Mimosa pudica L. (Laajvanti): An overview

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ABSTRACT

Mimosa pudica L. (Mimosaceae) also referred to as touch me not, live and die, shame plant and humble plant is a prostrate or semi-erect subshrub of tropical America and Australia, also found in India heavily armed with recurved thorns and having sensitive soft grey green leaflets that fold and droop at night or when touched and cooled. These unique bending movements have earned it a status of ‘curiosity plant’. It appears to be a promising herbal candidate to undergo further exploration as evident from its pharmacological profile. It majorly possesses antibacterial, antivenom, antifertility, anticonvulsant, antidepressant, aphrodisiac, and various other pharmacological activities. The herb has been used traditionally for ages, in the treatment of urogenital disorders, piles, dysentery, sinus, and also applied on wounds. This work is an attempt to explore and compile the different pharmacognostic aspects of the action plant M. pudica reported till date.

Key words: Antidepressant, aphrodisiac, diuretic, Mimosa pudica, pulvini, symbionts

INTRODUCTION

Mimosa pudica L. is a creeping annual or perennial herb. It has been identified as lajjalu in Ayurveda and has been found to have antiasthmatic, aphrodisiac, analgesic, and antidepressant properties. M. pudica is known to possess sedative, emetic, and tonic properties, and has been used traditionally in the treatment of various ailments including alopecia, diarrhea, dysentery, insomnia, tumor, and various urogenital infections. Phytochemical studies on M. pudica have revealed the presence of alkaloids, non-protein amino acid (mimosine), flavonoids C-glycosides, sterols, terpenoids, tannins, and fatty acids.[1] Two well-known movements are observed in M. pudica L. (ojigi-so in Japanese): one is the very rapid movement of the leaves when it is stimulated by touch, heating, etc., and the other is the very slow, periodical movement of the leaves called nyctinastic movement which is controlled by a biological clock.[2] The leaves of the sensitive plant M. pudica can adapt their closing response to electrical and mechanical stimulation so that they reopen to repeated stimulation. The more intense the stimuli and the longer the intertribal interval, the longer it takes to adapt. Leaves adapted to the effects of mechanical stimulation can still respond by closing to electrical stimulation and vice versa.[3]

BIOLOGICAL SOURCE

Mimosa pudica L. is a diffuse prickly undershrub belonging to family Mimosaceae [Figure 1].

Parts used
Whole plant, leaves, and roots.

Synonym
Laajvanti, Touch me not, and Chhui-mui

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Figure 1: Mimosa pudica flower head
Classical and common names
Ayurveda – Lajalu, Namaskari, Samangaa, Samokchini, and Shamipattraa
Siddha – Thottal Chinungi.[6]

Vernacular names
Sanskrit – Lajja
English – Sensitive plant
Hindi – Laajvanti and Chhui-mui
Bengali – Lajjabati
Telugu – Attapatti and Peddanidrakanni
Tamil – Tottaaladi and Thottalchnungi
Kannada – Laja, Nachika and Mudugu-davare
Malayalam – Tintarmani

Origin and geographical distribution
The plant is a native of tropical America and naturalized nearly all through the tropical and subtropical parts of India.

Habitat
Commonly distributed in open-spaces, especially road side, cultivated land, and waste area.

Propagation
By seeds and vegetative methods.

Description
Semi-prostrate, prickly course herb, or subshrub up to 0.5-m tall.[5]

MACROSCOPY

Root
Cylindrical, tapering rependant, with secondary and tertiary branches, varying in length up to 2-cm thick, surface more or less rough or longitudinally wrinkled; grayish-brown to brown, cut surface of pieces pale yellow, fracture hard, woody, bark-fibrous; odor, distinct; taste, slightly astringent.

Stem
Cylindrical, up to 2.5 cm in diameter; sparsely prickly, covered with long, weak bristles longitudinally grooved, external surface light brown, internal surface grey, bark fibrous; easily separable from wood.

Leaf
Digitately compound with one or two pairs of sessile, hairy pinnae, alternate, petiolate, stipulate, linear lanceolate; leaflets 10–20 pairs, 0.6–1.2-cm long, 0.3–0.4-cm broad, sessile, obliquely narrow or linear oblong; obliquely rounded at base, acute, nearly glabrous; yellowish green.

Flower
Pink, in globose head, peduncles prickly; calyx very small; corolla pink, lobes 4, ovate oblong; stamens 4, much exerted; ovary sessile; ovules numerous.

Fruit
Lomentum, simple, dry, 1–1.6-cm long, 0.4–0.5-cm broad, with indehisced segments and persistent sutures having —two to five seeds with yellowish spreading bristle at sutures, 0.3-cm long, glabrous, and straw colored.

Seed
Compressed, oval-elliptic, brown to gray, 0–0.3-cm long, 2.5-mm broad, having a central ring on each surface.

MICROSCOPY

Root
Mature root shows cork 5–12 layered, tangentially elongated cells, a few outer layer crushed or exfoliated; secondary cortex consisting of 6–10 layered, tangentially elongated thin-walled cells; secondary phloem composed of sieve elements, fibers, crystal fibers, and phloem parenchyma traversed by phloem rays, phloem fibers, single or in groups, arranged in tangential bands; crystal fibers thick walled, 3–25 chambered, each with single or two to four prismatic crystals of calcium oxalate; phloem rays uni-to-multi-seriate, —two to three seriate more common; secondary xylem consists of usual elements traversed by xylem rays; vessels scattered throughout secondary xylem having bordered pits and reticulate thickenings; crystal fibers containing one or rarely two to four prismatic crystals of calcium-oxalate in each chambers; parenchyma, thick walled, scattered throughout secondary xylem; xylem rays uni-to-bi-seriate; rarely multi-seriate, wider toward secondary phloem and narrow toward center; starch grains, prismatic crystals of calcium oxalate and tannin present in secondary cortex, phloem and xylem rays, and parenchyma; starch grains both simple and compound having two to three components, rounded to oval measuring 6–20 mm and 16–28 mm in diameter, respectively.

