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A Comprehensive Review on *Mentha arvensis* Species

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Abstract

Mentha arvensis L., often referred to as field mint or wild mint, is a fragrant medicinal herb in the Lamiaceae family and is extensively found in temperate and subtropical areas. The plant is appreciated for its essential oil, notably high in menthol, which adds to its unique scent and extensive medicinal possibilities. Historically, M. arvensis has been utilized in several medical systems for addressing digestive issues, respiratory problems, headaches, and skin infections. Recent scientific studies have confirmed numerous traditional assertions by showing its and pain-relieving characteristics, antioxidant, antimicrobial and anti-inflammatory properties. Phytochemical research indicates that M. arvensis is rich in various bioactive substances, such as menthol, menthone, phenolic acids, terpenoids and flavonoids, all of which collectively enhance its pharmacological effects. Besides its medicinal uses, M. arvensis is significant in the food, cosmetic, and pharmaceutical sectors, serving as a flavoring agent, fragrance element, and active substance in topical products. The plant holds economic importance because of its strong demand in the production of essential oils, especially in countries such as India. Even with its widespread application, additional investigation is needed to examine its molecular mechanisms of action, refine cultivation techniques, and guarantee sustainable use. In summary, Mentha arvensis constitutes a significant natural asset with great possibilities for medical and industrial uses.

Keywords: Flavor, health, *Mentha arvensis*, menthol, oil

INTRODUCTION

Mentha arvensis, often referred to as field mint or Japanese mint, is a fragrant perennial herb that is part of the Lamiaceae family [1]. It is among the most extensively grown mint varieties because of its rich essential oil content, especially menthol, which renders it significant both economically and medicinally. The plant originates from temperate areas of Europe and Asia but is now cultivated widely in various regions globally, particularly in India, Brazil and Japan [2]. Its ability to thrive in various climate and soil conditions has led to its widespread cultivation and economic importance worldwide. Botanically, its features a creeping rhizomatous root structure that enables the plant to expand quickly [3]. The stems are upright, four-sided, and branched, supporting opposite, ovate to lanceolate leaves with jagged edges. The leaves contain abundant oil glands that give the plant its potent minty scent [4]. Small, light purple to lilac blossoms emerge in clusters in the leaf axils, typically in the summer. The plant flourishes optimally in damp, well-aerated soils and favors moderate temperatures along with adequate sunlight [5]. The most striking characteristic of *Mentha arvensis* is its essential oil, which has a significant concentration of menthol, as well as other components like menthone, menthyl acetate, and limonene. This oil is extensively utilized in the pharmaceutical, cosmetic, flavor and food industries. Menthol derived from this plant is appreciated for its refreshing effect and is frequently utilized in lozenges, cough syrups,

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mouthwashes, toothpastes, and topical pain relievers [6]. From a therapeutic viewpoint, this plant has been traditionally utilized in different medical systems such as Ayurveda and traditional Chinese medicine. The herb is recognized for its antimicrobial, antispasmodic and anti-inflammatory qualities. It has been frequently utilized to ease digestive issues like indigestion and stomach pains [7]. Inhaling mint vapours or using menthol-infused products is commonly done to relieve breathing issues, nasal blockage and headaches. *Mentha arvensis* significantly contributes to agriculture and rural economies. It serves as a lucrative cash crop for farmers, especially in areas where climate conditions support its cultivation. Growing and processing mint create job opportunities and play a crucial role in the export market for essential oils [8, 9]. In general, it is a plant of significant medicinal, botanical and economic value. Ongoing research and sustainable farming methods can additionally boost its potential and guarantee its lasting advantages for human well-being and economic growth [10].

PHYTOCHEMICALS

Essential oil constituents (menthol, menthone, isomenthone), phenolic compounds, flavonoids, terpenoids [11], tannins, glycosides, alkaloids, etc.

Uses

Mentha arvensis, often referred to as field mint or corn mint, is a popular aromatic and medicinal herb appreciated for its health benefits, culinary uses, and industrial purposes. The plant contains abundant essential oils, particularly menthol, which lends it significant biological and commercial value [12]. In traditional medicine, it is frequently employed to address digestive issues. The leaves and oil assist in alleviating indigestion, stomach cramps, flatulence, and nausea by soothing the gastrointestinal muscles and enhancing bile production. Mint preparations are additionally utilized to enhance appetite and diminish vomiting [13]. The herb is widely recognized for its effectiveness in alleviating respiratory issues. Menthol found in this plant serves as a natural decongestant and is commonly utilized in inhalers, cough syrups, and ointments. It alleviates sinus congestion, cold, asthma, cough, and bronchitis by creating a cooling sensation and facilitating easier breathing [14]. It also demonstrates antimicrobial and antiseptic characteristics. Plant extracts are effective against various bacterial species, making them beneficial for treating minor skin infections, wounds, and oral health issues [15]. Mint oil is frequently utilized in toothpastes, mouthwashes, and lozenges to combat bad breath and dental infections. Given its cooling and calming properties, the plant is used externally to muscle discomfort, itching, and alleviate headaches.

