Available online on www.ijppr.com
International Journal of Pharmacognosy and Phytochemical Research 2020; 12(4); 3-12

ISSN: 0975-4873

Review Article

Review on Versatility and Potential of a Roadside Herb- *Mimosa pudica* Linn.

Sawant Rashmi[1], Narvekar Namita[2*], Dhargalkar Amita[1], Choudhari Vaibhavi[1], Gosavi Dhanarshri[1], Mete Neha[1]

[1]*Yashwantrao Bhonsale College of Pharmacy, 416510, India.*
[2]*Department of Pharmaceutics, Yashwantrao Bhonsale College of Pharmacy, 416510, India.*

Received: 18th May, 20; Revised 18th Nov,20, Accepted: 7thDec, 20; Available Online:25th Dec, 2020

ABSTRACT
This study is aimed in investigating various extraction processes, phytoconstituents, analytical techniques, therapeutic applications and formulations of the plant Mimosa pudica Linn. This study disseminates information of a highly useful plant which is capable of treating numerous aliments. Whole plant is a reservior of medicinal uses and can be easily cultivated and extracted, thus economical. In this literature review we are exploring recent researches and giving a collective data of this mysterious plant, which will be easily accessible for future researches.
Keywords: *Extraction, Phytoconstituents, Analytical Techniques, Therapeutic Applications, Economical, Future prospects.*

INTRODUCTION

Being one of its kind "Mimosa pudica" gained attention by people of all ages. In Latin 'pudica' means shy, bashful or shrinking. Plant is also known as sensitive plant, sleepy plant, action plant, touch-me-not, shame plant, zombie plant or shy plant. It is a creeping annual or perennial flowering plant belonging to family Fabaceae. In 1753, Carl Linnaeus was the scientist who first discovered Mimosa pudica. It comes under species planatarum. It has character of shrinking when comes in contact with external environment. M.pudica extracts and bioaccumulates pollutants like lead, zinc, arsenic, tin, copper from polluted soil and renders soil less toxic.

Scientific classification:
Kingdom: Plantae
Division: Magnoliophyta
Class: Magnoliopsida
Order: Fabales
Family: Fabaceae
Subfamily: Mimosoideae
Genus: Mimosa
Species: M. pudica Linn.
(Alternative Titles for Plant family- Leguminosae)
Mimosa pudica is kind of like an entire natural pharmacy in single plant. This herb has a long history of use in Ayurveda, a holistic healing system that originated in India in ancient time. Mimosa pudica has been used by ayurvedic practitioners for ailments from head to toe, like mood disorders, wound healing and diarrhea. The potential health benefits of the plant are being studied. All parts of plant including seeds, stem, leaves, roots, shoots are traditionally used to cure diseases and disorders.

The seeds of M. pudica swell when they come in contact with liquid and form gel. When ingested these mucilaginous seeds become sticky gel in digestive tract and latch onto chemical toxins, heavy metals, harmful parasites. This clitter of jelly mass and harmful toxins travel through gut and is excreted into stool. Digestive tract lacks the enzyme which break down mucilage thus M. pudica mucilage travel all the way through gut and do its cleansing action. Thus, it's a Powerful Gut Scrubber. Plant is also used widely as Antidepressant and to treat Anxiety1. M. pudica extract may help Regenerate the Sciatic nerve. Extract when given to rodents with sciatic nerve injury every four days for three months, 40% better regeneration of sciatic nerve was seen compared to those given hydrocortisone a steroid[2]. Extract prepared from whole plant acts as Antimumps and stops this virus from replicating[1]. The plant extract shows antiplasmodial action against P. berghei. Thus, plant is a potent antimalarial agent.

Figure 1: Image of Mimosa pudica Linn.

**Author for Correspondence: namitagnarvekar@gmail.com*

Thigmonastic movements (Opening-Closing movements):

Thigmonastic movements in the plant M. pudica Linn.; plant in contact with external stimuli show fast response, which are regulated through electrical and chemical signal transduction. Leaves reacts to stimulus when touched, as higher pressure at that point and water in vacuoles in leaf cells loss water to adjacent cell, all water escape the leaf and leaf become flaccid and this causes closing of the leaves. This sensitive plant causes rapid leaf movement and conduction of excitation. This rapid response is elicited by various agents such as mechanical stimuli, sudden temperature variation, high hydrostatic pressure, light electrical stimulation, chemical agents or injuries.[3]

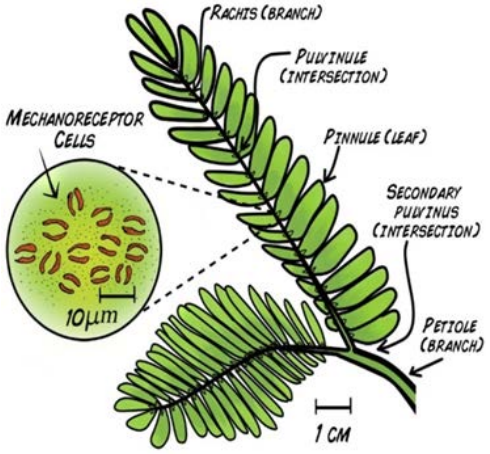


Figure 1: Different parts of leaves

Traditional uses:

All the five parts of plants (PANCHANG)-leaves, flowers, stem, roots and fruits have been used as medicine in traditional health care system. India have been popularly using different parts of plant for treating various aliments since long. The decoction of root is used with water to gargle to reduce tooth ache. It is very useful in diarrhea, ameobic diseases, bleeding piles and urinary infections as it stops bleeding and fastens the wound healing process. It is mainly used in herbal preparations for gynecological disorder and is said to have medicinal properties to cure skin diseases. It is also used to treat neurological disorders and also in conditions like bronchitis, general weakness and impotency. This plant has been used as antidepressant, anxiolytic agent and as a mood enhancer. The Roots of mimosa pudica show promising menorrhagic activity thus controlling excessive uterine bleeding. Some evidence suggest that plant is effective in relieving the symptoms of rheumatoid arthritis. In unani health care system, roots of plant an alternative, resolvant and useful in treatment of diseases arising from blood and bile impurities, piles, jaundice, bilious fever and leprosy. In Siddha health care system plant is used in treating and cleaning diabetes and diabetic ulcers, kidney and hip pain, skin itching and skin infections, bronchial asthma in children, and Pterygium.[4,5]

PHARMACOGNOSTIC OVERVIEW OF Mimosa pudica[6]:

Transverse section:

A TS of boiled root in water was prepared and mounted in glycerin on glass for identification and detection of various internal structures such as vascular bundle, pith, cortex and other parts using iodine and safranin solution. The powder of dried root was separately treated with phloroglucinol –HCL solution, glycerin and iodine solution, to determine the presence of lignified cells, starch grains and calcium oxalate crystals. In TS roots are characterized by the presence of thick brownish layer of cork cells, they are uniform in shape and more or less isodiametric ,flattened .Below this layer ,second layer is present that is endodermis further getting converted into medullary rays. The phloem is identified by presence of thick-walled oval shape cells. The horizontal tracks of cambium were observed followed by polygonal cells of xylem. At the center small circular pith was seen with dark brown colored outer covering, rhomboid calcium oxalate crystals were also present with simple or compound starch grains.

