



A Comprehensive Review of *Mentha Arvensis*



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	Abstract
Published on: 31.03.2026	Mentha arvensis Linn. (field mint), a perennial aromatic herb of the family Lamiaceae, is widely valued for its medicinal, pharmaceutical, and industrial significance. The present review provides a comprehensive overview of Mentha arvensis, encompassing its botanical description, taxonomical classification, geographical distribution, cultivation practices, and phytochemical composition. Special emphasis is placed on its essential oil, which is rich in menthol and other bioactive constituents such as terpenoids, flavonoids, and phenolic compounds. The review also summarizes physicochemical properties essential for quality control and standardization. Traditional uses in Ayurveda, Unani, and folk medicine are critically correlated with modern pharmacological studies. Experimental evidence supports a wide range of biological activities, including antimicrobial, anti-inflammatory, antioxidant, gastroprotective, analgesic, hepatoprotective, and radioprotective effects. Overall, Mentha arvensis emerges as an important medicinal plant bridging traditional knowledge and contemporary scientific research.
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	Keywords: Mentha arevensis , flavonoids , lamiaceae , Physicochemical Properties, Pharmacological Activities

1. INTRODUCTION

Mentha arvensis Linn., commonly known as field mint or corn mint and widely referred to as *Pudina* in India, is a perennial aromatic herb belonging to the family **Lamiaceae**. It is one of the most economically and medicinally important species of the genus *Mentha*, extensively cultivated for its essential oil rich in menthol. Since ancient times, *Mentha arvensis* has occupied a prominent place in traditional systems of medicine such as **Ayurveda, Unani, and traditional Chinese medicine**, where it has been used for the treatment of digestive, respiratory, hepatic, and inflammatory disorders [1].

Medicinal plants play a crucial role in primary healthcare, particularly in developing countries, where nearly 70–80% of the population relies on herbal remedies for basic medical needs. *Mentha arvensis* exemplifies such medicinal plants that bridge traditional knowledge and modern pharmacological research. The therapeutic potential of this plant is largely attributed to its volatile oil, which contains a high proportion of menthol along with other bioactive monoterpenes and flavonoids [2].

In addition to its medicinal applications, *Mentha arvensis* holds significant industrial value. The essential oil extracted from its aerial parts is widely used in the pharmaceutical, food, cosmetic, and perfumery industries. Menthol derived from *M. arvensis* is an important ingredient in cough preparations, topical analgesics, mouth fresheners, toothpastes, and confectionery products [3]. Due to increasing demand for natural products and plant-based therapeutics, *Mentha arvensis* has attracted

considerable scientific interest in recent decades.

Modern pharmacological investigations have validated many of the traditional claims associated with *Mentha arvensis*, including its antimicrobial, antioxidant, anti-inflammatory, antispasmodic, and gastroprotective properties. Experimental studies have demonstrated that extracts and essential oil of the plant exhibit broad-spectrum biological activities, supporting its potential as a source of novel therapeutic agents [4]. Consequently, *Mentha arvensis* serves as an excellent model plant for integrating ethnomedicinal knowledge with contemporary scientific research. This chapter aims to present a comprehensive and systematic review of *Mentha arvensis*, covering its botanical characteristics, distribution, cultivation aspects, phytochemical composition, physicochemical properties, traditional and modern uses, and pharmacological activities, based on available scientific literature.

2. PLANT PROFILE

Mentha arvensis Linn. is a fast-growing, strongly aromatic perennial herb characterized by creeping rhizomes and erect aerial stems. The plant typically attains a height ranging from 30 to 60 cm and exhibits profuse branching, which contributes to its bushy appearance. The stem is quadrangular, a characteristic feature of the Lamiaceae family, and may appear green to purplish depending on environmental conditions and growth stage [5]. The leaves are arranged oppositely on the stem and are ovate to oblong-lanceolate in shape, with serrated margins and a short petiole or sessile base. The leaf surface is generally covered with glandular trichomes, which are responsible for the synthesis and storage of essential oil. When crushed, the leaves emit a strong, characteristic minty aroma due to the presence of menthol-rich volatile oil [6].