Stem
Mature stem shows four to eight layered, exfoliated cork of tangentially elongated cell filled with reddish brown contents; secondary cortex wide, consisting of large, moderately thick walled, tangentially elongated to oval, parenchymatous cells, filled with reddish brown contents, a few cells contain prismatic crystals of calcium oxalate, a number of lignified, fibers single or in groups, scattered throughout; secondary phloem consisting of usual elements, two to five transversely arranged strips of fibers occur alternating with narrow strips of sieve elements and parenchyma, crystal fibers elongated, thick-walled, containing single crystal of calcium oxalate in each chamber; phloem rays thick walled radially elongated; secondary xylem composed of usual elements traversed by xylem rays, vessels, drum shaped with spiral thickenings, tracheids pitted with pointed ends, fibers of two types, shorter wide lumen and longer with narrow lumen; xylem rays radially elongated, thick walled, 1–6 cells wide and 3–30 cells high; pith consisting of polygonal, parenchymatous cells with intracellular spaces.

Leaf
Petiole shows single layered epidermis, covered with thin cuticle;
cortex four to seven layered of thin walled, parenchymatous cells; pericycle arranged in a ring; four central vascular bundles present with two smaller vascular bundles arranged laterally, one in each wing.

**Midrib**
Shows a single-layered epidermis, covered with thin cuticle, upper epidermis followed by a single-layered palisade, spongy parenchyma single-layered, pericycle same as in petiole; vascular bundle single.

**Lamina**
Shows epidermis on both surfaces, palisade single-layered; spongy parenchyma, three to five layers consisting of circular cells; rosette crystals and few veins present in spongy parenchyma.

**Fruit**
Shows single-layered epidermis with few nonglandular, branched, shaggy hair; mesocarp five to six layers of thin walled, parenchymatous cells; some amphilinbral vascular bundles found scattered in this region; endocarp of thick-walled lignified cells followed by single-layered thin-walled, parenchymatous cells.

**Seed**
Shows single-layered radially elongated cells; followed by five to six-layered angular cells filled with dark brown contents; endosperm consists of angular or elongated cells, a few containing prismatic crystals of calcium oxalate; cotyledons consist of thin-walled cells, a few cells containing rosette crystals of calcium oxalate; embryo straight with short and thick radical.

**Powder**
Reddish brown, shows reticulate, pitted vessels, prismatic and rosette crystals of calcium oxalate, fibers, crystal fibers, yellow or brown parenchymatous cells, palisade cells, nonglandular, branched, shaggy hair, single and compound starch grains, measuring 6–25 mm in diameter with two to three components [Figure 2].[6]

**BENDING MOVEMENTS OF THE CURIOSITY PLANT**

**MIMOSA PUDICA**

Plant leaf movements can be mediated by specialized motor organs, the pulvini or can be epinastic (i.e. based on different growth velocities of the adaxial and abaxial halves of the leaf).

Both processes are associated with diurnally regulated increase in the rates of membrane water transport, which in many cases, has been shown to be facilitated by aquaporins. Rhythmic leaf movements are known from many plant species but more recently a promising model plant to study pulvinus-mediated leaf movements is *M. pudica*. The contribution of both plasma membrane and tonoplast localized aquaporins to the seismosonatic leaf movements in *M. pudica* has been analyzed.[7] The bending movement of the pulvinus of *M. pudica* is caused by a rapid change in volume of the abaxial motor cell, in response to various environmental stimuli. The bending of the pulvinus is retarded by treatments with actin-affecting reagents and calcium channel inhibitors. The actin filaments in the motor cells are fragmented in response to electrical stimulation. Hence the study demonstrated that depolymerization of the actin cytoskeleton in pulvinus motor cells in response to electrical signals results in increased levels of calcium.[8]

The seismosonatic movement of *M. pudica* is triggered by a sudden loss of turgor pressure. On comparing the cell cytoskeleton by immunofluorescence analysis before and after movement and evaluation of the effects of actin and microtubule targeted drugs by injecting them into the cut pulvinus, it is seen that fragmentation of actin filaments and microtubule occurs during bending, although the actin cytoskeleton and not the microtubules are involved in the regulation of the movement.

TEM reveals that actin cables become loose after bending. On injecting phosphatase inhibitors into several pulvinus to examine the effects of such inhibitors, it is seen that changes in actin isoforms, fragmentation of actin filaments and the bending movements are all inhibited after injecting a tyrosine phosphatase inhibitor.[9] Special red cells are found on the adaxial surface of

**Figure 2:** (a) Stomata on *M. pudica* leaf. (b) Water transport system in *M. pudica* (800 × 800)
the tertiary pulvini of *M. pudica*. Using anatomical (light, scanning and transmission electron microscopy) and electrophysiological techniques it has been demonstrated that these red cells are the real mechanoreceptor cells. They can generate receptor potential following mechanical stimuli and they are in connection with excitable motor cells (through plasmodesmata). These red cells are derived from stomatal subsidiary cells and not the guard cells.[Figure 3][10]

**Mimosa pudica** symbionts

Bacteria isolated from Mimosa nodules in Taiwan, Papua New Guinea, Mexico, and Puerto Rico were identified as belonging to either the alpha- or beta-proteobacteria. The beta-proteobacteria *Burkholderia* and *Cupriavidus* strains formed effective symbiosis with the common invasive species *Mimosa diplosticha*, *M. pigra*, and *M. pudica*, but the alpha-proteobacterial *Rhizobium etli* and *R. tropici* strains produced a range of symbiotic phenotypes from no nodulation through ineffective to effective nodulation, depending on *Mimosa* species.

