

Manuscript ID:  
IJRSEAS-2025-0201044



Quick Response Code:



Website: <https://eesrd.us>



Volume: 2

Issue: 1

Pp. 186-193

Month: February

Year: 2025

E-ISSN: 3066-0637

Submitted: 01 Jan 2025

Revised: 15 Jan 2025

Accepted: 20 Feb.2025

Published: 28 Feb.2025

**Address for correspondence:**

Bhoomika S. Sankannavar  
M. Sc Biotechnology 2nd year, P.  
C. Jabin Science College Hubballi,  
Karnataka, India  
Email:  
[bhoomikassankannavar2002@gmail.com](mailto:bhoomikassankannavar2002@gmail.com)

**How to cite this article:**

Bhoomika S. Sankannavar (2025).  
A Review on Antioxidant Properties  
and Antibacterial Activity of  
*Mentha Arvensis*. International  
Journal of Research Studies on  
Environment, Earth, and Allied  
Sciences (IJRSEAS), 186-193.

## A Review on Antioxidant Properties and Antibacterial Activity of *Mentha Arvensis*

Bhoomika S. Sankannavar

M. Sc Biotechnology 2<sup>nd</sup> year, P. C. Jabin Science College Hubballi, Karnataka, India

### Abstract

*Mentha arvensis*, commonly known as mint, is a well-known medicinal and aromatic herb. It is an annual plant, typically grown in tropical and subtropical climates with adequate irrigation. This plant holds considerable value due to its various uses in food flavoring, traditional medicine, and essential oil production. The essential oil of *Mentha arvensis* is rich in compounds such as phenolics, aldehydes, ketones, and carbohydrates. One of its primary constituents is menthol, which has wide-ranging industrial applications, particularly in the food, cosmetic, and pharmaceutical industries. The quantity and quality of menthol can vary depending on the cultivar or species and the environmental and cultivation conditions, including climate, irrigation, soil properties, and pruning practices. Botanically and ecologically, *Mentha arvensis* is a fascinating plant, and its growth is significantly influenced by factors such as soil pH, temperature, and nutrient availability. Studies have shown that the methanolic root extract of this plant exhibits potent antioxidant properties. These effects are mainly attributed to the presence of phenolic compounds and flavonoids in the extract. Due to its strong antioxidant activity and cost-effective extraction process, *Mentha arvensis* root extract holds promise for use in managing and preventing several health conditions.

**Keywords:** *Mentha arvensis*, Bioactive compounds, DPPH free radical assay, Reactive oxygen species neutralization, Free radical inhibition potential, Antimicrobial properties, Common applications

### Introduction

*Mentha arvensis*, widely referred to as mint, belongs to the Lamiaceae family (also known as Labiatae), which is a group of flowering plants. This plant family is closely allied with the Verbenaceae family. Owing to the rich biodiversity within these groups, classification and naming can often be complex. Moreover, the presence of numerous local languages in various regions of the world adds to the difficulty in achieving consistent and standardized naming conventions for the plant. *Mentha arvensis* plants are named as podina or pudina or phodana (Qing, 2002). Globally, *Mentha arvensis* is commonly recognized by names such as wild mint, corn mint, or field mint. Within India, *Mentha arvensis* is locally identified by names like Pudina, Phutya, and Phuttiya depending on the region. This plant is widely utilized both for its medicinal properties and as an ornamental herb around the world.

However, some taxa of *Mentha arvensis* also exist in temperate and sub-tropical regions of the world (Ishtiaq, *et al.*, 2014). It can be successfully hybridized with other plants of genus *Mentha*. Its direct interactions of sunlight can change its color, length, age, and aroma of new hybridized mentha plants (Fatiha, *et al.*, 2017). Good Agronomic practices gave good health to flowers and leaves of wild mint (Mounira, *et al.*, 2009). The yield of essential oil is influenced by factors such as the plant's origin, genetic makeup, and the nutritional quality of the soil. Germination from seeds is difficult than other germination methods such as budding and grafting (Gobert, *et al.*, 2002). Literature reports of *Mentha arvensis* showed that it has strong anti-inflammatory activity, antioxidant activity, anticancer activity, and antibacterial activity (Khanuja, *et al.*, 2000). Natural products are known to play an important role in drug discovery. *Mentha arvensis* L. sources are important raw materials in the perfumes and flavour industry. In Indian folk medicine numerous plant products are used in the regulation of human fertility.