FIGURE: 1 *Mentha arvensis*

The flowers of *Mentha arvensis* are small, bisexual, and typically lilac to pale purple in color. They are arranged in axillary whorls known as verticillasters. Flowering usually occurs during the summer months and plays an important role in the reproductive cycle of the plant. The fruit is a schizocarp that splits into four small nutlets upon maturation. From a pharmacognostic perspective, the leaves and flowering tops constitute the most important medicinal parts of the plant. These parts are harvested during the flowering stage when the essential oil content is at its maximum. The plant is valued not only for its medicinal properties but also as a companion crop in agriculture due to its pest-repellent nature [7].

2.1 Taxonomical Classification

The taxonomical classification of *Mentha arvensis* places it within the family Lamiaceae, a family well known for aromatic plants rich in essential oils. Proper taxonomic identification is essential in pharmacognosy to avoid adulteration and substitution, which are common problems associated with crude drug trade.

Taxonomical hierarchy of *Mentha arvensis* Linn.:

- **Kingdom** : Plantae
- **Division** : Magnoliophyta

- **Class** : Magnoliopsida
- **Order** : Lamiales
- **Family** : Lamiaceae (Labiatae)
- **Genus** : *Mentha*
- **Species** : *Mentha arvensis* Linn.

The genus *Mentha* consists of more than 60 species and numerous natural hybrids. *Mentha arvensis* is taxonomically significant because of its high menthol content, which distinguishes it from other species such as *Mentha spicata* and *Mentha × piperita*. The plant exhibits considerable polymorphism due to environmental influence and frequent hybridization within the genus, which sometimes complicates its identification [8]. From a pharmaceutical viewpoint, correct taxonomical classification ensures authenticity of raw material used in medicinal and industrial applications. Microscopic and chemical evaluation is often employed alongside taxonomic classification to confirm the identity of *Mentha arvensis* in crude drug form.

Table : 1 Vernacular names of *Mentha arvensis* Linn.

Language	Vernacular name(s)
English	Field mint, Japanese mint, Pennyroyal, Spearmint, Garden mint
Hindi	Ban Pudina, Paudina, Podina, Pudina, Pudinah
Sanskrit	Pudina, Putha, Podinika, Phudino, Podina
Arabic	Fodnanje, Fotanaje, Habaqulhind, Naanaaul-hind, Nana, Nana hindi, Nana yabani
Burmese	Bhudina
Canada	Chetni-maruga
Japanese	Midorihakka
Nepali	Nawaghya
Kannada	Chetmarugu, Chetni-marugu, Chetnimarugu, Chetnimaruga
Malayalam	Putina, Puttina, Puttiyana
Marathi	Pudina
Persian	Pudinah
Tamil	Iyeccakkirai, Iyeccirkirai, Kumarakamuli, Potina, Pudina, Pudinah, Puthina, Putina, Putiyana, Putiyanmulu, Putiyanputina, Yechakkirai
Telugu	Igaenglikoora, Igaenglikura, Pudina, Pudinah
Urdu	Ab-i-podina, Arq nana, Nana (pudina), Podina, Podina khushk, Podina taza, Pudina, Pudinah

2.2 BOTANICAL DISTRIBUTION

Botanical distribution refers to the natural occurrence of a plant species based on climatic and ecological conditions. *Mentha arvensis* is believed to have originated in the temperate regions of **Europe and Western Asia**, from where it gradually spread to other parts of the world through natural dispersal and human cultivation. The species thrives particularly well in **temperate and subtropical climates**, where moderate temperature, adequate moisture, and fertile soil conditions are available. Among the species of the genus *Mentha*, *M. arvensis* is unique in its ability to adapt to a wide range of ecological environments, including riverbanks, grasslands, marshy areas, and cultivated fields [9]. In botanical terms, *Mentha arvensis* is considered a moisture-loving plant, commonly found growing wild near streams, irrigation channels, and damp meadows. Its ability to regenerate rapidly through underground rhizomes allows it to colonize new areas efficiently, contributing to its wide botanical distribution. Due to its economic importance as a menthol-yielding plant, *Mentha arvensis* has been introduced into several non-native regions, where it is now cultivated extensively. This wide botanical adaptability has played a key role in establishing *M. arvensis* as one of the most commercially valuable mint species worldwide.