The largest significant effect was for *M. pudica*, in which LMG19424 formed 57% of the nodules in the presence of 0.5 mM potassium nitrate. In the host, ammonium also had a similar, but lesser, effect. Comparable results were also found using an N-containing soil mixture, and environmental N levels are therefore suggested as a factor in the competitive success of the bacterial symbionts *in vivo*. The ability of *Burkholderia phytopathum* STM815 to effectively nodulate *Mimosa* species, and to fix nitrogen ex planta, was compared with that of the known Mimosa symbionts *Cupriavidus taiwanensis* LMG19424. Both strains were equally effective symbionts of *M. pudica*, but nodules formed by STM 815 had greater nitrogenase activity. STM 815 was shown to have a broader host range across the genus *Mimosa* than LMG 19424 nodulating 30 out of 31 species, 21 of these effectively. LMG 19424 effectively nodulated only nine species.[12]

**Phytochemistry**

Several studies have shown several biochemical substances involved in the contractility of the leaves.[13] Fresh tissues give nor-epinephrine, D-pinitol (3-mono-methyl ether of inositol), and b-sitosterol. Leaves contain alkaloids.[8] An alkaloid mimosine has been isolated from the plant.[13] The preliminary phytochemical screening of the *M. pudica* leaf extract showed the presence of bioactive components such as terpenoids, flavonoids, glycosides, alkaloids, quinines, phenols, tannins, saponins, and coumarins [Table 1].[14,23]

Roots of the plant are indicative of the presence flavonoids, phytoesterol, alkaloids, amino acids, tannins, glycoside, and fatty acids. Chromatographic procedures revealed that petroleum ether fraction majorly contains flavonoids, phytoesterol, alkaloids, and amino acids. Acetone fraction has confirmed the presence of flavonoids. The chloroform fraction showed the presence of alkaloids. The essential oils and fatty acids were majorly contained in the benzene extract [Table 2].[38]

![Figure 3: Mimosa pudica leaves (a) open and (b) closed](image)

The yield of the plant material in various solvents obtained by successive extraction was found out [Table 3].

Crocin dimethyl ester and tannin have been isolated from the plant. The mucilage from seed is composed of D-xyllose and D-glucoronic acid 4-O-(3,5-dihydroxybenzoic acid)-b-D-glucoronicide.[15] The constituents were separated and purified by column chromatography with macroporous adsorption resin Diaion HP-20, Sephadex LH-20, Tyopearl HW-40, MCI Gel CHP-20, RP-18, and normal phase silica gel. Their structures were identified on the basis of physical and spectral data. Four compounds were isolated and identified as:

- 7,8,3',4'-tetrahydroxyl-6-C-[alpha-L-rhamnopyranosyl-(1→2)]-b-D-glucopyranosyl flavone (I);
- 5,7,4'-trihydroxyl-b-C-[alpha-L-rhamnopyranosyl-(1→2)]-b-D-glucopyranosyl flavones (II);
- 5,7,3',4'-tetrahydroxyl-6-C-[alpha-L-rhamnopyranosyl-(1→2)]-b-D-glucopyranosyl flavone (III);
- catcher (IV).

Compound I is a new compound and compounds II–IV were isolated from this plant for the first time.[16] Cellular and chloroplast lipids of leaves of *M. pudica* have been analyzed. Qualitatively the total lipid composition of this plant is similar to that reported for the photosynthetic tissues of other plants.
Table 1: Phytochemical screening of *Mimosa pudica* leaf extracts

| Test            | n-Hexane | Chloroform | Ethyl acetate | Methanol |
|-----------------|----------|------------|---------------|----------|
| Alkaloids       | –        | +          | +             | +        |
| Glycosides      | –        | +          | +             | +        |
| Terpenoids      | –        | –          | –             | –        |
| Carbohydrates   | +        | +          | +             | +        |
| Proteins        | –        | –          | –             | –        |
| Steroids        | +        | +          | –             | +        |
| Flavonoids      | –        | +          | +             | +        |
| Phenols         | –        | –          | –             | +        |
| Tannins         | –        | –          | –             | –        |
| Quinones        | –        | –          | –             | –        |
| Saponins        | +        | +          | –             | –        |
| Resin           | –        | –          | –             | –        |

Table 2: Detection of constituents in roots of *M. pudica* by chromatographic scheme

| Solvent system used | Detection reagent | Observation                          | Inference                      | P | B | C | A | M | E |
|---------------------|-------------------|--------------------------------------|---------------------------------|----|---|---|---|---|---|
| Ethyl acetate:methanol: water (75.5:13.5:10) | KOH | Red. (Vis) yellow | Anthraquinone anthrone | – | – | – | – | – | – |
| | Vanillin sulphuric acid | Red/ yellow/brown/blue-green | Bitter principle | – | – | – | – | – | – |
| | Dragendorff’s reagent | Orange red (vis) | Alkaloid | + | – | + | – | – | – |
| | NP/PEG and UV | Yellow/green/orange | Flavonoid | + | – | – | + | + | – |
| | VS reagent | Blue (vis) | Saponin | – | – | – | – | – | – |
| Toluene:ethylacetate (93:7) | VS reagent | Red/ yellow/brown/blue-green | Essential oil | + | + | – | – | – | – |
| | HCl/acetic acid | Blue-brown | Valeoptriate | – | – | – | – | – | – |
| | NH3/KOH | Light blue brown | Coumarin | – | – | – | – | – | – |

P = Petroleum ether, B = Benzene, C = Chloroform, A = Acetone, M = Methanol, E = Ethanol

Table 3: Successive solvent extraction of *Mimosa pudica* Linn. leaves

| Solvent      | Color and consistency | Extractive value (% w/w) |
|--------------|-----------------------|--------------------------|
| n-Hexane     | Yellowish brown waxy   | 5.366                    |
| Chloroform   | Brownish waxy          | 7.75                     |
| Ethyl acetate| Dark brown waxy        | 10.25                    |
| Methanol     | Reddish brown waxy     | 17.90                    |

Chloroplast lipids show some resemblance to those of algae. The cerebrosides fraction of both leaves and chloroplasts contains a polyunsaturated fatty acid (20:4ω3) and a long chain sphingosine base whose Rf value coincides with that from ox brain cerebrosides and not of phytosphingosine from spinach[17] Jasmonic acid was identified from *M. pudica* L. plants by mass spectrometry, high performance liquid chromatography, and thin layer chromatography. Effects of authentic jasmonic acid on pulvinule movement and transpiration of the pinnae were compared with those of abscisic acid. Jasmonic acid and abscisic acid each at 10−5 M inhibited both auxin- and light-induced opening of the pulvini. A closure-inducing activity of jasmonic acid at 10−4 M was greater than that of abscisic acid at 10−4 M. Pinnae transpiration was reduced by 10−5 M abscisic acid but not by 10−4 M jasmonic acid.[18]

The secretory cells accumulate material that gives a positive test for carbohydrates and a negative test for proteins.[19] Interestingly certain compounds with enzyme inhibitory activity have also been isolated from *M. pudica* recently [Figure 4].

