiate lipid peroxidation and destroy hepatocyte membranes. Administration of the extract (200 mg/kg) significantly attenuated the sharp rise in serum liver enzymes, such as serum glutamic-oxaloacetic transaminase (SGOT), serum glutamic-pyruvic transaminase (SGPT), and alkaline phosphatase (ALP). The extract's ability to normalize these markers, as well as total bilirubin and cholesterol, indicates a mechanism rooted in its antioxidant and free-radical-scavenging properties, likely attributable to its high phenolic and flavonoid content [23].

3.4. Antimicrobial Activity

Phytochemical analysis of *M. pudica* has revealed compounds like flavonoids, alkaloids, and tannins, all known for antimicrobial properties. Methanolic leaf extracts have demonstrated notable dose-dependent inhibitory activity against a panel of microorganisms, including the fungal pathogen *Aspergillus fumigatus* and the bacteria *Citrobacter divergens* and *Klebsiella pneumoniae* [24]. Further studies have confirmed the antifungal activity of both methanolic and aqueous extracts, validating the plant's use in treating microbial infections [25]. The inhibitory action is broad-spectrum, and the proposed mechanisms, including microbial membrane disruption and enzymatic inhibition by phenolic compounds, are characteristic of a synergistic action of these metabolites.

3.5. Antioxidant Activity

The high concentration of phenolic and flavonoid compounds in *M. pudica* confers significant antioxidant potential. The free radical scavenging ability of ethanolic extracts has been confirmed *in vitro* using multiple assays, including 2,2-diphenyl-1-picrylhydrazyl (DPPH), nitric oxide (NO), and 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) (ABTS) models [26]. The DPPH assay measures the ability of the extract to donate a hydrogen atom to the stable DPPH radical. The NO scavenging assay is significant as chronic overproduction of NO is implicated in inflammation and carcinogenesis. The low IC_{50} values reported in these studies indicate that only a small concentration of the extract is needed to achieve a 50% reduction in these radicals, highlighting its potency [26].

3.6. Antihyperlipidemic Activity

In addition to its hypoglycemic effects, *M. pudica* also appears to modulate lipid profiles, which is critical for managing metabolic syndrome, a common comorbidity with diabetes. An 80% ethanol extract of the whole plant, when administered to diabetic Wistar rats, significantly reduced elevated levels of total cholesterol (TC), triglycerides (TG), and low-density lipoprotein (LDL) [27]. Concurrently, the extract beneficially increased levels of high-density lipoprotein (HDL). Similar hypolipidemic effects were observed with an ethanol extract of the leaves in CCl_4-intoxicated rats [28]. The mechanism may involve the inhibition of key enzymes in cholesterol synthesis, such as HMG-CoA reductase, or the enhancement of bile acid secretion.

3.7. Diuretic Activity

The plant is used in traditional systems for urinary complaints, and studies have investigated its diuretic properties. Both ethanolic extracts and leaf decoctions have been shown to induce significant diuresis in rat models, with effects comparable to the standard loop diuretic furosemide [29]. The mechanism appears to involve enhancement of electrolyte excretion. Studies noted increased urinary concentrations of sodium (Na^+, natriuresis) and chloride (Cl^-, chloruresis), without a significant disruption of potassium (K^+) homeostasis at all doses. This is a favorable diuretic profile, suggesting an aquaretic effect, possibly by inhibiting ion reabsorption in the renal tubules [29].

3.8. Anti-ulcer Activity

The gastroprotective potential of *M. pudica* has been explored in several preclinical ulcer models, including those induced by aspirin, alcohol, and pylorus ligation [30]. These models are distinct: alcohol causes direct necrotizing damage to the gastric mucosa, while aspirin inhibits prostaglandin synthesis, reducing the protective mucous layer, and pylorus ligation allows for the accumulation of endogenous acid. The extracts (ethanolic, methanolic) provided significant protection in all models, quantified by a reduction in the ulcer index. This efficacy suggests both a cytoprotective (mucosa-defending) action and an anti-secretory (acid-reducing) mechanism, similar to ranitidine [30].

3.9. Anti-oestrogenic Activity

M. pudica root powder has been investigated for its effects on the endocrine system, relevant to its use in traditional gynecological preparations. Using an immature female rat model (a standard uterotrophic assay), the powder itself did not demonstrate any intrinsic oestrogenic activity, as it failed to increase uterine weight [31]. However, when co-administered with estradiol monobenzoate (an exogenous estrogen), the root powder significantly inhibited the expected estrogen-induced uterine growth. This finding demonstrates a clear anti-oestrogenic or estrogen-antagonistic property, suggesting the presence of compounds with selective estrogen receptor modulator (SERM)-like activity. These molecules may competitively bind to estrogen receptors, acting as antagonists in specific tissues like the uterus [31].