Powdered analysis:

Powder analysis of M. pudica showed the presence of unicellular covering trichomes, pitted type of vessel, polygonal cells of parenchyma, electric cable like bunch of fibres with yellow thick mass of tissue along with mesh like structure.

EXTRACTION

Decoction:

Leaves were dried and boiled in 30ml distilled water for 30 mins. The supernatant was collected, filtered and evaporated to 6ml corresponding to concentration of 0.4g/ml (yield 5%).[7]

Soxhlet Extraction:

Fresh shoots and roots of M. pudica were used for extraction. The shoots were extracted for 5hrs with petroleum ether, 12hrs with chloroform, 24hrs with methanol and 24hrs with water. Except petroleum ether the roots were extracted using chloroform, methanol and water in same way as above done in shoot extraction. 250g of coarsely grounded powder of shoots and roots were extracted separately in soxhlet apparatus. The extract obtained was collected separately and concentrated by vacuum desiccator and further dried. % Yield of shoots extract were 6.4, 8, 5.2, 7.2 respectively and % yield of root extract obtained were 7.4, 5.6, 6.6 respectively.[8]

Supercritical Co2 Extraction:

10g of powdered sample of M. pudica was kept in extraction vessel and placed in column thermostat set at 60ºC. pressure (40MPa) was adjusted at the back-pressure regulator and the solvent pumps. The flow rates of CO2 and % modifier was fixed at 5mL/min and 30% respectively. Once the set temperature and pressure (at solvent pumps and backpressure regulator) were achieved after turning on injection valve and the system was in equilibrium, the extraction was carried out for 2hrs. the

percentage extract yield was measured by drying the liquid extract at 70ºC until constant weight of the extract was obtained. (yield 0.507g; 5.07%).

Conventional Maceration Extraction Process:

Fresh aerial parts of plant were dried at 40ºC and pulverized and stored in desiccator for further use. The coarsely grounded dry powder (500g) was macerated with 95% ethanol in round bottom flask and subjected to 3cycles (each 24hrs soaking) of ethanol extract (2.5L) at room temperature followed by 4cycles of heat under reflux (2hrs each) over boiling water bath. Further this ethanolic extract was filtered and concentrated using a rotary evaporator. (yield 34.07g; 6.814%).[9]

Microwave Assisted Extraction:

2g of powder of M. pudica along with 20ml solvent methanol and was placed in the extraction vessel and kept into microwave cavity. Extract was filtered through Whatman no.1 filterpaper and concentrated using rotary vacuum dryer at 40ºC. MAE was carried out to find the optimum parameters for extraction of total phenolic and total flavonoid compounds. Accordingly, optimum results were obtained at methanol 85%, microwave power 25%, irradiation temperature 60ºand irradiation time 15 mins. Under these circumstances the optimum yield of TPC and TFC are 635mg gallic acid equivalents (GAE)/g and 635mg rutin equivalent (RU)/g.[10]

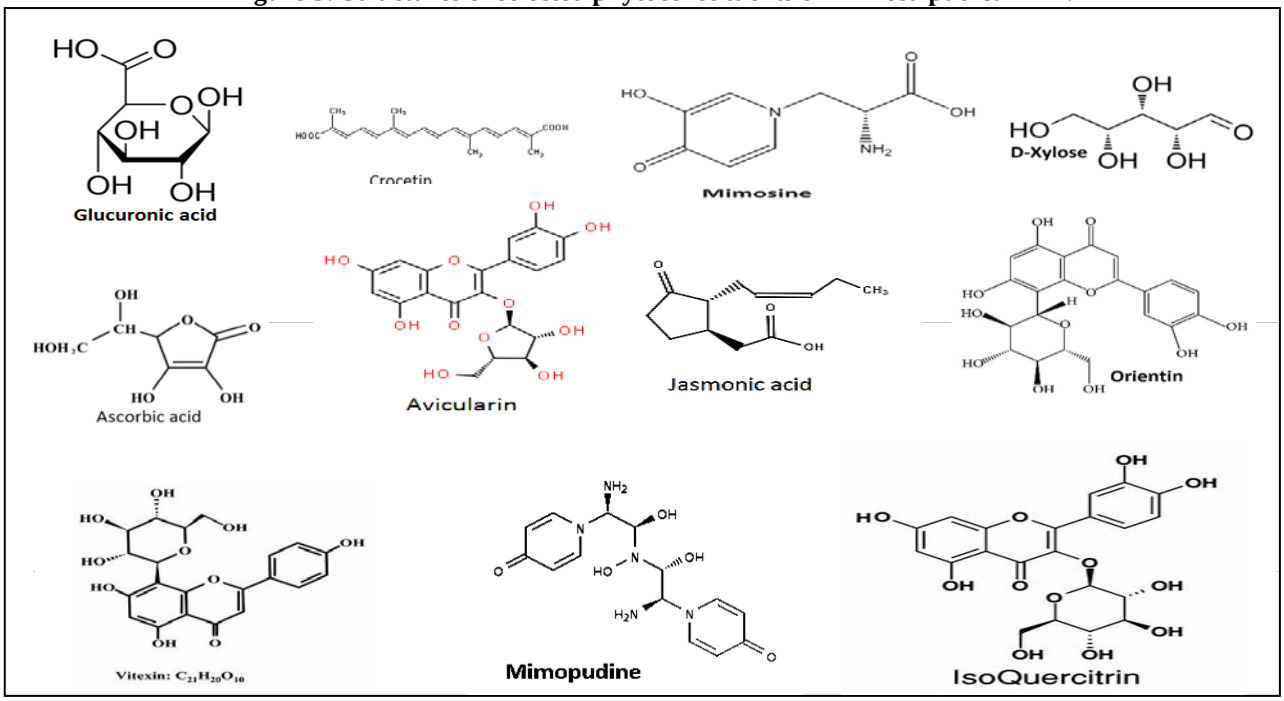
PHYTOCONSTITUENTS

Roots contains endophytes, which produces secondary metabolites such as tannins, phenols, steroids, terpenoids, alkaloids which protects the plant from various pathogens.

