PRESENT STATUS OF RESEARCH ON GENUS: MIMOSA

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ABSTRACT: The research work done on different species of the genus Mimosa have been reviewed with special reference to Chemistry, Biochemistry and Biological activities.

INTRODUCTION

Mimosa, one of the most important genus of the family Mimosaceae, comprises about 400 species (1), which are distributed throughout India and probably a native of tropical America (2). Extracts of difference parts of the Mimosa plant are reported to be used in the Ayurvedic system of Medicine for a variety of purposes (1-3); viz. the whole plant is used as diuretic, astringent, expectorant, stimulant, anti’s pasmodic and anti convulsant in children. In Cambodia, internally it is prescribed for vesical calculi and externally used in oedema, rheumatism, myalgia and tumour of uterus. Individually, the root is useful in diseases arising from corrupted blood and bile, bilious fevers, piles, fistula, jaundice, leprosy, ulcers, smallpox, asthma, inflammations, burning sensation and leucoderma. A decoction of root is an effective emetic and useful in scabellish complaints. The leaves are used as a powerful sudorific and its infusion is given as a bitter tonic. On rubbing as paste on hydrocoele and glandular swellings and their juice, mixed with an equal amount of horse’s urine, followed by making into an anjan, which is used to remove films of the conjunctive by setting up an artificial inflammation (1,3). The juice of leaves is used to impregnate cotton wool for dressing in any form of sinus. It is also employed as a bath in the pains of the hip and kidney (3).

The leaf and stem in combination with other drugs are recommended for the treatment of snake-bite (Bhavaprakasha, Rasaratnakara, Yogaratnakara) and scorpion-sting (Rasaratnakara, Vaidyavinoda). Both are not the antidote to either snake (Mhaskar and Caius) or scorpion – (Caius and Mhaskar) Venoms.

Chemical

First of all, Alfans (4) discussed a few selected formulas with respect to the compounds of Mimosa genus. Renz (5) crystallized a hydroxyamino acid of aromatic nature from leaf stalks and young shoots of M. pudica, which gave an intensive violet colour with FeCl3 and a blue colour with ninhydrin, and represented the molecular formula of the compound as C16H20-O8N4, m. 228° [α]22-D-21, the named as mimosine [I]. According to this and by own experiments Nienburg (6) suggested that hydroxyl groups are not an benzene ring because [I] was much less sensitive to alkali
than dihydroxyphenylalanine or 3-aminoxytyrosine. The 2-
hydroxyphenylaminoacetic acid (m.197°), 3-carboxyl 4-hydroxyphenylaminoacetic acid (decamps. 195°), 2:4-Dimethoxyphenyl-
ydantoin (m. 185-6°), 3-nitro-2:4-dimethoxy – phenylaminoacetic acid (m.162°) and 4-dimethoxyphenylamino-
acetic acid (m. 172°) were also obtained by him from various experiments. However, Kostermans (7) gave the empirical formula
for minosine as C₄H₅NO₂ but he could not elucidate its structure. He favoured the structure [I] indicating the empirical formula
as C₈H₁₀N₂O₄. Murakoshi et al (8) reported a major metabolic product in M. pudica i.e. mimosine – o – B – D – glucoside [II] and
compared it with the same compound obtained from L. leucocephala.

Apple white (9) reported serotonin and norepinephrine in various plants but M. pudica contained only norepinephrine probably, due to which stimulation occur, and De Alencar et al. (10) isolated the 3 – o – arabinosylmorolic acid from the powdered heartwood of M. caesalpiniasfolia, while Kumar et. al (11) reported that the non-
saponifiable fraction of the oil from dried and powdered root of M.rubicaulis yielded friedelin in petroleum ether eluate, β-amyrin in petroleum ether – Benzene [1:1] eluate, and β-sitosterol in C₆H₆ – eluate. Further, Schildknecht (12) isolated D-pinitol [III] from the extract of M.pudica and established the structure by its acetylation, demethylation to D-inositol and spectral studies. Again he (13, 16, and 17) isolated and identified the structure of leaf movement compound [IV] in M.pudica, which was a glycoside of 3:4:5 – Trihydroxybenzoic acid. Later he and his team (19) isolated a chemonastic substance and identified as 4-0-(3:5 – dihydroxy benzoic acid) – β-D-glucuronide by IR, C¹³ - , H’ – NMR and mass spectroscopy. This

In the meantime, Gupta et al. (14) for the first time reported the isolated of tryptamine and its methyl derivatives from Mimosa plant by TLC-analysis. And Farooqui et al. (15) observed that the defatted seeds powder contained a mucilage in which 35.5% galactana was present. It gave negative tests for uronic acid, starch and methylpentoses. Its solution afforded a heavy complex gel, suggesting that the mucilage was a neutral polysaccharide i.e a galactomannan and there is branching by D-galactose on every D-mannose unit of the main chain of the polysaccharide. Tran et al (18) reported on the basis of their experiment that Selinium in M.pudica exists in several different compounds, one of which was identified as seletine.

