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Review Article

A REVIEW ON BIOLOGICAL ACTIVITIES OF COMMON MALLOW (*MALVA SYLVESTRIS* L.)

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ABSTRACT

Since time immemorial, medicinal plants have been used by various communities to cure a large number of ailments. Research in medicinal plants has received a renewed focus in recent years. The plant-based system of medicine being natural does not pose any serious complications. Phytochemical compounds in plants are known to be biologically active aiding. *Malva sylvestris* L. (Malvaceae) is a medicinal plant usually known as common mallow. The purpose of this article is to review information available in the scientific literature on the biological activities of the plant. *M. sylvestris* having a strong antioxidant, anti-inflammatory, anticancer, wound healing, hepatoprotective, antinociceptive, and antimicrobial activities are reviewed in this article. It is evident from the current literature that *M. sylvestris* is one of the most promising medicinal plant species. However, extensive research in the area of isolation and characterization of the active compounds of *M. sylvestris* is essential so that better, safer, and cost-effective drugs for curing various diseases and infections can be developed.

Keywords: Common mallow, *Malva sylvestris*, Biological activities, Medicinal plant.

INTRODUCTION

Plants, especially medicinal plants play an important as well as a key role in drug discovery, and these are very useful for curing various disease ailments for humankind [1-3]. The utilization of various medicinal plants as a vital source for relief from different illness can be traced back over five millennia [4-6]. Medicinal plants are still vital source of non-toxic or less toxic, cost-effective, easily accessible, and safe natural resources of drugs all over the world [7,8]. According to the report of the World Health Organization (WHO), approximately 65-80% of the people of developing countries depend on traditional herbal medicine for their health care due to difficulties of acquiring modern medicine or poverty [9-11]. Ayurvedic, Unani, and Siddha medicine system of the Indian subcontinent, traditional Chinese medicines of China, and so many other traditional medicine systems are present in other countries of the world [12-15]. Today, we still dependent on "Ayurveda" in about 75% of our medicines [16]. It is estimated that of the discovered 17,000 species, approximately 3000 species are utilized in the pharmaceutical field [17,18].

Exploration of complementary and alternative medicine derived from the plant has getting successively importance in the recent years. In the last decade, there has been a continuous development in the area of plant-derived medicine or herbal medicine, and these plant derived herbal medicine are continuously receiving popularity both in developing and developed countries because of their origin in nature, more effective in treatment of various health problems and fewer side effects as compared to commercial drugs [19,20]. The therapeutic properties of these medicinal plants are attributed to the presence of biologically active substances or compounds such as alkaloids, coumarins, flavonoids, glycosides, tannins, vitamins, and other phenolic compounds [21-24]. In recent years, many of the plant species have been scientifically evaluated for their possible medicinal applications [25-28]. Therefore, medicinal plants are believed to be an important resource of new biochemical compounds with potential therapeutic activities.

Malva sylvestris L. (Malvaceae) is a medicinal plant usually known as common mallow in Europe and gulkhaira or vilayatti kangani in India and Pakistan [29]. *M. sylvestris* is a biennial–perennial herbaceous plant distributed mainly in Europe, North Africa, and South-West Asia, and its traditional use has been documented since a long-time ago [30,31]. The plant generally grows in moist areas such as near marshes, ditches, river banks, oceans, and meadows [32]. For its emollient and laxative properties, it was used by the Roman and Greek peoples [33]. Traditionally, *M. sylvestris* is used for the treatment of various infections or diseases, including cold, cough, tonsillitis, bronchitis, digestive problems, eczema, burn, and cut wound healing in rural areas [34-36]. Fluid extracts of *M. sylvestris* flowers and leaves are used as a valuable remedy for inflammatory diseases of mucous membranes, cystitis, and diarrhea [30,37]. This plant derives its healing abilities from the mucilage and flavonoids found in the leaves and flowers [38]. Young leaves, shoots, flowers, and fruits are consumed salads, leaves, and shoots are consumed in soups and as boiled vegetables [31]. The present study reviews the important biological activities of *M. sylvestris* for their therapeutic properties (Fig. 1).

PHYTOCHEMISTRY

The preliminary phytochemical analysis of the *M. sylvestris* showed the presence of polysaccharides, coumarins, flavonoids, malvin, malvidin 3-(6"-malonylglucoside)-5-glucoside, malvone A (2-methyl-3-methoxy-5,6-dihydroxy-1,4-naphthoquinone) malvaline, scopoletin, polyphenols, niacin, folic acid, vitamin A, vitamin C, vitamin E, and tannins [36,39-42]. Major flavonoids constituents gossypetin 3-sulphate-8-O-β-D-glucoside, hypolaetin 3'-sulphate, and three 8-hydroxyflavonoids were identified in *M. sylvestris* [38,43]. Cutillo *et al*. (2006) [40] have also reported the presence of terpenoids such as sesquiterpenes, diterpenes, and monoterpenes in the *M. sylvestris*.