2.3 GEOGRAPHICAL DISTRIBUTION

Geographically, *Mentha arvensis* is distributed across **Asia, Europe, and North America**, with large-scale cultivation concentrated in selected countries due to industrial demand for menthol.

In **Asia**, *Mentha arvensis* is extensively cultivated in **India**, particularly in the states of Uttar Pradesh, Punjab, Haryana, Bihar, Madhya Pradesh, and parts of Rajasthan. India is currently one of the largest producers and exporters of natural menthol obtained from *Mentha arvensis*, supplying raw material to pharmaceutical and flavoring industries worldwide [10].

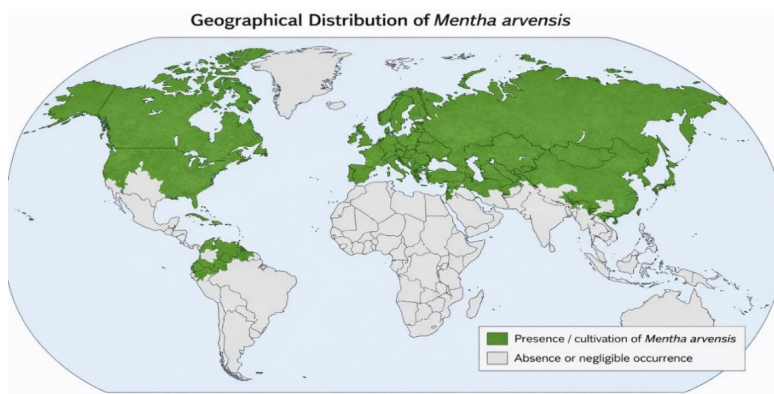


FIGURE: 2 Geographical Distribution of *Mentha arvensis*

The global distribution of *Mentha arvensis* is strongly influenced by:

- Climatic conditions
- Soil fertility
- Availability of irrigation
- Commercial demand for essential oil

Due to increasing preference for natural and plant-based products, the geographical cultivation area of *Mentha arvensis* continues to expand, especially in developing agricultural economies.

2.4 CULTIVATION AND CULTIVATION DEFECTS

Cultivation of *Mentha arvensis*

Mentha arvensis is a commercially cultivated aromatic crop, primarily grown for its menthol-rich essential oil. The plant requires specific agronomic conditions to achieve optimal growth and maximum oil yield.

Climate:

The crop grows best in temperate to subtropical climates with cool nights and warm days. An ideal temperature range of 20–30°C is favorable for vegetative growth and essential oil biosynthesis. Excessively high temperatures may reduce menthol content, while frost can damage young plants [11].

Soil:

Well-drained **loamy or sandy-loam soils** rich in organic matter are most suitable. Slightly acidic to neutral soil pH (6.0–7.5) supports optimal nutrient uptake. Waterlogging adversely affects root development and oil quality.

Propagation:

Mentha arvensis is primarily propagated vegetatively through **stolons, runners, or root suckers**, as seed propagation is unreliable due to poor seed viability and genetic variability. Vegetative propagation ensures uniform crop quality and consistent menthol yield.

Irrigation:

Regular irrigation is essential due to the shallow root system. However, over-irrigation should be avoided to prevent root rot and fungal infections.

Harvesting:

Harvesting is generally carried out during the **flowering stage**, when essential oil content is highest. The aerial parts are cut close to the ground and subjected to steam distillation for oil extraction.

2.5 CULTIVATION DEFECTS

Despite its adaptability, *Mentha arvensis* cultivation faces several defects that can reduce yield and quality:

1. Nutrient Deficiency:

Deficiency of nitrogen leads to poor vegetative growth, while lack of potassium affects oil composition and menthol percentage.

2. Pest Infestation:

Common pests include leaf rollers, aphids, and cutworms, which damage foliage and reduce photosynthetic efficiency.

3. Fungal Diseases:

Waterlogged conditions promote diseases such as **root rot, leaf spot, and rust**, resulting in reduced biomass.

4. Oil Quality Deterioration:

Improper harvesting time and poor distillation practices can reduce menthol concentration and overall oil quality.

