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PHYTOCONSTITUENTS, PHARMACOLOGICAL ACTIVITIES OF *MARSILEA MINUTA* L. (MARSILEACEAE) - AN OVERVIEW

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Keywords:

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ABSTRACT: Herbal drugs play an important role in the treatment of much illness. The plant has tremendous biological effects and applied in the different system of traditional medication for the treatment of various diseases. *Marsilea minuta* is one of the most popular foreground plants for aquariums that grows about two to three inches tall in shallow water and has attractive little markings on the tiny, variegated, green leaves. It is an aquatic or sub-aquatic fern used as a vegetable, has wide applications in traditional/folk medicine in India and Bangladesh. It is a member of the fern family. Synonyms of *Marsilea minuta* are *Marsilea crenulata* Desv, *Marsilea diffusa* A. Braun and *Marsilea rotundata* Wild. *Marsilea minuta* possesses many pharmacological activities such as antipyretic and analgesic, antidiabetic, antitussive, expectorant, antiamnesic, anti-aggressive, antimicrobial, hepatoprotective, antifertility, anti-tumor, antioxidant activity. This study was aimed to present an overview of traditional use, phytochemical and pharmacological investigations present in this plant.

INTRODUCTION: *Marsilea minuta* is a highly plastic and variable pteridophyte belongs to family Marsileaceae. Common names of this plant are water clover and four-leaf clover gelid water lawyer, small water clover, airy pepperwort, and pepperwort [1]. Water clover is a small, creeping fern with erect 4-foliolate leaves. Water clover is an ornamental pot plant and is used pond decoration. The bright green leaves are tender and are eaten as a potherb. The extract of the whole plant is used as an aphrodisiac and for increased fertility [2]. The plant is used as a sedative, and it has anticonvulsant activity [3].

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The leaves are used in treatment for indigestion when it was cooked with rice and then eaten. The juice of leaf extract is used to stop nose bleeding. The leaves of *Marsilea minuta* and leaf of *Shorea robusta* is boiled and then applied to swollen gums to reduce the swelling. When it fed to gerbils, leaves extract reduced cholesterol and triglyceride levels in blood and liver substantially [4].

It also acts as astringent, coolant, digestive, diuretic, hypnotic, and expectorant Effects when it is taken as an entire plant. Many of its potent effects reported in Ayurvedic treatment for the diseases such as psychopathy, diarrhea, cough, bronchitis, skin diseases and fever.

Fresh plant decoction is taken twice a day for 10-12 days for spasmodic muscular contraction of the urethra and bladder. Root paste is applied for atopic dermatitis [5].

Taxonomy Classification: [6]

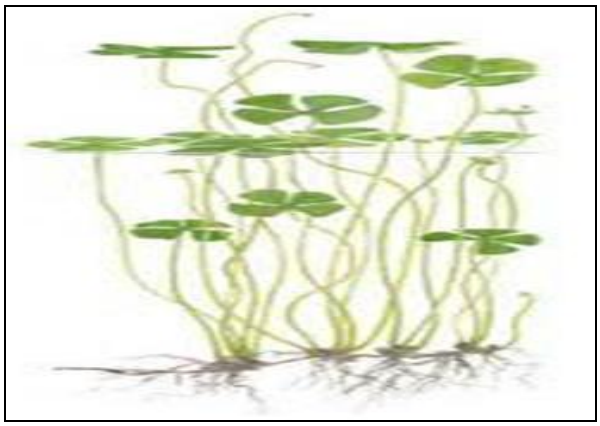


FIG. 1: ***MARSILEA MINUTA***

TABLE 1: TAXONOMY CLASSIFICATION

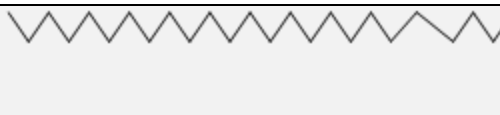
Kingdom	Plantae
Subkingdom	Tracheobionta
Division	Pteridophyta
Class	Polypodiopsida/Pteridopsida (disputed)
Order	Hydropteridales
Family	Marsileaceae
Genus	Marsilea L
Species	*M. minuta*

Geographical Distribution: *Marsilea minuta* is generally prevalent in almost all the states of India particularly tropical Africa and Asia. Generally, it grows freshwater or in brackish water (Trinidad) on sandy or clay substrates. It is also found in a swamp [7].