BIOLOGICAL ACTIVITIES

M. sylvestris is an important medicinal plant which shows a wide range of biological activities (Fig. 2). The plant exhibits antioxidant, anti-inflammatory, anticancer, wound healing, hepatoprotective, antinociceptive, and antimicrobial activities which are presented below.

Antioxidant activity

M. sylvestris has been reported to possess antioxidant property. DellaGreca *et al.* [30] measured the antioxidant activity of aqueous extract of *M. sylvestris* by its ability to scavenge the 2,2'-diphenyl-1-picrylhydrazyl (DPPH) and superoxide anion radicals and to induce the formation of a phosphomolybdenum complex. They reported strong antioxidant activity of extract and also isolated eleven compounds responsible for the activity. Barros *et al.* [31] studied the antioxidants and free radical scavengers as well as anti-

Fig. 1: Flower of *Malva sylvestris* L.

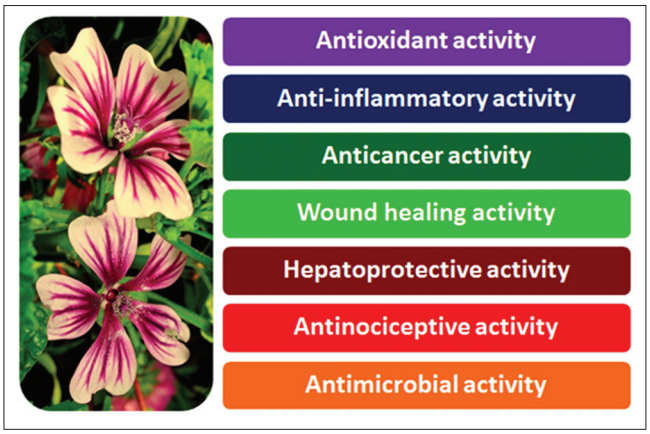

Fig. 2: Different biological activities of *Malva sylvestris* L.

inflammatory effect of different parts extract of *M. sylvestris* (leaves, flowers, immature fruits, and leafy flowered stems). *M. sylvestris* leaves revealed very strong antioxidant properties including radical-scavenging activity, reducing power and lipid peroxidation inhibition in liposomes and brain cells homogenates. The protective effect of the *M. sylvestris* decoction on renal damages in rats induced by ammonium metavanadate poisoning was evaluated by Marouane *et al*. [44]. *M. sylvestris* is proved to have a significant antioxidative property due to its richness in phenolic compounds. The antioxidant capacities of leaves and petioles of *M. sylvestris* were estimated using Folin-Ciocalteu, DPPH, Trolox equivalent antioxidant capacity, and ferric-reducing/antioxidant power (FRAP) radical scavenging assays by Tabaraki *et al*. [45]. Their study revealed that *M. sylvestris* had relatively high antioxidant capacity. Tešević *et al*. [46] determined the antioxidant activities of the seed oil of *M. sylvestris* from Serbia by radical scavenging activity using DPPH assay. Samavati and Manoochehrizade [47] demonstrated that crude polysaccharides derived from *M. sylvestris* leaves had strong scavenging activities *in vitro* on DPPH and hydroxyl radicals. Zakhireh *et al*. [48] studied the antioxidative effects of non-polar compounds extracted from the aerial parts of *M. sylvestris*. Beghdad *et al*. [49] also studied the antioxidant properties of leaves, flowers, stems, and seeds of *M. sylvestris* using FRAP assay, total antioxidant capacity, and scavenging of DPPH radical based on the reduction of molybdenum (VI) to molybdenum (V) in Algeria. They reported that the extracts possessed concentration-dependent antioxidant activity. In addition, the ethyl acetate fraction of *M. sylvestris* extract exhibited the highest value of antioxidant activities for almost all parts of leaves. Jaradat *et al*. [50] studied comparative antioxidant activity of wild *M. sylvestris* leaves and their cultivated species using DPPH radical scavenging activity and compared to Trolox ((S)-(-)-6-hydroxy-2,5,7,8-tetramethylchroman-2-carboxylic acid) antioxidant activity. Their results showed that the wild *M. sylvestris* leaves have higher antioxidant activity (IC_{50}) comparing with their cultivated species.