Antioxidants are active molecules that can fight and destroy excess free radicals and repair oxidative damage in bio-molecules.

Oxidation, a chemical reaction that transfers electrons from a substance to an oxidizing agent, produces free radicals and initiates chain reactions that may damage cells. Antioxidants terminate these chain reactions by removing free radical intermediates, inhibit other oxidation reactions, or enhance the endogenous antioxidant defence of the organism. They act by being oxidized themselves and are often reducing agents such as thiols, ascorbic acid, phenols, flavonoids, vitamins, carotenoids, terpenoids rich in antioxidant activity (Madsen and Bertelsen, 1995; Cai and Sun, 2003). These antioxidants may be natural (ascorbic acid and tocopherols) as well as synthetic molecules as propyl gallate [PG], tertiary butylhydroquinone [TBHQ], butylated hydroxyanisole [BHA] and butylated hydroxytoluene [BHT] thus they can be synthesized in the body.

## Review of Literature

### Morphology of *Mentha arvensis*

*Mentha arvensis* features leaves with wavy or curled edges, and each pair of leaves grows in opposite directions along the stem. The flowers of mints are seen in colors like pale purple, pink, and white (Jamal, *et al.*, 2006). The stem color of *Mentha arvensis* changes from green to brownish-green depending on its growth stage. It is typically classified as a perennial herb. The plant usually grows to a height of 10 to 120 cm (1 to 6 meters), while the leaves of wild mint generally measure about 4–7 mm in length. At full maturity, wild mint produces flowers at the top of the plant. Wild mint has a strong tendency to make new leaves, stems, and roots if they cut due to causing some reasons (Sushil, *et al.*, 2000).

Wild mint leaves are highly aromatic, whereas the stem, roots, and flowers have a much milder scent. The plant features square, branched stems that hold a notable amount of water and emit a faint minty aroma. The leaves are generally oblong to ovate in shape. Wild mint reaches peak flowering maturity between September and October. The plant shows faster growth rates from April to June than other months (Trudel, *et al.*, 1992).

### Taxonomical Classification of *Mentha arvensis*

| Kingdom      | Plantae                             |
|--------------|-------------------------------------|
| Phylum       | Tracheophyta                        |
| Class        | Magnoliopsida                       |
| Order        | Lamiales                            |
| Family       | Lamiaceae (Mint family)             |
| Genus        | <i>Mentha</i>                       |
| Species      | <i>Mentha arvensis</i>              |
| Common Names | Field mint, corn mint, or wild mint |

Table: 1 Taxonomical classification



Figure.1 *Mentha arvensis* plant

### 1. Phytochemical Composition of *Mentha arvensis*

Several studies have confirmed the presence of bio-active compounds in *Mentha arvensis*, including flavonoids, phenolic acids, tannins, terpenoids, and essential oils. These compounds are known to exhibit strong antioxidant activity.

A study by Singh *et al.*, (2017) reported that methanolic leaf extracts of *Mentha arvensis* contain a high concentration of polyphenols, which contribute to its antioxidant potential. The extract demonstrated an 82.45% inhibition rate in a hydrogen peroxide scavenging assay.

Kumar *et al.*, (2018) analyzed the essential oil composition of *Mentha arvensis* and identified major constituents such as menthol, menthone, and pulegone, which exhibit significant antioxidant and antimicrobial activities.

Over the past few decades, the photochemistry of essential oil derived from wild mint has attracted considerable interest among chemists. The distinct aromatic fragrance of *Mentha arvensis* is mainly due to its high levels of phenolic and flavonoid compounds. According to Guedes *et al.*, (2016), the essential oil extracted from wild mint leaves contains major components such as menthol, menthone, isomenthol, pulegone, and alpha-pinene.

#### Other Phytochemicals

- **Flavonoids:** These are well-recognized for their role as powerful antioxidants.
- **Tannins:** Responsible for imparting an astringent or bitter flavor to the plant.
- **Alkaloids:** A class of naturally occurring compounds that contain nitrogen atoms.
- **Glycosides:** Formed when sugar molecules bond with other functional groups or chemicals.
- **Phenols:** Possess notable antioxidant effects and also exhibit antimicrobial activity.
- **Vitamin K:** An essential nutrient involved in blood clotting and bone health.
- **Carbohydrates:** Serve as a primary source of energy and structural components in plants.
- **Terpenoids:** Aromatic compounds contributing to the plant's fragrance and potential therapeutic effects.
- **Hydroxycinnamic acids:** This group includes bioactive compounds such as caffeic acid, p-coumaric acid, ferulic acid, and rosmarinic acid, all known for their antioxidant potential.
- **Quercetin:**  
**Isorhoifolin** – A natural flavonoid with potential antioxidant and pharmacological benefits.
- **Menthosides** – These are bioactive components derived from mint species, contributing to medicinal effects.
- **Thymol and eugenol** – Both are aromatic compounds with strong antiseptic, antifungal, and antioxidant properties.

