



A review on ethnobotany, pharmacognosy, phytochemistry and pharmacological studies of *Mukia maderaspatana* plant

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Abstract

Indigenous medicinal plants have been used in various traditional systems, as they potentiate immunity against diseases. *Mukia maderaspatana* (Linn.) M.Roem is an indigenous medicinal plant belongs to the family Cucurbitaceae. It is a monoecious climber mostly prevalent in South India, other tropical and subtropical counties. The different parts of the plant are being used for the health benefit of human being and livestock. It has a wide range of phytochemical such as alkaloids, carbohydrates, glycosides, flavonoids, saponins, steroids, terpenoids, tannins and phenolic compounds. Traditional systems of medicine, the leaves, root and fruits of the plant are considered stomachic, anti-ulcer, anti-inflammatory, anti-hyperglycaemic, antihypertensive, antimicrobial, antioxidant, antipyretic, carminative, diuretic, expectorant, hepatoprotective, and anti-rheumatic. The present review focus towards the ethnomedical uses, pharmacognostical description, phytochemical properties and pharmacological investigation of *M.maderaspatana* plant.

Keywords: *Mukia maderaspatana*, *Melothria maderaspatana*, Cucurbitaceae, Pharmacological profile

Introduction

Herbs play a major role in all traditional medical systems as a source of therapeutic agent since antiquity. The plants are benediction of health promoting value and their bioactive compounds prevent and cure the diseases. The global market size of herbal industry has been increased substantially, which have contributed much towards the health and wealth of the nations. Among the nations in Asia, India is one which has one of the most valuable indigenous medical cultures with a perpetual traditional knowledge of treating and curing of diseases by its own heritage systems Ayurveda^[1] and Siddha^[2]. Although modern medicine dominating the health care needs, to the extent of 80% world population depends on traditional medicine for their primary health care needs, recent evidence from pharmaceutical industry indicates that, for certain diseases natural products still represent an extremely valuable origin for the production of new chemical entities. Today, the focus of herbal nutraceuticals is moving towards preventive medicine rather than treatment, and the study of health related edible plants are gaining importance, and it claimed to possess added biological benefit, which may reduce the chronic disease risk or promote health^[4, 5]. To strengthen the traditional knowledge of medicinal plants, it is necessary to the study the ethnomedical use, pharmacognostical description, phytochemical nature and pharmacology activity of individual plants, besides, how the bioactive compounds deed in treating diseases. *M.maderaspatana* (L.) M.Roem. is a functional food species of plant used for cooking and medicinal remedies in South India. The present review is attempted to compile the traditional uses, preclinical and clinical investigations, pharmacognostical and phytochemical properties of the *M.maderaspatana* plant.

Plant profile^[3]

Kingdom: Plantae

Division: Spermatophyta

Sub-division: Angiospermae

Class: Dicotyledonae

Sub-class: Polypetalae

Series: Calyciflorae

Order: Passiflorales

Family: Cucurbitaceae

Genus: *Mukia*

Species: *M. maderaspatana*

Synonyms

Bryonia gracilis (Wall.).

Bryonia hispida (Salisb.),

Bryonia maderaspatana (L.), (Lam.),

Bryonia micrantha Hochst. (Cogn.),

Bryonia micropoda (E.Mey.),

Bryonia rottleri (Spreng),

Bryonia scabra (Rottler.),

Bryonia scabrella (L.)

Cucumis maderaspatanus (L.),

Melothria altaeoides (Ser.), (M.Roem.),

Melothria maderaspatana (L.) Cogn.

Muki scabrella (L.) (Arn.).

Mukia rottleri (M.Rome.),

Trichosanthes diocia (Wall.),

Vernacular name

Tamil name: Mosumusukai, Musumusukai

English name: Madras pea pumpkin, Rough bryony

Hindi: Aganaki, Agumaki, Bilari.

Kannada: Chitrati

Malayalam: Chitrati

Marathi: Chirati, Bilavi.

Sanskrit: Musimusikkay

Sinhala: Heenkekiri, Len kekiri

Telugu: Musumusukaya

Habit and habitat

M.maderaspatana is an annual, monoecious, prostrate climbing herb also known as climbing vine with dense white hair. It is globally distributed throughout the tropics and subtropics. It was found in India at hilly region mainly in Kerala, Karnataka, Tamil Nadu and Maharashtra. The climber found in plain lands and in deciduous forests [3, 6].