After this, Delaude et al (20) detected various alkaloids from 35 species out of 190 species collected in Zaire. Then Tangenda et al (21) separated two compounds, i.e. mimosine and 3-hydroxy-4 (1H)-pyridone, from leaf extracts by using HPLC. The standard curve was linear for both mimosine and DHP, and the detection limits were 1 and 2ng for both respectively.

By methylation, periodate oxidation, Smith degradation and analysis of the aldobiouronic acid data, Doroso et al. (22) suggested that hemicellulose B and M. bracatinga was composed of D-xylose and 4-0-methyl-D-glucuronic acid. After this Bielenberg et al. (23) isolated the excitatory substance from the leaf extract of M. pudica. He studied two types of activity by sephadex column chromatography. First [E] had 80% and second [G] had 20% of the activity. By an experiment he showed that the β-glucosidase destroyed the activity of G but not to E; and finally, he suggested that the
excitatory substance had 1-OH groups and a carboxylic acid group in transposition. In the same time, Hettinger et al. (24) proposed the first leaf movement factor as [V] which was synthesized from gentisic acid acetobromoglucose and tetraacetylapiofuranose via. Glucoside [VI].

**Biological**

Bancroft et al. (25) suggested that the effect of anaesthetization is a reversible coagulation of the protein in living tissues by using various peptizing and coagulating agents. In the same year Raymond (26) also tested the anaesthetization effect by changing the position of petiole in various ways. After few years, Fischer et al (27, 28) reported that the acerin and mimosa tanning have a strong virucidal effect which is due to its tanning action on the various proteins. Later on, Hill et al. (29) reported a new herbicide i.e 3 – (3, 4-dicholorophenyl)-1-methoxy-1-methyl urea, which controlled the selective seed in mimosa plant. In the same year, Das et. al (31) proposed that the fernoxone killed *M. pudica* in 6 – 9 days. However, the mixture of this with 2:4:5 – T was much more effective than either of them acting alone. After this, Sudarraj et al. (33) reported the use of esters of 2,4-D and 2,4,5-T and the amine salt of 2,4-D for the control of *M. pudica* on rice field bunds. In the meantime, Laserna et al (30) suggested that the pollen extract of this plant responded to the positive clinical allergic reactions; and Farnsworth (32) reported the active hallucinogenic chemicals from various plants including *M. pudica*.

After a long gap, Apple white (34) observed that a variety of substances including plant harmones, anaesthetics, depressants, stimulants and poisons showed similar effects on the sensitivity to mechanical stimulation in mimosa plant and protoza spirostomum. Boveja et al. (35) studied the binding properties of the mucilage of *M. pudica* seeds and reported compared to tragacanth, gum acacia and methyl cellulose having a hydrophilic lipophile balance value of about 11. Succeeding, Phipps et al (36) suggested that the benomyl and thiobendazole controlled the fusarium wilt of mimosa by root drenching method at various time intervals, doses levels and frequencies before or after root dip spore suspension inoculation with the wilt fungus. In all treatments benomyl was more effective than thiobendazole in reducing symptom expression and fungus resolution. Recently Vaidya et al. (96) reported that extract of roots *M. pudica* showed satisfactory response on patients with dysfunctional uterine bleeding.
Bio-chemical

Previously Grasser (37) observed that the tanning materials of mimosa migrate anodically while in recent year Shirai et al. (38) obtained the pig-skin leather (free from Cromium based tanning agent or with a small amount of Cromium based tanning agent) and found that the tanned product contained 1.6% Cr$_2$O$_3$; and Corning (39) reported the partial biodegradation of the chemical products in 24-72 hrs by activated sludge treatment of tannery effluents containing biocides, dyes and tanning agent.

