An Overview on Anti-Ophidian and Anti-Inflammatory Activity of Mimosa pudica.

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***Abstract*- This article provides an overview of the general characteristics, mechanism of movement, and pharmacological activities i.e., anti-inflammatory activity and anti-ophidian activity of the traditional plant Mimosa pudica Linn. The source of raw materials is roots, leaves, seeds, bark, rhizome, stem, and flowers. The important constituents of this plant are flavonoids, alkaloids, tannins, phytosterols, d-xylose, d-glucuronic acid, and mimosine.**

***Keywords*- Mimosa pudica, touch me not, anti-inflammatory, anti-ophidian, phytochemistry.**

I. INTRODUCTION

The herbs having medicinal activities have been widely used in traditional medicinal practice for a thousand years now. Nearly 80% of the world's population still depends on traditional medicine [1]. One such plant i.e., Mimosa pudica Linn. is a creeping annual or perennial, semi-prostrate, prickly coarse herb, found in tropical and sub-tropical dry forests, tropical rain forests, savanna, grassland, and deserts. It was first described in Brazil and is found in America, South East Asia, Tanzania, and many parts of the Pacific Islands. This plant of the family Fabaceae is known by various names throughout the globe. Some common names are; Touch me not, live and die, humble plant, shameplant, Lajwanti, varakranta, Adamalati, Lajauni, Machigida, Lajan. TottalchurungiChhimui. Mudugudamara.Mimosa is popular for its natural movement of leaves by the sense of touch or heat. It is rich with a wide range of therapeutic activities like antiseptic, antimicrobial, antimalarial, immunostimulating, diuretic, sedative, and emetic activity. It is also used to treat flu, rabies, cut wounds, asthma, tumor, snake bite, dental caries, alopecia, dysentery, and insomnia [2-4].

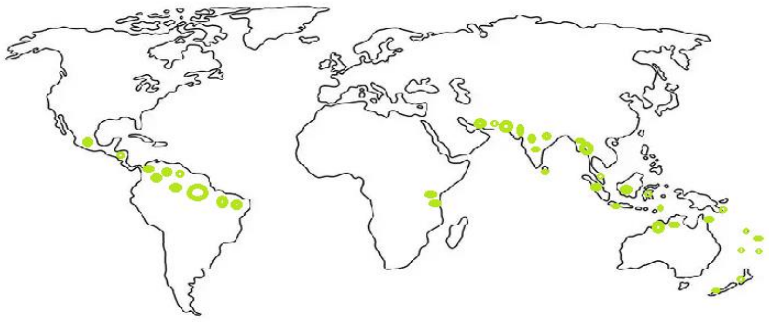


Fig. 1. Geographical distribution of Mimosa pudica

II. TAXANOMY [5]

Kingdom	**Plantae**
Division	Magnoliophyta
Class	Magnoliopsida
Order	Fabales
Family	Fabaceae/ mimosasea
Subfamily	Mimosoideae
Genus	Mimosa
Species	M.Pudica

III. DESCRIPTION

In 1753, Carl Linnaeus described the plant Mimosa pudica, the herb that belongs to the pea family Fabaceae. The name Mimosa pudica is derived from the word mimic meaning alludes i.e., the sensitivity of leaves, and pudica meaning bashful or shy or reserved due to its curious nature. Hence, it is also called the shyness plant or shame plant [6]. Mimosa Pudica is a short shrubby plant which is about 1-1.5-meter height, grown in all types of soils, and can withstand shading. Such kind of sensitive plants are grown in well-drained soils, eroded soils, and low-nutrient concentration soils [7]. Every part of the plant possesses medicinal use, used as a vegetable, spice, in cosmetic oil, and used for the treatment of leprosy, dysentery, vaginal and uterine-related problems, blood diseases, fatigue, burning sensation, inflammations etc. [8].