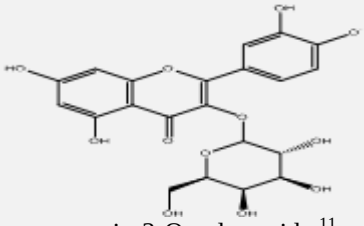
Different Species of *Marsileaminuta*: [6, 8] Other species of *Marsilea minuta are Marsilea aegyptica, M. ancyclopoda, M. apposita, M. burchellii, M. coromandelina, M. crenata, M. crotophora, M. deflexa,, M. distorta, M. drummondii, M. ephippiocarpa, M. farinosa, M. fenestrata, M. hirsuta, M. macrocarpa, M. macropoda, M. aminuta* L., *M. mollis, M. mutica, M. nubicam, M. oligospora, M. quadrifolia* L., *M. schelpeana, M. unicornis, M. vera, M. vestita M. villifolia, M. villosa*.

Phyto-constituents: *Marsilea minuta* contains various constituents like phenol, flavonoids, saponins, quinones, tannins, terpenoids, coumarins, total sugar and anthroquinones [9]. Also reported it contains Marsiline [3]. Marsileagenin- A [10]. Quercetin-3-O-glucoside, chalcone- O- glucoside kaempferol-3-O-glucoside, quercetin- 3- O-galactoside, like flavonoids were reported [11] naringenin-7-O-glucoside, quercetin-3-rutinoside (rutin) [12] also Presence of β-sitosterol and hentriacontane are reported. Around 36 phytocompounds including Phytol, n-Hexadecanoic acid, 9-Pentadecadien-1-ol, 2-Cyclohexane-1-one, 4-hydroxy-3, 5, 6-trimethyl- 4 (3-oxo-1-butenyl), 9, 12, 15-Octadecatrienoic acid, 3, 7, 11, 15-Tetramethyl-2-hexadecane-1-ol was reported in the methanolic extract of leaf of *M. minuta*. The methanolic extract of stem of *M. minuta* showed the presence of 27 bioactive compounds include, Glycerin, 1,19-Eicosadiene, n-Hexadecanoic acid, methyl ester, and 10-Octadecenoic acid methyl ester and Benzofuran, 2, 3-dihydro- 3, 7, 11, 15 – Tetramethyl-2 hexadecene-1-ol [13].

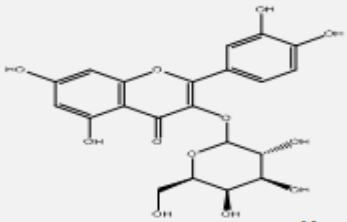
TABLE 2: ACTIVE CONSTITUENTS FROM PLANT *MARSILEA MINUTA*



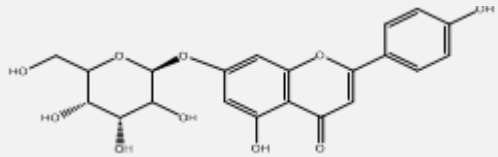
Marsiline[3]



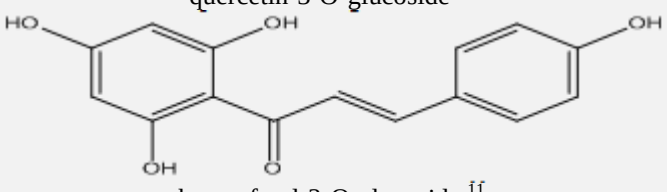
quercetin-3-O-galactoside [11]