## 2. Antioxidant Potential and Antibacterial Activity of *Mentha arvensis*.

#### Antioxidant potential:

Various in vitro assays have been conducted to evaluate the antioxidant capacity of *Mentha arvensis* extracts.

#### DPPH Radical Scavenging Activity:

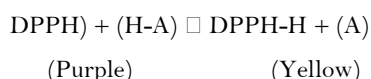
##### (1,1-Diphenyl-2-picrylhydrazyl)

A study by Sharma *et al.*, (2020) demonstrated that ethanol extracts of *Mentha arvensis* exhibited the highest DPPH radical scavenging activity (86.98%), indicating strong antioxidant potential.

#### Free Radicals

Atoms or molecules which unpaired electrons and highly reactive molecule now for stabilize itself it will take an electron from a stable molecule. When a stable molecule loses an electron, it becomes unstable and forms a free radical, triggering a damaging chain reaction. Even if the free radical later captures an electron from another stable molecule, it cannot regain its original structure or functionality (Halliwell *et al.*, 1992). Free radicals, often referred to as reactive oxygen species (ROS) or reactive nitrogen species (RNS), are predominantly composed of ROS (Halliwell and Gutteridge, 2000).

The scavenging reaction between (DPPH) and an antioxidant (H-A) can be written as:



DPPH is recognized as a stable free radical due to the delocalization of its unpaired electron, which stabilizes the molecule and prevents it from forming dimers, unlike most other free radicals. This electron delocalization results in a deep violet color, with a characteristic absorption peak at 517 nm. When DPPH interacts with a hydrogen-donating substance, it is reduced to a non-radical form, leading to a color change from violet to yellow.

#### Ferric Reducing Antioxidant Power (FRAP) Assay:

Gupta *et al.*, (2019) found that the reducing power of *Mentha arvensis* extracts correlated with their phenolic content, suggesting their potential in preventing oxidative damage.

#### Total Antioxidant Capacity:

According to Rao *et al.*, (2021), a comparative analysis of different *Mentha* species showed that *Mentha arvensis* demonstrated a total antioxidant capacity of 54.65 mg Trolox equivalents per gram, indicating its strong ability to neutralize harmful free radicals.

The methanolic root extract of *Mentha arvensis* displayed notable antioxidant activity, which can be attributed to its high content of flavonoids and phenolic compounds. As reported by Dar *et al.*, (2014), this extract provides a cost-effective and efficient natural source of antioxidants, with promising applications in the prevention and treatment of various health disorders.

In a recent 2023 investigation, different solvent extracts of *Mentha arvensis* were assessed for their antioxidant potential. Among them, the ethanolic extract showed the highest reducing power, measured at  $41.17 \pm 0.87$  mg ETA/g, and demonstrated considerable genoprotective effects. These findings were further confirmed

through High-Performance Liquid Chromatography (HPLC) analysis, underscoring the plant's potential use as a natural antioxidant (Wardah *et al.*, 2023).

#### Antibacterial Activity:

Studies on *Mentha arvensis* (wild mint) have shown that its ethanol extract exhibits strong antibacterial properties, particularly against multi-drug resistant *Acinetobacter baumannii*. The extract's antibacterial action was evaluated using disc diffusion and micro-dilution methods. The extract demonstrated concentration-dependent bacterial inhibition, with Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC) recorded as 23.5 µg/mL and 72.1 µg/mL, respectively. These outcomes indicate the potent antimicrobial potential of *Mentha arvensis* ethanol extract against *A. baumannii* (Zhang *et al.*, 2015).

#### Antibacterial assay

Further antibacterial testing of the ethanolic extract was conducted against four pathogenic bacterial strains. Using the disc diffusion technique, zones of inhibition were observed as follows: *Escherichia coli* (5.69 ± 0.49 mm), *Klebsiella pneumoniae* (13.39 ± 0.16 mm), *Staphylococcus spp.* (9.14 ± 0.42 mm), and *Klebsiella spp.* (7.42 ± 0.51 mm).