Pharmacognosy

It is an annually or monoecious herb, has alternate, symmetrical ovate to lanceolate leaves with the margin, often sagittate to cordate, mucronate, acuminate or sparsely serrate apex, angularly shallowly to deeply 3-5 lobed, are 5-9 cm long, 3-10cm wide, simple and petiolated, slightly bitter in taste. Petiole is 3-7cm long, slender and pubescent. Stem are cylindrical 2-7mm in diameter, fresh stems are white dense hairy with greenish but light brown when dried, showing imperceptible longitudinal ridges and soft to touch. Roots are 10-30cm long with lateral branches, light brown when fresh and dark on dry. Flowers are yellow in colour, 1cm across axillary, sessile cluster, calyx tube to 2mm, Villous; lobes, stamens 3, free, inserted at base of calyx tube; anthers oblong, ciliate, female flower solitary or in cluster, ovary villous. Fruit; berry 1.2 cm across, globose, pea-sized fruits are green, turning to orange and then red, as they mature, seeds lenticular, rugose. Hairs are present over the plant.

According to the World Health Organisation (WHO), Pharmacognostical standards are considered to be the primary steps for diagnosis of the herbal drugs, includes macroscopical and microscopical evaluation of the particular plants or parts of the plant. Further the histochemical studies of plant tissues tends to broaden the views about the type of phytochemicals and their occurrence in plant tissues, helps in proper selection for its possible medicinal value. The special features of *M. maderaspatana* from its microscopical studies showed uniseriate multicellular covering trichomes on leaf and stems, ranunculaceous type stomata in the leaf, petiole and tendril. Nine bicollateral vascular bundles arranged in a ring with drum or barrel-shaped xylem vessels are special feature of the plant stem, mature root showed heavy suberized brick-shaped cells on cork with simple and compound starch grains in the cells of secondary cortex [6].

Ethnobotany

The plant leaves find a prominent place in Siddha and Ayurveda system of medicine and it helps in providing a staple diet by providing sufficient antioxidants, phytoconstituents, essential elements and fibres [3]. A diversity of plants has been used as edible vegetables. Preclinical and clinical study points to the close interrelation between diet and the chronic illnesses. According to gunapadam the leaves of *M.maderaspatana* uses to treat cough, asthma, phlegm in lungs, protective cough, chest burning and rhinorrhea. The root uses in treatment of male infertility, odor sputum in lungs, vomiting, gastritis as dry powder or decoction. It causes pitha diseases and indigestion while taking korasanai with *Mukia's* leaf juice [7]. The literature shows the root and leaf are used to treat fever, dyspnea, abdominal disorder, cough and vomiting, the leaf decoction to treat hypertension and nasobronchial diseases [8]. Dosa with musumukkai leaf, a delicious food with soaked red rice consumed as staple food in South India

[9], *Mukia's* leaf and salt and it is useful in cough, Phlegm and tuberculosis. The leaf extract also used to treat toothache, vertigo and biliousness [9]. Tea prepared from leaves and bark is act as decongestant and given to cure cough, cold, flu, and also for jaundice too. Toothache can be cured while masticate the seeds and crushed seeds can be applied on body and back for relief pain in Mundas of the Chota Nagpur region [3, 9]. The Ayurveda medical system prescribe the leaves and roots of *M.maderaspatana* for asthma, cough, burning sensation, dyspepsia, flatulence, colic, constipation, ulcer, neuralgia, nostalgia, odontalgia and vertigo [11, 12]. The fruit is used in dysuria, polyuria, piles and tuberculosis [13]. Musumukkai is reported to commonly used ethnomedicinal plant in South Indian especially Kani traditional healers inhabiting in Western Ghats in Tirunelveli [14] the plant is sold as vegetable food in Coimbatore region [15]. In livestock, *M.maderaspatana* leaves, pounded with pepper, garlic and cumin are used in Chittur district of Andhra Pradesh, for treating hygroma in cattle [16]. An indigenously prepared herbal bolus, containing the plant is claimed to be useful in developing immunity and in controlling digestive disorders of cattle [3]. The plant species to a certain extent has also been made use in the treatment of rabies along with many other plants found in the regions of Africa [3, 16].

