

A Review on Peppermint

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Abstract: Peppermint oil is made from *Mentha piperita* L., a perennial herb, and *Mentha arvensis* var. *piperascens*, which belongs to the Labiatae family. Other essential oils, like spearmint, basil, lavender, rosemary, sage, marjoram, and thyme, also come from this family. Peppermint oil is valued for its many health benefits, such as pain relief, numbing effects, antiseptic properties, and helping with digestion, respiratory issues, and inflammation. It is used in various traditional medicine systems for treating stomach problems, ulcers, and other ailments. This review looks into the chemistry, health effects, and uses of peppermint oil.

Aromatic herbs like peppermint are in high demand in industries such as biotechnology, cosmetics, medicine, and food, which has increased their market value. Peppermint (*Mentha piperita* L.) is a popular medicinal herb known for its many health benefits and is widely used in the food and medicine industries. While it is commonly used as a flavoring in food, it is most recognized for its antimicrobial and antioxidant properties. Peppermint oil and its by-products are used in products like candies, teas, toothpaste, mouth fresheners, beverages, liqueurs, jellies, syrups, ice creams, cough drops, chewing gums, soaps, detergents, and mosquito repellents. Since peppermint is a seasonal and perishable plant, it needs to be dried to ensure it is available year-round.

This interaction shows that the compounds can block the activity of the enzyme. Quantum studies found that menthol (Egap = 16.9 eV) is a stable compound, while pulegone (Egap = 12.6 eV) is less stable. These theoretical findings match previous experimental results. Overall, peppermint is a promising plant for research, and more studies should explore its role in preventing human diseases.

Due to the importance of *Mentha piperita*, a detailed overview has been prepared. It covers almost all aspects of the plant to offer a complete source of information for current and future researchers. This will help in better understanding its health benefits and commercial uses.

Keywords: Taxonomy, Morphology, Chemical composition, Cultivation, Harvesting, Therapeutic effect, Adverse effect, Contraindications

I. INTRODUCTION

Mentha piperita L., also known as peppermint, is an important medicinal herb from the Lamiaceae family. It was named the "Medicinal Plant of the Year" in 2004 and has been used for centuries in both Eastern and Western medicine, though it was first described in 1753 by Carolus Linnaeus. Besides its medicinal uses, peppermint is also popular as a flavoring agent in products like chewing gum and mints, as well as in cosmetics and pharmaceuticals. This plant is a natural hybrid between *M. aquatica* and *M. spicata*. Known as "hierba buena" (meaning "good herb"), peppermint produces peppermint oil, which is mainly made up of menthol (C₁₀H₁₉OH), a waxy white crystalline substance that is solid at room temperature. The oil is found in the peltate glandular trichomes of the plant's aerial parts and is one of the most commonly used volatile oils. [2]

Peppermint is mainly grown in the Mediterranean region, where it is a key part of the vegetation. In 2014, the global production of peppermint reached around 92,296 tonnes, with Morocco contributing over 90% of the total (FAOSTAT, 2017). In India, mint is mainly grown in the southern Himalayan regions, including Himachal Pradesh, Haryana, Punjab, Uttar Pradesh, and Bihar (Kripanand et al., 2015). While this plant can grow in various environments, it thrives best in moist soils and humid conditions. It can also tolerate full sunlight (Maffei, 1999). Mints typically grow to a height of 10-120 cm and can spread widely, which is why some varieties are considered invasive (Park et al.).[4]



Medicinal plants are used by people worldwide and hold great potential for human societies. While many of their health benefits are not yet fully understood, they could be useful in treating current and future diseases. More than 80% of the global population relies on traditional medicine and medicinal plants, especially plant extracts and essential oils, for their basic healthcare needs. Peppermint (*Mentha piperita* L.), also known as mint, is a natural hybrid between spearmint (*Mentha spicata* L.) and water mint (*Mentha aquatica* L.). It is a perennial herb from the Lamiaceae family, originally native to the Mediterranean but now grown worldwide for its flavor, aroma, and medicinal uses.[1]

