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REVIEW ARTICLE

Phytochemical Constituents and Pharmacological Activity of *Malva parviflora* plant: A Review

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ABSTRACT

Malva parviflora L. is a perennial herbaceous plant from *malvaceae* family, largely distributed in areas with tropical, subtropical, and moderate climates of Asia, Africa, and Europe.

M. parviflora contains glycosides, alkaloids, steroids, flavonoids, terpenes, saponin, and tannin in methanolic extract, flavonoids and alkaloid in petroleum ether extract, steroids, alkaloids, terpenes, flavonoids, and saponins in acetone extract, and steroids, flavonoids, saponins, tannins and terpenes in the water extract. In addition to other seven components incorporate β- amyrin, α-amyrin, a mixture of stigmasterol and β sitosterol, cholesterol, campesterol, β- sitosterol-O-β-D- glucoside and ergosterol in petroleum ether extract, tribuloside, a flavonoid glycoside, in ethyl acetate extract and ethyl vanillin in chloroform fraction. *M. parviflora* plant has important uses as a medicinal plant and an edible plant. High-Performance Liquid Chromatography (HPLC) analysis identified the major polyphenol components that were extracted at optimal conditions like ρ-coumaric acid, naringenin, luteolin, cinnamic acid, and apigenin-7- glucoside. These results indicate that *M. parviflora* leaves extracts have DPPH radical scavenging activity and might be used as a natural source for bioactive compounds.

Gas Chromatography-Mass Spectrometer (GC-MS) analysis of *M. parviflora* plant leaves showed the presence of several active components such as Pentadecanoic acid, 14-methyl ester, 10,13-octadecadienoic acid, methyl ester, Allantion, Trans-13-octadecenoic acid, methyl ester, 9,12-octadecadienoic acid (Z,Z) methyl ester, Methyl 10-trans, 12-cis-octadecadienoate, Hexasiloxane,1,1,3,3,5,5,7,7,9,9,11,11dodecamethyl, 4-hydroxy-3,5,5-trimethyl-4-(3- oxo-1- butenyl)-2-cyclohexenone,3,7,1,15-tetramethyl-2-hexadecenol, 6,10,14-trimethyl-2- pentadecanone, hexadecanoic acid, 9,12,15-octadecatrienoic acid methyl ester, and others.

M. parviflora L. has several pharmacological activities in various diseases. Leaves have benefits in swelling and wounds management. A lotion prepared from leaves is effective in the treatment of broken limbs and bruises. Leaves have benefits in swelling and wounds management. A lotion prepared from leaves is effective in the treatment of broken limbs and bruises. *M. parviflora* has antioxidant, anti-carcinogenicity, anti-aging, anti-mutagenicity, antibacterial, anti-irritant, antidiabetic, neuroprotective, antifungal, anti-ulcerogenic, hepato-protective, and analgesic.

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INTRODUCTION

Medicinal plants have been a crucial source of both therapeutic and prophylactic medical treatment preparations for human beings and have also been used to extract significant active components.[1-3] It is found that about 80% of the world's people regularly based on traditional medicine and products for their health care needs, especially in third world countries. In developing regions, many people who are sick combine traditional medicine with conventional medicine.[4-6] Almost traditional medicines are cheaper than modern medicines.[7] Plant has the unlimited capability to synthesize secondary metabolites such as alkaloids, tannins, glycosides, phenols, and terpenoids that have antimicrobial activity. It was estimated that 14–28% of higher plant species are utilized for medicinal reasons and 74% of pharmacologically active plant-derived compounds were investigated after following upon ethnobotanical uses of the plants.[8]

The undirected uses of the plant because of the absence of phytochemical, pharmacological, and mainly toxicological comprehension is of considerable interest for human well-being. The right investigation of medicinal plant species is important, especially when they are refined to misuse these medicinal plants.[9] Studying plants' anatomy and morphology can aid in the quality management of processed medicinal plants.[10]

Malvaceae family is, also known as mallows, has a large diversity of species. It is consists of about 245 genera and 4465 species.[11]

Malva L. (Cheeseweed) is a genus within the Malvaceae family, containing herbaceous biennial, annual, and perennial species that are native in Asia, Europe, and Africa.[12] Malva genus is very diverse in morphology but some species are scarcely recognizable based on morphological characters.[13]