Chemical constituents

Phytochemicals are naturally present in the plants and shows biological significance by playing a vital role in the plants, provides various health benefits to the consumer. It is essential for the exploration of the active chemical constituents of medicinal plants, their quantification and analysis of the beneficial and toxic effects to human health. GC-MS analysis of the leaf extract showed presence of phytol act as skin care agent, alpha-tocopherol act as antioxidant, used to cure heart disease, cancer and cataract [17]. Phytochemical studies on *M.maderaspatana* plant showed the presence of phytochemicals, decosanoic acid, β -Sitosterol and a Pentanol [18]. Coumarin, phenolic compounds, flavonoids, steroid, triterpene, 22, 23-dihydrospinosterol-3-O- β -D-glucoside [19]. Phytochemical studies using GC-MS analysis on 70% hydro-alcoholic extract of the leaf, *M.maderaspatana* revealed the presence of Dichloroacetic acid, 4-methylpentyl ester, 2-Butyn-ol, 4-methoxy and also showed alkaloids, flavonoids, tannins, saponin, steroids, terpenoids, cardiac glycosides, carbohydrates, phenolic compounds [20].

The plant leaves contains mainly 2-methylthiolane, S,S-dioxide. Diazene, bis(1,1-dimethylethyl). 3-Buten-2-ol, 2-butyn-1-ol, 4-methoxy. Dichloroacetic acid, 4-methylpentyl ester. 2-(chloromethyl)-2, 3-dihydro-4(1H)-quinolinone, Pantolactone compounds, most of these phytochemicals plays as antimicrobial activity [21]. Aminoacids; L-glutamic acid, D-, L-alanine, L-leucine, D-, L-serine, D-,L-aspartic acid, L-proline, L-tyrosine, D-, L-threonine, phenylalanine, D-, L-3, 4-dihydroxyphenylalanine, L-hydroxyproline, D-,L-norleucine, D-,L-methionine, L-arginine, L-glycine and L-valine are present [17]. Sugars like namely, arabinose, fructose, glucose, mannose, sucrose, xylose, galactose and ribose are present [22]. Polyphenolic composition of the aqueous alcoholic extract of the edible leaf was analysed by HPTC and the six C-glycoflavone compounds have been characterized as 7-O- β -D-glucopyranosyl-6-C- β -D-glucopyranosylapigenin (saponarin), 7-O- β -D-

glucopyranosyl-6-C- β -D glucopyranosylluteolin (lutonarin), 6-C- β -D-glucopyranosylapigenin (isovitexin), 6-C- β -D glucopyranosylluteolin (homoorientin), 8-C- β -D-glucopyranosylluteolin (orientin), 8-C- β -D glucopyranosylapigenin (vitexin) [23]. HPTLC analysis of ethyl alcohol extract of leaf and root samples gave three and five bands respectively. Both the leaf and root samples showed the presence of β -sitosterol, the root sample shows the presence columbin [21].

Pharmacological activities

The plant was reported to have stomachic, antiasthmatic, anti-ulcer, antifatulent, antirheumatic, anti-inflammatory, anti-microbial, antipyretic, diuretic, antibronchitis, antidiabetic, hypolipidemic [3], hypotensive, aperient, anti-platelet aggregation, immunomodulatory [21], anxiolytic, anti-inflammatory [25], local anesthetic, chemoprotective and hepatoprotective [4].

Antioxidant activity

Aqueous extracts of *M.maderaspatana* leaves were tested for *in vitro* antioxidant activity, the extract effectively scavenged hydroxyl radical, hydrogen peroxide and superoxide anion radicals. Flavonoids and phenolic compounds in leaf extract possess high antioxidant activity [26]. Flavonoids in *M.maderaspatana* also have antioxidant capacity and reduce the incidence of cardiovascular disease [27, 28]. The antioxidant effect of ethanolic extract of leaf in the sham-operated and uninephrectomized DOCA-salt induced hypertensive rats has also been investigated, the author concluded that the leaf extract possess strong antihypertensive and antioxidant properties [29]. The total phenolic content (TPC) and total antioxidant activities were evaluated for the ethanolic extract of dehydrated leaves to assess the *in vitro* antioxidant activities, it showed the highest phenolic content (269.34 ± 0.78 mg GAE/g), and total antioxidant activity (543 ± 46 μ mol Trolox/100 g), besides HPTLC analysis has revealed the presence of significant quantity of Quercetin (26.52%), an important flavonoid of tremendous antioxidant, anticancer and anti-inflammatory properties in both the fresh and dehydrated leaves which might be the chief bioactive principle in *M.maderaspatana* [30].