Snow (40) demonstrated that the rate of ascent of transpiration current in cut shoots is approximately equal to the rate of excitatory conduction in stems of such shoots. So the normal excitatory conduction depends on the transpiration current; and Seltys et al (41,42) reported that the stimulative substance of mimosa is possibly a nitrogenous, monobasic oxyacid (molecular weight of 300 – 450). If plant is exposed to Et$_2$O – vapours, the amount of stimulative substance which can be extracted, is greatly decreased. Gerhard (43) studied the nature of stimulating substance of $M.$ pudica and suggested that the purified solution losses activity due to an oxidation but can be restored by means of reducing substances. In connection with that Hug et al (44) subjected to the x-rays for 10 – 15 hrs. On various parts of mimosa plants and suggested that the irritation transmission rate or the action potential averaged 1cm / sec. and wave of negativity was propagated at 0.01 cm/ sec. The action potential was conducted only through the joint of the petiole and the negativity through the stem and adjacent leaves. In the meantime Krauss et. al (45) reported from the comparative view point, the occurrence and distribution of rare amino acids in 104 species and 40 genera of Mimosaceae, and Bell (46) studied the potential value of that amino acids. Later on, Schildknecht et al. (47) isolated various free aminoacids (viz. arginine, praline, norleucine γ-aminobutyric acid) and some (viz. L-glutamic acid, α – alanine) with D, L – Serine from mimosa plant, which are active leaf movement factors. Further they (48) isolated and identified the substance p-hydroxybenzoic acid linked to an unknown sugar which was linked to mannose [VII] causing leaf closure. Recently, Yeoh et al. (49) studied the differentiatation of mimosoideae from papilionoidae and caesalpinoideae on the basis of leaf protein content, which ranges from 2.8 to 9.4 gm% fresh weight with an average of 5.3.

Lyubimova et al. (50, 51) studied the apyrase system in the leaves of $M.$ pudica and its relation to leaf drop. In connection of this, the adenosine pyrophosphatase and ATPase of the homogenates and extracts were specially activated by Mn$^{++}$ions. Consequently, they (52, 54) also reported that the ultrasonic treatment of leaf cushions of mimosa, after trituration of the leaves with quartz, and sucrose at 0°, resulted in the liberation of a structural protein having distinct Mg-ATPase activity. Again they (55) proposed that $M.$ pudica contains a protein with Ca++, Mg++ - ATPase activity and other properties resembling those of (acto) mysin, which is purified 10 to 15 – fold by reprecipitation at low ionic strength and pH 6. 7. Succeedingly, Toriyama (56) and Fondeville (57) reported the structure and physiology of movement cells in leaves and distribution of ATPase activity in these cells. After a few years, Shtein (58 – 60) reported the location of Ca++ - ATPase and Mg++ - ATPase distribution in chloroplasts, mitochondria, nuclei and on plasma membrane of mimosa leaflet by
cytochemical study. In the same year, Biswas et al. (61, 62) prepared a myosin like suspension by macerating healthy leaflets of *M. pudica* with suspension was a contractile protein on the basis of ATPase activity and change in activity which involved in the rapid movement of mimosa leaflets.

Toriyma (63-66) showed the migration of K⁺ in the petiole of *M. pudica* by histochemical tracer method, and suggested the presence of semicircular tennin vacuole in motor cells of main pulvinus of the plant immediately after stimulation. In presence of 0.01 MEDTA, the recovery of tannin vacuole was accompanied by an increase in the volume, surface area in media containing KCL recovery occurred in 30 - 40 minutes. In connection of this, Zholkevich et al. (67) observed by EPR spectra that the upper leaf tiers in *M. pudica* were richer in free radicals than the lower leaf tiers, while Weigl (68) observed that Xe brought about a marked diminution or total inhibition in the seismonastic stimulation of *M. pudica*; and Kalinin et al (69) proposed that the antioxidiant ability of proteolipids paralleled the radical formation level in the cells of *M. pudica* petiole. Later on, Opritov et al. (70) reported that the formation of free radicals demonstrated by in-vivo – polymerization of acrylamide – C¹⁴ after stimulation of *M. pudica* leaves. In the meantime, Allen (71) proposed that the efflux of K⁺ from the pulvinar cells of *M. pudica* increases substantially during the seismonastic reaction. A large differences in K⁺ and CL⁻ concentrations between top and bottom pulvinar halves was evident in reactive pulvinii but not in unreactive pulvinii; while Vanden (72) proposed a model for mechanism of seismonastic movement in leaves by which the fibriller network of cytoplasmic contractile protein rapidly contract and provoke H₂O and K⁺ electron from extensor pulvinar cells. According to Samejima et al. (73, 74), the re-entry of ions into motor cells during recovery partially requires a photosynthetic energy supply. On the basis of their observations, they suggested that the action potential in excitable cells of petiole and main pulvinus of plant is a CL⁻ spike. Later on, Abe (75) reported the mean values for CL⁻ efflux and shortening as 183 p mol/mg fresh wt./ impulse and 87.0 / um respectively in the main pulvinus of *M. pudica*. In corporation of this, Otsiogo et al. (76) reported that the glycine (1 – 50 mM) increases the rate of scotonastic movement and decreases the amplitude and rate of photonastic movement of the secondary pulvinii of *M. pudica* leaves. The H⁺ fluxes (obtained from fusicoccin) mediate the scotonastic and photonastic pulvinar movements during glycine uptake, recently, Kumon et al (77 – 78) suggested that the photostimulation induced a transient and concurrent efflux of K⁺ and CL⁻ from the motor cells and acidification of extracellular pH during slow downward movement of the petiole of *M. pudica*; while Roblin et al. (79 , 80) determined the contents of K⁺, CL⁻, Ca⁺⁺ in various parts of *M. pudica* namely in YI, Al, UP₁, LP₁, P₂ pt and B₁. K⁺ was found in following distribution, YI = LP₁> P₂ > UP₁ > Pt > Al > B₁ and was thus localized in parts showing a great metabolic activity. They also suggested that larger H⁺ fluxes may be required in tissues showing a high metabolic activity.