Malva species contain a lot of flavonoids, mucilage, vitamin A, terpenoids, polysaccharides, and malvin.[14,15] Therefore, flowers, leaves, seeds, roots, and the whole plant are used in traditional phytotherapy, functional food industry, medicine, and horticulture.[16] Some species like *M. parviflora* L. *M. sylvestris* L. and, *M. neglecta* Wallr. are consumed as vegetables in Iraq, Egypt, Morocco, Mexico, and Turkey.[17] In medicine, these mallow species are used in the treatment of urinary, respiratory, and digestive problems as they have high anti-inflammatory, bactericidal, antiulcerogenic, antidiabetic, and hepatoprotective activities. *M. parviflora*, *M. sylvestris, M. verticillata L* and *M. neglecta*. are the most identified species in the genus and are the most used species in the industry.[18-20] Furthermore, some of the mallow species used for phytoremediation due to their ability in heavy metals accumulation.[21-23]

According to the Phytotherapeutic Guideline of Brazilian Pharmacopoeia, the plant parts such as flowers and leaves are used internally as an expectorant, and externally as an antiseptic for oral problems.[24]

Malva parviflora has common names: cheese weed, cheese weed mallow, Egyptian mallow, least mallow, little mallow, marshmallow, small-flowered mallow, small-flowered marshmallow, and small flower mallow.[25]

The word "Malva" is derived from the Greek word "malakos" (soft) and the word "Parviflora" is derived from the Latin word "Parvus" (small) and "Floris" flower.[26]

It was found that the methanol fraction of polyphenol components from *M. parviflora* stems and leaves contain various quantities of flavonoids, phenols, alkaloids, saponins, tannins, and resin. The methanol fraction showed high antioxidant potential.[27]

M. parviflora is broadly used in various portions of the world for different curative ailments. People used a dressing made from all parts of plant to treat inflamed pussy wounds, swellings, and boils. A hot poultice of leaves is used to treat swellings and wounds and tea of leaves is used as a nervine boost and utilized as a taenicide and for profuse menstruation. An infusion or a dried powder of roots and leaves is utilized to deans sores and wounds. Leaves tea is taken to treat irritation, dryness, cough, and bronchitis.[28]

The decoction of roots and leaves is a benefit for hair rinse to soften hair and remove dandruff, and tea of the leaves is also utilized to drain the mother's system after delivery. Plant seeds are demulcent, useful for bladder ulcers, and cough also. Pharmacological studies show that *M. parviflora* possesses antidiabetic, antifungal activities.[29]

M. parviflora oil is not produced on a manufacturing scale. Furthermore, no data about its worldwide besides export and import are recognized.

Plant Taxonomy

The systematics and taxonomical characteristics of the Malva genus are still uncertain and very intricate. Several studies have been directed to clarify the taxonomic association of Malva species using different characters, such as morphological characteristics of the plant, pollen grains morphology, stem hairs, epidermal structures, seed coat structure, differentiation of seed[30] in addition to internal transcribed spacer (ITS) region, molecular data (nuclear ribosomal DNA (rDNA), inter simple sequence repeat polymerase chain reaction (ISSR) markers, and intron-exon splice junction (ISJ).[31]

Taxonomy of *M. parviflora*[32]

- Kingdom - Plantae
- Division – Tracheophyta
- Class – Magnoliopsida
- Superorder - Rosanne
- Order - Malvales
- Family - Malvaceae
- Genus - Malva
- Species – parviflora

Distribution of *M. Parviflora*

M. parviflora is grown in various climatic conditions but the plant grows in warmer areas has greater height and a wider period of development. Warmth, moisture, and light are the key ecological requirements for its cultivation.[26,33]

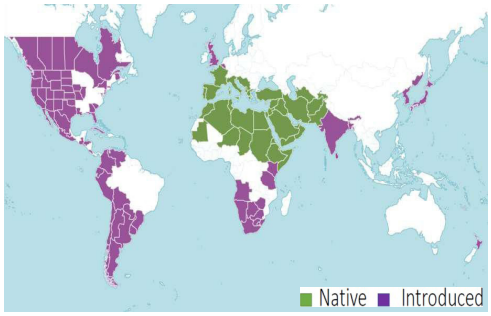


Figure 1: *M. parviflora* distribution in the world

Figure 2: *M. parviflora* plant

Climatic Conditions

High illumination, medium humidity, relatively high temperature, medium sea altitude.