Table 1- Phytoconstituents isolated from different parts of Mimosa pudica[1]

Plant parts	Phytoconstituets
Root	Crocetion,Ascorbic acid, D-glucoronic acid, linoleic acid, D-xylose, and B-sitosterols, mimosine, flavonoid, tannin, phenols, alkaloids, phytosterol, linolenic acid, palmitic acid, stearic acid.
Leaves	Nor-epinephrine, d-pinitol, b-sitosterol, alkaloid-mimosine, terpenoid, flavonoid, glycosides, coumarins, poly-unsaturated fatty acids, sphingosine, adrenaline, orientin, isovitexin, vitexin and tyrosine.
Stem	Alkaloid- mimosine, β-[N-(3-hydroxypyridone-4)]-α-aminopropionic acid, 5-MeO-DMT.
Seed	D-xylose, D-glucoronic acid, tubulin, C-glycoflavones, phenolic ketone, buffadienolide.
Aerial part	O-glycosyl favanoid named isoquercitrin, avicularin and epigenin-7-O-D-glucoside and also four Cglycosyl flavonoids, cassiaoccidentalin B, orientin and iso orientin from the aerial part of the plant.
Plant	Mimosinamine, mimosinic acid, tyrosine, jasmonic acid, abscisic acid, mimosine, d-xylose, d-glucoronic acid, tubulin, gallic acid, phytohormones –turgorins, nor epinephrine, thiamine, L-noradrenaline, mimopudine.

Figure 3: Structures of selected phytoconstituents of Mimosa pudica Linn.



Also roots contains sac like structures that release organic and organosulphur compounds including SO2, methylsulphinic acid, pyruvic acid, lactic acid, ethanesulphinic acid, S-propyl propane 1-thiosulfinate, 2-mercaptoaniline, and thioformaldehyde.
Mimopudine is responsible for leaf movement at night. Even at its low concentration, the leaf opened by mimopudine are sensitive to touch.
Potassium glucopyrosyl genistate is responsible for slow leaf movement and it is acts as leaf closing substance.
Important protein isolated from M.pudica, known as tubulin, is considered to be responsible for leaf movement.
Volatile flavonoid derivative such as Kaempfero-3-rutinoside, leutolin-3-xyloside, Acacentin-7-rutinoside and non-volatile flavonoid, glucoside such as quercetin - 7- rhamnoside, qerceitin-3-glucosie-7-rhamnoside high concentration of this constituents are also present in the plant.
Potassium-L-malate, magnesium potassium trans aconitate, dimethyl ammonium salt, potassium 5-O-B-D-glucopyranosyl genistate are the phytoconstituents responsible for sensitive rapid movement and periodic slow movement.
A new class of phytohormone "turgorins" which are the derivative of gallic acid has been discovered within the plant.[11]

ANALYSIS
Analytical Techniques used in detection of phytoconstituents and the result obtained during study are given below:

Thin Layer Chromatography (TLC)
Qualitative analysis of extracts showed presence of phytochemicals like alkaloids, flavonoids, tannins, steroids and phenolic compounds.
Mimopudine- Extract were prepared by Soxhlet extraction using three solvents; Methanol, Chloroform and diethyl ether. Further Fractionation of compounds from M. pudica using Column Chromatography was carried out. Fraction of methanolic extract obtained using ethyl acetate and methanol at a ratio of 20:80, yielded identifiable compound. The spot with standard Rf value 0.62 matches with standard marker Mimopudine.
Jasmonic acid & Abscisic acid- TLC was conducted using using toluene-ethyl acetate-acetic acid (80:10:4, v/v) and isopropyl alcohol-ammonia-water (10:1:1, v/v) solvent systems. The JA spot was developed with iodine vapor. Rf values (of JA 0.34 and 0.56 & ABA 0.11 and 0.58) on TLC agreed with those of authentic JA in two different developing systems (0.34 and 0.56).[12]

High Performance Liquid Chromatography (HPLC)
Mimopudine- HPLC analysis of methanolic extract of M. pudica presented a distinct peak at a retention time of 9.141 which is similar to standard mimopudine (retention time 9.439)[10]
For Phenolic and flavonoid compounds- Mobile phase 1. 40mM potassium dihydrogen phosphate (pH 2.3 with 85% Orthophosphoric acid) 2. Methanol. The gradient elution was 95% A to 58% A over 52.5min., 58:42 (52–57min) then again to initial composition (57–60min) at a flow rate of 1ml/min. In study 13 standards of phenolic and flavonoid compounds were used. Hydro-alcoholic fraction of M. pudica showed seven peaks and the retention time of these peaks coincided closely with the retention time for Gallic acid, Chlorogenic acid, Hyperoside, Luteolin, Rutin, Fisetin and Chrysin indicating the presence of phenolic compounds. Chloroform fraction demonstrated six peaks coinciding closely with the standard retention times for Gallic acid, Hyperoside, Luteolin, Fisetin, Naringenin and Benzene-triol. n-Butanol fraction represented 11 peaks, again with very similar retention times to the standard Gallic acid, Chlorogenic acid, Ferulic acid, Hyperoside, Luteolin, Fisetin, Apigenin-7-O-glucoside, Naringenin, Benzene-triol, Apigenin and Chrysin peak. The order of presence of phenolic and flavonoid compounds is n-butanol > ethanolic extract > chloroform as evident from the HPLC assay.13
Jasmonic acid- HPLC was performed using methanol-0.01% acetic acid (30:70, v/v) as a solvent at 40°C. The retention volume of the inhibitor on HPLC was 28 ml, the same as authentic JA. The amount of finally purified JA from 10 kg fresh weight of the plants was estimated to be 1.9μmol by HPLC.[12]