This plant is commonly used in folk remedies and traditional medicine to treat digestive problems and nervous system issues. It is valued for its antitumor and antimicrobial properties, as well as its potential to prevent cancer. Additionally, it has benefits for the kidneys, can reduce allergic reactions, and is helpful for easing cramps, digestive discomfort, and loss of appetite. Peppermint is used to treat nausea and diarrhea. It can be prepared in various forms, such as leaves, leaf extracts, and water. However, the plant is mainly grown for its essential oil, which is extracted by distilling freshly ground leaves.[3]

II. TAXANOMY

Kingdom	Plantae
Subkingdom	Tracheobionta
Domain	Eukarya
Superdivision	Spermatophyta
Phylum	Angiospermophyta
Class	Magnoliopsida
Order	Lamiales
Family	Lamiaceae
Species	<i>Mentha x Piperita</i>
Genus	<i>Mentha</i>

III. MORPHOLOGY

Peppermint has pinkish-lavender flowers that grow in blunt, oval clusters on square stems. The plant also has smooth, dark green leaves with stalks. Like other mint plants, peppermint spreads quickly through underground stems called stolons. The leaves are oblong, pointed, and have a darker green color on top, with a lighter green underside. The small purple flowers are arranged in clusters at the tips of the stems, with some interruptions below.

Morphology of Peppermint (*Mentha × piperita*)

Peppermint is a herbaceous perennial plant that belongs to the Lamiaceae family. It is a hybrid species derived from watermint (*Mentha aquatica*) and spearmint (*Mentha spicata*). The plant displays several distinctive morphological features:

1. Root System

Peppermint has a fibrous root system with creeping underground rhizomes. These rhizomes allow the plant to spread horizontally and produce new shoots, aiding in vegetative propagation.



2. Stem

The stem of peppermint is quadrangular (four-sided) and erect or sometimes slightly spreading. It is typically green to purplish in color and may be covered with fine hairs. The stem is hollow in cross-section and contains nodes from which leaves and branches arise.

3. Leaves

Type: Simple, opposite (arising in pairs at each node)

Shape: Ovate to lanceolate (egg-shaped to narrow and pointed)

Margin: Serrated (toothed edges)

Color: Dark green on the upper surface and lighter on the underside

Texture: Smooth to slightly hairy.[1]



IV. CHEMICAL COMPOSITION

Peppermint (*Mentha piperita*, also known as *Mentha balsamea*) is a perennial herb that belongs to the mint family, Lamiaceae, as shown in Fig. 1. It is known for its strong antioxidant and antimicrobial properties, as well as its active compounds. Peppermint plays an important role in boosting the immune system and improving appetite (Dorman et al., 2003; Yalcin et al., 2012). The plant is a hybrid cross between watermint (*Mentha aquatica*) and spearmint (*M. spicata*) (Khalil et al., 2015).[4]

The aerial parts of mint are used to extract polyphenols, such as rosmarinic acid, eriocitrin, cinnamic acid, caffeic acid, and naringin-7-O-glucoside. Other compounds include luteolin-diglucuronide and eriodictyol glucopyranosyl-rhamnopyranoside. Different species of mint contain varying amounts of these compounds. The chemical composition of mint plants can differ based on factors like physiological differences, environmental conditions, geographic location, and genetic variations.[1]

V. CULTIVATION

Peppermint grows best in soil that holds water well. All commercial types of mint are seed sterile, which means they cannot produce seeds. Instead, they are grown using underground stolons, also known as runners or rootstock, from existing plants. These stolons cannot be stored for long, as they spoil quickly due to heat or lack of moisture. Mint plants can adapt to different growing conditions and can also grow well in full sunlight.[3]