Dirt Conditions

The pH of the soil is basic, the degree of humidity is semi-arid, the type of soil is clayey, it is rich in nutrients and is not salty, it does not require organic matter.[34]

Distribution in Iraq

M. parviflora is one of the plants that are suitable for pastoral areas in Iraq, where some types of perennial weeds or perennial legumes stop growing in permanent pastures and their tolerability is greatly reduced. In every season, when the temperature is low or high, so it is necessary to plant annual or transformer crops, i.e., construction of temporary pastures to help permanent pastures during the production period.

Temporary pastures or annual pastures must be established on the steep area for fear of the dangers of erosion, when the land becomes barren, this can be achieved through an appropriate succession of some Annual crops, we can have a long period of grazing in all parts of the country.

Therefore, this plant is found in the following regions of Iraq such as Ghurraf district, Lower Jazeera district, Southern desert district, Western desert district, Kirkuk district, Persian foothill district, Central alluvial district, Eastern alluvial district, lower Iraq.[35,36]

Distribution in the World

It is one of the most familiar plants in the Arabian Peninsula and it has a high nutritional value, as it contains quantities of beneficial minerals for the body such as calcium, magnesium, potassium, vitamin A and vitamin C. It is found in the Levant,

Figure 3: *M. parviflora* leaves

Figure 4: *M. parviflora* flowers

North Africa and, most regions of the Mediterranean Basin. It is widely dispersed in India, Saudi-Arabia, Pakistan, and, Europe (southwest and southeast areas) in Pakistan, it is found in Murree, Azad Kashmir, Rawalpindi, Hazara, Swat and, Margalla Hills Southeastern Europe like Albania, Bosnia, and Herzegovina, Greece, Croatia, Italy and, Malta Southwestern Europe like Spain (incl. Baleares), France and, Portugal.[37] (Figure 1)

Botanical description

Malva parviflora its origin is in Arabia Khabaz. It is an annual herbaceous plant whose height ranges from 30 cm to 50 cm. It usually grows in lawns and roadside, leaves and flowers contain mucilage in varying proportions and this substance has a curative effect against diseases, leaves possess a large proportion of secondary metabolites (phenols, terpenes, anthocyanins, etc.)[38,39] (Figure 2).

Leaves

The leaves are lengthy-petioled, petiole typically many times the length of the blade. The leaf blade is about 30 mm broad and 25 mm long. Leaves are semi-circular, with woven and irregular edges. Its color is dark green, alternating, auricular, large in size, very soft, slightly fuzzy, its blade is round and lobed to five or seven lobes[40] (Figure 3).

Flower

The flowers are mostly 3 or 4 in axils, rarely solitary. The corolla has pink in color and has two or three times the calyx length. The petals are ovate, claw-long-fringed at the base, notched at the apex.

Venus is a large hanging reddish or violet flower. Small in size, axillary in diameter, about 4 cm in diameter, the cup is green in color and the sepals are fused in number, five-pointed, the petals are striped with three branching lines, purple and dark in color heart-shaped, the plant contains from 2 to 5 flowers (Figure 4).[41,42]

Figure 5: *M. parviflora* fruits

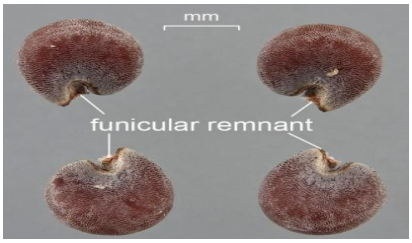


Figure 6: *M. parviflora* seeds

Figure 7: *M. parviflora* roots

Figure 8: *M. parviflora* stems

Fruits

The fruits are slightly nodding, terete, connect near the flower, several times the length of the flower, but shorter than subtending leaf. The lobes ovate triangular, somewhat a crescent, and close above the fruit.

They are round, fluffy, and each fruit contains about 10 carbs containing kidney-shaped seeds. The fruits remain surrounded by the cup until they dry up and fall (Figure 5).[43]

Seeds

The seeds are dark brown, very finely wrinkled, reniform, and whitish at the hilum, rough, arranged around the main axis, 2 to 3 mm long. The plant can be found in gardens, roads, fences, and waste places generally[44] (Figure 6).

Roots

Is a thick and white root that is very deep in the ground and is studded with many strings from which many branches emerge, fluffy, forked, and flabby (Figure 7).