5. Genetic Degeneration:

Continuous vegetative propagation without selection may result in reduced vigor and oil yield over successive crops [12]. Effective agronomic management and crop rotation are essential to minimize these cultivation defects.

3. ACTIVE CONSTITUENTS OF MENTHA ARVENSIS

The therapeutic and commercial importance of *Mentha arvensis* Linn. is mainly attributed to its rich phytochemical composition, particularly its essential oil and associated secondary metabolites. The plant contains a complex mixture of volatile and non-volatile compounds that collectively contribute to its pharmacological, aromatic, and industrial applications [12].

3.1 Essential Oil Constituents

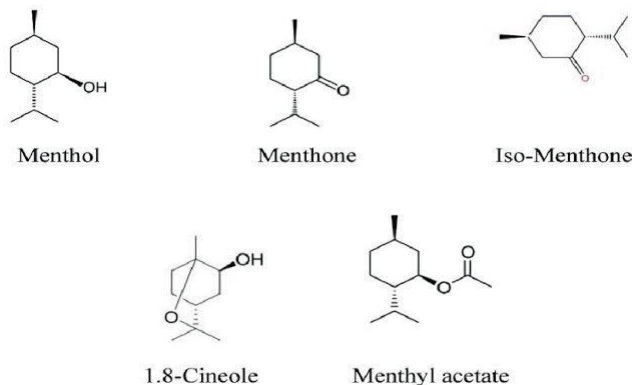
The essential oil of *Mentha arvensis* is primarily obtained from the leaves and flowering tops by steam distillation. The oil yield generally ranges from 0.5–1.0%, depending on agronomic conditions, cultivar, and harvesting stage [13]. The oil is dominated by monoterpenoid compounds, with menthol as the principal constituent.

The major volatile constituents identified in *Mentha arvensis* essential oil include:

- Menthol
- Menthone
- Isomenthone
- Neomenthol
- Menthyl acetate
- Piperitone

- Limonene
- 1,8-Cineole
- α -Pinene and β -

Among these, menthol is the most abundant compound, accounting for approximately 40–70% of the total oil composition [14]. The high menthol content distinguishes *Mentha arvensis* from other species of the genus *Mentha* and makes it a preferred source for natural menthol production in pharmaceutical and flavoring industries.



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3.2 Terpenoids and Related Compounds

Terpenoids form the largest class of bioactive constituents in *Mentha arvensis*. These compounds are synthesized in glandular trichomes present on the aerial parts of the plant and play a major role in its biological activity [15]. Monoterpenes such as menthol and menthone are responsible for the plant's **cooling, analgesic, antimicrobial, and antispasmodic** effects. Sesquiterpenes like β -caryophyllene contribute to anti-inflammatory and antioxidant actions. Oxygenated terpenes enhance the stability and therapeutic potential of the essential oil [16]. The relative proportion of terpenoids varies with environmental conditions, soil nutrients, and harvesting time, leading to qualitative and quantitative differences in oil composition.

3.3 Flavonoids

Flavonoids are important non-volatile constituents of *Mentha arvensis* and contribute significantly to its antioxidant and anti-inflammatory properties. Several flavonoids have been identified in different parts of the plant, including:

- **Luteolin**
- **Apigenin**
- **Hesperidin**
- **Rutin**
- **Eriocitrin**
- **Chrysoeriol**

These compounds are known to scavenge free radicals, inhibit lipid peroxidation, and protect tissues from oxidative stress, thereby supporting the traditional use of *Mentha arvensis* in inflammatory and hepatic disorders [17].

3.4 Phenolic Compounds

Phenolic compounds constitute another major group of secondary metabolites present in *Mentha arvensis*. These compounds contribute to the plant's antioxidant, antimicrobial, and protective effects against cellular damage [18].

Important phenolic acids reported include:

- **Rosmarinic acid**
- **Caffeic acid**
- **Chlorogenic acid**
- **Ferulic acid**

Rosmarinic acid is particularly significant due to its strong antioxidant and anti-allergic properties. The presence of phenolic compounds enhances the medicinal value of *Mentha arvensis* and supports its use as a natural preservative in food and pharmaceutical preparations [19].