Fig 2. Mimosa pudica

IV. MECHANISM OF MOVEMENT

1. Seismonastic Movement/Thigmonastic Movement

By touch and osmosis:

Due to the environmental stimulus on the plant, it shows a protective action in response to it which is called a seismonastic reaction. Leaflets and pinnae bend downwards near the petiole attachment this action occurs quickly, and instantly when touched. Leaves tend to bend during nights and in a condition like when exposed to uncontrolled heat and rain [7]. The touch reflex is not restricted to only one leaflet, but also to the adjacent leaflets. Mimosa pudica contains a motor organ with mechanoreceptors and photoreceptors that are present near the petioles and are responsible for the transmission of mechanical signals by hair structure to the mechano-sensing cells. H+-ATPase proteins are abundantly present in Mimosa motor cells to accommodate for high pump activity [8]. The motor organ can be epinastic or pulvini, which increases the rate of membrane water transport that is facilitated by aquaporin. Plasma membrane as well as tonoplast helps in constrain/localize aquaporin for the seismonastic leaf movement [9].

By calcium release:

The three theories which are responsible for the sudden turgor loss in the lower region of the pulvinar cells are an increase in permeability; a decrease in intracellular osmotic pressure and protoplasmic contraction. Tannin vacuoles of plant cells store calcium, and release it as a cell signaling compound. Tannins vacuoles ascribe thigmonastic movements. The release of these calcium ions results in the movement of the leaf.

By sugar concentration:

When the level of sugar concentration increases in the apoplast that reduces the water potential and surrounding cells tend to leak potassium ions, followed by water causing an imbalance in turgor pressure in pulvini cells [8].

2. Nyctinastic Movemment

Nyctinastic plants contain Leaf closing and leaf-opening substances. A chemical substance is responsible for the regulation of the Nyctinastic movements and it varies depending on the plant. Specific leaf movement factors are present in every plant family that will be effective only on those plants belonging to that family. The leaf movement factors of Mimosa pudica are S-riboglucoside of 2, S-dihydroxy-benzoic acid, indole-3-acetic acid, adenosine 3’-monophosphate (3’-AMP), and guanosine 3’-monophosphate (3’-GMP). Depending on the concentration of the leaf opening factors and their interactions, Nyctinastic leaf movements are

assumed. If the leaf-closing substance concentration is higher than the leaf-opening substance, then the leaves close during the day but the condition is reversed if the leaf-closing substance has less concentration.

3. Nastic Movement

Due to external stimuli like temperature, and light irradiance plant responses and results in movement that can be due to changes in the turgor [8].

V. CHEMICAL CONSTITUENTS OF MIMOSA PUDICA

1. Leaves

Leaves are bitter, tonic, and used in hemorrhoids, conjunctivitis, cuts, wounds, scrofula, and hemorrhages [7]. The initial phytochemical screening has shown the presence of tannins, saponins, quinines, alkaloids, phenols, flavonoids, coumarins, and terpenoids in the leaf extract of mimosa pudica. The main constituent in the leaf is Mimosine an alkaloid which is considered a toxic alkaloid and tends to have potent apoptotic and antiproliferative effects. It also contains polyunsaturated fatty acids, nor-epinephrine, d-pinitol, b-sitosterol, 5-MeO-DMT,6,7,3',4'-tetrahydroxy-6-C-D-apiose D-glucopyranosyl flavone, isorientin, orientin, Isovitexin, vitexin, tyrosine. Leaf extracts contain adrenaline-like substances. Periodic Leaf movement factors are reportedly the derivatives of 4-α-(b-D-Glucopyranosyl-6-sulphate) Gallic acid [10,11].