PHARMACOLOGICAL PROPERTIES

Anti-Cancer

Mentha arvensis has attracted scientific interest for its possible anticancer properties owing to the presence of bioactive compounds. These substances enhance the plant's capacity to suppress cancer cell proliferation and safeguard healthy cells from harm. Research indicates that *Mentha arvensis* extracts display cytotoxic properties toward different cancer cell lines. The anticancer effect is largely ascribed to its antioxidant characteristics [16], which assist in neutralizing free radicals and lowering oxidative stress, an essential element in cancer development and advancement. By reducing oxidative harm to DNA, the plant can assist in preventing mutations and unchecked cell proliferation. Phenolic compounds and flavonoids found in this plant are recognized for programmed cell death or triggering apoptosis in cancer cell. This procedure is crucial for removing abnormal cells while preserving healthy tissues. Moreover, these substances could disrupt the cell cycle of cancerous cells, thus hindering their growth. Menthol, the primary component of this plant has been noted to inhibit tumor development by altering signaling pathways related to inflammation and cellular survival. Additionally, the plant's anti-inflammatory characteristics assist in decreasing chronic inflammation, which is strongly linked to the progression of cancer. In conclusion, *Mentha arvensis* demonstrates encouraging anticancer properties, and additional studies may validate its application in creating natural anticancer compounds.

Antioxidant

Mentha arvensis shows notable antioxidant properties thanks to various phytochemicals such as flavonoids, phenolic acids, and elements of its essential oil. Substances, like quercetin, rosmarinic acid, luteolin, caffeic acid, and menthol, are significant in shielding cells from oxidative harm. Oxidative stress arises when there is a disparity between the generation of free radicals and the body's antioxidant defense [17], resulting in cellular harm and the onset of several chronic illnesses. Extracts from this plant have demonstrated the ability to effectively eliminate free radicals, which reduces oxidative stress and hinders lipid peroxidation in biological systems. The flavonoids found in the plant enhance antioxidant activity by donating hydrogen atoms or electrons to counteract reactive oxygen species. Phenolic compounds can chelate metal ions, aiding in the prevention of highly reactive radical formation. Moreover, the elements found in essential oils improve the total antioxidant capacity by stabilizing free radicals and safeguarding cellular membranes.

Anti-Diabetic

Mentha arvensis has been used in herbal medicine for diabetes management, and recent research backs its possible antidiabetic properties. The plant possesses various bioactive compounds, such as flavonoids, phenolic acids, terpenoids, and constituents of essential oils, which aid in its glucose-lowering properties [18]. A key mechanism underlying the antidiabetic effects of *Mentha arvensis* is the inhibition of carbohydrate-digesting enzymes like α-amylase and α-glucosidase. By decelerating the digestion and absorption of carbohydrates in the gut, the plant aids in averting rapid spikes in blood sugar levels post meals. The antioxidant effects of *Mentha arvensis* are also essential in managing diabetes. Oxidative stress is strongly linked to insulin resistance and harm to pancreatic β-cells. The antioxidants found in the plant aid in safeguarding pancreatic cells against oxidative damage and enhance insulin sensitivity.

Anti-Inflammatory

Mentha arvensis exhibits significant anti-inflammatory effects, primarily due to its abundant levels of flavonoids, phenolic substances, and essential oil components like menthol and menthone. Inflammation is a biological reaction to damage or infection of tissues, but extended inflammation may result in chronic illnesses. The bioactive substances found in this plant assist in controlling this inflammatory reaction [19]. The extracts from plants have demonstrated the ability to block the release of pro-inflammatory substances, such as cytokines and prostaglandins, which cause swelling, and pain. By inhibiting these mediators, this plant aids in lowering inflammation at the cellular level. Phenolic acids and flavonoids found in the plant inhibit inflammatory enzymes (lipoxygenase and cyclooxygenase) thus reducing the production of inflammatory substances. Menthol, a primary element of the plant, offers a cooling and calming sensation when used topically and aids in alleviating pain linked to inflammation. Moreover, the antioxidant properties of this plant aid its anti-inflammatory effects by diminishing oxidative stress, which is strongly associated with inflammatory responses. Studies using animal models have shown that extracts of *Mentha arvensis* greatly decrease edema and inflammatory reactions.

Anti-Microbial

Mentha arvensis shows considerable antimicrobial properties, primarily due to its essential oil constituents and phenolic substances. The plant has bioactive components, like menthol, menthone, phenolic acids and flavonoids, that are effective against various microorganisms. Extracts and essential oils from this plant have demonstrated inhibitory effects on both Gram-positive and Gram-negative bacteria [20]. These consist of prevalent pathogenic bacteria linked to gastrointestinal issues, skin infections, and respiratory disorders. The antimicrobial effect mainly results from the capacity of essential oil components to disrupt microbial cell membranes, causing the leakage of cellular contents and ultimately cell death. Besides antibacterial properties, this plant also exhibits antifungal effects. The extracts from plants have demonstrated the ability to hinder the growth of different fungal species by disrupting their cell wall formation and metabolic functions. Flavonoids and phenolic compounds boost antimicrobial effectiveness by deactivating microbial enzymes and inhibiting biofilm

development. The antioxidant properties of this plant indirectly aid its antimicrobial action by decreasing oxidative stress and enhancing the host's defense responses.

CONCLUSION

Mentha arvensis is a significant aromatic and medicinal plant with extensive therapeutic and economic importance. The plant contains abundant bioactive phytochemicals, like menthol, flavonoids, phenolic acids, and terpenoids, which enhance its various pharmacological effects. Research validates its traditional applications, showing antimicrobial, antioxidant, antidiabetic, anti-inflammatory, and anticancer properties. These biological functions are mainly linked to its capacity to diminish oxidative stress, impede microbial development, manage inflammatory mediators, and enhance metabolic processes. Besides its therapeutic importance, *Mentha arvensis* is essential in the food, cosmetic, and pharmaceutical sectors because of its potent fragrance and cooling effects. Even with its potential therapeutic benefits, additional clinical studies are required to determine standardized dosages, safety profiles, and mechanisms of action.

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