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Review article

COMPARATIVE STUDY BETWEEN TWO MENTHA SPECIES

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ABSTRACT: Mint not only gained its importance from its medicinal uses, but also for its ability to be grown in the new reclaimed soils i.e. New Valley Governorate. Therefore, this vital plant needed to assess its nutritional requirements under the new reclaimed soils. In this review article, we will discuss the botanical, chemical composition and uses of two species of mint, spearmint (*Mentha spicata*) and peppermint (*Mentha piperita*) plants. This article summarizes comprehensive information concerning traditional uses, phytochemistry, and pharmacological activities of the two *Mentha spp.*

Keywords: Spearmint, peppermint, traditional uses, pharmacological, phytochemistry

Contents

1. Introduction

Mentha plants belong to the Lamiaceae family, was characterized as unusual blooms featuring a large lower petal that resembles a lip. All continents have a large population of *Mentha* L. plants (with the exception of Antarctica and South America). There are eighteen species and eleven hybrids in this genus that are farmed worldwide (Abbaszadeh *et al*., 2009 and Kızıl *et al*., 2010).

It has been hypothesized in the Mentha section that eleven naturally occurring and named hybrids have been derived from the five fundamental species, *Mentha arvensis* L., Mentha aquatica L., *Mentha spicata* L., *Mentha longifolia* (L.) Huds., and *Mentha suaveolens* Ehrh. All *species* in this group, however, may have seen some expansion of reticulate gene flow during their development, as suggested by the hybrid origins of *M. spicata* and perhaps *M. longifolia*, as well as the incongruence of nuclear and plastid DNA-based phylogenies (Saric-Kundalic *et al*., 2009). *Mentha* located as follows: *M. spicata* (Brazil, Morocco, India, Turkey and France), *M. pulegium* (Brazil, Algeria and Iran), *M. rotundifolia* (Iran, Spain, Morocco and France), *M. longifolia* (Iran), *M. piperita* (India, Egypt,

Finland and USA), *M. arvensis* (India), *M. australis* (Australia) and *M. haplocalyx* (China) are among the medicinal species distributed and used worldwide (Akdogan *et al*., 2007; Chinese Pharmacopoeia Commission, 2010; Kapp, 2013 and Balakrishnan, 2015).

The percentage of essential oil and its constituents vary depending on the species, the locality, the habitat, maturity, and the parts used. *Mentha spp*. essential oil is an antibacterial, an ingredient in many analgesic lotions, and is applied topically to alleviate oral mucosal irritation. *Mentha* spp. oil has been approved for internal use and is also used as an anti-inflammatory and expectorant for the treatment of diverticulitis, myalgia and neuralgia, irritable bowel syndrome, bile duct discomfort, oral mucosal inflammation, menstrual cramp discomfort, secondary amenorrhea and oligomenorrhea, and diverticulitis (Peixoto *et al*., 2009 and Diop *et al*., 2016).

Numerous classes of physiologically active substances are found in phenolic compounds, which are secondary metabolites found throughout whole plants. Esters and glycosides are common forms of these chemicals in their natural environments (Pereira *et al*., 2016). A variety of substances, such as cinnamic acids and aglycon, glycoside, and/or acylated flavonoids, have been found to be present in species of the genus *Mentha* (Dorman *et al*., 2003). Moreover, Triantaphyllou *et al*. (2001) reported that glycosidic flavonoids hydroxylated at position 3 or 5 as well as esters of phenolic acids and flavonoid derivatives are present in aqueous extracts of *Mentha*.

The two species of *M. spicata* and *M. piperita* have varied amounts of triterpenoids, steroids, and fatty acids, particularly linoleic, linolenic, and palmitic acid, which are found in peppermint. Furthermore, recent research has discovered two novel ceramides called longifoamides from the methanolic extract of *M. longifolia*. Nevertheless, distinct pigments were detected and measured in *Mentha* species. For example, *M. spicata* comprises carotenes (a-carotene), xanthophylls (violaxanthin, neoxanthin, and lutein, zeaxanthin), and chlorophylls (a and b). Additionally, it was found that dried peppermint tea contained carotenoids (lutein and ß-carotene isomers). Mints included vitamins like ascorbic acid and a-tocopherols, as well as sugars, saponins, alkaloids, anthraquinones, and quinines (Padmini *et al*., 2008; Sun *et al*., 2014; Riachi and De Maria, 2015).

2. What is peppermint (*Mentha piperita*)?

Botanical name: *Mentha* × *piperita* L.

Synonyms: brandy mint; balm mint.

Family: Lamiaceae (Labiatae).

Common Names: French: Menthe poivree; German: Pfefferminz; Italian: Menta piperita; Spanish: Mentha pimienta and in Egypt: filfli mint.