Peppermint grows best in moist, shaded areas with plenty of water. As a hybrid, it is usually sterile and produces very few seeds. It mainly reproduces vegetatively, spreading quickly through underground runners during the rainy season and stolons in the winter. Planting typically happens between the last week of December and the last week of January using live, healthy stolons that are 8-10 cm long (about 400-450 kg per hectare, with 40-60 cm spacing). The plant is often



grown in areas with partial sunlight or shade. Harvesting occurs twice: the first in June, after 100-120 days of growth, and the second in October, about 80-90 days after the first harvest. Harvesting is done on sunny days, as menthol content decreases on cloudy or rainy days.[2]



VI. HARVESTING

The herb is usually trimmed just before it flowers, depending on the local climate. If grown well and watered properly, a second crop may be harvested 60 to 75 days after the first. Harvesting should be done in the late morning on a dry, sunny day, once the dew has evaporated. To protect the stolons, the first crop is always cut with a sickle. In India, mint crops planted in January–February are typically ready for the first harvest between April and June. The second harvest comes 60–70 days after the first. After harvesting, the herb is spread in the shade to reduce bulk and improve oil recovery. The average yield is 60–70 kg of oil and 15–20 tons of herb per hectare, but this can vary.[1]

A study by Gulati et al. (1978) looked at how crop age affects the yield and quality of peppermint oil. It was found that in India, the first harvest should be made after 145 to 160 days of growth, and the second harvest after 97 to 111 days. The amount of oil and its chemical composition depend on the plant's growth stage.

The average yield of peppermint is about 20 tonnes of fresh herb per hectare, which produces around 250 kg of oil each year. India is the top producer, consumer, and exporter of mentha oil globally, with a production of about 14,000 metric tons (followed by China and Brazil). India also exports around 3,000 metric tons of mentha oil annually, worth about 100 crore rupees. This data is from 2003 and includes all species of mentha oil.[2]

VII. THERAPEUTIC EFFECTS

1. Anti-bacterial activity

Medicinal plants have long been used in traditional medicine, and their secondary metabolites are becoming more popular as antimicrobial agents. Peppermint, in particular, has attracted attention from scientists studying infectious diseases due to its biologically active compounds. Peppermint oil (PO) and extracts have shown strong antimicrobial activity against a variety of bacteria, including *Escherichia coli*, *Salmonella pullorum*, *Streptococcus faecalis*, *Staphylococcus aureus*, *Salmonella typhi*, *Proteus vulgaris*, and many others. Studies have found that peppermint leaf extracts are more effective against Gram-negative bacteria than stem extracts. The essential oil from peppermint leaves has the highest antibacterial activity, with inhibition zones ranging from 11.58 to 17.24 mm, while the stem extract has an average inhibition zone of 15.82 mm.[3]

2. Anti-viral activity

One of the most studied ways to treat harmful viruses today is by developing plant-based treatments, which can be used alongside traditional antiviral medications. Since many viruses have become resistant to treatment, viral infections remain a serious global health problem. There are currently very few antiviral drugs that effectively treat viral diseases. It's important to find new molecules with both external and internal antiviral effects. Many studies have shown that



peppermint extracts have strong antiviral properties. Peppermint seems to help strengthen the immune system and protect the body from infections.[1]

3. Anti-plasmid activity

The antiplasmid properties of peppermint were studied using the *E. coli* bacterial strain. Three different peppermint oils showed antiplasmid activity, while all oils showed antimicrobial effects. Using a method called the checkerboard approach, researchers tested how menthol and peppermint oil affected antibiotics in the same bacterial strain. The tests confirmed that both peppermint oil and menthol have antiplasmid effects. This suggests that menthol-containing compounds could help eliminate bacterial plasmids that cause antibiotic resistance. The unique way menthol works to eliminate these plasmids is a key feature, as it makes bacteria with plasmids more sensitive to menthol, leading to their destruction. Research also found that peppermint leaf extract has stronger antibacterial activity than peppermint stem extract, especially against Gram-negative bacteria.[1]

4. Anti-fungal activity

In lab tests, peppermint oil (PO) and its extracts showed strong fungicidal activity against *Candida albicans*, *Aspergillus albus*, and dermatophytic fungi. The leaf oil of *Mentha spicata* showed moderate activity against *Aspergillus fumigatus*, with a 16 mm inhibition zone, and against *A. niger*, with a 14 mm inhibition zone.[3]