Following these preliminary findings, a more detailed evaluation was conducted to determine the MIC values of the extract. The MIC, established through serial dilution, represents the lowest concentration needed to prevent visible bacterial growth, confirming the extract's broad-spectrum antibacterial efficacy.

The Minimum Inhibitory Concentration (MIC) values observed were 3.2 µg/mL for *Escherichia coli*, 7.8 µg/mL for *Klebsiella pneumoniae*, 4.5 µg/mL for *Staphylococcus*, and 5.1 µg/mL for *Klebsiella*. Furthermore, the study determined the Minimum Bactericidal Concentration (MBC) as 6.2 µg/mL for *Escherichia coli*, 5.7 µg/mL for *Klebsiella pneumoniae*, 4.6 µg/mL for *Staphylococcus*, and 2.8 µg/mL for *Klebsiella aerogenes*.

**Table 2: Antibacterial activity of *Mentha arvensis***

| Bacterial Strains            | Inhibition Zone (mm) | MIC (µg/mL) | MBC (µg/mL) |
|------------------------------|----------------------|-------------|-------------|
| <i>Escherichia coli</i>      | 5.69 ± 0.49          | 3.2         | 6.2         |
| <i>Klebsiella pneumoniae</i> | 13.39 ± 0.16         | 5.7         | 7.8         |
| <i>Staphylococcus</i>        | 9.14 ± 0.42          | 4.5         | 4.6         |
| <i>Klebsiella</i>            | 7.42 ± 0.51          | 2.8         | 5.1         |

#### • Modulation of Antibiotic Resistance in *Staphylococcus aureus*:

A study published in December 2024 investigated the effects of buffered crude extracts from *Mentha arvensis* leaves on methicillin-resistant *Staphylococcus aureus* (MRSA). The addition of the extract to Oxacillin significantly reduced the antibiotic's minimum inhibitory concentration (MIC) against MRSA strains, indicating that Compounds in *Mentha arvensis* may enhance the efficacy of certain antibiotics against resistant bacterial strains. (Aprilyn *et al.*, 2024)

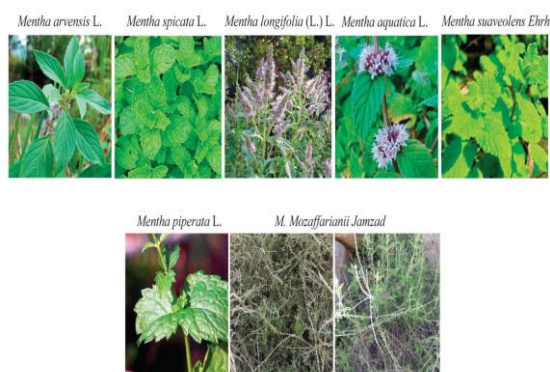
#### 3. Comparative Antioxidant Studies Among *Mentha* Species.

Patel *et al.*, (2022) conducted a comparative study of different *Mentha* species and found that *Mentha arvensis* had one of the highest antioxidant activities among them, making it a superior candidate for pharmaceutical and nutraceutical applications.

#### Antioxidant Activity and Phenolic:

- A study evaluating the antioxidant potential of nine *Mentha* species using the DPPH assay found that *Mentha asuaveolens* exhibited the highest scavenging activity at 82%, followed by *Mentha longifolia* (79%), *Mentha officinalis* (76%), and *Mentha piperita*, *Mentha pulegium*, and *Mentha royleana* (each at 75%). *Mentha arvensis* and *Mentha spicata* showed similar activities, while *Mentha citrata* had the lowest at 64%. (Nisar ahmad *et al.*, 2011)
- Another research assessed the total phenolic content (TPC) and antioxidant capacity (AC) of different *Mentha* species. *Mentha x villosa* demonstrated the highest TPC (106.04 mg TE/g), correlating with its strong antioxidant activity. Conversely, *Mentha x piperita* Perpetua exhibited lower TPC (52.63 mg TE/g) and correspondingly reduced antioxidant capacity. (Sanja *et al.*, 2021)

**Figure.2** Different species of menthe



#### Influence of Specific Compounds:

- The presence of specific phenolic compounds, such as rosmarinic acid significantly contributes to the antioxidant properties of *Mentha* species. For instance, *Mentha spicata* populations with high rosmarinic acid Content have shown considerable antioxidant capacity.
- Variations in essential oil composition also impact antioxidant activity. *MenthaX piperita*, rich in menthol and menthone, exhibited notable antioxidant effects, while *Mentha aquatica*, containing linalool and linalyl acetate, showed different activity levels.