Stem

The stems are innumerable, procumbent or ascending, very rarely erect, branched except at ends, often woody at base, terete, often turning dark purple in the lower part, rarely has green color throughout, densely clothed from the base with stellate down (Figure 8).[45]

Folk Uses

- Malva leaves are used as a disinfectant and kill bacteria and fungi, as it is considered a repellant for intestinal worms that live in the human digestive system, especially Ascaris worms, a colostomy, and others.
- Decoction of leaves is useful in treating menstruating, rashes, tonic for nerves and moisturizes the skin also used as a lotion for the eyes and vagina.
- The seeds are analgesic for pain and are used in the treatment of cough and bladder ulcers.
- Flowers are used to treat burns, but their infusion is used in the form of an enema to moisten the intestine and relieve abdominal pain.
- The decoction of flowers and leaves is used against back pain.
- Roots are used in the treatment of asthma, stomatitis, respiratory passages, skin eczema, and urinary tract infections. In the past, roots were used as an alternative to soap and shampoo, washing hair as it gives a great lather and increases the luster and shine of hair.
- The baking plant contributes to the treatment of chest diseases, prostatitis, urinary retention, bloody urine, inflammation of the kidneys and intestines, and its hot soak, soaks the pain in the throat, where it is taken every 4 hours.
- It is sold in wintertime as one of the vegetables that cook and eats.
- Finely, also it's important to drain the mother's system after delivery.[46,47]

Phytochemical Constituents

Preliminary phytochemical screening of fruits extract of *M. parviflora* plant revealed the existence of glycosides, flavonoids, alkaloid, steroids, terpenes, tannins, and saponins in methanolic extract, flavonoids and alkaloids in petroleum ether extract, steroids, alkaloids, terpenes, saponins, and flavonoids in acetone extract, and steroids, flavonoids, terpenes, tannins and saponins in the water extract (Table 1).

The plant revealed the existence of alkaloids, flavonoids, resin, saponins, tannins and phenols, anthocyanin, asparagine, ascorbic Acid, quercetin, phenolic acid, salicylic acid, vitamins A, B & C, and Pectin in leaves and stems of *M. parviflora*[48,49] and other components including β- amyrin, α-amyrin, a mixture of stigmasterol and β sitosterol, cholesterol, campesterol, β- sitosterol-O-β-D-glucoside and ergosterol in

Table 1: Phytochemical Screening of *M. parviflora plant*

No.	Phytochemical components	Solvents			
		PET	ACE	MeOH	H_2O
1.	Alkaloids	+	+	+	-
2.	Flavonoids	+	+	+	+
3.	Glycosides	-	-	+	-
4.	Steroids	-	+	+	+
5.	Terpenes	-	+	+	+
6.	Saponins	-	+	+	+
7.	Tannins	-	-	+	+

+ : Present, - : Absent, H2O: aqueous, MeOH: Methanol, ACE: Acetone, PET: Petroleum ether

petroleum ether extract, tribuloside, a flavonoid glycoside, in ethyl acetate extract and ethyl vanillin in chloroform fraction. These phytochemical constituents are responsible for the odor, color, biological, and disease preventive properties. In addition to other enzymatic activity, antioxidant activity, hormonal action, interference with DNA replication, and antimicrobial activity.[50]

Malva parviflora contains β-carotenes, ascorbic acid, glutathione, and α- tocopherols. It also contains minerals such as zinc, iron, copper, manganese, and phosphorous.[26]

Phytochemical analysis of roots, stems, and leaves of cultivated and wild *Malva parviflora* plant indicated the existence of alkaloids, tannins, flavonoids, phenolic compounds, and saponins, in addition, there are significant differences in their active constituents such as tannins identified in the cultivated plant while not present in the wild one, as well as there are some differences between different organs of the same plants (Table 2).[51]

Tannins reached (8.25 mg/g) as the highest concentration in the leaves of cultivated plants but were not detected in the wild. The leaves in the wild plant had the highest values of flavonoids, saponins, alkaloids, and total phenols (32.02, 12.23, 4.21, and 2.92 mg/g), respectively. While the lowest values of flavonoids and alkaloids (9.61 and 1.10 mg/g) were identified in the roots of cultivated plants, while the lowest value of total phenols and saponins (0.50 and 2.01 mg/g) was achieved by the leaves of cultivated plant.[52]

Detection of the active compounds in *M. parviflora*

High-Performance Liquid Chromatography (HPLC) and GC-MS analysis were used to identify the active compounds in the leaves of *Malva parviflora* plant.