2. Root

Roots are bitter, resolvent, astringent, acrid, used as antispasmodic, emetic, diuretic, ulcers, inflammations, dysentery, burning sensation, asthma, jaundice, smallpox, hemorrhoids, vaginopathy, leucoderma, fevers, spasmodic infections [7]. Mimosa pudica roots mainly consist of flavonoids, glycosides, fatty acids, alkaloids, phytosterol, amino acids, ascorbic acid, linolenic acid, linoleic acid, palmitic acid, stearic acids, D-glucuronic acid, D-sitosterol, mimosine. Aqueous extracts of M.pudica roots have neutralizing effects on the infectious venom of the Indian spitting cobra or monocled cobra (Najakaouthia) by inhibiting the enzyme activity and the myotoxicity of the venom. Roots also contain 10% of tannins. [10.11]

3. Seed

Chemical constituents present in the seed are phenolic ketone, C-glycosyl flavones, tubulin, and bufadienolides. The mucilage present in the seed is composed of d-xylose and d-glucuronic acid.

4. Plant

Plant extract of mimosa pudica contains 17% green-yellow fatty oil. It also comprises tubulin, jasmonic acid, abscisic acid, mimosinicacid, mimosinamine, gallic acid, d-xylose, d-glucuronic acid, norepinephrine, thiamine, L-Noradrenaline, mimopudine, etc.

5. Aerial part

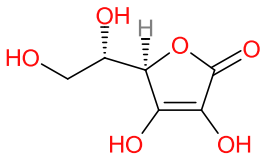
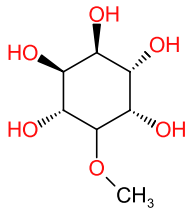
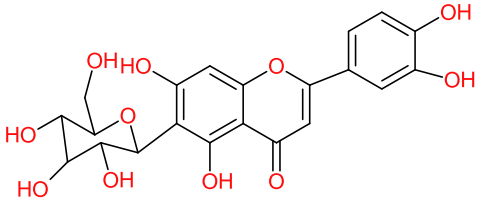
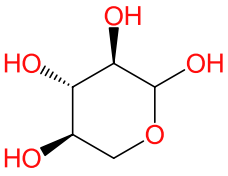
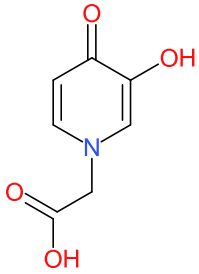
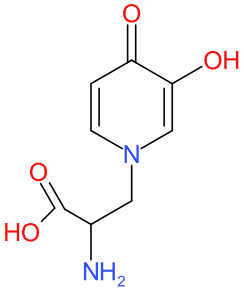
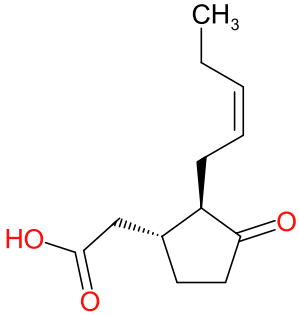
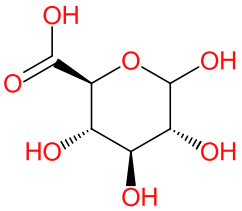
Aerial part of the mimosa pudica consist of avicularia and apigenin-7-O-D-glucoside, orientin, isoorientin, isoquercitrin [10,11].