**Table 3:** Various regions around the world utilize *Mentha arvensis* for its wide range of applications and beneficial properties

| Region               | Indication                                                                                                                                        | Reference                        |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| India                | Mentha is main constituent of leaves (84.63%).                                                                                                    | Derwich <i>et al.</i> ,2010      |
| Chennai,Tamil Nadu   | Menthol present as major constituent fresh leaves (52.34%) essential oil.                                                                         | Arjun <i>et al.</i> ,2017        |
| India                | Anti-allergic and Anti-inflammatory Activity, Anti-fertility Activities, Antibacterial Activities, Antioxidant Activities and Active Constituent. | Thawkar <i>et al.</i> , 2016     |
| Iran                 | Drought resistant species.                                                                                                                        | Haydari <i>et al.</i> , 2019     |
| Pullman              | Climatic resistant cultivars is an important component of Verticillium wilt management.                                                           | Dung <i>et al.</i> , 2010        |
| northeastern Algeria | Menthol was reported in fresh leaves (55%) essential oil                                                                                          | Benabdallah <i>et al.</i> , 2018 |
| India                | Possess abortifacient property                                                                                                                    | Aggarwal & Kunnumakkara, 2009.   |
| Australia            | Decoctions were used to treat colds and coughs. Plant is also used as an abortifacient                                                            | Tang <i>et al.</i> ,2016         |

#### Case Studies on Antibacterial Activity of *Mentha arvensis*

##### Case Study 1:

**Title:** Antibacterial activity of essential oil from *Mentha arvensis* against pathogenic bacteria

**Authors:** Singh *et al.*, 2015

**Journal:** *Asian Journal of Pharmaceutical and Clinical Research*

**Summary:** The essential oil obtained from *Mentha arvensis* leaves was evaluated for its effectiveness against *Escherichia coli*, *Staphylococcus aureus*, and *Pseudomonas aeruginosa* using the disc diffusion technique.

**Zone of Inhibition:** Ranged from 14 to 22 mm

**MIC Values:** Between 125–250 µg/mL

**Conclusion:** The oil showed significant antibacterial activity, especially against Gram-positive strains.

##### Case Study 2:

**Title:** Comparative study of antibacterial activity of *Mentha arvensis* extracts

**Authors:** Rani and Sharma, 2017

**Journal:** *International Journal of Pharmaceutical Sciences and Research*

**Summary:** Methanolic and aqueous extracts of *Mentha arvensis* were tested on *Bacillus subtilis* and *E. coli*.

Methanolic extract showed stronger antibacterial activity.

Suggests phenolic and flavonoid compounds contribute to the effect.

## Case Studies on Antioxidant Properties of *Mentha arvensis*

### Case Study 3:

**Title:** Evaluation of antioxidant activity of *Mentha arvensis* extracts

**Authors:** Kumar *et al.*, 2016

**Journal:** *Journal of Food Science and Technology*

**Summary:** Methanol and ethanol extracts were evaluated for antioxidant properties using DPPH and FRAP assays.

**DPPH Scavenging Activity (IC<sub>50</sub>):** ~34 µg/mL

**Total Phenolic Content:** 96.5 mg GAE/g extract

**Conclusion:** Extracts possess strong antioxidant potential due to high polyphenol content.

### Case Study 4:

**Title:** Phytochemical screening and antioxidant activity of *Mentha arvensis*

**Authors:** Patel *et al.*, 2018

**Journal:** *Research Journal of Medicinal Plant*

**Summary:** Aqueous and acetone extracts were tested for radical scavenging activity and phytochemical content.

The aqueous extract demonstrated moderate antioxidant potential, while the acetone extract exhibited stronger antioxidant activity. The analysis confirmed the presence of flavonoids, tannins, and terpenoids in the extracts.

## Conclusion

The review of existing literature emphasizes the noteworthy antioxidant capacity of *Mentha arvensis*, largely due to its abundance of bioactive compounds such as flavonoids, phenolic acids, and essential oils. Numerous in vitro and in vivo experiments have confirmed its ability to neutralize free radicals, mitigate oxidative stress, and provide a variety of health-promoting effects.