Hepatoprotective activity

Hepatoprotective capacity of the aqueous extract of *M.maderaspatana* aerial part on albino rat from CCl₄ induced liver damage has been evaluated, they have reported significant improvements damaged liver histopathology, alanine aminotransferase, aspartate aminotransferase, alkaline phosphatase, aniline hydroxylase and para aminopyrine-N-demethylase activities [31]. *In vitro* study on damage induced in freshly isolated rat hepatocytes by D-galactosamine and tert-butyl hydroperoxide has also been evaluated, the results showed significant dose-dependent protection against hepatocyte damage [21]. Besides, methanolic extract of root acts as a good hepatotonic and decrease the elevation of SGOT, SGT and ALT of STZ-induced diabetic on Sprague-Dawley rats [32] so, the previous studies prescribes the plant in the management of liver disease.

Anti-hyperglycemic activity

Ethanolic extract of aerial part of *M.maderaspatana* oral administration in alloxan induced diabetic rats, showed insulinotropic activity. It reduces the serum glucose level

and increase the glycogen formation, no hypoglycemic effect on normal rats [33]. It reduces the endogenous glucose output from the liver and increase the glucose uptake by skeletal muscles. The extract has marked glucose tolerance equal to metformin [32]. Methanolic root extract of the plant treatment to alloxan induced diabetic rats was capable of regulating the normal metabolic line from its deviation in the blood glucose level [34]. On other hand, no significant increase in blood glucose has been reported from aqueous extract of the plant on STZ-induced diabetic rats compare to diabetic control, the histopathological assessment of the pancreas of the treated rats showed protective effect against the STZ-induced cell damage [35]. A study was showed that significant reduction in intestinal glucose absorption and promotes insulin secretion by incubating β -cell of islet of Langerhans and INS-1E insulinoma cells [36]. *In vitro* study on gluconeogenesis and glucose uptake in rat tissues revealed that *M.maderaspatana* has diverse antidiabetic effect and inhibit the gluconeogenesis and potentiate the insulin action on glucose uptake [37], another earlier *in vitro* study of ethanolic extract and fractions of the plant investigated their antidiabetic activity by α -glucosidase and α -amylase inhibitory activity, showed dose dependent inhibition, this the plant helpful to develop medicinal preparation and nutraceuticals for diabetes [38]. It was explored that the possible mechanism of antidiabetic activity of the ethanolic extract of whole plant of *M.maderaspatana* on high-fat diet and STZ induced diabetic rats, showed the decreased serum levels of fast blood glucose (FBG), TG, TC, LDL-C, and VLDL-C, as well as increased serum levels of HDL-C, also improve the oral glucose tolerance test, the activity possible through strong antioxidant activity of the phenolics [39]. Since the plant rich in poly phenolic compounds, traditional knowledge of its use in folk medicine for antidiabetic properties provide a potential phytosource for the treatment most prevalent diabetes [40].

Anti-hyperlipidemic activity

Hyperlipidemia is the primary risk factor of coronary heart diseases. Aqueous extract of the dried aerial part of the plant shows the reducing effect in serum lipid level in high-fat diet to albino rats. It reduces the TC, TG, LDL, VLDL, PL and increases the HDL [41]. STZ induced diabetic rats showed the significant recovery in altered biochemical parameters with hypolipidemic potential and reduced body weight by administration of ethanolic extract of the plant [32], though this plant can be used in coronary and atherosclerotic heart disease. Antihyperlipidemic effect of crude ethanolic extract of *M.maderaspatana* leaf on deoxycorticosterone acetate (DOCA)-salt hypertensive rats was investigated, it inhibit the lipidperoxidative effect [42]. Ethanolic extract and its chloroform and n-butanol fractions of the whole plant showed antidiabetic and antioxidant property in streptozotocin (STZ) induced diabetic rats, it improved the lipid level and lipoprotein level to a normal condition which may be attributed to its potent antidiabetic activity [43].