The Latin term ‘piper’ from alludes to pepper and its spicy, aromatic flavor; piperita, and the genus name *Mentha* is derived from the Greek word ‘Mintha’ the name of a legendary nymph who transformed into this plant. Early information about it as a flavoring and digestive aid was noted in the London Pharmacoepia (Tyler *et al*., 1988 and Charles, 2013).

As a perennial herbaceous plant, peppermint has upright green stalks and leaves (Fig., 1). It can be grown in cultivation or at a height of 30-90 cm, and it can be easily spread through subterranean runners. It can be found in temperate parts of North Africa, Asia, and Europe.

Fig. 1. Leaves of peppermint.

The natural cross between water mint (*Mentha aquatica*) and garden spearmint (*Mentha spicata*) is peppermint. *M. piperita* var. *officinalis*, or white peppermint, and *M. piperita* var. *vulgaris*, or black peppermint, are the two most often used types. Both are typical members of the mint family, which includes herbs with serrated edges on their lanceolate leaves, square stems, and horizontal rhizomes. While white peppermint has green stems with lighter green leaves, poor peppermint has deep red stems with purplish-tinged dark green foliage. Purple blooms are produced by both types in the summer. The aerial part of the plant is most commonly used for therapeutic purposes. It is drought-sensitive. Purplish or green in color, the leaves are opposite, petiolate, ovate, pointed, or oblong, with coarse serrations; the flowers are purplish in dense terminal spikes and are smooth and dark green above, pale or sparingly hairy below. There are more glandular trichomes on the bottom surface. The terminal spikes of the cephalic (verticillate) inflorescence are not sharply pointed, but rather blunt, with little purple flowers (Fig., 2). *Mentha piperita* may usually be propagated readily through cuttings (Charles, 2013 and Nair, 2022).

Used parts of peppermint:

Fresh, dried, or squat dried mint leaves; optional: peppermint extract or essential oil. The fresh version can be cooked, pureed, or consumed raw (Table, 1), sold whole, chopped, as flakes in dried form.

Fig. 2. Flowering of peppermint.

Peppermint has a strong menthol flavor, is cooling, fragrant, and minty. It tastes cool and minty, sweet and spicy, fragrant and slightly pungent. There is a cooling, minty, and herbaceous aftertaste. The plant has a very pleasing scent because of the essential oils that are present in the leaves and other sections of the plant (Charles, 2013).

It is the most widely used herb. It is a common flavor, fragrances and medicinal found in beverages, ice cream, liquors, sauces, confectionary, candies, and after dinner mints. The crushed leaves can be used in jellies, beverages, sherbets, soups, sauces, stews, meat, fish, and vegetables. The oil containing chemical substances which act as antibacterial, anti-inflammatory, antispasmodic (Charles, 2013 and Alaşalvar and Çam, 2020), antioxidant activity [mint oil reduced DPPH to 50% and also exhibited high OH radical scavenging activity, insecticide activity (Mimica-Dukic *et al*. 2003 and Brahmi *et al*. 2017)], carminative, choleretic, antiviral agents (Zong *et al*. 2011). Peppermint tea is considered a stimulant and has antiseptic properties. It is effective in treating headaches, common colds, sore throats, insomnia, fever, and nervous tension. Peppermint is one of the most widely used single ingredient herbal teas. Peppermint to possess excellent antimicrobial activities against *E. coli*, *Staphylococcus aureus*, and *Candida albicans* (Yadegarinia *et al*. 2006). Methanolic extracts of spearmint and peppermint significantly inhibited SW-480 colon cancer cell growth (Yi and Wetzstein, 2011).

The most valuable *Mentha piperita* 'Frantsila' extract was discovered when water-soluble extracts from many Mentha species were evaluated for their antioxidant qualities (Dorman *et al*., 2003). There was a substantial correlation between the detected activity level and the phenolic content. Both fresh and air-dried herbs' total phenolics, ascorbic acid, and carotenoid concentrations, as well as their antioxidant capacity (two tests), were investigated and reported.

Table 1. Nutrient composition and ORAC values of peppermint fresh leaf.

Nutrient	Units	Value per 100 g
Water	G	78.65
Energy	Kcal	70
Protein	g	3.75
Total lipid (fat)	g	0.94
Carbohydrate, by difference	g	14.89
Fiber, total dietary	g	8.0
Calcium, Ca	mg	243
Vitamin C, total ascorbic acid	mg	31.8
Vitamin B-6	mg	0.129
Vitamin B-12	mcg	0.00
Vitamin A, RAE	mcg RAE	212
Vitamin A, IU	IU	4,248
Vitamin D	IU	0.00
Fatty acids, total saturated	g	0.246
Fatty acids, total monounsaturated	g	0.033
Fatty acids, total polyunsaturated	g	0.508
H-ORAC	mmol TE/100	13,978
Total-ORAC	mmol TE/100	13,978
TP mg GAE/100 g	mg GAE/100 g	690