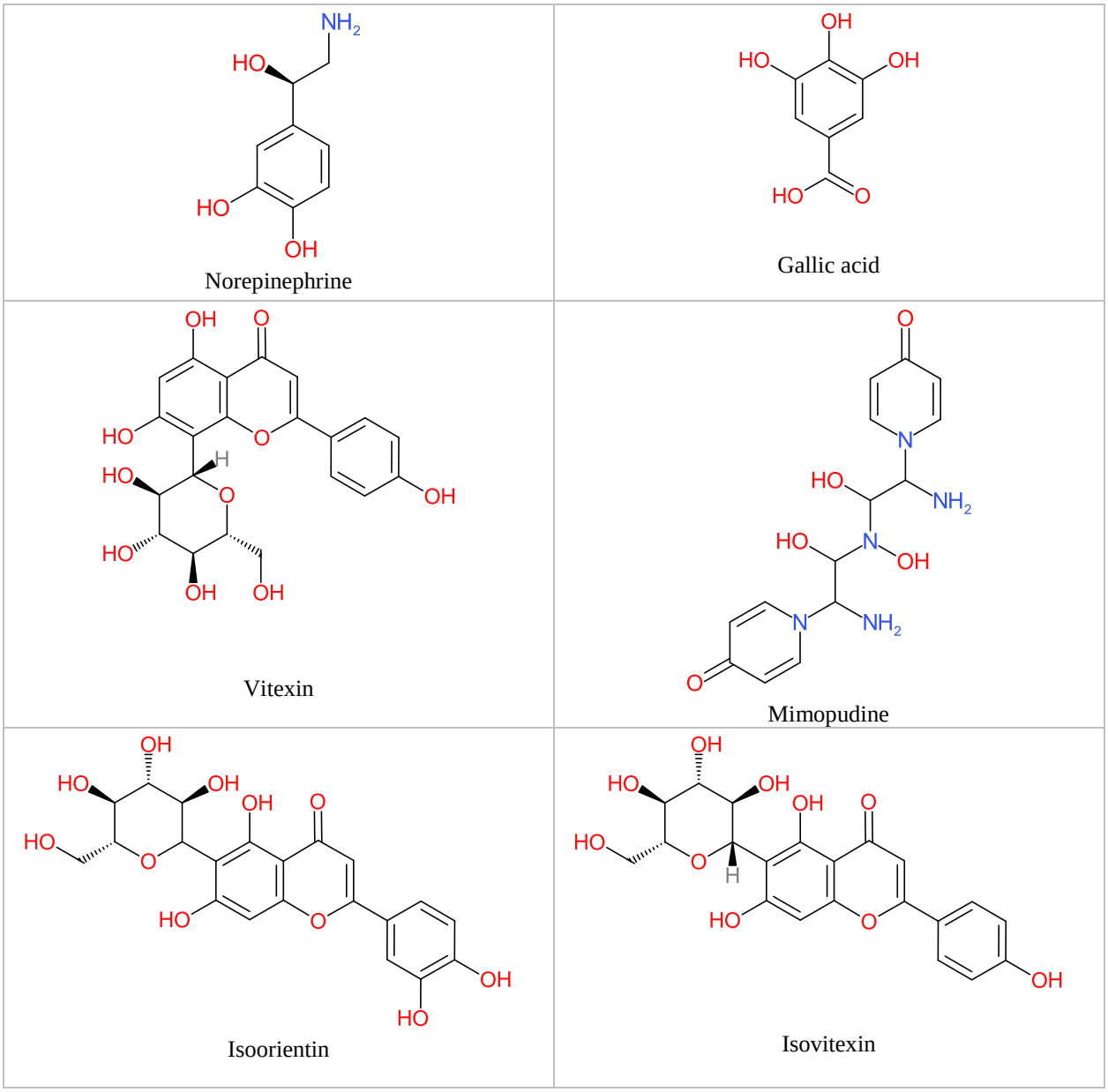
Table 1: Plant Parts and their Properties [12]

Parts	Macroscopic properties	Microscopic properties
Root	Cylindrical, Grayish-brown or brown-colored, surfaces are roughly wrinkled, distinct odor, and astringent taste	5-12 Layered cork; secondary cortex of 6-10 layered; secondary phloem consists of phloem fibers, phloem parenchyma, sieve elements, crystal fibers; Secondary xylem consists of xylem rays, xylem parenchyma, crystal fibers
Stem	Cylindrical shaped with a diameter of 2.5cm, fibrous bark, externally brown and internally grey colored	Tangentially elongated cork cells; secondary cortex contains thick-walled, tangentially elongated cells, parenchyma, secondary phloem consists of sieve elements, crystal fibers, parenchyma, phloem rays; secondary xylem contains xylem rays, tracheid's, fibers, pith
Leaf	Sessile, leaflets of 10-20 pairs with 0.6-1.2cmm long, 0.3-0.4cm broad; yellowish green colored	Petiole with the epidermis of single-layered which is covered with a thin cuticle; cortex of 4-7 layered; parenchyma; 4 vascular bundles MIDRIB with a single layer epidermis covered with cuticle, single layer spongy parenchyma, and palisade, vascular bundle LAMINA with single layered palisade; a single layer of spongy parenchyma which contains rosette crystals and veins in it, circular cells of 3-5 layers
Fruit	Dry, contain two to five seeds, straw-colored; 1-1.6cm long,	Epidermis of single-layered with branched, non-glandular, shaggy hair;