## EVALUATION AND ANALYSIS

**Identity, purity, and strength**

*Foreign matter* – not more than 2%

*Total ash* – not more than 10%

*Acid-insoluble ash* – not more than 5%

*Alcohol-soluble extractive* – not less than 9%

*Water-soluble extractive* – not less than 9%.

**Thin layer chromatographic studies**

TLC of alcoholic extracts of *M. pudica* leaves on Silica Gel G plates using n-butanol:acetic acid:water (4:1:5). Under UV (366 nm) four fluorescent zones appear at Rf 0.35, 0.62, 0.69 (all blue) and 0.81 (bluish pink). On exposure to iodine vapor two spots appear at Rf 0.35 and 0.94 (both yellow). On spraying with the Dragendorff reagent followed by 5% methanolic sulfuric acid reagent one spot appears at Rf 0.35 (orange).[6]

**Reverse phase HPTLC**

A sensitive, simple, and reliable reversed-phase HPTLC method has been established for quantification of mimosine in *M. pudica* L. whole plant powder. The plant powder was first extracted with methanol. The residue was then extracted with water and the aqueous extract was used for quantification. Chromatography was
performed on silica gel RP-18 F254s plates with ethyl acetate–
glacial acetic acid–water, 6 + 1 + 1.7 (v/v), as the mobile phase.  
Quantification was achieved by densitometric scanning at $\lambda_{max} = 282$ nm in the reflectance–absorbance mode. The response 
to mimosine was a linear function of concentration over the 
range 30–100 mg/mL in the extract. The amount of mimosine 
in M. pudica was found to be 20 mg g$^{-1}$ whole plant powder.  
The method was validated for linearity, precision, accuracy, and 
robustness.[24]

**NMR imaging**

The water distribution in the pulvinus of Mimosa can be visualized 
by an NMR imaging technique. After stimulation of a Mimosa 
plant, water in the lower half of the main pulvinus disappeared, 
the water previously contained in this area seems to be transferred 
to the upper half of the main pulvinus. Movement of the water 
in conjunction with Mimosa movement was visualized sequentially 
bym a noninvasive NMR imaging procedure.[21]

**Bioassay**

Wherever a movement factor is suspected, its aqueous extract is 
prepared and tests are performed on it as such or after separation 
into components, making use of the rapid reactivity of M. pudica.  
In the bioassay in the climate chamber, a pinna of M. pudica is 
placed in a solution of the supposed active principles and is 
observed. The movement factors are drawn up and cause each 
pair of the pinnules to fold up neatly one behind the other. The 
reaction behavior induced by the chemonastic stimulus of a 
Mimosa crude extract can be demonstrated as a function of its 
concentration in a number of tests. Despite individual variation 
which can always be observed in the bioassay, a clear decrease in 
the reaction time with declining concentrations can be seen.[22]

**Fluorescence analysis**

The powdered leaf samples as well as leaf extracts were subjected 
to fluorescence analysis on long and short wavelengths in day 
light [Tables 4 and 5].[23]

### MAJOR PHARMACOLOGICAL ACTIVITIES

#### Wound healing activity

The roots of M. pudica were studied for wound healing activity by incorporating the methanolic and the total aqueous extracts in simple ointment base B.P. in concentration of 0.5% (w/w), 1% (w/w), and 2% (w/w). Wound healing activity was studied in three types of model in rats viz. excision, incision, and estimation of biochemical parameters. Treatment of wound with ointment containing 2% (w/w) the methanolic and 2% (w/w) the total aqueous extract exhibited significant ($P < 0.001$) wound healing activity. The methanolic extract exhibited good wound healing activity probably due to phenols 
constituents.[24]

| Extracts | Day light | UV light |
|----------|-----------|----------|
| n-Hexane | Green     | Green    | Yellow fluorescence |
| Chloroform | Dark green | Red | Brown |
| Ethyl acetate | Pale green | Blue fluorescence | Dark orange |
| Methanol | Reddish brown | Blue fluorescence | Black |
| n-Hexane | Reddish brown | Blue fluorescence | Green |
| Chloroform | Yellow | Dark green | Pale green |
| Ethyl acetate | Red | Green | Red |
| Methanol | Yellow | Green | Green |

**Table 4: Fluorescence analysis of extracts of Mimosa pudica L. leaves**

| Treatment | Day light | UV light |
|-----------|-----------|----------|
| Powder | Pale green | Dark green | Pale green |
| Powder + water | Brown | Green | Green |
| Powder + 1 N HCl | Greenish brown | Pale brown | Brown |
| Powder + 1 N HNO$_3$ | Pale green | Green | Pale brown |
| Powder + 1 N H$_2$SO$_4$ | Reddish brown | Blue fluorescence | Green fluorescence |
| Powder + 1 N NaOH | Greenish brown | Dark green | Pale green |
| Powder + Alc. NaOH | Pale green | Brown | Green |
| Powder + 1 N KOH | Yellow | Green | Dark brown |
| Powder + Alc. KOH | Red | Red | Green fluorescence |
| Powder + ammonia | Pale green | Green | Brown |