Detection of active compounds using HPLC

The identification of active constituents in the leaves of *M. parviflora* by High-Performance Liquid Chromatographic (HPLC) identified the presence of flavonoids and phenolic acid compounds such as kaempferol, luteolin, naringenin, ρ-coumaric acid, cinnamic acid, and apigenin-7-glucoside, catechin, chrysin, gentisic acid, ferulic acid, vanillic acid, sinapic acid, rosmarinic acid.[53,54] These compounds play an important role in the therapeutic and inhibitory effects of the plant (Table 3).

Detection of active compounds of *M. parviflora* using GC-MS

Gas Chromatography-Mass Spectrometer (GC-MS) analysis of *M. parviflora* plant leaves showed the presence of several active components such as Pentadecanoic acid, 14-methyl ester, 10,13-octadecadienoic acid,methyl ester, Allantion, Trans-13-octadecenoic acid, methyl ester, 9,12-octadecadioenoic acid(Z,Z) methyl ester, Methyl 10-trans, 12-cis-octadecadienoate, Hexasiloxane,1,1,3,3,5,5,7,7,9,9,11,11dodecamethyl, 4-hydroxy-3,5,5-trimethyl-4-(3-oxo-1-butenyl)-2-cyclohexenone,3,7,1,15-tetramethyl-2-hexadecenol,6,10,14-trimethyl-2- pentadecanone, hexadecanoic acid, 9,12,15-octadecatrienoic acid methyl ester, Hexanedioic acid, bis (2-ethylhexyl) ester, 7- dehydrodiosgenin, 9-Octadecenamide, (z)-, Acetic acid,2-(2,2,6- trimethyl-7-oxa-bicyclo[4.1.0] heptyl)-propenyl ester, 1,2-benzenedicarboxylic acid, butyl 2- ethylhexyl ester, 2-Cyclohexen-1-one,4hydroxy-3.5.5-trimethyl-4(3-oxo-1-butenyl)-, Hexadecanamide, 2-Pentadecanone,6,10,14 trimethyl-, Hexadecanoic acid, methyl ester (Table 4).[56-58]

Fourteen fatty acids were identified in the aerial parts of *M. Parviflora* L. including about 99.9 % of the total fatty acids contents, the more prominent are linoleic, Palmitic, and linolenic acid.

GC.MS apparatus is frequently used to diagnose the chemical profile of the essential oils. *M. parviflora* has been extensively used in different portions of the world to cure various diseases[59] (Table 5).

Table 2: Mean ± SE of the secondary metabolites (mg/g) produced by different parts of cultivated and wild *Malva parviflora*. *: $p < 0.001$, ND: not detected.

Phytochemical	Plant organ						F-value
	Leaves		Stem		Root		
	Cultivated	Wild	Cultivated	Wild	Cultivated	Wild	
Tannins	8.25 ± 0.27a	ND	3.05 ± 0.39c	ND	2.60 ± 0.50b	ND	87.2*
Alkaloids	1.60 ± 0.14a	4.21 ± 0.12b	2.90 ± 0.05c	3.16 ± 0.15b	1.10 ± 0.30b	3.01 ± 0.15d	166.2*
Saponins	2.01 ± 0.01a	12.23 ± 0.30b	2.67 ± 0.31c	10.12 ± 0.29b	2.04 ± 0.14d	5.22 ± 0.02a	96.6*
Flavonoids	10.25 ± 0.24a	32.02 ± 0.06b	12.84 ± 0.20c	28.42 ± 0.42d	9.61 ± 0.27e	21.12 ± 0.34a	3598.6*
Total Phenols	0.50 ± 0.15a	2.92 ± 0.36b	1.00 ± 0.16a	2.15 ± 0.07c	0.57 ± 0.14d	1.52 ± 0.02a	80.6*

Table 3: Active compounds identified by HPLC in the leaf powder of *Malva parviflora*[55]