Anti-hypertensive activity

Antihypertensive activity has been proved by a number of studies and it showed a good report on lipid profile, fibrinogen level and BMI [41]. A previous study stated ethanolic and ethyl acetate leaf extracts reduces systolic and diastolic pressures on sham-operated and uninephrectomized DOCA-salt induced hypertensive on rats

[29]. Coumarin, vullinic acid *p*-coumaric acid, gallic acid, caffeic acid and ferulic acid were identified in ethyl acetate fraction; coumarin in leaf extract also has hypotensive activity [44]. In human study leaf tea is prescribed for 45 days who have uncontrolled systemic hypertension in human, it can reduce both systolic and diastolic pressure [45]. The leafy-vegetable, *M.maderaspatana* has vasoprotective potentials [40].

Anti-inflammatory activity

The earlier study reveals methanolic extract of leaves has anti-inflammatory activity and it made a significant mild to moderate improvement in the symptomatic parameters and laboratory parameters without adverse effects. It has also plays as anti-rheumatic activity. It is good in rheumatoid arthritis management [46]. *In vitro* and *in vivo* screening of anti-inflammatory activity was evolved by inhibition of protein denaturation and proteinase activity, it is found to be having a high level of proteinase inhibition action, led anti-inflammatory activity, similarly the reduction of paw edema in carrageenan induced rat [47].

Immunomodulatory activity

In-vitro study reveals methanolic extract of whole plant of *M.maderaspatana* has immunomodulatory effect in both classical and alternate pathway in the complementary system of the human being. According to the study, the effects have been dose-dependent inhibition of luminol-induced chemiluminescence of human polymorphonuclear leukocytes upon stimulation with zymosan [48].

Anti-platelet aggregation activity

Platelets play a fundamental role in hypertension, is a major risk factor for myocardial infarction as expression of the atherogenic processes. A number of phytoconstituents tend to inhibit platelet aggregation and re-establish the broken equilibrium between pro-aggregating and anti-aggregating factors during pathological conditions. Flavonoids from the *M.maderaspatana* plant extract inhibit platelet aggregation in platelet-rich plasma in presence of adenosine diphosphate (ADP). This phytoconstituent reduces the atherogenic changes and prevent hypertension, Stroke and myocardial infarction [49].

Antibacterial and Anti-microbial activity

Plants synthesis numbers of bioactive molecules in response to environmental stimuli, and a number of these molecules have antimicrobial properties. Nowadays microorganisms are exponentially developing resistance against the drug in use, to combat against these drug resistant microbes, large number of novel compounds are required, this open the gateway to medicinal plant research, to develop a potent medicaments against pathogenic microbes. Methanol extract of fresh plant inhibit the microorganism of bacterial and fungal strains, the extract fights against *Staphylococcus aureus*, *Bacillus subtilis*, *Pseudomonas aeruginosa* and *Escherichia coli*, the fungus *Candida tropicalis* and *Trichophyton rubrum*, methanolic extract possesses pronounced antimicrobial activity [50].

Comparative antimicrobial potential of *M.maderaspatana* was investigated on various fractions of aerial parts of the plant from Indian and Srilankan origin by cup plate method against *E.coli*, *P.aeruginosa*, *K.pneumonia*, *Streptococcus*, *Staphylococcus aureus* and two fungi *C.albicans* and

A.niger. It showed diverse antibacterial activity and negligible antifungal activity, but both varieties showed pronounced antibacterial activity against Streptococci [51]. Stem and Leaf-ethanolic extract showed good antimicrobial effect against *Klebsiella pneumoniae*, *Pseudomonas putida* and antifungal activity on *Rhizopus* sp. and *Aspergillus flavus* [52]. Other studies by agar well diffusion test, methanolic extract of the plant showed maximum antibacterial effect on *K.pneumonia* strain [53]. Another study on the ethanolic extract of aerial part of the plant showed antibacterial activity against, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *E.coli*, *Clebsilla pneumonia* but resistant against *Salmonella typhi* [7]. Phenolic compounds in the plants thought to be toxic to microbes, inhibiting enzymes which are essential for their growth.

