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A review on pharmacological activities of Mukia maderaspatana

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Abstract--Cucurbits are consumable crops, belonging to the family of Cucurbitaceae. They are widely distributed in the regions of tropical and sub-tropical region. These tendril climbers are grown in village surrounding. The plant has been grown from olden days for its medicinal value. It is used as herbal drug for cough and cold. All parts of plant such as leaf, stem, root, fruit and seeds are used in historical system of medicine. Cucurbits are naturally trailing plant. Edible food such as watermelon and cucumber are found in cucurbit family. Plants belonging to cucurbits family are higher in nutritional value. Mukia maderaspatana belongs to Cucurbitaceae genus. It is (called as “musumusukkai” in tamil). It is also known as Cucumis maderaspatana. Mukia maderaspatana has pharmacological activities such as aperient, diuretic, stomachic, antipyretic, anti-flatulent, anti-asthmatic, antitussive, antihistaminic, antibronchitic, hypolipidemic, hepatoprotective, hypoglycaemic, antiulcer. Phytochemical screening shows the presence of glycosides, flavonoids, phenols, alkaloids, saponin, carbohydrate and steroid in ethanol and methanol

extraction. In this article we discuss on pharmacological activities of *Mukia maderaspatana*.

Keywords--cucurbits, herbal drug, mukia maderaspatana, musumusukkai, pharmacological activity, phytochemicals.

Introduction

Cucurbitaceae family are generally called as gourds (Sugashini Settu & Sathiavelu Arunachalam, 2019). Plants are essential for surviving of human and providing food and medicine (Gomathy G et al., 2012). India follows a variety of medicine system such as Ayurveda, siddha, unani, naturopathy relying on the varieties of plants and originated from the ancestral ethnic group. Currently nutritional research focussing on the preventive medicine. The edible part of *Mukia maderaspatana* repeatedly consumed in dishes, savouries in South India (Petrus A J A 2013). The leaves and roots of musumusukkai are consumed as vegetables and also both ripe and unripe fruit also consumed (Rahman A.H.M.M et al., 2006). The phytoconstituents of *Mukia maderaspatana* possess hepatoprotective, antirheumatic, diuretic, antiflatulent, antidiabetic, antiasthmatic activity (Gomathy G et al., 2012). The aerial parts of plants are also used for vertigo and biliousness (Moumita Banerjee & Thankamani V, 2013). *Citrullus lanatus* commonly known as watermelon belongs to Cucurbitaceae family, posses pharmacological activities due to presence of phytochemicals such as phenolic compounds, Flavonoids, terpenoids and also excellent source of micronutrients (Habibur Rahman et al., 2013). In Naturopathy, the drug from musumusukkai has been used to treat chronic respiratory disease for humankind, and drug product such as Asthacure, Asthmex, Bronkease, Respease and Musumusukkai chooranam, and also used as drug for cattle classically (Petrus A J A 2013). Industries relied with medicinal plants in field of cosmetic, food and pharmaceutical (Sugashini Settu & Sathiavelu Arunachalam, 2019).

Botanical description

Mukia maderaspatana (Linn) Cogn. Agmuki is known as common name for musumusukkai. The leaves of plant are deltoid-ovate in shape. It is entirely angled or 3-5 lobed, acute or subacuminate, coarsely dentate-serrate, scabrous with tiny hairs on dorsal and ventral sides. Colour of the flower is yellowish. The matured fruits are spherical, shiny and red in colour (Rahman A.H.M.M et al., 2006). The leaves of *Mukia maderaspatana* are ovate and the margin are generally sagittate, cordate, macronate, acuminate (Asha K Rajan et al., 2016).



Figure 1. The leaves of *Mukia maderaspatana*

Taxonomy

The species of Cucurbitaceae family are monoecious and dioecious in nature (Rahman A.H.M.M et al., 2006). Taxonomical classification of *Mukia maderaspatana* are (Sujeethasai K, 2020).