Simultaneously, by the triple response of seedlings, Isaac (81) proposed that the young plants of potato seem to be more ethylene than *M. pudica* and African marigold; Tyukiti (82) proposed the reductive power of cell extract of young petiole of *M. pudica* by operating IAA, and showed that the reductive power of cell extract was highest in pH 7.2 – 7.5 and the effect of IAA also was highest in these
values. After sometimes, Baruah et al. (83) showed a positive correlation between the Hb – content of the nodules and the N- content of the plants of *M. pudica*. The response to nodulation in *M. pudica* and *A. hypogea* was different in different soils; and Nozzolillow (84) proposed that the germination, growth and red pigmentation of various plants were adversely effected when they inbided in 0.05 M aniline. However, the pigmentation in *M. pudica* was enhanced. After this, Whitworth et al. (85) reported the compounds for stabilizing soil which was the mixture of alkaline solutions of gelling agents and aqueous alcoholic suspensions of polyphenolic vegetable materials viz. mimosa extract. Gaillochet et al. (86) reported that the degree of inhibition of geotropic leaf movement was dependent on Et2O concentration, duration of etherization, time of anaesthetic admission and sequence of motor organs. Successively, Campbell et al (87) reported that Lanthanum and EDTA affected the rapid leaf movements of *M. pudica*. They further studied that Lanthanum mimics calcium and inhibited the closing response while low concentration of EDTA retarded the reopening process and a higher EDTA concentration prevented the closing movement/ Waidyanatha et al (88) observed the effect of four scarification treatments for dormancy breaking in 5 species of cover legumes including mimosa and suggested that the treatment with concentrated H2SO4 was superior to treatment with concentrated HCL, hot water [≤90°]; Roblin et al. (89) proposed that the abscisic acid produced a closure of leaflets and pinnules of excised *M. pudicai* and fusicoccin induced their opening during night. This is a new example of an antagonistic effect between ABA and FC and the apparent action threshold of ABA and FC were ~ 10^-5 M and ~ 10^-6 M in *M. pudica*. After this, Jonas (90) studied and found that digitoxin in glycerol weakly arrested the response to electric shock but strongly inhibited the response to mechanical stimulation during diurnal cycle of *M. pudica* leaves in presence of steroid cardenolides. While Mukherjee et al (91) isolated and characterized a nucleoside triphosphatase from *M. pudica* which is associated with polysaccharide; and Choudhury et. al (92) observed that both leaf and chloroplast cerebroside fractions contained a polyunsaturated fatty acid \{ 20 : 4ω3\} and a long chain sphingosine base and compared it with OX – brain cerebroside. Immediately. Lasheras et al (93) observed that the hydrolysable and condensed tannin extract of Mimosa, both inhibited the intestinal absorption of glucose in rats.

According to Watanabe et al. (94), the opening movement of leaflets on cut pinnae of *M. pudica* can be maintained by IAA and 5-OH-IAA in a concentration dependent manner, suggesting that the substances which liberate the excitatory substance of mimosa prolong in high concentrations. They (95), further, added that the leaflet pairs from detached pinnae of *M. pudica* after the pinnae had been irradiated with light [2W/m²] of 726 or 403 nm, whereas they remained almost closed with light of 585 or 656 nm. Light induced leaflet opening was absorbed only in day-time from 6.00 to 16.00 while auxin induced only in darkness with lag times of ~100 minutes.

**CONCLUSIONS:**

Though, the genus *mimosa* consists of very important and medicinally useful plants but it appears from the extensive review that more work has been done on the movement of the leaves of *M. pudica* with particular reference to the mechanism of movement. More phytoc hemical and experimental works need to be done in order to verify
important medicinal uses of these plants mentioned in Ayurvedic text.

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