As the demand for natural antioxidants continues to rise as safer alternatives to synthetic chemicals, the relevance of studying *Mentha arvensis* becomes even more apparent. Future investigations should prioritize comprehensive clinical trials to validate its therapeutic effectiveness and safety in humans, along with an assessment of its industrial applications.

Overall, *Mentha arvensis* shows great promise as a natural antioxidant source, with potential uses in human health, food preservation, and cosmetic product development. A deeper understanding of its active constituents and underlying mechanisms will broaden its application in both medical and commercial sectors.

In addition, research findings confirm that *Mentha arvensis* also exhibits notable antibacterial effects against a range of pathogenic microbes. The ethanolic extract proved effective in suppressing bacterial growth, as indicated by clear inhibition zones and low minimum inhibitory (MIC) and bactericidal concentrations (MBC). These results underline the plant's potential as a natural antibacterial compound, supporting its use in developing alternative treatments for bacterial infections.

## Acknowledgment

I am Bhoomika S.Sankannavar thankful to HOD Dr. Sanjay Tambat, Department of Communication and Journalism, Savitribai Phule Pune University for granting permission to carry out the work.

## Financial support and sponsorship

Nil.

## Conflicts of interest

The author declare that there are no conflicts of interest regarding the publication of this paper.

## References:

1. Abdallah, E. H., Musa, Y., Mustafa, M., Sjahril, R., & Riadi, M. (2016). Comparison between hydro-and osmo-priming to determine period needed for priming indicator and its effect on germination percentage of aerobic rice cultivars (*Oryza sativa* L.). *AGRIVITA, Journal of Agricultural Science*, 38(3), 222- 230.
2. Akram, M., Asif, H. M., Akhtar, N., Shah, P. A., Uzair, M., Shaheen, G., & Ahmad, K. (2011). *Tribulus terrestris* Linn.: A review article. *J Med Plants Res*, 5(16), 3601-3605.
3. Al-Sabahi, J. N., Hanif, M. A., Al-Maskari, A. Y., Al Busaidi, M. S. M., Al-Maskari, M. Y., & Al-Haddabi, M. H. (2016). Chemical report on wild growing *Mentha arvensis* and *Citrullus colocynthus* from Oman. *Journal of Essential Oil Bearing Plants*, 19(3), 719-726.
4. Alvi, K. A. (2001). Screening natural products: bioassay-directed isolation of active components by dual-mode CCC. *Journal of liquid chromatography & related technologies*, 24(11-12), 1765-1773.
5. Cai YZ and Sun M (2003) Antioxidant activity of betalins from plants of the Amaranthaceae. *Journal of Agriculture and Food Chemistry*, 51: 2288-2294.
6. Chand, S. U. K. H. M. A. L., Patra, N. K., Anwar, M., & Patra, D. D. (2004). Agronomy and uses of menthol mint (*Mentha arvensis*)- Indian perspective. *Proceedings of the Indian National Science Academy Part B, Biological Sciences*, 70(3), 269-297.
7. Choudhury, R. P., Kumar, A., & Garg, A. N. (2006). Analysis of Indian mint (*Mentha spicata*) for essential, trace and toxic elements and its antioxidant behaviour. *Journal of Pharmaceutical and Biomedical Analysis*, 41(3), 825-832.
8. Coutinho, H. D., Costa, J. G., Lima, E. O., & Siqueira-Junior, J. P. (2010). Additive effects of *Hyptis martiusii* Benth with Harbans, S., Devendra, S. K., Vijaylata, P., Bikram, 2023.