5. Anti-inflammatory activity

Inflammation is a major factor in many serious diseases, such as cancer, septic shock, atherosclerosis, diabetes, and obesity (Ku and Lin, 2013). Some studies have shown that peppermint compounds play an important role in preventing diseases related to inflammation and angiogenesis (Kaefer and Milner, 2008; Kale et al., 2008). Liu et al. (2014) found that using peppermint methanol extract on L1210 tumor cells caused toxic effects, suggesting its potential for cancer treatment.[3]

6. Mosquito repellent action

The mosquito-repellent effects of peppermint oil (*Mentha piperita*) were tested against three mosquito species: *Aedes aegypti*, *Anopheles Stephansi*, and *Culex quinquefasciatus*. The mosquito larvae were exposed to the oil in water-filled trays. When applied to human skin, the oil showed strong repellent effects on adult mosquitoes. It provided 100%, 92.3%, and 84.5% protection against *An. annularis*, *An. culicifacies*, and *Cx. quinquefasciatus*, respectively. The repellent effect of peppermint oil was similar to that of Mylol oil, which contains dimethyl and butyl phthalates.[1]

VIII. ADVERSE EFFECTS

Although peppermint is used as a medicinal plant for treating human diseases, studies have shown that in rats, peppermint oil (PO) can cause cyst-like changes in the brain and kidney problems when given in doses of 40-100 mg/kg per day for 28-90 days. Adverse reactions to enteric-coated PO capsules are rare but can include allergic reactions, skin irritation, stomach pain, heartburn, burning around the anus, slow heart rate, and muscle tremors. In people with chronic cough, inhaling menthol beforehand can reduce sensitivity to cough-inducing substances like capsaicin and affect breathing. In rats, doses of 80 and 160 mg of pulegone for 28 days caused symptoms like muscle weakness, weight loss, lower blood creatinine levels, and liver damage. Menthol has also been shown to cause liver changes in rats.[3]

IX. CONTRAINDICATIONS

Peppermint oil can cause serious side effects like acute kidney failure and inflammation of the kidneys if used in high doses, and it can even be fatal in extreme cases. It should not be used by people with gallstones or gallbladder inflammation due to its potential to increase bile production. Since peppermint oil can trigger menstruation, it is not safe to use during pregnancy. There is not enough information to determine if it's safe while breastfeeding. Peppermint oil can cause breathing problems, spasms in the tongue, and even stop breathing in babies and young children, so it should not



be applied to their skin or near their face. However, small amounts of peppermint found in over-the-counter medicines, topical treatments, and herbal teas are generally considered safe for children, pregnant women, and nursing mothers.[1]

X. CONCLUSION

Peppermint oil, derived from *Mentha piperita*, is a versatile and highly valued natural product with a wide range of therapeutic benefits. Its medicinal properties, including antibacterial, antiviral, antifungal, and anti-inflammatory effects, have been extensively studied and proven to be effective in various health conditions. The oil is used not only for its medicinal properties but also in a variety of consumer products like food, cosmetics, and pharmaceuticals. The global demand for peppermint, particularly in industries such as biotechnology, food, and healthcare, continues to rise due to its medicinal and commercial uses.

However, while peppermint oil offers numerous health benefits, it must be used with caution. High doses or improper use can lead to adverse effects such as kidney damage, allergic reactions, and respiratory issues, especially in infants and young children. It is also contraindicated for individuals with gallstones or gallbladder issues and should be avoided during pregnancy. Despite these potential risks, peppermint oil remains a safe and effective treatment when used correctly in controlled amounts, particularly in over-the-counter products.

Further research into the chemical composition, therapeutic effects, and safety profiles of peppermint oil is necessary to unlock its full potential and better understand its impact on human health. As a widely used and beneficial herb, peppermint continues to be a promising candidate for both traditional and modern medicinal applications.

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