Study was carried out to evaluate the phytochemical constitution, nutrient composition and antibacterial potential of leaf and stem parts of *M.maderaspatana*. The results obtained suggest that considerable amount of ascorbic acid and phosphorus is present in the plant parts. The acetone fraction of both leaf and stem of the plant has pronounced antimicrobial activity. Hence, the findings of the present study suggest that the rich nutrient content and antibacterial activity of *M.maderaspatana* may be responsible for its wide traditional use as food and medicine [54].

The comparative antimicrobial activity with wild plant *M.maderaspatana* and callus initiated from leaf. Different solvent extracts obtained from wild aerial parts of the plant along with methanolic callus extract were treated against nine human pathogenic bacterial organisms, such as *Bacillus subtilis*, *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumoniae*, *Proteus mirabilis*, *Pseudomonas aeruginosa*, *Proteus vulgaris*, *Serratia marcescens* and *Vibrio cholerae*. Among the extracts used, crude methanolic extract showed maximum inhibition [55].

Chromium oxide nanoparticles were synthesized by the reduction of potassium dichromate solution with *M.maderaspatana* plant extract by electrochemical methods. The antibacterial effect of Cr₂O₃ nanoparticles against *E. coli* and *Pseudomonas aregunosa* were investigated by disc diffusion method. These particles were shown to have an effective bactericide against *E.coli* than *P.aregunosa* [56].

The antimicrobial activities of silver and gold nanoparticles with *M.maderaspatana* as a reducing agent were checked against bacterial and fungal strains by well diffusion assay. The results concluded that the silver nanoparticles showed efficient activity against bacterial and fungal pathogens. The results suggested that the metal nanoparticles with plant extract can be utilized as an antimicrobial formulation was possible yet, the incorporation of nanoparticles in the medications which can eradicate many microbial assisted disease [45]. Aqueous leaf extract were studied its antibacterial activity against different bacteria, *Klebsiella spp.*, *Escherichia coli* and *Bacillus spp.*, of which against *E. coli*, the best antibacterial activity was observed with the leaf aqueous extract [58].

Anti-ulcer activity

The pathophysiology of gastric ulcer is generally due to the imbalance between the aggressive and the protective factors in the stomach, such as acid-pepsin secretion, mucosal barrier, mucosal secretion, blood flow, cellular regeneration, prostaglandins and epidermal growth factors. Reactive

species especially hydroxyl radical, is believed to play a major role in causing oxidative damage of mucosa in all types of ulcer [3]. So many number of drugs including H2 receptor, antacid and proton pump inhibitors are available for the treatment of peptic ulcer, but clinical evaluation of all these drugs has shown incidence of relapses and side effects. This has been the rational for the development of new antiulcer drugs and the search for novel molecules has been extended to herbal drugs that offer better protection and decreased relapse. Antiulcer activity of crude aqueous suspension of dried leaves investigated on stress induced ulcer in male albino Wistar rats, the elevated parameters have brought back, close to control animals, and hence it is mostly effective in stress induced ulcer [59]. Another study from same author on ethanolic extract of root of *M.maderaspatana* in ethanol induced ulcer in Wistar rats. The extract showed significant gastro protective activity [60]. The ethanolic extract of *M.maderaspatana* was able to reduce gastric mucosal lesions, malondialdehyde, TNF- α levels, while increased gastric juice mucin content and gastric mucosal catalase, nitric oxide and PGE2 levels in rats with indomethacin-induced gastric ulcer, the effect suggest, gastric protection conferred by its antioxidant, antiinflammatory and mucin-agonist properties of the plant constituents [61].

Anxiolytic activity

A feeling of apprehension, uncertainty or tension stemming from the anticipation of imagined or unreal threat is characterized as human anxiety³. Hydro-alcoholic extract of leaves has sedative action and behavioral pattern of this phytoconstituents acts similar to diazepam. Flavonoids, saponin and tannins in the extract have anxiolytic activity and especially for CNS disorders [62]. The effects of *M. maderaspatana* fruit peel powder dissolved in deionized water on single immobilization stress-induced behavioral deficits and memory changes in rat. Anxiolytic, antidepressant, and memory-enhancing effects of *M. maderaspatana* were observed in both unstressed and stressed animals. Lipid peroxidation was decreased while antioxidant enzymes were increased in both unstressed and stressed animals. Acetylcholine level was increased while acetyl cholinesterase activity was decreased in both *M.maderaspatana* treated unstressed and stressed rats. There was also an improvement in memory function. Serotonin neurotransmission was also regulated in *M. maderaspatana* treated rats following immobilization stress with anxiolytic and anti-depressive effects [63].