9. Dar, M. A., Masoodi, M. H., Wali, A. F., Mir, M.A., & Shapoo, N. S. (2014). Antioxidant potential of methanol Root extract of *Mentha arvensis* L. from Kashmir Region. *Journal of Applied Pharmaceutical Science*, 4(3), 50
10. de Sousa Guedes, J. P., da Costa Medeiros, J. A., eSilva, R. S. D. S., de Sousa, J. M. B., da Conceicao, M. L., & de Souza, E. L. (2016). The efficacy of *Mentha arvensis* L. and *M. piperita* L. essential oils in reducing pathogenic bacteria and maintaining quality characteristics in cashew, guava, mango, and pineapple juices. *International journal of food microbiology*, 238, 183-192.
11. Dorman HJ, Kosar M, Kahlos K, Holm Y, Hiltunen R. Antioxidant prosperities and composition of aqueous extracts from *Mentha* species, hybrids, varieties and cultivars. *J Agric Food Chem*. 2003; 51:4563-9.
12. Džamić AM, Soković MD, Ristić MS, Novaković M, Grujić-Jovanović S, Tešević V, Marin PD. Antifungal and Antioxidant Activity of *Mentha Longifolia*(L.) Hudson (Lamiaceae) Essential Oil. *Botanicaserbica*. 2010;34(1):57-61.
13. Elansary HO, Yessoufou K, Shokralla S, Mahmoud EA, Skalicka-Woźniak K. Enhancing Mint and Basil Oil Composition and Antibacterial Activity Using Seaweed Extracts. *Ind Crops Prod*. 2016; 92:50-6.
14. Gobert, V., Moja, S., Colson, M., & Taberlet, P. (2002). Hybridization in the section *Mentha* (Lamiaceae) inferred from AFLP markers. *American Journal of Botany*, 89(12), 2017-2023.
15. Khanuja, S. P. S., Shasany, A. K., Srivastava, A., & Kumar, S. (2000). Assessment of genetic relationships in *Mentha* species. *Euphytica*, 111(2), 121-125.
16. Ishtiaq, S., Ahmad, M., Hanif, U., Akbar, S., & Kamran, S. H. (2014). Phytochemical and in vitro antioxidant evaluation of different fractions of *Amaranthus graecizans* subsp. *silvestris* (Vill.) Brenan. *Asian Pacific journal of tropical medicine*, 7, S342-S347
17. Kekuda PTR, Praveen Kumar SV, Vinayaka KS, Sudharshan SJ, Mallikarjun N, Swathi D (2011) Studies on Antibacterial, Anthelmintic and Antioxidant activities of a Macrolichen *Parmotrema pseudotinctorum* (des. Abb.) Hale (Parmeliaceae) from Bhadra wildlife sanctuary, Karnataka. *International Journal of PharmTech Research*, 2(2):1207-1214.
18. Kokab, S., Majeed, S., and Ahmad, S., 2010. Economic Viability of Mint Production and Processing for Product Development in Pakistan. petroleum ether extract of the leaves of *Mentha arvensis* L. in male albino mice. *Journal of Ethnopharmacology*. 75: 5- 12.
19. Londonkar, R. L., & Poddar, P. V. (2009). Studies on activity of various extracts of *Mentha arvensis* Linn against drug induced gastric ulcer in mammals. *World Journal of Gastrointestinal Oncology*, 1(1), 82.
20. M, J., Syad, A. N., & P, T. V. (2017). Food as Medicine: Assessment of Antioxidant Potential of Methanolic Leaf Extracts of *Coriandrum sativum*, *Mentha arvensis* and *Leucas aspera*. *Asian Journal of Pharmaceutical and Health Sciences*, 7(4), 1762-1768.
21. Malik, F., Hussain, S., Sadiq, A., Parveen, G., Wajid, A., Shafat, S., & Raja, F. Y. (2012). Phyto-chemical analysis, anti-allergic and anti-inflammatory activity of *Mentha arvensis* in animals. *African journal of Pharmacy and Pharmacology*, 6(9), 613-619.
22. Mihajlov, L., Kostadinovic Velickovska, S., Naumova, G., Podea, P. V., & Mirhosseini, H. (2019). Isolation, chemical composition, antioxidant and antimicrobial potential of essential oil from *Mentha arvensis* L. organically planted from Macedonia. *RISG Rivista Italiana Sostanze Grasse*, 96(3), 151- 160.
23. Mkaddem, M. G., Romdhane, M., Ibrahim, H., Ennajar, M., Lebrihi, A., Mathieu, F., & Bouajila, J. (2010). Essential oil of *Thymus capitatus* Hoff. et Link. from Matmata, Tunisia: gas chromatography massspectrometry analysis and antimicrobial and antioxidant activities. *Journal of medicinal food*, 13(6), 1500-1504.
24. Phatak, S. V., & Heble, M. R. (2002). Organogenesis and terpenoid synthesis in *Mentha arvensis*. *Fitoterapia*, 73(1), 32-39.
25. Profiles of the essential oils of Indian menthol mint *Mentha arvensis* cultivars at different stages of crop growth in northern plains. *Journal of Medicinal and Aromatic Plant Sciences*, 22(1B), 774-786.
26. Qing, W. (2002). *Mentha's* historical textual research and clinical new application. *Journal of Haidian University*, 2.
27. Rashid, W., Asim, S., Rashid, S., Rafique, S., Aziz, R. S., Iftikhar, S., Rashid, M., & Arfat, Y. (2023). Antioxidant and Anti-Mutagenic Potential of Mint (*Mentha arvensis*) and its Chemical Characterization by HPLC. *Pakistan Journal of Medical & Health Sciences*, 17(04), 514.
28. Rashmi Bariya, Roshni Adiyecha, Himanshu Pandya (2024). Analysis of Antioxidant Activity from *Mentha arvensis* Extracts by DPPH Method. *International Journal of Current Science Research and Review*, 7(5), 3136-3138
29. Samarasekera, R., Weerasinghe, I. S., & Hemalal, K. P. (2008). Insecticidal activity of mentho derivatives against mosquitoes. *Pest Management Science: formerly Pesticide Science*, 64(3), 290-295.
30. Shaik, G., Sujatha, N., & Mehar, S. K. (2014). Medicinal plants as source of antibacterial agents to counter *Klebsiella pneumoniae*. *J Appl Pharm Sci*, 4(1), 135-147.
31. Sharma, N., & Jacob, D. (2001). Antifertility investigation and toxicological screening of the petroleum ether extract of the leaves of *Mentha arvensis* L. in male albino mice. *Journal of Ethnopharmacology*, 75(1), 5-12.
32. Sharma, S., Sangwan, N. S., & Sangwan, R. S. (2003). Developmental process of essential oil glandular trichome collapsing in menthol mint. *Current science*, 544-550.
33. Shrigod, N. M., Swami Hulle, N. R., & Prasad, R. V. (2017). Supercritical fluid extraction of essential oil from mint leaves (*mentha spicata*): Process optimization and its quality evaluation. *Journal of Food Process Engineering*, 40(3), e12488.