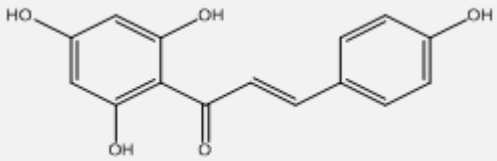
quercetin-3-O-glucoside [11]



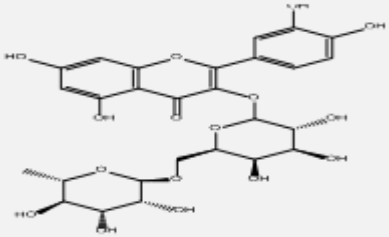
Naringenin-7-O-glucoside [12]



kaempferol-3-O-glucoside [11]

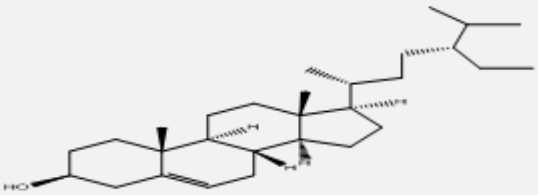


Chalcone-3-O-glucoside [11]



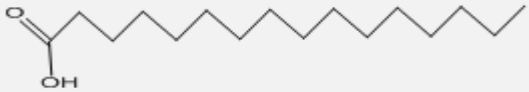
Quercetin-3-rutinoside (rutin) [11]

1,19-Eicosadiene [11]

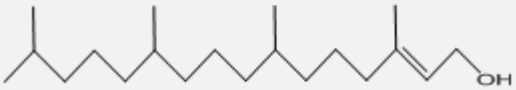


β-sitosterol [11]

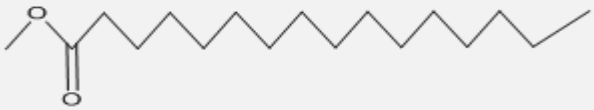
Hentriacontane [13]



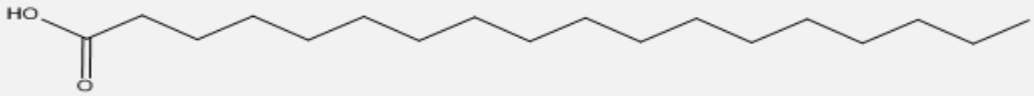
Hexadecanoic acid [13]



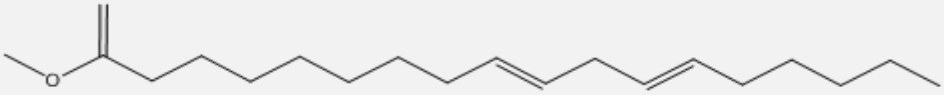
Phytol [13]



n-hexadecanoic acid methyl ester [13]

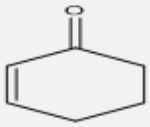


Octadecanoic acid [13]



10-Octadecanoic acid methyl ester [13]

9-Pentadecadien-1-ol [13]



2-Cyclohexane-1-one [13]

Physico - Chemical Characters: Preliminary phytochemical studies, morphological characters, powder microscopy and quantitative microscopy and determination of physicochemical parameters of leaves of *Marsilea minuta* Linn. was carried out to identify the plant material and for the isolation of components [14].

Pharmacological Activity:

TABLE 3: PHARMACOLOGICAL ACTIVITY

Activity	Parts used	Extracts used	Dose	Method	Result
Antipyretic and analgesic properties	leaves	Ethanolic extract	200 and 400 mg /kg	Tail- immersion method Eddy's hot plate method, Yeast	Maximum activity observed at 400 mg/ kg [15]