**Table 5: Fluorescence analysis of drug powder of Mimosa pudica Linn. leaves**

| Treatment | Day light | UV Light |
|-----------|-----------|----------|
| Powder | Pale green | Dark green | Pale green |
| Powder + water | Brown | Green | Green |
| Powder + 1 N HCl | Greenish brown | Pale brown | Brown |
| Powder + 1 N HNO$_3$ | Pale green | Green | Pale brown |
| Powder + 1 N H$_2$SO$_4$ | Reddish brown | Blue fluorescence | Green fluorescence |
| Powder + 1 N NaOH | Greenish brown | Dark green | Pale green |
| Powder + Alc. NaOH | Pale green | Brown | Green |
| Powder + 1 N KOH | Yellow | Green | Dark brown |
| Powder + Alc. KOH | Red | Red | Green fluorescence |
| Powder + ammonia | Pale green | Green | Brown |
Regeneration of sciatic nerve
An extract administered in a dose of 1.6 mg/100 g parenterally every 4th day up to 120 days in rats having experimental injury of sciatic nerve, exhibited 30–40% higher results in the process of regeneration of sciatic nerve as compared to the hydrocortisone group.[4]

Antidepressant action
In Mexico, aqueous extracts from dried leaves of *M. pudica* are employed to alleviate depression. In this study, behavioral actions of aqueous extracts of *M. pudica* at various concentrations were tested. Rats having received saline (0.9%; 0.30 mL; I.P.), clomipramine, desipramine, or several dosage of aqueous extracts from *M. pudica* (*m*₁ = 2.0 mg/kg; *m*₂ = 4.0 mg/kg; *m*₃ = 6.0 mg/kg; *m*₄ = 8.0 mg/kg) during a 30-day period were submitted to the forced swimming test and to the test for differential reinforcement of low rates of response at 72 s (DRL-72 s). Any possible anxiolytic action resulting from several doses (*m*₁ = 2.0 mg/kg; *m*₂ = 4.0 mg/kg; *m*₃ = 6.0 mg/kg; *m*₄ = 8.0 mg/kg) of extracts of *M. pudica* were compared with those caused by diazepam (1.3 mg/kg, I.P) in the elevated plus-maze test.

Results showed that clomipramine (1.25 mg/kg, I.P), desipramine (2.14 mg/kg, I.P), and *M. pudica* (6.0 mg/kg and 8.0 mg/kg, I.P) reduced immobility in the forced swimming test and increased the rate of reinforcements received in the DRL-72 s test; these data suggest that *M. pudica* produces antidepressant effects in the rat. Diazepam increased the open-arms exploration time in the elevated plus-maze test, but *M. pudica* did not show any comparable action at any tested dose. *M. pudica* therefore produced an anti-depressant like profile similar to two tricyclic anti-depressants.[29]

Anticonvulsant action
The decoction of *M. pudica* leaves given intraperitoneally at a dose of 1000–4000 mg/kg protected mice against pentylentetrazole induced seizures. *M. pudica* had no effect against picrotoxin-induced seizures. It also antagonized N-methyl-D-aspartate-induced turning behavior. These properties could explain its use in African traditional medicine.[26]

Hyperglycemic effect
Ethanolic extracts of *M. pudica* leaves given by oral route to mice at a dose of 250 mg/kg showed a significant hyperglycemic effect.[27]

Diuretic effect
Decoction of leaves of *M. pudica* in doses of 200, 500, 1000, and 2000 mg/kg in rats and dogs exhibited diuretic activity (considering urinary output Na⁺–K⁺–Cl excretion). The activity in rats at 250 mg/kg dose was found to be 82% of standard diuretic (hydrochlorothiazide 2.5 mg/kg) treated group of rats. There was significant reduction (above 50%) of Na⁺ and Cl⁻ excretion without affecting K⁺ excretion. The drug can be combined as a moderate diuretic with any modern synthetic diuretic causing K⁺ loss.

Effect on uterine bleeding
Aqueous extracts of root powder in pilot studies on patients with dysfunctional uterine bleeding gave promising results.[4]

Antifertility activity
*Mimosa pudica* is one of the folk medicinal plants commonly used as antifertility agent in some places in India. Air-dried roots of *M. pudica* were extracted using methanol. The dried methanol extract of the root was administered orally to Swiss albino mice for 21 consecutive days. Estrous cycle, reproductive hormones (LH, FSH, prolactin, estradiol, and progesterone) and number of litters produced were studied in both control and extract administered groups by using standard methods. Phytochemical studies of the methanolic root extract were carried out using qualitative and TLC methods. The root extract of *M. pudica* has antifertility effect as it prolongs the estrous cycle and disturbs the secretion of gonadotropin hormone in albino mice. The decrease in FSH levels in the proestrus and estrous stages in the extract administered group compared with those of control animals indicates the disturbance of estrous cycle and ovulation through suppression of FSH.[28]

*M. pudica* root powder (150 mg/kg body weight) when administered intragastrically, altered the estrous cycle pattern in female *Rattus norvegicus*. Nucleated and cornified cells were absent in all rats. The smear was characterized by leucocytes only, as in diestrus, which persisted for 2 weeks. There was a significant reduction in the number of ova in rats with the root powder compared with the control rats, and a significant increase in the number of degenerated ova.[29]

Spasmodic potential
Ethanol extracts (50%) of the whole plant exhibited spasmodogenic activity in isolated guinea pig ileum.[41]

Antiehepatotoxic and antioxidant potential
Reactive oxygen species (ROS) are believed to be responsible for pathogenesis of various diseases affecting tissues and the main organ, the liver. Hence, in this study, the extent of lipid peroxidation (LPO) and ROS elimination and its defense mechanisms by the enzymic and nonenzymic antioxidants in liver and serum was investigated. Hepatotoxicity was manifested by significantly decreased (*P* < 0.05) levels in the activities of the enzymic antioxidants such as superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase, and the non-enzymic antioxidants such as glutathione and vitamin-C in rats with induced hepatic damage by ethanol. Simultaneous administration of the leaf extract *M. pudica* along with the toxin ethanol in rats showed a considerable protection against the toxin-induced oxidative stress and liver damage as evidence by a significant increase (*P* < 0.05) in antioxidant activities. The study reveals that the co-administration of the *M. pudica* aqueous extract significantly lowered the level of lipid peroxidation in alcohol-fed mice.[90]

Antivenom activity
The aqueous root extract of *M. pudica* dose dependently inhibited
the hyaluronidase and protease activities of Indian snakes (Naja naja, Vipera russellii, and Echis carinatus) venom.