33. Singh, P., & Pandey, A. K. (2018). Prospective of essential oils of the genus *Mentha* as biopesticides: A review. *Frontiers in plant science*, 9, 1295. Stevovi, S., & Calic-Dragosavac, D. (2010). Environmental study of heavy metals influence on soil and Tansy (*Tanacetum vulgare* L.). *African Journal of Biotechnology*, 9(16), 2392-2400. Sushil, K., Bahl, J. R., Bansal, R. P., Kukreja, A. K., Garg, S. N., Naqvi, A. A., & Sharma, S. (2000).
34. Sugandhi BRM, Bai GM. Antimicrobial activity of *Mentha arvensis* L. (Lamiaceae). *J Adv Lab Res Biol*. 2011;2(1):8–11.
35. Tang, K. S., Konczak, I., & Zhao, J. (2016). Identification and quantification of phenolics in Australian native mint (*Mentha australis* R. Br.). *Food Chemistry*, 192, 698-705.
36. Thawkar, B. S. (2016). Phytochemical and pharmacological review of *Mentha arvensis*. *International Journal of Green Pharmacy (IJGP)*, 10(2).
37. *Toxicol Ind Health*. 2012 Feb; 28(1):83-9. doi: 10.1177/0748233711407238. Epub 2011 Jun 6. Free radical scavenging (DPPH) potential in nine *Mentha* species Nisar Ahmad 1, Hina Fazal, Iftikhar Ahmad, Bilal Haider Abbasi.
38. Vaya J, Avriam M (2001) 'Nutritional antioxidants: mechanisms of action, activities and medical applications'. *Current Medical Chemistry-Immunology Endocrine and Metabolic Agents*, 1(1): 99-117.
39. Wardah Rashid, Shazia Asim, Shazma Rashid, Shakeela Rafique, Rao Salman Aziz, Salman Iftikhar, Muhammad Rashid, Yasir Arfat. (2023). Antioxidant and Anti-Mutagenic Potential of Mint (*Mentha Arvensis*) and its Chemical Characterization by HPLC. *Pakistan Journal of Medical & Health Sciences*, 17(04), 514. <https://doi.org/10.53350/pjmhs2023174514>
40. Zhang, L., Xu, S. G., Liang, W., Mei, J., Di, Y. Y., Lan, H. H., & Wang, H. Z. (2015). Antibacterial activity and mode of action of *Mentha arvensis* ethanol extract against multidrug-resistant *Acinetobacter baumannii*. *Tropical Journal of Pharmaceutical Research*, 14(11), 2099- 2106.