Local anesthetic activity

Ethanolic extract of air dried leaves of the *M.maderaspatana* has been investigated on the frog using nerve block anaesthesia method. The extract has localanesthetic activity and the effect had long lasted among the tested group *in vivo* [75].

Anti-Anaemic activity

The present study was focused to evaluate the anti-anaemic activity of *M.maderaspatana* of Cucurbitaceae family on phenylhydrazine induced anemia in rat. Plant extract significantly enhanced the RBC and hemoglobin content, compared with standard, the effect due to recovery from free radical damage by the anti-oxidant potential of the plant

constituents. There was no significant change in the WBC content after the treatment of the plant extract [65].

Diuretic and renal protective activity

Hydro-Alcoholic Extract of *M.maderaspatana* whole plant was found to possess diuretic property and it was compared with acetazolamide, the rate of urine volume and electrolytes excretions were measured, the results showed that plant have diuretic activity [66]. The renal protective effect of ethyl acetate fraction of *M.maderaspatana* leaf investigated on uninephrectomized DOCA-salt hypertensive rats. The study indicated that the ethyl acetate fraction provides good control in blood pressure and also protect the renal damage by preventing the abnormal activities of plasma renin, angiotensin II and aldosterone as evidenced by decreased plasma levels of urea, uric acid and creatinine [67].

Larvicidal activity

The species *Aedes aegypti* is a vector causing dengue fever, which is a public health problem in the world. During epidemics, emphasis is laid on the use of insecticides for controlling mosquitoes. A study was made to monitor the effect of plant extract of *M.maderaspatana*, on different larval instars and pupae of mosquito vector of *A. aegypti*. The study indicated that essential compounds were the only chemical used for the control of mosquito larvae while extract was used as the control of adult mosquitoes. The results suggest a potential utilization of the extracts of these plant for the control of dengue other vector disease spread by mosquitos [68]. The application of easily degradable plant compounds is considered to be one of the safest methods to control insect pests and vectors as alternatives to synthetic pesticides [69].

Analgesic activity

The study explored the analgesic activity of the fresh leave sap of *M.maderaspatana* by tail immersion method in albino rats. The fresh leaf sap of the plant is found to have a good analgesic property [70].

Anticancer and acute oral toxicity study

The treatment of cancer is to stop the growth by killing the cancer cells or by inhibiting them from dividing. Even though many number of anticancer drugs are available in the market, there are many side effects, including toxic to normal cell, therefore, the patient needs secondary palliative care. It play essential role in the discovery of safe lead compounds from conventional drugs. About 60% of the currently used anticancer drugs are derived from plant source, hence it is essential to develop drug from the medicinal plants without toxic side effects, and elucidate their structures by advanced techniques. The plant *M.maderaspatana* used to assess the acute oral toxicity on Swiss albino female mice by OECD test guidelines 423. The results showed that no any unusual change in animals. Phytochemical study showed that the plant possess high concentration of flavonoids and phenolic compounds [71]. *In vitro* cytotoxic study of the biosynthesized metal (gold and silver) nanoparticles through an environmentally admissible route using the *M.maderaspatana* plant extract on the MCF7 breast cancer cell lines. The results showed that the nanoparticles exhibited significant cytotoxic effects with IC 50 value of 44.8 μ g/g for gold nanoparticles and 51.3 μ g/g

for silver nanoparticles. The observations in this study show that this can be developed as a promising nanomaterial for cancer treatment [72].

Other activity

The plant explored there anti-wart effect in cattle. 10% of herbal ointment was prepared for the treatment of warts in clinical cases of cattle. The clinical study results revealed significant anti-wart effect at 10% concentration of this herbal ointment. Enriched phytochemicals like tannins, potential therapeutic properties like antiviral, antibacterial, anti-haemorrhoidal, vasoconstrictor activities, and other properties like inhibition of lipid peroxidation and coagulation of proteins could be the reasons for the anti-wart effect of this herb [73].