	0.4-0.5cm broad	Mesocarp with 5-6 layers of thin cells and parenchyma cells; Endocarp with thick lignified cells followed by thin cells, parenchymatous cells; vascular bundles
Seed	Oval elliptical; brown to grey colored 0-0.3cm long, 2.5mm broad	Radially elongated cells of single layer followed by 5-6 layers of angular cells; Endosperm contains both elongated and angular cells, prismatic crystals

Table 2: Chemical constituents of M. pudica plant.

 Ascorbic acid	 D- Pinitol
 Orientin	 D- Xylose
 Mimosinic acid	 Mimosinamine
 Jasmonic acid	 D- Glucuronic acid



VI. ANTI-OPHIDIAN ACTIVITY OF MIMOSA PUDICA

Snake venom generally consists of cardiotoxins, cytotoxins, neurotoxins, myotoxins, blood clotting toxins, phospholipase A2 i.e., PLA2s, and hemorrhagic metalloproteinases. Depending on the location and species, the type of venom present in the snake may differ. Majorly these are classified as Haemotoxic venoms, the ones which affect the activity of the cardiovascular system. Neurotoxic venoms affect the nervous system. Cytotoxic venoms target specific cellular sites and influence their activity. Anti-venoms are used for the treatment of snakebite and it is considered the only effective treatment for snakebite. Most of the herbal plant extracts act as anti-venomic substances, among them Mimosa pudica root extract is effective against Indian spitting Cobra. Anti-venoms are of two types monovalent anti-venoms i.e., efficacious against only one specific species of venom, and polyvalent anti-venom which is efficacious against various species of snakebite [13].

DISCUSSION:

One of the studies concluded that aqueous extracts of Mimosa Pudica root is having Anti-venom activity against the Indian Spitting Cobra otherwise called NajaKaouthia. Enzyme activity, fatality rate, and myotoxicity of the venom are inhibited. In contrast to alcoholic root extract greater inhibitory activity is shown with the aqueous extract. Anti-venom activity of M.pudica extract showed the neutralizing activity on phospholipase A2 (PLA2s), and acetylcholinesterase (AchE), and a decrease in creatinine phosphate activity. 100% neutralizing activity was obtained on NajaKaouthia and more than 50% activity was shown on other snakes.

In another study, anti-ophidian activity was determined by using 5mg/ml of M.pudica aqueous root extract in which it concluded that Hyaluronidase and the protease activities of some of the species' venom like Najanaja, Echiscarinatus, and Viperarusselli were inhibited.

By using in-vitro Haemolytic and fibrinolytic assay, the pharmacological activity of mimosa pudica was determined. Results showed the effective inhibitory action of fibrinolytic activity, phospholipase A2, and hemolytic activity against Najanigricollis and Bitisarietans [14].

In another study, Mimosa Pudica Tannin isolate (MPT)

- 100% survival rate was observed when Mice is injected with pre-incubated along with Najakaouthia venom at a concentration of 0.625 mg/ml.
- In proteomics or large-scale study of proteins, mice were injected with MPT pre-incubated along with NajaKaouthia venom that showed down-regulation of serum protein.
- In the protein-dye binding study, the percentage of Bradford dye protein binding reduced relative to the decrease in MPT concentration used.
- Animal study results showed that MPT had no In-vivo activity against NajaKaouthia venom [15].