3.5 Tannins and Glycosides

Tannins present in *Mentha arvensis* impart **astringent and antimicrobial** properties, which are beneficial in treating gastrointestinal disturbances such as diarrhea and dysentery. These compounds also contribute to wound healing and infection control [20].

Glycosides, especially flavonoid glycosides, improve the solubility and bioavailability of active constituents. Upon metabolism, they release biologically active aglycones that enhance therapeutic efficacy [21].

3.6 Other Minor Constituents

In addition to major phytochemicals, *Mentha arvensis* contains small quantities of:

- Alkaloids
- Saponins
- Sterols
- Organic acids
- Vitamins (A and C)
- Essential minerals such as calcium, potassium, magnesium, and iron

Although present in minor amounts, these constituents contribute synergistically to the overall pharmacological profile of the plant [22].

3.7 Significance of Active Constituents

The wide spectrum of active constituents present in *Mentha arvensis* explains its diverse medicinal applications. The synergistic interaction between volatile and non-volatile compounds enhances its therapeutic potential. Variations in phytochemical composition due to cultivation practices emphasize the need for standardization and quality control in medicinal use [23].

4. PHYSICOCHEMICAL PROPERTIES OF MENTHA ARVENSIS

Physicochemical evaluation of *Mentha arvensis* is essential for the **standardization, quality control, and authentication** of its crude drug and essential oil. These parameters help in distinguishing genuine material from adulterants and ensure consistency in pharmaceutical and industrial applications [24].

4.1 Physicochemical Properties of the Crude Drug

The dried leaves and flowering tops of *Mentha arvensis* possess characteristic physicochemical constants that are useful in pharmacognostic evaluation.

- **Color:** Green to dark green

- **Odor:** Strong, aromatic, characteristic mint-like
- **Taste:** Cooling, pungent, slightly bitter
- **Texture:** Brittle when dried

The presence of glandular trichomes on the leaf surface is responsible for the aromatic nature of the drug and serves as an identifying microscopic feature.

4.2 Ash values are used to assess the purity and quality of the crude drug

- **Total ash** indicates total inorganic content
- **Acid-insoluble ash** reflects contamination with siliceous matter
- **Water-soluble ash** gives an idea of water-soluble minerals

Excessive ash values may indicate adulteration or improper processing of the crude drug [25].

4.3 Physicochemical Properties of Essential Oil

The essential oil of *Mentha arvensis* is a **colorless to pale yellow liquid** with a strong minty aroma and cooling sensation. These properties are primarily attributed to its high menthol content.

Standard physicochemical parameters include:

- **Appearance:** Clear, mobile liquid
- **Odor:** Strong, penetrating, mint-like
- **Taste:** Cooling and refreshing
- **Specific gravity:** 0.890 – 0.910 at 25°C
- **Refractive index:** 1.458 – 1.465
- **Optical rotation:** Levorotatory
- **Solubility:**
- Sparingly soluble in water
- Freely soluble in alcohol, ether, and chloroform

These parameters are routinely employed to evaluate oil quality and to detect adulteration with synthetic menthol or other essential oils [26].

4.4 Chemical Stability and Volatility

Menthol, the chief constituent of *Mentha arvensis* oil, is chemically stable under normal storage conditions but may volatilize or oxidize when exposed to heat, light, or air for prolonged periods. Oxidation leads to alteration in aroma and reduction in therapeutic efficacy [27].

Proper storage in **airtight, amber-colored containers** at cool temperatures is recommended to maintain physicochemical stability. Loss of volatile components during improper storage can significantly affect the pharmacological potency of the oil. **4.5 Solubility and Partition Behavior**

The essential oil exhibits **lipophilic characteristics**, which facilitate its penetration through biological membranes. This property explains the effectiveness of *Mentha arvensis* oil in topical formulations such as ointments, balms, and inhalation preparations [28].

Menthol readily dissolves in organic solvents and alcohol, making it suitable for incorporation into syrups, sprays, lozenges, and transdermal preparations.