				induced pyrexia method	
Antidiabetic activity	leaves	Ethanolic extract	100, 250 and 500 mg/kg	glucose tolerance test	500 mg/kg of ethanolic extract showed a significant rise in blood glucose level compared to untreated diabetic rats [16]
Anti-tussive, expectorant activity	Whole plant	Methanol, ethyl acetate, and petroleum ether	Methanolic extract of MM (250 and 500 mg/kg), Ethanolic extract of MM (250 and 500 mg/kg), petroleum ether extract of MM (250 and 500 mg/kg)	Ammonium liquor induced cough, Sulfur dioxide (SO_2) induced cough	500 mg/kg reduced the number of coughs. Methanol extract (500 mg/kg) exhibited good expectorant effect [17]
Anti-amnesic activity	Whole plant	Ethanolic extract	200 and 400 mg/ kg	Rat amnesic models, Assay of acetylcholinesterase (AChE) activity in rat brain, Radio ligand-receptor binding assay	400 mg/kg showed better Anti-amnesic activity [18]
Anti-aggressive activity	Whole plant	-	100, 200, and 400 mg	Footshock-induced aggression, Isolation-induced aggression, and resident-intruder aggression	*Marsilea minuta* extract showed anti-aggressive activity based on dose [19]
Antimicrobial activity	Whole plant	Petroleum ether, chloroform-ethyl acetate, alcohol, and water	100-500 mcg/ml	Agar well diffusion method	Significant activity was observed for ethyl acetate extract against *E. coli-*, *S. aeruginosa* and alcoholic fractions showed action against *E. coli, P. aeruginosa* for concentration 500 mcg/ml [20]
Antimicrobial activity	Rhizome	Acetone, DMSO, ethanol, chloroform, and petroleum ether	100 microgram/ml	Agar well diffusion method	Maximum inhibition area reported in Ethanol and DMSO extract [21]
The gold nanoparticle of *Marsilea minuta*	leaves	Distilled water	(50-400 µl)	Agar well diffusion method	GNP prepared from *Marsilea minuta Linn* showed better antibacterial effect against *Escherichia coli* and *Staphylococcus aureus* [22]
Hepatoprotective Activity	Whole plant	Methanolic extract	100, 200, 400 mg/ kg	Assessment of Hepatoprotective Activity, Determination of Serum Biochemical Parameters, Assessment of Anti-Hepatotoxic Activity	MMME at dose 200 mg/ kg shows good hepatoprotective effect [23]
Antifertility activity	Whole plant	Methanolic extract	250mg/kg	-	Antifertility action produced significantly due to inhibition of gonadal steriodo-genesis [24]
Antitumor activity	Whole plant	Ethanolic extracts	Plant extract used in a range of 10, 100 and 1000 ppm	Antitumor potato disc bioassay	82.32% percentage of tumor inhibition was found in *M. minuta when compared to S. ciliaris* (80%) and *T. prolifera* (75.68%) [25]
Antidepressant activity		Ethanolic extract	(400 mg/kg, p.o.)	learned helplessness test, tail suspension test, forced swimming test	*Marsilea minuta* (400 mg/kg, p.o.) shows antidepressant nature [26]
antioxidant activity	leaves	Methanolic extract	25, 50, 100, 150, 200 µg/ml	DPPH Radical Scavenging Method, Hydrogen Peroxide Scavenging Activity	Highest free radical scavenging was at concentration 200 µg/ml. highest H_2O_2 scavenging concentration effect with was at 100 µg / ml [14]

CONCLUSION: *Marsilea minuta* L. has numerous activities and treat much illness such as insomnia, mental disorders, kidney infection, Skin diseases, as diuretic, hepatitis, diarrhoea, bronchitis, diabetes, blood purifier and treatment of piles and it possesses many biological effects like anti- pyretic and analgesic, antidiabetic, antitussive, expectorant, antiamnesic, anti-aggressive, antimicrobial, hepatoprotective, antifertility, anti-tumor, antioxidant. The benefit of the vital nature of *Marsilea minuta* L. and its wide geographical distribution might offer an opportunity to develop many formulations by usage of this plant. Thus, this article offers an excellent accessible source for a study on active compounds for traditional medicine and allied applications for future researchers and make it useful for the society.

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CONFLICT OF INTEREST: We declare that we have no conflict of interest.

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