Kingdom	:	Plantae
Division	:	Sermatophyta
Sub-division	:	Angiospermae
Class	:	Dioctyledonae
Sub-class	:	Polypetalae
Series	:	Calyflorae
Order	:	Passiflorales
Family	:	Cucurbitaceae
Genus	:	<i>Mukia</i>
Species	:	<i>maderaspatana</i>

Phytochemistry

The qualitative phytochemical screening of *Mukia maderaspatana* shows the presence of Carbohydrates, protein, alkaloid, tannin, saponins, steroids and glycosides in the ethanolic extraction. Compounds like alkaloids and flavonoids are present in the aqueous extract of stem and leaves of *Mukia maderaspatana* (Kavitha M et al., 2013). The phytochemical compounds obtained from the extraction of ethanol and aqueous are detailed in Table 1.

Table 1
Phytochemical analysis of leaves and whole plant of *Mukia maderaspatana* with
Aqueous and ethanol extraction (Raja MJ & Jagadeswaran A, 2021)

S. No	Phytochemical constituents	Leaves extract		Whole plant extract	
		Aqueous	Ethanolic	Aqueous	Ethanolic
1	Terpenoids	++	++	++	+++
2	Carbohydrates	++	++	++	+

3	Hydrolysable Tannins	+	-	+++	-
4	Glycosides	++	++	+	-
5	Cardiac Glycosides	++	++	+	+
6	Alkaloids	+	+	+	+
7	Flavonoids	-	+	+	+

Pharmacological activity

The phytoconstituents in *Mukia maderaspatana* has high potential curing tendency for disorders such as asthma, histamine, bronchitis, chronic obstructive lung disorder, high fever, flu and also in the treatment of Rheumatoid arthritis, hypertension. It also reported that fruits of *Mukia maderaspatana* used in treatment of piles, polyuria, dysuria, tuberculosis. Fruit has been prepared as lehium and consumed for treatment of naso-bronchial disorders, and also reduces pain during urination. Risks of osteoporosis in senior citizens is reduced by the plant extract, toothache is cured by chewing the roots of *Mukia maderaspatana* (Asha K Rajan et al., 2016).

Antioxidant activity

Antioxidants protects the body from free radicals possessing radical scavenger property (Rekha Rajendran et al., 2010). Oxidative stress is a imbalance between pro-oxidants and antioxidants. Oxidative stress leads the body to disease such as cancer and obesity. Compounds present in curcubits such as cucurbitacins B and E, belonging to family of tannins exhibits antioxidant activity and also possess free radical scavenging tendency (Agata Rolnik MSc & Beata Olas PhD, 2020). The plant constituents such as flavonoids, polyphenols, tannins and saponins are responsible for antioxidant activities. The free radicals are neutralized by phenolic phytoconstituent possessing hydrogen donation in nature (Udaya Prakash N.K et al., 2014). The 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay confirmed the antioxidant activity of *Mukia maderaspatana*. The radical scavenging assays such as DPPH, hydrogen peroxide and hydroxyl radical proved the antioxidant activity by the aqueous extract of *Mukia maderaspatana*. The acetone and methanol extract of roots, stems, leaves and fruits of *M.maderaspatana* exhibit antioxidant activities, the methanolic extract has higher potential than aqueous (Indhumathi paramasivam et al., 2017). Bioflavonoids like quercetin and catechin of polyphenolic compounds possess free radical scavenging and anti-inflammatory action (Moyeenudin H.M & Vijayalakshmi S, 2019).

Antimicrobial activity

Antimicrobial activity performed on Agar well diffusion method by the extracts such as hexane, ethyl acetate, methanol and water from *Mukia maderaspatana* proved inhibition effect on the suspended microorganisms such as *Klebsiella pneumonia*, *Staphylococcus aureus* and *Escherichia coli*. The maximum inhibition by methanolic extract of *Mukia maderaspatana* was against *Klebsiella pneumonia* proved that the phytoconstituents such as flavonoids, alkaloids, phenolics and

saponin is accountable for antimicrobial effect (Moumita Banerjee & Thankamani V, 2013).