Gas Chromatography and Mass spectroscopy analysis (GC-MS)
GC-MS analysis was carried out on the Methanol extract of M. pudica and 19 compounds were identified of which 10 were found to have proven therapeutic values. Detected compounds include Glycerin (alcohol), Myo-inositol (aromatic compound), Trimethyl caffine (alkaloid), Hexadecen-1ol (terpene alcohol), Hexadecanoic acid (palmitic acid), Phytol (diterpene), Octadecadienoic acid (linoleic acid), Vitamin-E and Squalene (tri-terpene). The highest peak area (%) of 46.61 was obtained by myo-inositol (Retention-time 20.42) and the lowest peak area (%) of 0.90 was obtained by Glycerin (Retention-time 0.42).[14]
Supercritical fluid ethanol extract and Ethanolic conventional extracts were subjected to GC-MS analysis. To overcome the problem of inability to vaporise high molecular weight compounds like phenols and flavonoids sample was derivatised using N,O-Bis(trimethylsilyl)trifluoroacetamide (BSTFA). 17 compounds were detected. Glycine was major compound in ethanol extract, other compounds detected are 3-Phenylpropionic acid, Thieno(2,3-b)quinoline, Tetradecapentaenoic acid, Butanoic acid. SFE Extract showed compounds like resorcinol, oleic acid, monolinoleoyl glycerol, ethyl isoallochate, cyclopropane butanoic acid, Heptatriacotanol, etc.[9]

Liquid chromatography − tandem mass spectrometry (LC-MS-MS)
Quantitation of Mimosine- Stock solution was prepared and subjected to LC-MS-MS method.

Method validation- The % RSD was found to be 1.27% for Mimosine, which was acceptable as it is less than 2%. The signal-to-noise ratio of 3:1 and 10:1 was used to establish LOD (Limit of Detection) and LOQ (Limits of Quantitation), respectively. The LOD and LOQ of Mimosine were 100 ng mL-1 and 400.0 ng mL-1. The mean assay value of Mimosine was found to be 1.938 mg/g of plant powder with % RSD as 1.55%. The % RSD for intra-day and inter-day precision for Mimosine were 0.66 and 1.06%, respectively.
The best signal for Mimosine was achieved using a mobile phase containing 10mM ammonium formate buffer pH adjusted to 3.00 ± 0.05 with formic acid in combination with Methanol (20:80 v/v).[15]

Reversed-Phase High-Performance Thin-Layer Chromatography (RP-HPTLC)
Quantification of Mimosine- Chromatography was performed on silica gel RP-18 F254s plates with ethyl acetate–glacial acetic acid–water, 6:1:1.7 (v/v), as mobile phase. The mean amount of mimosine in 25 mg dried plant powder was 0.49 mg. RSD values were less than 2%, indicating the method is precise and reproducible. The accuracy of the method was established by means of a recovery experiment. Mean recovery of mimosine was 100.67%, which indicates the method is accurate and the robustness of the method was studied. Quantification was achieved by densitometric scanning at λ max = 282 nm in reflectance–absorbance mode. The response to mimosine was a linear function of concentration over the range 30 to 100 μg mL–1 in the extract. The concentration of mimosine whole plant powder was found to be 20 mg g–1.[16]
Nuclear magnetic resonance imaging (NMR)
Movement of the water in conjunction with Mimosa movement was visualized sequentially by a non-invasive NMR imaging procedure. The proton signal from a certain area of the pulvinus was measured. After stimulation of a Mimosa plant, water in the lower half of the main pulvinus disappeared, the water previously contained in this area seeming to be transferred to the upper half of the main pulvinus.[17]

Other compounds identifed using various techniques
Galactomannans from seeds of M. pudica- Nuclear magnetic resonance spectroscopy and Gas Chromatography results revealed the presence of 4-linked mannose backbone with galactose side chains linked at the C6 position. Scanning Electron Micrographs showed smooth, elongated and irregular granular structure of galactomannan. Structural analysis by Attenuated total reflection infrared spectroscopy presented the Mannose to Galactose ratio while the X-ray diffraction studies showed the presences of A-type crystalline pattern of the galactomannan. Thermo Gravitimetric Analysis showed the three steps weight loss event and determined the thermal stability.[18]
Two C-glycosylflavones- 1.6,7,30,40-tetrahydroxyl-8-C-[a-L-rhamnopyranosyl-(1!2)]-b-D-glucopyranosyl flavone, 2.5,7,30,40-tetrahydroxy-8-C[b-Dapiose-(1!4)]-b-D-glycopyranosyl flavone. Their structures elucidated by chemical and spectroscopic analysis including IR, MS, 1D and 2D NMR spectra.[19]

THERAPUETIC USES:
Part of plant, Phytoconstituents showing therapeutic action on and its mechanism of action is listed below.

Antivenom activity[20]
Aqueous root extract
Tannins
Russell viper venom, Sawscaled viper venom, Cobra (Naja naja) venom, Kraits (Bangarus caerulus) venom.
Inhibit toxic enzymes hyaluronidase and protease.

Anticancer activity[21,22]
Whole plant hydroalcoholic extract
L-mimosine. A derivative of myricetin –compound interpreted as: 2-(2', 6'-dimethyl-3', 4', 5'-alkyl or hydroxy alkyl substituted phenyl)-3-oxy-(alkyl or hydroxy alkyl)-5-7-dihydroxy-chromen-4-one.
Daudi lymphoma cell line (l-mimosine). Human lung adencarcinoma cell line, human erythroleukamic cell line (in-vitro) & daltons ascites lymphoma (in-vivo).
Inhibits the cell growth proliferation and kills the cell.

Antioxidant activity[23]
Ethanolic leaf extract
Flavonoids & Phenols
5 Flavonoid monomers- 1.5,7,3',4'-tetrahydroxy-6-C[β-D-apiose-(1→4)]-β-D-glycopyanosyl flavone >2.isorientin >3.orientin>4.isovitexin>5.vitexin
Scavenging oxygen free radicals.
Interrupt radical reaction by providing electronic (hydrogen) to free radical˙ and transforming into stable compound.

Wound Healing action[24]
Methanolic and Aqueous Root extract
Phenols constituents, Tannins
Promote wound healing, increase cellular proliferation, promote synthesis of collagen, Increase rate of wound healing.

Antinflammatory & Analgesic action[25]
Leaves extract of M. pudica
Vitexin
COX -2 enzyme inhibition.

Antimicrobial action[26,27,28]
Ethanolic leaves extract
Tannins, Flavonoids, Glycosides, Alkaloids
S.aureus, P.aeruginosa, ,E.coli, Aspergillus flavus, T.verrucosum, T.soudanense.
Kills the microbes and stunts its growth.