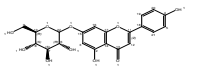
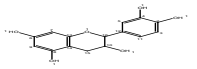
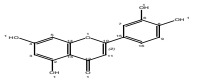
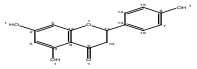
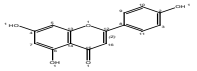
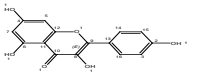
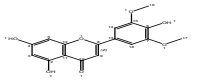
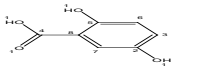
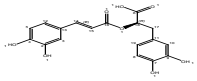
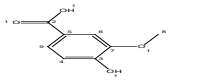
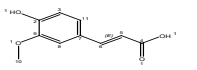
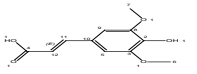
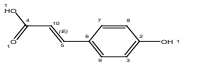
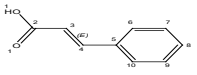
Name	Active compound µg/g leaf powder	Structure
Apigenin-7-glucoside	346.28	
Catechin	35.78	
Luteolin	271.66	
Naringenin	557.33	
Apigenin	10.80	
Kaempferol	27.54	
Chrysin	6.04	
Gentisic acid	101.55	
Rosmarinic acid	57.85	
Vanillic acid	11.33	
Ferulic acid	3.99	
Sinapic acid	86.44	
p-coumaric acid	371.86	
Cinnamic acid	126.07	

Table 4: Active components in the leaves of *M. parviflora* by GC-MS.

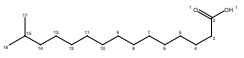
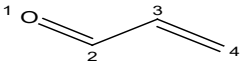
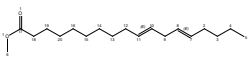
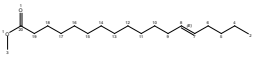
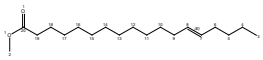
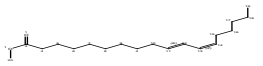
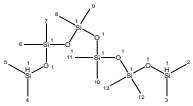
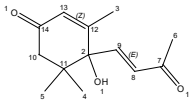
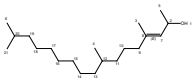
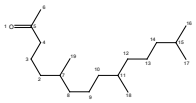
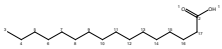
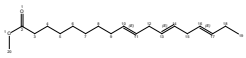
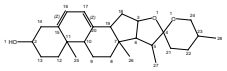
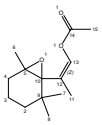
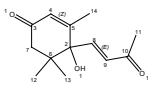
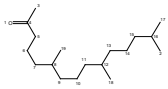
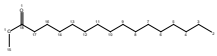
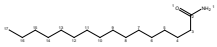
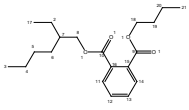
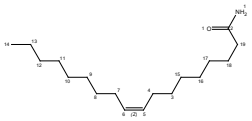
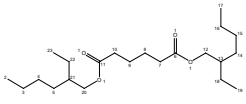
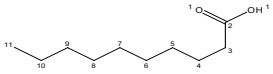
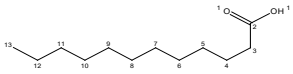
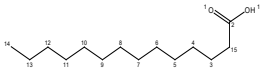
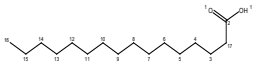
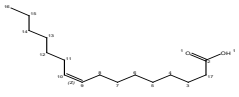
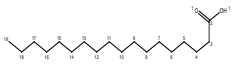
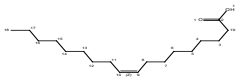
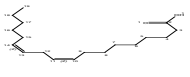
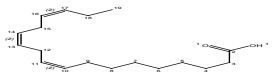
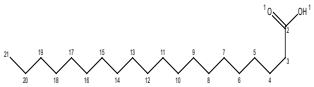
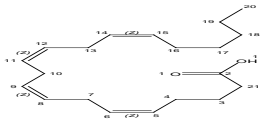
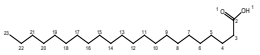
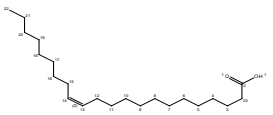
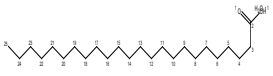
No.	Compound name	Retention time (s)	Structure
1	Pentadecanoic acid, 14-methyl ester	34.819	
2	Allantoin	35.051	
3	10,13-octadecadienoic acid,methyl ester	36.308	
4	9,12-octadecadioenoic acid(z,z) methyl ester	38.174	
5	Trans-13-octadecenoic acid, methyl ester	38.445	
6	Methyl 10-trans, 12-cis-octadecadienoate	38.609	
7	Hexasiloxane,1,1,3,3,5 ,5,7,7,9,9,11,11dodeca methyl	39.054	
8	4-hydroxy-3,5,5-trimethyl-4-(3-oxo-1-butenyl)-2-cyclohexenone	17.71	
9	3,7,1,15-tetramethyl-2-hexadecenol	18.06	
10	6,10,14-trimethyl-2-pentadecanone	18.13	
11	hexadecanoic acid	19.34	
12	9,12,15-octadecatrienoic acid methyl ester	21.04	
13	7- dehydrodiosgenin	32.76	
14	Acetic acid,2-(2,2,6-trimethyl-7-oxa-bicyclo [4.1.0] heptyl)-propenyl ester	17.298	
15	2-Cyclohexen-1-one,4hydroxy-3.5.5-trimethyl-4(3-oxo-1-butenyl)-	17.495	
16	2-Pentadecanone,6,10,14 trimethyl-	17.895	
17	Hexadecanoic acid, methyl ester	18.697	
18	Hexadecanamide	21.154	
19	1,2-benzene dicarboxylic acid, butyl 2-Ethylhexyl ester	21.870	
20	9-Octadecenamide, (z)-	22.901	
21	Hexanedioic acid, bis (2-Ethylhexyl) ester	23.085	