4.5 Analytical Parameters

Various analytical techniques are employed for physicochemical characterization:

- **Thin Layer Chromatography (TLC)** for qualitative identification

- **Gas Chromatography (GC)** for volatile oil profiling
- **Gas Chromatography–Mass Spectrometry (GC–MS)** for detailed constituent analysis

These techniques help in confirming the presence of menthol, menthone, and related compounds, ensuring compliance with pharmacopeial standards [29].

4.6 SIGNIFICANCE OF PHYSICOCHEMICAL EVALUATION

Physicochemical characterization plays a crucial role in:

- Ensuring **identity and purity**
- Maintaining **batch-to-batch consistency**
- Supporting **regulatory approval**
- Enhancing **therapeutic reliability**

Standardized physicochemical parameters of Mentha arvensis form the foundation for its safe and effective use in pharmaceutical, cosmetic, and food industries [30].

5. TRADITIONAL VIEW OF MENTHA ARVENSIS

From a traditional medicine perspective, Mentha arvensis has been valued for centuries across various indigenous medical systems, particularly Ayurveda, Unani, Siddha, and Traditional Chinese Medicine. Its long-standing use as a household remedy reflects the empirical knowledge accumulated over generations.

5.1 AYURVEDIC PERSPECTIVE

In Ayurveda, Mentha arvensis (Pudina) is described as:

- **Rasa (taste):** Katu (pungent), Tikta (bitter)
- **Guna (property):** Laghu (light), Ruksha (dry)
- **Virya (potency):** Sheeta (cooling)
- **Vipaka:** Katu

It is traditionally used to balance Pitta and Kapha doshas, making it effective in conditions such as indigestion, acidity, nausea, flatulence, and inflammatory disorders [31]. Fresh leaf juice is commonly administered for:

- Dyspepsia
- Vomiting
- Intestinal colic
- Heat-related disorders

Decoctions of the leaves are also used in the treatment of jaundice, liver enlargement, and anorexia.

5.2 Unani System of Medicine

In the Unani system, Mentha arvensis is known as Pudinah and is described as:

- **Mizaj (temperament):** Cold and dry

It is used as:

- Carminative
- Digestive

- Antispasmodic
- Antiseptic

Unani physicians traditionally prescribe Pudina for:

- Gastritis
- Diarrhea
- Dysentery
- Intestinal infections
- Headache and migraine

The leaf infusion is also applied externally for inflammatory swellings and joint pain [32].

5.3 Folk and Ethnomedicinal Uses

Across rural India and other parts of Asia, *Mentha arvensis* has been extensively used as a folk remedy. Crushed leaves are applied directly to:

- Insect bites
- Skin rashes
- Itching
- Minor wounds

Leaf paste mixed with water or honey is administered for cough, cold, and fever. In many communities, mint leaves are chewed to improve oral hygiene and to relieve halitosis. These traditional practices laid the foundation for modern investigations into the antimicrobial and anti-inflammatory properties of the plant [33].

6. MODERN VIEW OF MENTHA ARVENSIS

With advances in phytochemistry and pharmacology, many traditional claims associated with *Mentha arvensis* have been scientifically validated. Modern research focuses on bioactive compounds, mechanisms of action, and clinical relevance.

Pharmaceutical Applications

Menthol derived from *Mentha arvensis* is widely used in:

- Cough syrups and lozenges
- Nasal inhalers
- Topical analgesic formulations
- Antipruritic creams

Menthol activates cold-sensitive TRPM8 receptors, producing a cooling sensation and mild local anesthetic effect, which explains its use in pain relief and respiratory congestion [34].

6.1 Nutraceutical and Functional Food Uses

Modern nutrition science recognizes *Mentha arvensis* as a functional herb due to its:

- Antioxidant potential
- Antimicrobial activity

Mint extracts are incorporated into herbal teas, digestive formulations, and dietary supplements. The presence of flavonoids and phenolic acids contributes to protection against oxidative stress and metabolic disorders [35].

6.2 Cosmetic and Aromatherapy Uses

The essential oil is used extensively in:

- Toothpaste
- Mouthwashes
- Shampoos
- Soaps
- Perfumes

In aromatherapy, Mentha arvensis oil is believed to improve alertness, relieve mental fatigue, and reduce stress-related symptoms. Its antimicrobial properties also support its use in personal hygiene products [36].