Anticonvulsant activity[5]
Leaves extract
Clonic seizures

Acts on GABAnergic neurotrsmission
Hypolipidemic activity[29]
Whole plant ethanolic extract.
Flavonoids, glycosides, alkaloids
Lowering serum level of LDL, VLDL, triglycerides, cholesterol and increase in HDL level.
Antidiarrheal activity[30]
Ethanolic leaves extract
Tannins and flavonoids
Precipitate proteins of the electrolytes and reduce peristalsis movememnt and intestinal secretion.
Hepatoprotective activity[31]
Methanolic leaves extract
Flavonoids, glycosides, alkaloids
Carbon tetrachloride induced hepatotoxicity
Extract neutralizes toxic effects and helps in regeneration of hepatocytes
Aphrodisiac property[32]
Ethanolic root extract males
Extract increased libido and hormone levels of testosterone.
Antidiabetic activity[33]
Aerial parts and whole plant
Stigmaserol, quercetin, avicularin
Diabetis mellitus
Reduce the absorption of glucose by inhibiting the digestive enzymes α-amylase & α-glucosidase.
Antiulcer activity[34]
Ethanolic leaves extract
Alcohol induced ulcer and Pyloric ligation ulcer
Reduce acidity and increase gastric pH and secretion of protective factors. Reduce lipid peroxide level and increase catalase and superoxide dismutase activity.
Anti-helminthic activity[35]
Aqueous leaves extract
P. posthuman
Cause paralysis and further death.
Antifertility action[36]
Methanolic root extract in females.
Decrease in follicle stimulating hormone (FSH) levels in the pro-oestrus and oestrous stage and disturbs ovulation.
Anti-hepatitis B virus[37]
Methanolic whole plant extract of M. pudica
Hepatitis B virus
Inhibition of HBsAg (surface antigen) to its receptor (prevent attachment of virus to host tissue).
Anti-dermatoheliotic action[13]
Extract of Seeds of M.pudica
Polyphenols like Gallic acid, hyperoside, fisetin, luteolin, Chlorogenic acid, benzene-triol
Dermatoheliosis
Photo-protection by absorbing harmful sunrays topically. Inhibition of inflammatory mediators' production. Ameliorated skin hydration by skin barrier function. Decreased elastin degradation by inhibition of elastase activity. Decrease melanogenisis by inhibition of tyrosinase enzyme. Decrease sebum production by inhibition of 5α-reductase.

MARKETED FORMULATIONS OF Mimosa pudica PLANT (LAJJALU) -

Marketed formulations containing M. pudica along with M. pudica content and uses are listed below:
Pilocure tablet (50mg): hemostyptic activity and reduce bleeding,anti-inflammatory action, anti-microbial effect.
Oral BPH capsule (100mg): Significant reduction in residual urine volume, frequency of urine, relieves pain associated with urination, increase force of detrosur contraction, Relieves bothersome urinary track symptoms.
Selip Syurp (24mg): In bleeding piles, relieves itching and pain from piles, relieves constipation and correct bowel movement, reduces post-surgery recurrence of piles.
Samangadi churna (10mg): In bleeding and non-bleeding piles.
Kutajavaleham churna (48mg): in the treatment of piles, ulcerative colitis, diarrhoea, anemia, bleeding disorder, inflammatory conditions and liver complaints.
Lakshadi churna: In treating haemoptysis and nasal bleeding haemophilia, in chest lesion and in heavy period, short menstrual cycle, menstrual bleeding with clots etc.
Brihat gangeadhara churna (10mg): used in dysentery and diarrhoea and ulcerative colitis.
Amen Mimosa pudica seed capsules: used in intestinal support and healthy intestinal track.
Para 1 – immune and digestive support: In immune and GI system support, helps remove the parasites.
Pilex ointment (5%): In Fissures, Itching, Hemorrhoids, feeling of discomfort or pain at the excretory opening and Pregnancy induced hemorrhoids.

OTHER POTENTIAL USES:

SUSTAIN RELEASE PROPERTIES OF Mimosa pudica SEED MUCILAGE[38]
Natural gums and mucilage have been used as emulsifying, suspending, binding and disintegrating agents and as sustained release matrix. Natural polymers are preferred over synthetic or semi-synthetic polymers because they are cheap, non-irritating, biodegradable and eco-friendly. Mimosa pudica yield mucilage which is composed of d-xylose and d-glucoronic acid, mimosa seed mucilage hydrates and swell rapidly on coming in contact with water. Matrix tablets of diclofenac sodium containing different proportions of mimosa pudica seed mucilage and dibasic calcium phosphate as diluent was formulated by wet granulation method. This study was carried out by using USP Type 2 dissolution rate apparatus, in a dissolution media comprising of 900ml of 0.1N HCl for 2hrs followed by phosphate buffer (pH 6.8) for 24hrs at 37ºC and 50rpm.The study revealed that as the proportion of mucilage in the matrix was increased there was corresponding decrease in release of drug due to increased swelling of mucilage.

SOLAR CELL PRODUCTION BY Mimosa pudica [39]
Leaves were collected and placed in hot air oven at 100˚C for an hour for drying (initial weight 335g). Dried leaves were pulverized. Two units of 50g were weighed out;

placed in Soxhlet extraction unit to completely extract the chlorophyll constituents using distilled water. Separation was carried out using mixture of petroleum ether and aqueous methanol. Two components Chlorophyll a and Chlorophyll b were yielded out, of which Chlorophyll b was compound of interest. The second half of leaves(50g) were placed in muffled furnace to remove organic constituents. The ash obtained was washed with distilled water and the filtrate concentrated was identified as thiosulphite. The isolates of chlorophyll b and thiosulphate were mixed in three different ratios of 1:1, 1:2, 2:1. Further a mimosa solar accumulator was produced which generated energy in form of DC current.
2:1 mixture gave te highest output of 250mA and 0.9V that lit an LED bulb.
Laboratory investigation showed that light absorption catalysis of oxidation-reduction reaction between chlorophyll b an oxidizing agent and thiosulphite an reducing agent is responsible for sensitivity of plant. The challenge faced was utilization of electrons released by redox reaction and their conversion to solar renewability.
The energy in the Mimosa solar panel is renewable. Also, the panel assembled at a very low cost compared to other techniques. Electric potential of mimosa pudica for solar cell production presents a novel way of green energy production.