Anti-inflammatory activity

The anti-inflammatory activity of *M. sylvestris* has been studied by numerous research groups. Sleiman and Daher [51] studied the role of the aqueous extract of *M. sylvestris* aerial part upon lipemia, glycemia, inflammation, and gastric ulcer using rats as a model and significant anti-inflammatory activity was observed. Prudente *et al*. [52] evaluated the anti-inflammatory properties of *M. sylvestris* hydroalcoholic extract and its compounds in mice ear inflammation caused by 12-O-tetradecanoylphorbol-acetate. Their results support the notion that *M. sylvestris* leaves possesses topical anti-inflammatory activity and the compound malvidin 3-glucoside seems to be major responsible for this effect. The anti-inflammatory effects of *M. sylvestris* alcoholic extracts were also evaluated by measuring the pro-inflammatory mediators PGE_2 and PGD_2 in desferrioxamine-stimulated phorbol 12-myristate 13-acetate-differentiated U937 cells by Martins *et al*. [53]. They suggested that the anti-inflammatory activities evoked by *M. sylvestris* may be related to modulation of these mediators. Benso *et al*. [54] investigated the *in vitro* anti-inflammatory activity of *M. sylvestris* leaves extract and fractions in a co-culture model of cells infected by *Aggregatibacter actinomycetemcomitans*. According to them, *M. sylvestris* and its chloroform fraction minimized the *A. actinomycetemcomitans* infection and inflammation procedure in oral human cells by a putative pathway that involves important cytokines and receptors. Hajyani *et al*. [55] evaluated the effect of *M. sylvestris* L. aqueous extract on blood cell parameters in mice with *Candida albicans* infection. According to them, aquatic extract of *M. sylvestris* plant is able to boost innate immune system and reduce effect of *Candida* infection.

Anticancer activity

Cancer is a generic term for a large group of diseases that can affect any part of the body. According to the WHO, cancer is a leading cause of death worldwide. Reports show that *M. sylvestris* possesses anticancer potential. Daniela *et al*. [56] demonstrated cytotoxic activity of *M. sylvestris* leaves extract on murine and human cancer cell lines using a MTT assay. The biological assay showed that *M. sylvestris* extracts significantly reduces proliferation of cancer cell lines.

Wound healing activity

Several studies have proven wound healing activity of *M. sylvestris*. Pirbalouti *et al*. [35] evaluated the wound healing activity of diethyl ether extract of *M. sylvestris* flowers in Wistar rats. Pirbalouti *et al*. [36] also evaluated the wound healing activity of diethyl ether extract of *M. sylvestris* flowers at 200 mg/kg/day dose in alloxan-induced diabetic rats. The chloroform extract of *M. sylvestris* flowers were also used to evaluate the wound healing activity at same dose in Wister rats [57]. Kovalik *et al*. [58] also assessed the wound healing effect of *M. sylvestris* on a palate mucosa wound in rats. The extract-treated diabetic animals exhibited a significant reduction in the wound area when compared with control. Afshar *et al*. [59] assessed the effect of *M. sylvestris* aqueous extract on cutaneous wound in BALB/c mice. Their results showed the significant reduction in the wound in *M. sylvestris* extract-treated mice than the control group.

Hepatoprotective activity

M. sylvestris was found to exhibit hepatoprotective activity against paracetamol-induced hepatotoxicity in mice. Hussain *et al*. [60] assessed the hepatoprotective effects of *M. sylvestris* against paracetamol-induced hepatotoxicity in mice. The results of their study strongly suggest that the extract of *M. sylvestris* has strong hepatoprotective effects against paracetamol-induced liver injury. The extract of *M. sylvestris* significantly reduced the serum levels of these elevated liver enzyme markers in a dose-dependent manner, and histopathological examination of liver tissues also exhibited hepatoprotective effects of *M. sylvestris* in restoring normal functional ability of the liver.

Antinociceptive activity

The antinociceptive activity of *M. sylvestris* aqueous extract was evaluated against classical models of pain in mice by Esteves *et al*. [61]. It showed a significant antinociceptive activity in writhing test (76.4% of inhibition) and also inhibited the neurogenic (61.8%) and inflammatory (46.6%) phases of the formalin model. Their results suggest that *M. sylvestris* possesses interesting substances, which act as antinociceptive agents.