Antidiabetic activity

Increase in level of blood sugar is seen in Diabetes mellitus (Sengottuvel T & Sanish Devan V, 2020). *Mukia maderaspatana* has been used for the treatment and prevention of diabetes. In in-vitro study the ethanolic extract of *Mukia maderaspatana* has potent inhibition on the enzymes α -glucosidase and α -amylase that are responsible for digestion of carbohydrates. The active inhibitory effect is performed by flavonoids, terpenes and phenolic compounds. Type 2 diabetes is reduced by the presence of Flavonoids (Ramachandran Vadivelan et al., 2012). Antihyperglycemic activity was proved by the ethanolic and aqueous extract of whole plant of *Mukia maderaspatana*. Ergosterol is an active compound extracted from the methanolic extraction of whole plant of *Mukia maderaspatana* exhibits antidiabetic activity (Jamuna S et al., 2015). *Cucumis melo var agrestis* belonging to Cucurbitaceae family possess antidiabetic potential, the hydroalcoholic leaf extract of *Cucumis melo var agrestis* inhibits movement of glucose across membrane (Sengottuvel T & Sanish Devan V, 2020).

Antimitotic activity

The leaf acetone extract of *Mukia maderaspatana* proved antimitotic activity in *Allium cepa* root model (Kavitha M et al., 2014). Meristematic cells undergo rapid division similar to metastasis of cancer in human. Preliminary screening of drug from *Allium cepa* possess anticancer activity (Katolkar P.P et al., 2012). The EC50 value of leaf acetone extract is 10 mg/ml. In cell cycle study changes in chromosomes were observed. Inhibition occurs in various stages of cell cycle of meristematic cell by leaf acetone extract. Apoptosis occurs due to DNA fragmentation and also inhibited the synthesis of DNA. Polyphenolic phytoconstituents of *Mukia maderaspatana* such as phenols and tannins possess antimitotic activity (Kavitha M et al., 2014).

Anticancer activity

Cancer is known as hyperproliferative disorder. Chronic hepatitis B virus is the risk factor for liver cancer (Dr. Julius.A et al., 2017). Cancer caused by factors like exposure to toxic chemicals, external environment, diet and unhealthy living. Treatment, control and survival of cell includes the management of cancer (Amaq Fadholly et al., 2020). Antioxidant like Beta carotene protects body from free radicals that is responsible for diseases like cancer. The invitro cytotoxic activity performed on MCF-7 cell line with the methanolic extract of *Mukia maderaspatana* and proves it with an IC50 value as 32 μ g/ml. MTT[3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide] assay is performed to evaluate the inhibitory concentration (IC50) value. The methanolic extract of *Mukia maderaspatana* exhibits suppressive effect by dose dependent on cell proliferation. The results of *Mukia maderaspatana* on MCF-7 cells is similar to the anti-proliferative effect of *Ganoderma lucidum* against MCF-7 cells by alcoholic extraction (Suganthy A & Mary Josephine R, 2017).

Gastroprotective activity

The defensive effect of ethanolic extract of *Mukia maderaspatana* reduces gastric ulcer in rats induced by indomethacin belonging to nonsteroidal anti-inflammatory drugs (NSAIDS). Malondialdehyde and serum tumour necrosis factor- α were reduced by the extract of *M.maderaspatana*. Activity such as increase in reactive oxygen species, lipid peroxidation, infiltration of leucocytes, induction of apoptosis is induced in ulcer. Oral administration of extract of *Mukia maderaspatana* reduces ulcer with notable change in pepsin activity and free and total gastric values. Antisecretory drug such as RAN terminated Indomethacin-induced ulceration. RAN drug possess antioxidant, immunosuppressive actions and antiulcerogenic activity (Gomathy G et al., 2014).

Anti-inflammatory activity

Inflammation is caused by the denaturation of protein. The *M.maderaspatana* extract shows positive effect on inhibition of protein denaturation and proteinase activity. Proteinase activity is inhibited by extract of *M.maderaspatana*. The inhibitory effect on protein denaturation and proteinase activity is shown in Table 2. Leucocyte proteinase plays a vital role in development of tissue damage in course of inflammatory reaction. Study on the methanol extract of *M.maderaspatana* proved excessive proteinase inhibitory activity. *Coccinia grangis* species of Cucurbitaceae family possess similar effect as *M.maderaspatana* (Mallikadevi T et al., 2012).