NANOPARTICLES
Plant-mediated biological synthesis of nanoparticles is gaining importance due to its simplicity, eco-friendliness and extensive photocatalytic activity.
Using Extract of Mimosa Pudica Plant leaves for synthesis of ZnO Nanoparticles [40]
Zinc oxide (ZnO) is a potential photocatalyst due to its band gap energy and stability. By its wide bandgap, ZnO can be applied in a broad range of applications, including self-cleaning, photocatalysis and environmental purification. The synthesis of ZnO nanoparticles by comparing the use of two plant extracts; Mimosa pudica leaves extract and coffee powder extract. Materials used in this synthesis zinc acetate dehydrate, methylene blue, isopropanol, Mimosa pudica plant leaves.
Using Extract Mimosa Pudica Plant leaves for synthesis of Silver Nanoparticles [41]
Silver Nanoparticles is one of the Nanoparticles for application ranging from catalysis and photocatalysis, water treatment, cancer detection, therapeutic and antibacterial agent.
The extract of mimosa pudica plant leaves use in synthesis of Ag Nanoparticles by microwave irradiation method for antibacterial activity test. The synthesized silver nanoparticles were tested for their antibacterial activity to the cultures of Escherichia coli and Pseudomonas aeruginosa by using the disk diffusion method.
Using Extract Mimosa Pudica Plant flowers for synthesis of Gold Nanoparticles [42]
Gold nanoparticles (AuNPs) is an important application in arenas like cancer therapeutics, bioimaging, optoelectronics, catalysis, biosensing etc.
Fresh flowers of Mimosa pudica were freshly collected, weighed and thoroughly washed with deionized water, put in a beaker containing 25 mL deionized water was heated to boiling, continued heating for 2 more min after boiling and then allowed to cool before filtering. The filtrate was used for AuNP synthesis.

Mimosa pudica USE AS A BIOPRESERVATIVE FOR FOOD PRODUCT [43]
The extract of various parts of Mimosa pudica plant also used as a bio-preservative for food product. The extract of mimosa pudica plant leaves exhibit prevention effect against gram positive bacteria such as S. aureus, K. pneumoniae, B. cereus, and B. subtilis as well as gram-negative bacteria such as E. coli, S.typhi, P. aeruginosa, and P. Vulgaris. The methanol extract of leaves has inhibitory effect against S. aureus, B. subtilis, K. pneumoniae, P. vulgaris and P. aeruginosa. The content of bioactive compounds in leaves extracts might differ depending on extraction methods used. The ethanol extract of leaves, which contains higher flavonoids content than aqueous extract, exhibit greater prevention effects on four different bacteria compared to aqueous extract, recommended flavonoids are among liable compounds for the antibacterial activity. Besides, the extracted chlorophyllin from the leaves also exhibit a prevention effect towards gram-positive and gram-negative bacteria, so this compound also plays a role in antibacterial activity. These extracts also showed no significant toxicity towards brine shrimps, suggesting their activities are specific only to bacteria.
Mechanism of action of each constituent: -

Tannins have been found to form irreversible complexes with highly rich protein resulting in the prevention of cellular protein synthesis.

Flavonoids have antifungal activity by inhibiting spore germination of pathogens.

Saponins are detergent-like substances thus increases cell permeability of bacterial cell membrane, causing subsequent leakage of ions, ATP, nucleic acids, and amino acids.

Terpenoids also act by destruction the cytoplasmic membrane of bacterial cells through its hydrophobic nature.

Phenolic groups can cause severe structural damage and significant morphological alteration by damaging the integrity of bacterial cell wall.

The bio-preservative prepared from M. pudica plant allows life of food product to be extended and prevent the growth of spoilage microorganisms.

DISCUSSION

This bashful plant had gained attention by researchers due to its unique leaf bending movements in response to stimulus. Literature claims that plant has wide use in therapeutics. M. pudica grows most effectively in nutrient poor soil, thus it is economically viable. Literature-based phytochemical screening revealed that plant is rich in medicinally important secondary metabolites including alkaloids, flavonoids, tannins, amino acids, fixed oils,

glycosides. Table no.1 shows important phytoconstituents isolated from plant. Decoction, maceration, Soxhlet extraction, Microwave assisted extraction, Supercritical fluid extraction (SFE) are some of the extraction methods used for extraction of bioactive compounds. From the study it's been perceived that SFE i.e. Green method is a safe method than Maceration extraction i.e. Conventional method. Data reviewed revealed the fact that inspite of slightly higher yield, conventional method consumed higher amount of solvent and took longer time to accomplish the extraction process. It's also been reported that conventional method produces toxic extracts i.e. they contain toxic organic solvent leftover that may lead to deleterious side effects and cause environmental threats after disposure. SFE is a method with relatively higher safety profile. SFE uses CO2 as major extracting solvent which can be recycled, imposes very less impact on nature and process is completed within short span of time. In terms of activity conventional extract shows potent activity and SFE extract shows relatively less activity, yet it can be deduced that, parameter like time period of process played major role in extraction of bioactives and therapeutics.

M. pudica is a kind of like entire pharmacy in a single plant. Studies have concluded that plant is rich in alkaloid, mimosine which has anticancer property. Isolated L-mimosine is a potent anticancer agent than plant extract. Another derivative of myricetin found in the plant also showed a competent anticancer activity; in histopathological studies, normal liver, kidney was seen, thus no adverse effect was recorded as in other agents. Antivenom activity of plant is due to the presence of tannins. Hypersensitivity reactions are the major concern of animal derived antivenoms, as no such side effect and death were reported during the study, it can be considered safe for use. Tannins responsible for activity should be isolated in pure form and must be developed into formulations which may help save lives. Due to Presence of abundant bioactives like 1.5,7,3',4'-tetrahydroxy-6-C[β-D-apiose-(1→4)]-β-D-glycopyanosyl flavone 2. isorientin 3. orientin 4.isovitexin 5.vitexin, plant is associated with antioxidant property; of which Compound 1 show stronger action than other 4 compounds. Wound Healing property of plant is known since long back in Ayurveda; extract showed good wound healing property than the standard drug. Anti-inflammatory and analgesic activity is due to Vitexin an effective COX-2 inhibitor; this is a new source of NSAIDs drug development having social benefit of reduced time and cost which should be taken into consideration by researchers. M. pudica has been extensively studied for its antimicrobial activity, hence efforts should be made to develop new antibiotics by isolating compounds from plant. A higher dose of extract showed no gastric ulceration and adverse effects, thus can be clinically useful as sexual invigorator in males. Extraction of active constituents show path in development of a new antidiabetic agent from M. pudica. Seed extract could be a great strategy to deal with dermatoheliosis. This extract is proven to be biosafe and cytocompatible with human skin and shows promising positive effects on skin parameters like erythema, melanin, elasticity, hydration, sebum. Plant have been used in bleeding piles, mennoraghia, bleeding of any type (urethral, vaginal, nasal, anal), wound healing, prolapse uterus by Ayurvedic physicians up-to-the-date.