7. PHARMACOLOGICAL STUDIES OF MENTHA ARVENSIS

Extensive pharmacological investigations have been conducted on Mentha arvensis Linn. to validate its traditional medicinal uses. Experimental studies using in vitro, in vivo, and ex vivo models have demonstrated that the plant exhibits a broad spectrum of biological activities. These pharmacological effects are largely attributed to the presence of menthol, flavonoids, phenolic acids, and other secondary metabolites [37].

TABLE: 2 PHARMACOLOGICAL ACTIVITY OF MENTHA ARVENSIS

Activity	Major Constituents
Antimicrobial	Menthol, phenolics
Anti-inflammatory	Flavonoids, terpenoids
Antioxidant	Rosmarinic acid, flavonoids
Gastroprotective	Menthol
Analgesic	Menthol
CNS activity	Volatile oils
Radioprotective	Phenolics
Hepatoprotective	Flavonoids

7.1 ANTIMICROBIAL ACTIVITY

The antimicrobial activity of Mentha arvensis has been widely studied against bacterial and fungal pathogens. Both aqueous and organic solvent extracts, as well as essential oil, have shown strong inhibitory effects.

Studies report significant antibacterial activity against:

- *Staphylococcus aureus*
- *Escherichia coli*
- *Pseudomonas aeruginosa*
- *Streptococcus pyogenes*
- *Klebsiella pneumoniae*

Fungal strains such as *Candida albicans*, *Aspergillus niger*, and *Aspergillus clavatus* are also susceptible to *M. arvensis* extracts [38–40].

MECHANISM OF ACTION

Menthol and other monoterpenes disrupt microbial cell membranes, increase permeability, cause leakage of intracellular components, and inhibit enzymatic systems necessary for microbial survival. Phenolic compounds further enhance antimicrobial efficacy through protein denaturation and oxidative stress induction [41].

7.2 ANTI-INFLAMMATORY ACTIVITY

Anti-inflammatory effects of *Mentha arvensis* have been demonstrated in various experimental models such as carrageenan-induced paw edema and cotton pellet granuloma tests.

Flavonoids and terpenoids inhibit:

- Cyclooxygenase (COX) pathways
- Lipoxygenase (LOX) pathways
- Release of pro-inflammatory cytokines (TNF- α , IL-1 β)

These actions result in reduced edema, pain, and tissue inflammation [42,43]. This pharmacological activity supports the traditional use of *Mentha arvensis* in arthritis, rheumatism, and inflammatory joint disorders.

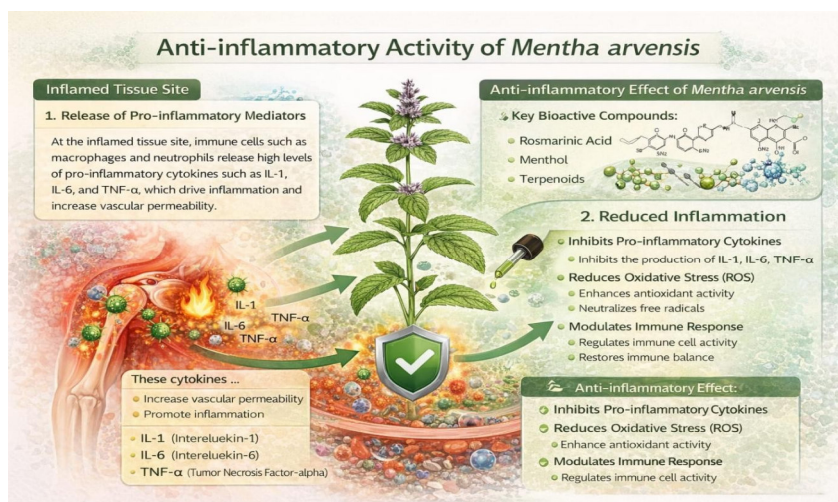


FIGURE: 5 Anti-inflammatory effects of *Mentha arvensis*

7.3 ANTIOXIDANT ACTIVITY

Oxidative stress plays a critical role in the pathogenesis of chronic diseases. *Mentha arvensis* has shown strong antioxidant potential in multiple in vitro assays such as:

- DPPH radical scavenging assay
- Ferric reducing antioxidant power (FRAP)
- Lipid peroxidation inhibition assays

Phenolic acids (rosmarinic acid, caffeic acid) and flavonoids act as hydrogen donors and metal chelators, neutralizing free radicals and protecting biomolecules from oxidative damage [44– 46].