Table 2
Inhibitory effect of whole plant methanolic extract of *Mukia maderaspatana* on protein denaturation and proteinase activity

Sample concentration ($\mu\text{g}/\text{ml}$)	Inhibition of protein denaturation (%)	Proteinase inhibition (%)
200	58.24	51.80
400	65.71	62.19

Hypolipidemic activity

The major risk factor coronary artery diseases and atherosclerosis is Hyperlipidemia. Medicinal plants are used to treat hyperlipidemia in many developing countries (Sundarajan T & Vijey Aanandhi M, 2018). The aqueous extract of *Melothira maderaspatana* proves the hypolipidemic activity in rats fed with high fat diet. The high fat diet increases body weight, plasma cholesterol, triglycerides, lipoproteins (HDL and LDL) and atherogenic index levels, lipid peroxidation in rats. Treatment with aqueous extract increases the HDL-cholesterol due to the activity of lecithin acyl transferase, and also significantly leads to decrease in body weight, cholesterol, triglycerides and lipoproteins. Plasma cholesterol is decreased by the bioactive phytoconstituent β -sitosterol in the leaves of *Melothira maderaspatana* (Deepali Pandey et al., 2010). Alkaloids such as Umbelliferone, xanthotoxol, isopimpinellin and scopoletin are present in leaves and roots of musumusukkai are possessing hypolipidemic activity (Manoharan A et al., 2015).

Antihypertensive activity

Hypertension is a common factor for cardiovascular disease and major cause for disorders such as strokes and coronary heart disease (Chinnadurai Verramani et al., 2010). It is a condition in increase in pressure in blood vessels with elevation more than 140 mmHg in (SBP) and 90 mmHg in (DBP) (Bhavika D., et al 2020). In hypertensive animals ROS are elevated and results in conversion of oxygen to hydrogen peroxide. Ethanolic extract of *Melothira maderaspatana* proved antihypertensive activity in in-vivo study on male albino wistar rats induced with DOCA-salt (Chinnadurai Verramani et al., 2010). Relaxation of aorta endothelium of rat is caused by leaf extract of *M.maderaspatana* in in-vitro study (Boobalan Raja et al., 2007). Significant decrease in levels of systolic and diastolic blood pressure is seen in animals treated with MME. Studies on phytochemicals shows that the phenolic constituents possess antioxidant and antihypertensive activity. Free radical scavenging activity is seen in extract of *M.maderaspatana*. Coumarine belongs to family of triterpene possessing pharmacological activity such as anti-clotting and anti-inflammatory activities. Increase in intake of antioxidants results in reduction of oxidative stress and preventing from cardiac and renal disorder. Ethanolic extract of *Melothira maderaspatana* significantly increases the level of enzymatic and non-enzymatic antioxidants (Chinnadurai Verramani et al., 2010).

Anti-wart property

Warts are infectious disease among cattle that spread by direct contiguity with infected animals. Cutaneous warts appear as single or multiple, brown or black. Warts commonly occur in skin of udder, neck, shoulder, inner ear. Warts present in udder and teats results in mastitis. Homeopathic drug is unsatisfactory due to reoccurrence of warts, and drugs from medicinal herbs were used due to high effective and low in price. The ethanolic and aqueous extract shows the presence of tannins, terpenoids, glycosides, flavonoids, saponins, alkaloids responsible for anti-wart property. Eugenol is a constituent in *Mukia maderaspatana* possessing fly repellent activity. White soft paraffin bases is used for preparation of ointment. The *Mukia maderaspatana* ointment results significant healing on wart at 10% w/w strength. Drug shows 80% healing of warts located other than udder and teats (Raja MJ & Jagadeswaran A, 2021).

Hepatoprotective activity

Albino rat liver is protected from carbontetrachloride (CCl₄)-induced damages by aqueous extract of aerial parts of *M.maderaspatana*. Histopathology reports significant improvement in CCl₄-mediated liver, and also maintained the levels of alanine aminotransferase (serum glutamic pyruvic transaminase-SGPT), aspartate aminotransferase (serum glutamic oxaloacetic transaminase-SGOT), alkaline phosphatase-ALP, Aniline hydroxylase activities by *M.maderaspatana* extract. Levels of serum glutamic pyruvic transaminase, serum glutamic oxaloacetic transaminase and alkaline phosphatase is reduced by aqueous extracts of *M.maderaspatana* in rats induced with streptozotocin. Methanolic root extract shows significant decrease in levels of -SGOT, -SGPT AND -ALP in diabetic rats at (500 mg/kg) (Petrus A J A, 2013).