Table 5: fatty acids contents of *Malva parviflora* as identified by GC-MS

No.	Compound name	Structure	Percentage (%)
1	Capric acid		0.78
2	Lauric acid		0.59
3	Myristic acid		1.31
4	Palmitic acid		26.5
5	Palmitoleic acid		1.29
6	Stearic acid		3.83
7	Oleic acid		7.15
8	Linoleic acid		24.73
9	Linolenic acid		28.25
10	Arachidic acid		0.8
11	Arachidonic acid		1.45
12	Behenic acid		1.65
13	Erucic acid		0.83
14	Lignoceric acid		0.77

Pharmacological Activity

Antibacterial Activity

The chloroform extract of *M. parviflora* exhibit antibacterial activity against *Escherichia coli* and *Staphylococcus aureus* (MIC: 20 mg/mL), while the ethanol extract exhibit antibacterial activity against only *S. aureus*, (MIC: 15 mg/mL), this indicate that *S. aureus* was more sensitive to ethanolic extract than the chloroform extract. This result shows that ethanol solvent has greater extraction capacity, which could produce a larger number of active components responsible for the antibacterial activity against *S. aureus*. However, the chloroform extract is the only one that exhibits antibacterial activity against *E. coli* (β-sitosterol was isolated from the root bark of *M. parviflora* by chloroform). The reality of antibacterial activity of *M. parviflora* root bark against *E. coli* and *S. aureus* might warrant why this plant is used in traditional medicine as therapy for diseases caused by tested bacteria pathogens.[60]

Antioxidant Activity

Antioxidants can be defined as substances that delay an oxidation process, inhibiting the chain of polymerization initiated by free radicals and other subsequent oxidizing reactions. The preliminary phytochemical analysis of *M. parviflora* stems and leaves exhibit the presence of flavonoids, alkaloids, saponins, polyphenols, tannin, and resin. The useful effects of polyphenols on health might result from either their functions as an antioxidant and/or independently from other properties such as acting as modulators of the cellular signaling processes. However, the health-beneficial functions of these polyphenols, include anticarcinogenic, anti-aging, and antimutagenicity. Many reports on polyphenols, flavonoids, and triterpenoids approved they had free radical scavenging activity and antioxidants. Because of their free radical scavenging activities, these phyto-components may exert numerous biological effects against heart disease, tumors, AIDS, and different pathologies.[61]

Hepatoprotective Activity

Elevated ALP, AST, TBR, and ALT values in hepatotoxic mice can be reduced by the Aqueous methanol extract of *M. parviflora* that gives significant results when compared with paracetamol as a control. The most important plant compound with hepatoprotective activity is flavonoids that were previously reported to have this activity. Flavonoids amount in the whole plant is moderate. Qualitative identification by HPLC apparatus of flavonoids exhibits the presence of kaempferol, luteolin, rutin, and apigenin. Therefore, the hepato-protective activity of *M. parviflora* may be due to the presence of flavonoids.[62]

Anticancer Activity

Anticancer activity of *M. parviflora* plant was evaluated by utilizing 3-(4,5-dimethylthiazol-2-yl)- 2,5-diphenyltetrazolium bromide (MTT) measures and lactate dehydrogenase enzyme, against bosom malignancy cells. Results revealed the cytotoxic ability of *Malva parviflora* plant. Withdrawal of cellular material, cell separation, and loss of cellular integrity was seen in concentrate treated cells.[63]