7.4 GASTROPROTECTIVE AND DIGESTIVE ACTIVITY

Digestive disorders are among the most traditional indications of *Mentha arvensis*.

Pharmacological studies confirm its:

- Carminative
- Antispasmodic
- Anti-ulcer
- Gastroprotective properties

Menthol relaxes gastrointestinal smooth muscles by calcium channel modulation, thereby reducing intestinal spasms. Increased secretion of digestive enzymes and bile has also been reported, improving

digestion and appetite [47]. Animal studies demonstrate reduced gastric acidity and enhanced mucosal protection, validating its use in dyspepsia, flatulence, and gastritis [48].

7.5 ANALGESIC AND ANTINOCICEPTIVE ACTIVITY

Mentha arvensis exhibits analgesic activity in experimental pain models such as hot plate and acetic acid-induced writhing tests.

Mechanism:

Menthol activates TRPM8 receptors, producing a cooling sensation and reducing pain perception. It also inhibits nociceptive signal transmission at peripheral nerve endings [49].

This explains its widespread use in topical analgesics, balms, and headache preparations.

7.6 CENTRAL NERVOUS SYSTEM (CNS) ACTIVITY

Menthol and aromatic compounds of *Mentha arvensis* exert mild CNS effects. Experimental studies indicate:

- CNS stimulation at low doses
- Improved alertness and cognitive performance
- Reduction in mental fatigue

Aromatherapy studies suggest anxiolytic and mood-enhancing effects, supporting its traditional use in stress-related conditions and headaches [50, 51].

7.7 ANTICANCER AND CYTOTOXIC ACTIVITY

Preliminary studies indicate that *Mentha arvensis* extracts exhibit cytotoxic activity against certain cancer cell lines. Flavonoids and phenolic compounds induce apoptosis and inhibit cell proliferation by modulating oxidative stress pathways and mitochondrial function [52]. Although promising, further clinical and mechanistic studies are required to establish its anticancer potential.

7.8 RADIOPROTECTIVE ACTIVITY

Radioprotective effects of *Mentha arvensis* leaf extract have been demonstrated in animal models exposed to gamma radiation. Treatment improved survival rate, reduced radiation-induced sickness, and protected bone marrow and gastrointestinal tissues [53]. The protective effect is attributed to antioxidant enhancement and free-radical scavenging activity.

7.9 IMMUNOMODULATORY ACTIVITY

Immunological studies suggest that *Mentha arvensis* modulates immune response by enhancing antioxidant enzyme levels and improving resistance to oxidative and inflammatory stress. This activity supports its traditional use in infections and inflammatory disorders [54].

7.10 HEPATOPROTECTIVE ACTIVITY

Extracts of *Mentha arvensis* have shown protective effects against chemically induced liver damage in experimental models. Reduced serum enzyme levels and improved histopathological features indicate hepatoprotective potential [55].

8. CONCLUSION

Mentha arvensis Linn. represents a highly significant medicinal and aromatic plant with extensive traditional and modern applications. Its rich phytochemical profile, particularly the high menthol content, underpins its broad pharmacological activities, including antimicrobial, anti-inflammatory, antioxidant, gastroprotective, and analgesic effects. The review highlights the importance of physicochemical evaluation and standardization to ensure quality, safety, and therapeutic consistency. Traditional medicinal claims have been largely validated by experimental studies, reinforcing the plant's relevance in modern phytotherapy. However, despite substantial preclinical evidence, further clinical trials and mechanistic studies are required to fully establish its therapeutic potential and safety profile. Sustainable cultivation practices and quality control measures are essential to meet growing

industrial and pharmaceutical demand. Overall, *Mentha arvensis* stands as a promising natural resource for future drug development and functional health products.

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