M. pudica seed mucilage have been evaluated for it sustain drug release property. Solar cell production is a novel way of production of green energy. M. pudica synthesized nanoparticles are applied in a broad range of applications. Plant is of great value to R&D scientists in food science.

CONCLUSION

Market of synthetic drugs is developing along with their side-effects. Thus, more importance must be given in formulating herbal drugs with minimal side-effects and cost. Ayurveda is long being practiced in India and thus it is advantageous for the nation in finding and formulating herbal medicines.

Versatility and Potential of M. pudica is well understood and recognized, thus study suggests that plant is an effective source of generation and isolation of bioactives as a future prospect of new drugs. Emphasis should be given in formulating new medicines beneficial for humanity. We speculated the formation of a herbal suppository of M.pudica in treating bleeding piles. As plant is associated with remarkable character of folding leaves i.e. shrinking, in response to stimuli, it might be this action which may have evoked the thought of using this plant in bleeding disorders and prolapse.

REFERENCES

1. Bharati B Zaware, SR Chaudhari, Manisha T Shinde. An Overview of Mimosa pudica Linn: Chemistry and Pharmacological Profile. Research Journal of Pharmaceutical, Biological and Chemial Sciences 2014; 5(6): 754-761.
2. Hafsa Ahmad, Sakshi Sehgal, Anurag Mishra, Rajiv Gupta. Mimosa pudica L.(laajvanti): An Overview, Pharmacognosy Reviews ,2012;6(12):115-124.
3. Alexander G. Volkov, Justin C. Foster, Talithaa. Ashby, Ronald K. Walker, Jon A. Johnson, Vladislav S. Markin. Mimosa pudica: Electrical and mechanical stimulation of plant movements. Plant,Cell and Environment 2010; 33(2):163–173.
4. Baby Joseph, Jency George, Jeevitha Mohan. Pharmacology and traditional uses of Mimosa pudica. International Journal of Pharmaceutical Science and Drug Research 2013; 5(2): 41-44.
5. Srivastava Varnika, Sharma Ashish, Alam Imran. A review on ethnomedical and traditional uses of Mimosa pudica (CHUI-MUI). International Research Journal of Pharmacy 2012;3(2): 41-44.
6. Milind Pande, Anupam Pathak. Preliminary pharmacognostic evaluation and phytochemical studies of on roots of Mimosa pudica. International journal of pharmaceutical sciences review and research 2010;1(1): 50-52.
7. E. Ngo Bum, D.L. Dawack, M. Schmutz, A. Rakotonirina, S. V. Rakotonirina et.al. Anticonvulsant

activity of Mimosa pudica decoction. Fitoterapia 2004;75(3-4):309-314.
8. S.Kannan, S. Aravinth Vijay Jesuraj, E. Sam Jeev Kumar, K. Saminathan, R. Suthakaran, M. Ravi Kumar, B. Parimala Devi. Wound Healing Activity of Mimosa pudica Linn Formulation. International Journal of PharmTech Research 2009; Vol 1:1554-1558.
9. Tasnuva S T, Sahena F, Qamar U A, Kashif G, Juliana J, Zaidul I S M. Mimosa pudica L.: A comparative study via in vitro analysis and GC Q-TOF MS profiling on conventional and supercritical fluid extraction using food grade ethanol. Indian Journal of Natural Products and Resources 2017;8(1): 54-62.
10. Vinothapooshan Ganesan, Vijaya Gurumani, Selvaraj Kunjiappan, Theivendran Panneerslvam, et al. Optimisation and analysis of microwave assisted extraction of bioactive compounds from Mimosa pudica L. using RSM and ANFIS modeling. Journal of Food Measurement and Characterization 2018; 12(1): 228-242.
11. Gulzar Muhammad, Muhammad Ajaz Hussain, Ibrahim Jantan, Syed NasirAbbas Bukhari. Mimosa pudica L., a High-Value Medicinal Plant as a Source of Bioactive for Pharmaceuticals. Comprehensive Reviews in Food Science and Food Safety 2016; 15:303-315.
12. Seiji Tsurumi and Yoshihiko Asahi. Identification of jasmonic acid in Mimosa pudica and its inhibitory effect on auxin- and liglit-induced opening of the pulvinules. Physiologia Plantarum 2006 ;64(2): 207-211.
13. Shakeel Ijaz, Haji Muhammad Shoaib Khan, Zeeshan Anwar, Brian Talbot, John J. Walsh. HPLC profiling of Mimosa pudica polyphenols and their non-invasive biophysical investigations for anti-dermatoheliotic and skin reinstating potential, Biomedicine & Pharmacotherapy 2019; 109:865-875.
14. Sriram Sridharan, Meenaa Vaidyanathan, Kavitha Venkatesh, Agnel Arul John Nayagam. GC-MS study and phytochemical profiling of Mimosa pudica Linn. Journal of Pharmacy Research 2011,4(3),741-742.
15. Parikshit A. Champanerkar, Vikas V. Vaidya, Sunita Shailajan, Sasikumar N. Menon. A sensitive, rapid and validated liquid chromatography − tandem mass spectrometry (LC-MS-MS) method for determination of Mimosine in Mimosa pudica Linn. Natural Science 2010;2(7):713-717.
16. Lakshmi S. Nair, Sasikumar N. Menon, Sunita Shailajan, Manisha M. Baing, and Ramesh T. Sane. Reversed-Phase High-Performance Thin-Layer Chromatographic Quantification of Mimosine from Whole Plant of Mimosa pudica Linn.Journal of Planar Chromatography-Modern TLC 2007; 20(1):49-51.
17. Toru Tamiya,Toshiyuki Miyazaki, Hiroshi Ishikawa, Norio Iriguchi, Takeshi Maki, Juichiro J. Matsumoto, Takahide Tsuchiya. Movement of Water in Conjunction with Plant Movement Visualized by NMR Imaging, The Journal of Biochemistry,1988;104(1):5-8.
18. Harikrishna Naik Lavudi, Sshagirirao Kottapalli, Francisco M. Goycoolea. Extraction, purification and characterization of water soluble galactommans from Mimosa pudica seeds. The EuroBiotech Journal 2017; 1(4):303-309.
19. Ke Yuan, Jie Li Lu, An Jia, Jian Xin Zhu. Two new C-glycosylflavones from Mimosa pudica. Chinese Chemical Letters 2007;18(10): 1231–1234.
20. J. Vejayan, H. Ibrahim, I. Othman. The potential of Mimosa pudica (Mimosaceae) against snake envenomation. Journal of Tropical Forest Science,2007;19(4):189-197.
21. Joby Jose, A. T. Dhanya, Karickal R. Haridas, T.M. Sumesh Kumar, et al. Structural Characterization of a novel derivative of myricetin from Mimosa pudica as an anti-proliferative agent for the treatment of cancer. Biomedicine & Pharmacotherapy 2016; Vol 84:1067-1077.
22. Felisa Paramar, Nisha Kushawaha, Hyacinth Highland, Linz-Buoy George. In Vitro Antioxidant and Anticancer Activity of Mimosa Pudica Linn Extract and L-Mimosne on Lymphoma Daudi Cells. International Journal of Pharmacy and Pharmaceutical Sciences 2015; 7(12):100-104.
23. Jing Zhang, Ke Yuan, We-long zhou and Jian Zhou, Ping Yang. Studies on the active components and antioxidant activities of the extracts of Mimosa pudica Linn. from southern China. Pharmacognosy Magazine 2011; 7(25):35-39.
24. Chhaya H. Gadgoli, Dnyaneshwar D. Kokane, Rahul Y. More, et al. Evaluation of wound healing activity of root of Mimosa pudica. Journal of Ethnopharmacology 2009; 124(2):311-315.
25. Ashekul Islam, Mohammad Shah Hafez Kabir, Raju Dash, Talha Bin Emran, Md. Zia Uddin, Khairun Nesa, et al. Virtual screening for potential COX-inhibiting constituents from Mimosa pudica. Journal of Applied Pharmaceutical science 2015;5(7):71-75.
26. MT Muhammad, K Abdullahi, K Shehu, SA Shinkafi. Antifungal activity of Mimosa pudica leaves against fungal isolates from razor bumps in Sokoto Metropolis, Nigeria. Annals of Biological Sciences 2015; 3(1): 16-19.
27. Palwinder Kaur, Nilesh Kumar, TN Shivananda, Gagandeep Kaur. Phytochemical screening and antimicrobial activity of the plant extracts of Mimosa pudica L. against selected microbes. Journal of Medicinal Plants Research 2011, 5(22):5356-5359.
28. Varahalarao Vadlapudi, K Chandrashekar Naidu. In-vitro bioactivity of Indian medicinal plants Lantana camara and Mimosa pudica against important pathogens. Annals of Biological research,2010,1(1):98-101.
29. Rekha Rajendran, Ekambaram Krishnakumar. Hypolipidemic Activity of Chloroform Extract of Mimosa pudica leaves. Avicenna Journal of Medical Biotechnolgy 2010; 2(4):215-221.
30. Md. Saifuddin Khalid, Shah Jinesh Kumar, D. K. Suresh, Rajnish Kumar Singh, I. V. Narasimha Reddy, Sunil Kumar. Evaluation of anti-diarrhoeal potential