VII. ANTI-INFLAMATORY ACTION OF MIMOSA PUDICA

When the body is affected by microbial infections and tissue injuries, inflammation an innate immune response is activated. Inflammation is the system of protection, elimination of harmful agents, and repair of damaged tissues. It is characterized by heat, pain swelling, redness, and loss of tissue function. The pattern recognition receptors (PRRs) expressed in dendritic cells and macrophages recognize the endogenous microorganisms. These comprise transmembrane proteins i.e., Toll-like receptors (TLRs) and C-type lectin receptors (CLRs); and cytoplasmic proteins like NOD-like receptors (NLRs), Rectinoic acid-inducible gene (RIG)-I-like receptors (RLRs). The PRR signaling cause the activation of pathways comprising the pro-inflammatory cytokines like tumor necrosis factor (TNF) and interleukins (IL-1, IL-6), type-I interferons (INFs), antimicrobial proteins, and chemokines [16].

The flavonoids of root extract have an inhibitory action on the release of monocyte chemotactic protein-1 (MCP-1) and interleukin-6 (IL-6); also causes eosinophilia, leukocytosis, mucus hypersecretion in asthmatic patients [17].

An in silico study of M. pudica on TLRs was performed showing the effective binding affinity. In this assay the β-carotene had greater binding affinity to TLR 4 (-8.9 kcal.mol^{-1}) and TLR 7 (-8kcal.mol^{-1}), tugorin showed binding affinity to TLR 9 (-7.6 kcal.mol^{-1}). These values were higher than the antagonists chloroquine (-6.3 & -7.1 kcal.mol^{-1} for TLR 7 & 9) and fumaric acid (-4.3 kcal.mol^{-1} for TLR 4). The Swiss ADME and standard drugs were used to predict pharmacokinetic and physicochemical properties. Some restrictions were observed in the ADME analysis [18].

In another study, the ethanolic extract of M. pudica roots was used to determine its anti-inflammatory activity using carrageenan-induced paw edema in the rat method. Here two dose levels were studied i.e., 200 and 400 mg/Kg body weight. Significant activity was found in 400mg/Kg body weight having 72.3 percentage inhibition at 6 hours. According to previous reports, phenolic compounds like flavonoids and tannins exhibit anti-inflammatory activity in the carrageenan model. The presence of phenolic compounds in M.pudica is indicated by phytochemical studies [19].

In the pharmacological study, the in vitro anti-inflammatory activity of M.pudica was studied using methods of Mizushima and Kobayashi i.e., Bovine serum albumin and egg method by comparing diclofenac sodium and different concentration of M.pudica (0.2, 0.4, 0.6, 0.8, 1.0 %). The plant extract showed a significant reduction in inflammation compared to diclofenac sodium [20].

The symptoms of hyperuricemia are pain and edema which are characteristics of inflammation. According to *invitro* studies, the M.pudica extract shows inhibition of uric acid formation by inhibiting xanthine oxidase. The anti-inflammatory activity study using in vivo method of carrageenan-induced paw edema in Wistar albino rats (150-200 g weight). The doses of 250, 500, and 1000 mg/Kg of body weight showed 35.20, 42.74, and 51.10 percent inhibition indicating bioactivity against hyperuricemia [21].

VII. CONCLUSION

Mimosa pudica is one of the diverse species which has a variety of therapeutic actions on systems like on heart, lungs, infections, CNS, immune system, and uterus. This ancient plant has advantages like very less to no side effects, easy to be found, budget-friendly, and due to its wide range of therapeutic spectrum, it can be highly used for new drug development studies.

In the present review, we can conclude that the root extract of M. pudica may have anti-inflammatory and anti-ophidian effects, which can be used for the treatment of various diseases and illnesses.

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