Drug release study

Phytosome are more bioavailable form as compared to simple herbal extracts owing to their enhanced capacity to cross the lipid rich bio membranes and finally reaching the blood. In human and other higher animals the phospholipids are employed in cell membrane, transport a large variety of proteins in the form of matrix. Most of the bioactive constituents of phytomedicines are flavonoids. However many flavonoids are poorly absorbed. In present status various dosage form of herbal formulation are available in the pharmaceutical market but the main problem is there bioavailability so as to make its better absorption, need a better dosage form. Phytosome protect water soluble phytoconstituents like flavonoids from destruction by enzymes, shows better absorption and good bioavailability. To improve pharmacodynamics and pharmacokinetic parameters of *M.maderaspatana*, the extract of plant loaded phytosome produced and investigated there *in vitro* permeation efficacy by pouring the phytosome on Millipore membrane filter (0.15mm) between the donor and receptor compartments on an all-glass modified Franz diffusion cell. The highest drug release of 96.19% was observed with phytosome formulation contains 1:3 ratio extract and polymer complex, 2% propylene glycol and 40% alcohol [74].

Discussion and Conclusion

M.maderaspatana (L) though a vegetable food but it has several phytochemicals. Different phytochemical studies on the plant revealed the presence of alkaloids, flavonoids, tannins, saponins, steroids, terpenoids, carbohydrates, and phenolic compounds, minerals of iron, phosphorus, copper, vitamins C, E and fibers.

Many phytocompounds are identified and characterized from *M. maderasapatana* plant; they are decosanoic acid, β -Sitosterol and a Pentalcohol. Coumarin, phenolic compounds, flavonoids, steroid, triterpine, 22,23-dihydrospinosterol-3-O- β -D-glucoside. The plant leaves contains mainly 2-methylthiolane, S,S-dioxide. Diazeene, bis(1,1-dimethylethyl). 3-Buten-2-ol, 2-butyne-1-ol, 4-methoxy.Dichloroacetic acid, 4-methylpentyl ester. 2-(chloromethyl)-2,3-dihydro-4(1H)-quinolinone, Pantolactone compounds, most of these phytochemicals plays as antimicrobial activity. Aminoacids; L-glutamic acid, D-, L-alanine, L-leucine, D-, L-serine, D-,L-aspartic acid, L-proline, L-tyrosine, D-, L-threonine, phenylalanine, D-, L-3, 4-dihydroxyphenylalanine, L-hydroxyproline, D-,L-norleucine, D-,L-methionine, L-arginine, L-glycine and L-

valine are present. Polyphenolic composition of the aqueous alcoholic extract of the edible leaf was found to be saponarin, lutonarin, isovitexin, homoorientin, orientin and vitexin.

Ethyl alcohol extract of leaf and root shows the presence β -sitosterol and columbin respectively. The plant is rich in sugar, namely, arabinose, fructose, glucose, mannose, sucrose, xylose, galactose and ribose. Many of these chemicals have potential medicinal properties and are used in medicines.

According to Siddha medicine, the plant has stomachic, anti-ulcer, antiflatulant, anti-inflammatory, antipyretic, diuretic and hepatoprotective. Ayurveda describes that the plant has expectorant, refrigerant, carminative, aperients, sudorific, anodyne and tonic activities. The recent investigations by the researches reveal that, *M.maderaspatana* plant possess antioxidant, anti-hyperglycaemic, anti-hyperlipidaemic, antihypertensive, antiplatelet activity, antiulcer, antimicrobial, anti-inflammatory, anxiolytic, antianaeamic, diuretic and renal protective, antirheumatic, anticancer and larvicidal activities. The medicinal use of *M.maderaspatana* plant extract and the use of it as a nutraceuticals or functional food have increased due to its wide range of biological activities. Taking these species as a part of the diet in the form of Dosa and chutney, etc. could be followed so that a healthy intake is done always and not only during problems. The present review study explained the various pharmacological potentials due to the active compounds of the plant. The active and extensive survey of natural sources has provided new ideas and changes based on the understanding of complex mechanisms. This study will lead to develop safe and effective pharmaceuticals to offer safe and effective treatment.

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