Antimicrobial activity

M. sylvestris poses antimicrobial activity against various bacterial and fungal species. Dulger and Gonuz [62] investigated antimicrobial activity of *M. sylvestris* flower and leave extracts against nine bacterial species (*Escherichia coli, Staphylococcus aureus, Klebsiella pneumoniae, Pseudomonas aeruginosa, Proteus vulgaris, Bacillus cereus, Mycobacterium smegmatis, Listeria monocytogenes*, and *Micrococcus luteus*) and three yeasts (*C. albicans, Rhodotorula rubra*, and *Kluyveromyces fragilis*) using the disc diffusion method. They found that *M. sylvestris* has moderate activity against tested microorganisms when compared to standard antibiotics. De Souza *et al*. [63] also studied antimicrobial activity of *M. sylvestris* aerial part extract against *S. aureus, Staphylococcus epidermidis, M. luteus, Bacillus subtilis, E. coli, C. albicans,* and *Saccharomyces cerevisiae*. Their study reported that ethanol extracts of *M. sylvestris* were active against *B. subtilis, P. aeruginosa,* and *E. coli*, but methanol extract showed activity only against *S. cerevisiae*. Cheng and Wang [64] studied antimicrobial activity of anthocyanin extracted from *M. sylvestris*. According to them, the anthocyanin showed a promising antimicrobial activity to *S. aureus* but had no bacteriostasic activity to both *Aspergillus niger* and *E. coli*. The bacteriostasic activity to *S. aureus* increased with increasing anthocyanin content of *M. sylvestris* in the solid-culture experiment. The antibacterial activity of *M. sylvestris* extract was also evaluated against two reference strains and 11 clinical isolates of *Helicobacter pylori* [65]. Their results demonstrated that *M. sylvestris* extract was capable of inhibiting the *in vitro* growth of *H. pylori*. Malik *et al*. [66] investigated the antibacterial activity of ethanolic extract of *M. sylvestris* leaves against *Salmonella typhimurium in vitro* using agar well diffusion method. Walter *et al*. [67] also examined the antibacterial activity of *M. sylvestris* against one Gram-positive (*S. aureus*) and two Gram-negative (*E. coli* and *P. aeruginosa*) bacteria. Their results showed a significant antibacterial activity. Cardoso *et al*. [68] evaluated antifungal activity of *M. sylvestris* (mallow) tinctures on *C. albicans*, *Candida tropicalis,* and *Candida krusei*. According to them, *M. sylvestris* tincture showed a significant antifungal activity against all the tested fungal strains at lower concentrations. The antifungal activity of plant extracts (seeds, stem parts, and leaves) of *M. sylvestris* has also been evaluated against four fungal pathogens such as *Rhizopus stolonifer*, *Trichoderma* sp., *Fusarium oxysporum,* and *Penicillium* sp. [69,70]. They demonstrated that among the plant extracts studied, the seed and stem of *M. sylvestris* extracts were capable of inhibiting *in vitro* growth of the four tested fungal pathogen, but stem was the most effective. Abu-Qatouseh *et al*. [71] evaluated *in vitro* antimicrobial activity of methanolic leaves extracts of Algerian originated *M. sylvestris* against *H. pylori*. According to them, potential antimicrobial activities of *M. sylvestris* extracts against *H. pylori* would be potential novel agents for the control of *H. pylori* infections. Zohra *et al*. [72] also studied the antimicrobial activity of *M. sylvestris* seed oil against the standard strains of *S. aureus, L. monocytogenes, B. cereus, Enterococcus feacalis, E. coli, P. aeruginosa, K. pneumoniae*, as well as the fungi *C. albicans* by agar diffusion method. Their study revealed that the seed oil inhibits the growth of all microorganisms tested except the Gram-negative bacteria *P. aeruginosa*. Parveen *et al*. [73] evaluated the antifungal activity of *M. sylvestris* leaves extract against *A. niger* causing black mold rot of pear (*Pyrus communis* L.). It was revealed from their results that different concentrations of *M. sylvestris* leaves extract caused a significant reduction in spore germination of *A. niger* compared to control.

CONCLUSIONS

M. sylvestris is an important resourceful plant due to its various medicinal properties. It possesses a broad spectrum of biological activities as evident from this review. A broad range of phytochemical components such as polysaccharides, coumarins, anthocyanin, malvin, malvidin 3-(6”-malonylglucoside)-5-glucoside, malvone A (2-methyl-3- methoxy-5,6-dihydroxy-1,4-naphthoquinone) malvaline, scopoletin, polyphenols, niacin, folic acid, vitamin A, vitamin C, vitamin E, and tannins reviewed that it possess antioxidant, anti-inflammatory, anticancer, wound healing, hepatoprotective, antinociceptive, and antimicrobial activities. So, it can concluded that common mallow is a traditionally and clinical proven plant species for both its application and efficacy. Research aimed at identifying active compounds responsible for the bioactivities of common mallow (*M. sylvestris*) could contribute positively to the discovery of new drugs.

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