Neuroprotective Activity

M. parviflora L. plant has spectacular neuroprotective activity. An examination was carried out on the ethanolic extract of *M. parviflora* leaves to research the neuroprotective activity using Morris water maze assay, against Alzheimer's disease that occurs by amyloid-β-(Aβ-), in mice. The surrendered memory of model animals was improved by plant extract through

re-establishing the degrees of cerebrum cell reinforcement catalysts including glutathione peroxidase, superoxide dismutase, glutathione reductase, and catalase. The degrees of lipid peroxidase were diminished by extract to the ordinary level.[64]

Antidiabetic Activity

Diabetic rats intoxicated with streptozotocin were cured with different doses of *M. parviflora* leaves extracts (hexane, chloroform, and methanol) for twenty-eight days. Results exhibit that hexane extract has higher antidiabetic activity than other solvent extracts. In other studies, a new compound oleanic acid derivative (triterpenes were isolated from the aerial parts of *M. parviflora*), revealed significant hypolipidemic and antidiabetic activity against streptozotocin-induced type-1 diabetes, and streptozotocin nicotinamide-induced type-2 diabetes, in mice.[65]

Antifungal Activity

M. parviflora extract has fungicidal effects against *Arthrinium sacchari*, and *Chaetomium funicola* these compounds are recognized as Glabridin (3-(2',4'- dihydroxy phenyl)-8-dimethylpyrano chroman). Others like OEL had wide effectiveness against filamentous fungi and several bacteria, such as *Alicyclobacillus* spp. and heat-stable bacilli like *Bacillus* spp. and. Furthermore, Glabridin eradicates filament fungi, yeast, and toughness adjusting activity against *Candida albicans*. *In vivo* studies exhibit the antifungal activity of glabrol, Glabridin, and their derivatives towards *Mycobacterium smegmatis* and *Candida albicans*.[66,67]

Anti-inflammatory Activity

The anti-inflammatory activity of *M. parviflora* leaves extract was investigated utilizing xylene intoxicated ear edema assay. When administered orally, the aqueous and methanolic extract revealed significant inhibitory activity in mice. Results were compared with standard drugs. Total antioxidant capability assay was used in antioxidant effect evaluation, in mice. Both extracts when administered daily for three weeks revealed dose-dependent antioxidant action. *M. parviflora* stem extract has anti-inflammatory activity that was examined using histamine-induced paw edema and carrageenan. The acetic acid writhing assay was used for the assessment of analgesic activity. Edema formation was significantly inhibited by the extract. The number of writhes was significantly decreased in a dose-dependent manner. Results were compared with standard drug (indomethacin).[58]

Anti-irritant Activity

Acute and chronic irritant responses were shown by *M. parviflora* chloroform extract. Ethanol and hexane extracts also revealed acute irritant responses.[68]

Wound Healing Activity

Swellings and wounds treated by a hot poultice made from *M. parviflora* leaves. *M. parviflora* roots and leaves showed anti-inflammatory activity *in vitro* by inhibition of COX-1 enzyme.[69]

Analgesic Activity

M. parviflora extract exhibits analgesic activity in the acetic acid-induced writhing model, this effect was categorized by a decrease in the writhes numbers while associated to the standard. Licking frequency and time were decreased in a dose-dependent in rats injected with 2.5% formalin, signifying its analgesic activity. These results were also associated with indomethacin.[70]

Anti-ulcerogenic Activity

Studies revealed a substantial rise in the spleen weight/body, an increase in colon weight/length proportion associated with the standard control group, and severe colon inflammation caused by acetic acid. Pretreatment with AEMP and MEMP for 5 days after that stimulation of colitis lead to substantial attenuation of colon weight/length ratio and spleen weight compared with the acetic acid control group. *M. parviflora* methanolic extract gives a better anti-colitis effect than an aqueous extract; the effect was well-known at the dose of 200 mg/kg. Histopathological outcomes established the MEMP protective effect.[71]

CONCLUSION

Excess survey of researches exhibits the pharmacological uses of *M. parviflora* include the antioxidant, antibacterial, antidiabetic, antifungal anti-inflammatory activity in addition to the wound healing effect of the crude extract and isolated compounds, In future studies, this plant and its components are very interested to be taken in consideration in the preparation of drugs that treat the previously mentioned diseases due to its important active compounds in different parts of the plant.

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