of ethanolic extract of Mimosa pudica leaves. International Journal of Green Pharmacy 2011;5(1):75-78.
31. Rekha Rajendran, S. Hemalatha, k. Akasakalai, C.H. MadhuKrishna, Bavan sohil et al. Hepatoprotective activity of Mimosa pudica leaves against Carbontetrachloride induced toxicity, Journal of natural product, Vol 2 (2009):116-122.
32. Joby Jose, A. T. Dhanya, Karickal R. Haridas, T.M. Sumesh Kumar, et al. Structural Characterization of a novel derivative of myricetin from Mimosa pudica as an anti-proliferative agent for the treatment of cancer. Biomedicine & Pharmacotherapy 2016; Vol 84:1067-1077.
33. Tasnuva Sarwar Tunna, Md Zaidul Islm Sarker, et al., Enrichment, in vitro, and quantification study of antidiabetic compounds from neglected weed Mimosa pudica using supercritical CO2 and CO2- Soxhlet, Separation science and technology,2018, 53(2):243-260.
34. F. N. Momin, B.R. Kalai, V.S. Godse, N.S. Patole, T.Shikalgar, N.S. Naikwade. Gastroprotective Effect of Mimosa pudica Leaves Extract on in-vivo Test Models in Rats. Journal of Biologically Active Products from Nature 2011; 1(3): 160-167.
35. Ndanusa Abdullahi Hassan, Rohini Karunakaran, Suleiman Abdlmumin. A review on a pharmacological and traditional properties of Mimosa pudica. International Journal of Pharmacy and Pharmaceutical Sciences 2019;11(3):12-6.
36. Mausumi Ganguly, Nirada Devi,Rita Mahanta, Mridul K Borthakur. Effect of Mimosa pudica root extract on vaginal oestrous and serum hormones for the screening infertility activity in albino mice, Contraception 2007; 76(6): 482-485.
37. Rohan N, Durgadevi P, Mythily V. B., Elanchezhiyan M. Prevention of hepatitis B virus (HBV) replication by extracts of Mimosa Pudica, an unique Indian medicinal plant. BIOINFO Drug targets 2014;2(1):20-23.
38. Kuldeep Singh, Ashok Kumar, Naresh Langyan, Munish Ahuja. Evaluation of Mimosa pudica Seed mucilage as Sustained-Relese Excipient. American Association of pharmaceutical Scientists Pharm Sci Tech 2019;10(4):1121-1127.
39. Nwaoga J.A., Okonkwo W.I., Unachukwu G. O. Exploring the Photosensitivites of Mimosa pudica for Solar Cell Production. 26th European Photovoltaic Solar Energy Conference and Exhibition 2011: 406-410.
40. Is Fatimah, Rizqi Yulia Pradita, Annisa Nurfalinda. Plant Extract Mediated of ZnO Nanoparticles by using Ethanol Extract of Mimosa Pudica leaves and coffee powder. Procedia Engineering 2016; 148: 43-48.
41. Is Fatimah, Nur Afisa Lintang Mutiara. Biosynthesis of Silver Nanoparticles Using Putri Malu (Mimosa pudica) Leaves Extract and Microwave Irradiation Method. Molekul, 2016; 11(2): 288-298.
42. K Mapala, M Pattabi. Mimosa Pudica Flower Extract Mediated Green Synthesis Gold Ganoparticles, Nano World Journal 2017; 3(2): 44-50.
43. Fadzlie Wong Faizal Wong, Mohd Ezuan Khayat, Zulfazali M sobri, Arbakariya B Ariff. The Potential of Mimosa pudica as Biopreservative for food products: a Bio Processing Perspective. Nutritions & Food Science International Journal 2018; 5(3):001-004.