Aqueous and alcoholic extracts of dried roots of M. pudica were tested for their inhibitory activity on lethality, myotoxicity, and toxic enzymes of Naja kaouthia venom. The aqueous extract, particularly the normal water extract, displayed a significant inhibitory effect on the lethality, myotoxicity, and tested enzyme activities of venom compared with alcoholic extracts. The present findings suggest that an aqueous extract of M. pudica root possesses compound(s), which inhibit the activity of cobra venom.[31]

Antimicrobial properties
Antimicrobial activity of the successive extracts of M. pudica whole plant in petroleum ether, chloroform, ethyl acetate, methanol, and water was studied against various Gram positive and Gram negative bacterial strains using the zone of inhibition. Both the agar well diffusion method and agar disc diffusion method were used to evaluate the antibacterial efficacy of the said plant extracts. The microorganisms used in the test were: Escherichia coli, Staphylococcus aureus, Staphylococcus albus, Proteus vulgaris, Salmonella typhi, Salmonella paratyphi A, Salmonella paratyphi B, Shigella flexneri, Klebsiella pneumonia, and Pseudomonas aeruginosa. The minimum inhibitory concentration (MIC) of the methanolic extract of said plant was determined by the agar well diffusion method. The reference antibiotics chloramphenicol and ampicillin were also tested against the said microorganisms used in the assay and the results were compared with that of the plant extracts. The results of the study revealed that the M. pudica whole plant extract possesses good antimicrobial activity between the range of 7–18 mm against the pathogens used for screening.[32]

Antifungal activity
The methanolic extract and aqueous extract of 100, 200, and 500 mg were tested against different fungal pathogens, Aspergillus fumigates for their antifungal activity. It was demonstrated by a well diffusion assay.[14]

Antiviral properties
Four of the seven tested medicinal plants exhibited antimicrobial activity against Vibrio cholerae. These seven plants are: Ficus racemosa, Mitragyna stipulosa, Entada Africana, Piliostigma reticulatum, Terminalia arvenoides, M. pudica, and Lannea acid. M. pudica showed antimicrobial activity. Potential of these herbs in the control of cholera needs to be determined.[33]

Aphrodisiac property
This study was aimed to investigate the effect of the ethanolic extract of roots of M. pudica Linn. (Mimosae) on libido of sexually normal Swiss albino male mice. The suspension of the extract was administered orally at the dose of 100, 250, and 500 mg/kg, to different groups of male mice (n = 6) once a day for 7 days. The female albino mice involved in mating were made receptive by hormonal treatment. The general libido and potency were determined and compared with the standard reference drug sildenafil citrate. A change in hormonal parameter like testosterone was evaluated. Oral administration of the extract significantly increased the libido and hormonal levels of testosterone. The most appreciable effect of the extract was observed at the dose of 500 mg/kg. The results indicated that the ethanolic extract of roots of M. pudica Linn. (Mimosae) produced a significant and sustained increase in the aphrodisiac activity of normal male mice, without any adverse effects.[34]

USES

Classical/traditional uses
Charak and Sushruta prescribed a decoction, with Samanga as an important ingredient in hemothermia, piles, diarrhea, and persistent dysentery. Included in an ointment, the herb was applied over piles, ulcers, and wounds.

During 16th century, Lajjalu was a popular herb for treating piles and diseases of female genital tract. Samangaadi churna is available over the counter, prescribed internally in bleeding piles.[35]

Therapeutic uses
Rakpatita, atisara, yoniroga, sopha, dha, svasa, vrana, and kustha.[36] The plant is sheetala (Sheetaveerya), tikta, kasha; subdues deranged kapha and pitta beneficial in hemorrhagic diseases, diarrhea, and gynecological disorders.[37]

Leaves
The leaves together with leaves from other medicinal plants are used in treating hemorrhoids and urinary infections.[38] The juice is used in sinus, sores, piles, and fistula, paste is applied to glandular swellings, and hydrocele.

Roots
Decoction is efficacious in gravel and other urinary complaints.[39] Treats dysentery, fever, syphilis, leprosy, stomach worms, venereal diseases, insect bite, insomnia, nervousness, and piles.[40]

Some endemic uses of Mimosa
- As Chhui-mui, leaves used for increasing the sexual potency in men in Kurukshetra District (Haryana), India.
- As Laajvanti; its leaves and roots are used for gravel and other kidney diseases, also for piles and fistula in the Sagar District, Madhya Pradesh, India. The roots are also used in an oral snakebite remedy.
- As Lazaoni, root decoction is gargled for gum trouble and toothache by Rahba in West Bengal.
- As Punyo-sisa; leaves are used in pillows to induce sleep in children and the elderly in Ecuador.[41]
- In Orissa (Kandhamal district) as Lajakulilata: The warmed root paste is plastered with the help of a cloth on boils to get relief. The paste of root fried in castor oil is applied on deep cut wounds to stop bleeding and for healing. The warmed leaf paste is applied around furuncle, abscess, and boils to burst and release of pus. The leaf paste is applied on the burst boils and itches for quick healing. The paste of
root fried in ghee is applied on caries teeth for relief from toothache. The leaf paste is applied on forehead to get relief from headache and migraine. The leaf paste with honey is prescribed twice a day in empty stomach for 3–4 days for stomach ache and intestinal worms.[36]

**Mimosa mucilage as a sustained release excipient**

This study was conducted to investigate the sustained release properties of *M. pudica* seed mucilage. Matrix tablets of diclofenac sodium containing different proportions of mucilage and dibasic calcium phosphate as diluent were formulated by the wet granulation method. The tablets had uniform physical appearance, average weight, drug content, and adequate hardness. The results of in vitro release conducted using an USP type II dissolution rate apparatus, in a dissolution media comprising of 900 mL of 0.1 N HCl for 2 h followed by phosphate buffer (pH 6.8) for 24 h at 37 °C and 50 rpm, revealed that as proportion of mucilage in the matrix was increased there was corresponding decrease in the release of drug.