Immunomodulatory activity

In in-vitro study the extract shows anticomplement effect in both classical and alternate pathways of complement system in human. Luminol-induced chemiluminescence is inhibited in dose-dependent manner by aqueous extract. In human immune system the outcome of whole plant by aqueous extract is examined (Petrus A J A, 2013).

Antiplatelet aggregation activity

Myocardial infarction caused by hypertension and atherogenic processes. In in-vitro using platelet-high plasma the effect of hexane, chloroform, ethyl acetate, and methanol extract of *M.maderaspatana* studied the antiplatelet aggregation activity. Dose-dependent activity is proved by ethyl acetate fraction of *M.maderaspatana* against platelet aggregation. The presence of flavonoids inhibited the platelet aggregation by elevating cyclic AMP by adenylate cyclase stimulation conversely activity of cyclic AMP phosphodiesterase is inhibited (Petrus A J A, 2013).

Anaesthetic activity

In in-vivo study the ethyl alcohol extracts of leaves of *M.maderaspatana* proves maximum potential as local anaesthesia in both sex of healthy frogs. In tested groups the effect of anaesthesia by extract last longer and exhibits its maximum activity (Petrus A J A, 2013).

Mosquito ovicidal, larvicidal, repellent potential

The mosquito ovicidal activities of fractions of benzene, acetone, ethanol, hexane and methanol of *M.maderaspatana* studied against *Aedes aegypti*, a human vector mosquito. Protection of 100% against *Aedes aegypti* bites is obtained by the isopropanolic solution of crude acetone fraction, ethyl acetate fraction, hexane fraction, and methanol fraction at a concentration of 3.0 mg/cm² on the dorsal surface of skin upto 140 minutes. No significant skin irritation occurs in the individual due to plant extract has been reported (Petrus A J A, 2013).

Anthelmintic activity

Mukia maderaspatana belongs to consumable leafy crop possessing anthelmintic activity. Anthelmintic activity of ethanolic and aqueous extract of whole plant of *Mukia maderaspatana* proves in in-vitro study on *Pheretima posthuma* with the standard drug Albendazole. In comparison aqueous extract shows more anthelmintic activity than ethanolic extract by estimating parameters such as time for paralysis and death time. Mechanism of anthelmintic activity proved by *Mukia maderaspatana* due to presence of phytochemical such as tannin and alkaloids. Alkaloids are responsible for paralysis of *Pheretima posthuma* by acting on central nervous system. Tannin intrusion in generation of energy by uncoupling oxidative phosphorylation (Lavanya M et al., 2013).

Anti-anaemic activity

Hydroalcoholic extract of *Mukia maderaspatana* shows anti-anaemic activity against wistar rats induced with phenylhydrazine. The anti-anaemic effect of extract is studied with equipotent to standard drug vitamin B₁₂. Phenylhydrazine increases the formation of reactive oxygen species and leads to oxidative damage. Induction of Phenylhydrazine causes anaemia in wistar rats in a period of 6 days and decreases levels of RBC and haemoglobin than compared to control. Treatment with hydroalcoholic extract of *Mukia maderaspatana* shows consecutive results with increase in RBC and Haemoglobin content and retrieval from free radical due to anti-oxidant potential of *Mukia maderaspatana* by presence of alkaloids and flavonoids (Saravanan V.S & Manokaran).

Conclusion

The present review study of pharmacological potential of *Mukia maderaspatana* shows the presence of active phytoconstituents possessing medicinal properties present in all parts such as leaves, seeds, stem, root, fruit. Plants are widely used by human due to its chemical potential and eco-friendly nature for treating various disorders. Chemicals present in plant differ in structure, mechanism of action and biological properties. Recent studies disclose that the plant possessing anti-hyperglycaemic, anti-hyperlipidaemic, antimicrobial, anti-anaemic, anti-inflammatory, anticancer, anthelmintic, antioxidant activities. Researchers have contributed in developing plant derived drugs for disorders like cancers to reduce the side effects. Eugenol is a secondary metabolite in *Mukia maderaspatana* possessing fly repellent activity. Clinical investigation elaborates the usage of plant in traditional medicine, and also local anaesthetic potential of plant. Though the in-vitro study of free radical scavenging and lipid peroxidation is inhibited by the compounds such as flavonoids and tannins present in the *Mukia maderaspatana*. Scavenging of free radical is attributed to phenolic groups by their hydrogen donating nature.

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