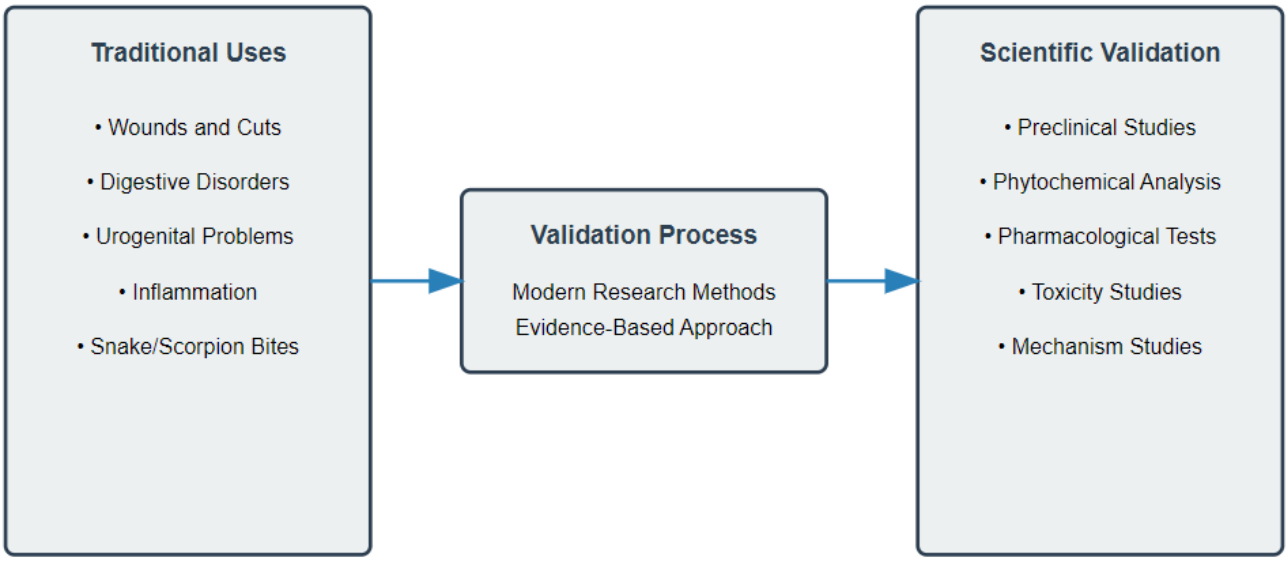

Figure 3. Traditional Uses and Scientific Validation Pathway of *Mimosa pudica*

Table 4. Pharmacological Activities of *Mimosa pudica*

Pharmacological Activity	Extract Type / Plant Part	Experimental Model	Findings
Wound Healing	Methanolic root extract (ointment)	Rat excision wound model	Accelerated epithelialization; increased wound contraction and hydroxyproline content [21].
Antidiabetic	Ethanolic leaf extract	Alloxan-induced diabetic rats	Significant reduction in plasma glucose levels, comparable to metformin [22].
Hepatoprotective	Methanolic extract	Carbon tetrachloride (CCl_4)-induced hepatotoxicity in rats	Attenuated rise in serum SGOT, SGPT, ALP, and bilirubin [23].
Antimicrobial	Methanolic leaf extract	Agar disc/well diffusion	Inhibitory activity against *Aspergillus fumigatus*, *Klebsiella pneumoniae*, *Citrobacter divergens* [24, 25].
Antioxidant	Ethanolic extract	*In vitro* DPPH, NO, ABTS assays	Potent free radical scavenging activity with low IC_{50} values [26].
Antihyperlipidemic	Ethanolic whole plant extract	Diabetic rats	Significant reduction in TC, TG, LDL; increase in HDL [27].
Diuretic	Ethanolic extract, Leaf decoction	Wistar rat model	Increased urine output and electrolyte (Na^+, Cl^-) excretion, comparable to furosemide [29].
Anti-ulcer	Ethanolic leaf extract	Aspirin, alcohol, & pylorus ligation-induced ulcer models in rats	Significant reduction in ulcer index; decreased gastric acid secretion [30].
Anti-oestrogenic	Root powder	Immature female rat (uterotrophic assay)	No intrinsic estrogenic activity; significantly inhibited estradiol-induced uterine growth [31].

4. Conclusion

Mimosa pudica L. is a plant of significant duality. Ecologically, it is a resilient and problematic invasive species, yet medicinally, it is a rich repository of bioactive compounds. Its long-standing applications in traditional medicine are not merely folkloric; they are increasingly being validated by modern preclinical research. The plant's complex phytochemistry, characterized by mimosine, C-glycosylflavonoids, and tannins, provides a clear basis for the observed pharmacological activities, including potent antioxidant, anti-inflammatory, antimicrobial, hepatoprotective, and antidiabetic effects. The documented evidence confirms its capacity to mitigate chemically-induced hepatotoxicity, modulate blood glucose and lipid levels, promote wound healing, and protect against gastric ulcers. While these preclinical findings are promising, future research should focus on the isolation and characterization of specific

lead compounds and the elucidation of their precise mechanisms of action. Moreover, the significant toxicological concern of mimosine necessitates investigation into traditional preparation methods (e.g., decoction, extraction) that may mitigate its toxicity.

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