Further, the matrix tablets were found to release the drug following Higuchi root kinetics, with the mechanism of release being diffusion for tablets containing higher proportion of mucilage and a combination of matrix erosion and diffusion for tablets containing smaller proportion of mucilage. The swelling and erosion studies revealed that, as the proportion of mucilage in tablets was increased, there was a corresponding increase in percent swelling and a decrease in percent erosion of tablets. The SEM photomicrographs showed gelling structures in tablets containing higher percentage of mucilage, while both pores and gelling structures were present on the surface of tablets containing smaller proportion of mucilage and commercial formulation. On comparative evaluation, the dissolution profile from formulation containing mucilage to drug in the proportion of 1:40 was found to be similar to the commercial sustained release formulation of diclofenac.[37]

**Toxicity**

The brine shrimp lethality assay (BSL) has been used routinely in the primary screening of the crude extracts as well as the isolated compounds to assess the toxicity toward brine shrimp, which could also provide an indication of possible cytotoxic properties of the test materials. It has been established that the cytotoxic compounds usually show good activity in the BSL assay, and this assay can be recommended as a guide for the detection of antitumor and pesticidal compounds because of its simplicity and cost effectiveness. The extracts of *M. pudica* did not show any significant toxicity toward brine shrimps in the BSL assay. Owing to a high degree of lipophilicity, the n-hexane extract could not be tested. Whereas the LD$_{50}$ value of the DCN and MeOH extracts of *M. pudica* was 1.0 mg/mL. The LD$_{50}$ value of the positive control, podophyllotoxin, was $2.8 \times 10^{-3}$ mg/mL.[31]

**Formulations**

Samangaadi Churna, Kutajavaleha, Pusyanug Churna, Bhret Gangadhara Churna.

**Dose**

10–20 g of drug for decoction.[6]

**CONCLUSIONS**

The plant prominently features in the texts of ‘Ayurveda’, i.e. the traditional Indian system of medicine, which prompted the authors to compile the published data and to critically analyze it, and is an honest, though rather the preliminary attempt for the preparation of the plant monograph. The review presented a brief profile of *M. pudica*, a plant associated with fond memories of almost every Indian childhood (chhui-mui). The literature claims that there is vast potential in this herb in view of therapeutics and furthermore, commercialization of this herb would be in line with the WHO guidelines (developing country needs to give more emphasis on exploration of their natural resources like medicinal plants) is highly desirable for the benefits of humanity. It is suggestive of greater benefits as it is economically viable, easily available and a reservoir of significant medicinal properties.[39]

**REFERENCES**

1. Genest S, Kerr C, Shah A, Rahman MM, Saif-E-Naser GM, Nimam P, et al. Comparative bioactivity of two Mimosa species. Lat Am Caribb Bull Med Aromat Plants 2008;7:38-43.
2. Ueda M, Yamamura S. The chemistry of leaf movement in *Mimosa pudica* L. Tetrahedron 1999; 55:10937-48.
3. Applewhite PB. Behavioral plasticity in the sensitive plant, *Mimosa*. Behav Biol 1972;7:47-53.
4. Khare CP. Encyclopedia of Indian Medicinal Plants. Germany: Springer; 2004. p. 313-4.
5. Prajapati ND, Purohit SS, Sharma AK, Kumar T. A Handbook Of Medicinal Plants. A complete Source Book. Jodhpur: Agrobios India; 2003. p. 271.
6. The Ayurvedic Pharmacopoeia of India. New Delhi: Govt. Of India. Ministry of Health and Family Welfare. Dept. Of Indian Systems of Medicines and Homeopathy. Part 1, 1st ed, vol 2. 98-101.
7. Uehlein N, Kaidenhoff R. Aquaporins and plant leaf movements. Ann Bot (Lond.) 2008;101:1-4.
8. Yao H, Xu Q, Yuan M. Actin dynamics mediates the changes of calcium level during the pulvinus movement of *Mimosa pudica*. Plant Signal Behav 2008;3:954-60.
9. Kanzawa N, Hoshino Y, Chiba M, Hoshino D, Kobayashi H, Kamasawa N, et al. Change in the actin cytoskeleton during seismonic movement of *Mimosa pudica*. Plant Cell Physiol 2006;47:531-9.
10. Visnovitz V, Vilagi I, Varro P, Kristof Z. Mechanoreceptor cells on the tertiary pulvini of *Mimosa pudica* L. Plant Signal Behav 2007:2:462-6.
11. Elliot GN, Chou JH, Chen WM, Bloemberg GV, Bontemps C, Maartinez-RE, et al. Burkholderia spp. are the most competitive symbionts of *Mimosa*, particularly under N-limited conditions. Environ Microbiol 2009;11:762-78.
12. Elliot GN, Chen WM, Chou JH, Wang HC, Sheu SY, Perin L, et al. Burkholderia pyrhamatum is a highly effective nitrogen fixing symbiont of *Mimosa* spp. and fixes nitrogen explanta. New Phytol 2007;173:168-80.
13. Jha NK. Mimosa pudica: Lajjalu. Phytopharm 2007;8:3-8.

14. Gandhiraja N, Sriram S, Meena V, Srilakshmi K, Sasikumar C, Rajeshwari R. Phytochemical Screening And Antimicrobial Activity of the Plant Extracts of Mimosa pudica L. Against Selected Microbes. Ethnobotanical Leaflets 2009;13:618-24.

15. Chatterjee A, Pakrashi SC. The Treatise on Indian Medicinal Plants. New Delhi: National Institute of Science Commission and Information Resources; 2006. p. 65-6.

16. Yuan K, Lu JL, Yin MW. Chemical constituents of C-glycosylflavones from Mimosa pudica. Yao Xue Xue bao 2006;41:435-8.

17. Choudhary MD, Chakrabarti P. Cellular and chloroplast lipid composition of the leaves of Mimosa pudica. Phytochemistry 1980;19:519-23.

18. Tsurumi S, Asahi Y. Identification of jasmonic acid in Mimosa pudica and its inhibitory effect on auxin- and light-induced opening of the pulvinules. Physiologia Plantarum 2006;64:207-11.

19. Katherine E. On the phloem of Mimosa pudica L. Ann Bot 1970;34:505-14.

20. Nair LS, Menon SN, Shailajan S, Baing MM, Sane RT. Mimosa pudica Linn. Phytochemistry 1980;19:519-23.

21. Rajendran R, Sundararajan R. Preliminary Phytochemical Analysis and Anti-Bacterial Activity of roots of Mimosa pudica Linn. J Planar Chromatogr 2007;20:49-51.

22. Tamya T, Miyazaki T, Ishikawa H, Iriuchi N, Maki T, Matsumoto JJ, et al. Movement of Water in Conjunction with Plant Movement Visualized by NMR Imaging. J Biochem 1988;104:5-8.

23. Schildknecht H, Schumacher K. Nyctinastinenes-An Approach to New Phytohormones. Pure Appl Chem 1982;54:2501-14.

24. Kokane DD, More RY, Kale MB, Nehete MN, Mehendale PC, Badmanaban R. Phytochemical investigation and enzyme inhibitory activity of Mimosa pudica root extract on vaginal estrous and serum hormones for screening of antifertility activity in albino mice. Contraception 2007;76:482-5.

25. Valsala S, Karpagaganapathy PR. Effect of Mimosa pudica root powder on oestrous cycle and ovulation in cycling female albino rat, Rattus norvegicus. Phytother Res 2002;16:190-2.

26. Nazeema TH, Brindha V. Antihypotensive and antioxidant defense potential of Mimosa pudica. Int J Drug Disc 2009;1:1-4.

27. Mahanta M, Mukherjee AK. Neutralization of lethality, myotoxicity and toxic enzymes of Naja kaouthia venom by Mimosa pudica root extracts. J Ethnopharmacol 2001;75:55-60.

28. Pawaskar SM, Kale KU. Antibacterial activity of successive extracts of Mimosa pudica. Indian Drugs 2006;43:476-80.

29. Akkinsinde KA, Olukoya DK. Vibriocidal activities of some local herbs. J Diarrhoeal Dis Res 1995;13:127-9.

30. Pande M, Pathak A. Aphrodisiac Activity of Roots of Mimosa pudica Linn. Ethanolic Extract in Mice. Int J Pharm Sci Nanotechnol 2009;2:477-86.

31. Singh K, Kumar A, Langyan N, Ahuja M. Evaluation of Mimosa pudica Seed Mucilage as Sustained Release Excipient. AAPS Pharm Sci Tech 2009;10:1121-7.

32. Behera SK, Panda A, Behera SK, Misra MK. Medicinal Plants Used By the Kandhas of Kandhamal District of Orissa. Indian J Tradit Knowl 2006;5:519-28.

33. Singh K, Kumar A, Ahuja M. Evaluation of Mimosa pudica Seed Mucilage as Sustained Release Excipient. J Pharm Sci 2010;99:3218-22.

34. Behera SK, Panda A, Behera SK, Misra MK. Medicinal Plants Used By the Kandhas of Kandhamal District of Orissa. Indian J Tradit Knowl 2006;5:519-28.

35. Muthumani P, Meera R, Devi P, Koduri LV, Manavarthi S, Badmanaban R. Phytochemical investigation and enzyme inhibitory activity of Mimosa pudica root extract on vaginal estrous and serum hormones for screening of antifertility activity in albino mice. Contraception 2007;76:482-5.

36. Valsala S, Karpagaganapathy PR. Effect of Mimosa pudica root powder on oestrous cycle and ovulation in cycling female albino rat, Rattus norvegicus. Phytother Res 2002;16:190-2.

37. Nazeema TH, Brindha V. Antihypotensive and antioxidant defense potential of Mimosa pudica. Int J Drug Disc 2009;1:1-4.

38. Mahanta M, Mukherjee AK. Neutralization of lethality, myotoxicity and toxic enzymes of Naja kaouthia venom by Mimosa pudica root extracts. J Ethnopharmacol 2001;75:55-60.

39. Pawaskar SM, Kale KU. Antibacterial activity of successive extracts of Mimosa pudica. Indian Drugs 2006;43:476-80.

40. Akkinsinde KA, Olukoya DK. Vibriocidal activities of some local herbs. J Diarrhoeal Dis Res 1995;13:127-9.

41. Pande M, Pathak A. Aphrodisiac Activity of Roots of Mimosa pudica Linn. Ethanolic Extract in Mice. Int J Pharm Sci Nanotechnol 2009;2:477-86.

42. The Vaults of Erowid. Erowid Online Books: Ayahuasca: Alkaloids, plants and analogs; c1995-2010. Available from: http://www.erowid.org/. [Last updated on 2009 Apr 21; cited 2010 May 26].

43. Singh K, Kumar A, Langyan N, Ahuja M. Evaluation of Mimosa pudica Seed Mucilage as Sustained Release Excipient. AAPS Pharm Sci Tech 2009;10:1121-7.

44. Pande M, Pathak A. Preliminary pharmacognostic evaluations and phytochemical Studies on roots of Mimosa pudica (Laajvanti). Int J Pharm Sci Res 2010;1:50-2.

45. Muthumani P, Meera R, Devi P, Koduri LV, Manavarthi S, Badmanaban R. Phytochemical investigation and enzyme inhibitory activity of Mimosa pudica root extract on vaginal estrous and serum hormones for screening of antifertility activity in albino mice. Contraception 2007;76:482-5.

46. Valsala S, Karpagaganapathy PR. Effect of Mimosa pudica root powder on oestrous cycle and ovulation in cycling female albino rat, Rattus norvegicus. Phytother Res 2002;16:190-2.

47. Nazeema TH, Brindha V. Antihypotensive and antioxidant defense potential of Mimosa pudica. Int J Drug Disc 2009;1:1-4.

48. Mahanta M, Mukherjee AK. Neutralization of lethality, myotoxicity and toxic enzymes of Naja kaouthia venom by Mimosa pudica root extracts. J Ethnopharmacol 2001;75:55-60.

49. Pawaskar SM, Kale KU. Antibacterial activity of successive extracts of Mimosa pudica. Indian Drugs 2006;43:476-80.