Source: USDA (2011)

The concentrated extracts of fresh and dried oregano exhibited the maximum antioxidant capacity, measured in terms of prevention of LA peroxidation (TAA). There was less action for peppermint. Dried peppermint has an extremely high total soluble phenolic content (Capecka *et al*., 2004). According to Srika *et al.* (2005), eriocitrin, a polyphenolic molecule extracted from an aqueous peppermint extract, is a potent antioxidant and scavenger of free radicals. When fed to newborn Swiss albino mice after an initial dosage of benzo[a]pyrene, a peppermint extract has been shown by Samarth *et al*. (2006a) to be both chemopreventive and antigenotoxic. The antioxidative characteristics of the peppermint extract were proposed as a possible explanation for the chemopreventive activity and antigenotoxic effects. By using the carotene/linoleic acid systems and the DPPH test, peppermint oil shown higher antioxidant activity than myrtle oil (Yadegarinia *et al*. 2006). Based on their evaluation of the radiomodulatory impact of peppermint leaves extract on lipid peroxidation and hepatic antioxidant status in Swiss albino mice, Samarth *et al*. (2006b) hypothesized that peppermint leaves' ability to scavenge free radicals and act as antioxidants was the most likely system of shielding against radiation. In addition to quantifying the phenolic and flavonoid content, Dorman *et al*. (2009) assessed the iron (III) reductive, iron (II) chelating, and free radical scavenging properties of seven distinct peppermint extracts. Strong activities were observed for each of the seven extracts in various chelating, reductive, and radical scavenging assays. According to Schmidt *et al*. (2009), peppermint oil demonstrated antiradical activity against both hydroxyl and DPPH radicals, with a greater antioxidant effect on the former. The abundance of phenolic chemicals, flavonoids, and flavanols in the peppermint extract, which have potent antioxidant and radical scavenging properties, may be the cause of peppermint's notable radioprotective action (Samarth and Samarth, 2009). Peppermint methanolic extracts significantly ($p < 0.05$) protected PC12 cells from oxidative stress (Lopez *et al*., 2010). Yi

and Wetzstein (2010) found that peppermint cultivated in greenhouses had greater total phenolic content and antioxidant capacity than peppermint grown in fields. Substantial antioxidant activity and polyphenol content were observed in the methanolic extract of peppermint and other mint species (Kratchanova *et al*., 2010 and Ahmad *et al*., 2012). Both conventional and organic peppermint shown strong antioxidant activity and a high phenolic content (Lv *et al*., 2012). The physico-chemical properties of peppermint oil listed in Table (2).

Essential oils are natural and volatile secondary metabolites characterized by a strong odor and a complex composition. They are usually obtained by steam or hydro-distillation from various aromatic plants, generally localized in temperate to warm countries like Mediterranean and tropical countries where they represent an important part of the traditional pharmacopoeia (Bakkali *et al*., 2008). The essential oil is obtained by steam distillation of the flowering plant. The oil is a pale yellow to pale olive-green mobile liquid. Redistilled oils are generally colorless. Yield is about 1-3.9% differ from region to another, used parts (leaves, whole plant with or without flower) (Charles, 2013).

Most of peppermint oil medicinal properties are ascribed to menthol, their major active component, while esters, such as methyl acetate, provide the familiar minty taste and associated aroma (Peixoto *et al*., 2009). The major groups of chemical composition of essential oil of peppermint are listed in Table (3) as reported by Bakkali *et al*. (2008).

The two components of peppermint volatile oil that were discovered to be the most potent scavenging agents were menthone and isomenthone (Charles, 2013).

Table 2. Physico-chemical properties of peppermint oil.

Characteristics	Requirements	
	Type 1	Type 2
Color and appearance	Colorless, pale yellow or greenish yellow	Pale Yellow
Odor and taste	Characteristic strong minty, herbal, followed by cooling sensation	Characteristic minty, intense herbal, followed by cooling sensation
Rel.density at 27/27 °C	0.8773-0.9123	0.8923–0.9123
Optical rotation	-35 to -45°	-20 to -40
Refractive index d27 °C	1.4562–1.4642	1.4512–1.4632
Free alcohols as 1-menthol	Minimum 60	20
(mol.wt.156.26)%, m/m per cent by mass	Maximum	30
Esters, as methyl acetate (mol.wt. 198.28)	3-15	5-30
Total alcohols	65 Min	5 Min
Ketones, as methone (mol. wt. 154.25) % m/m (using free hydroxylamine alcohol)	5–20	20–40

Source: Nair (2022)

Table 3. Major groups of chemical composition of essential oil of peppermint.

No.	Compound name	Percentage
1.	The terpene class (monoterpenes):	52%
	Menthol	35-60%
	Menthone	2-44%
	methyl acetate	0.7-23%
	1,8-cineole (eucalyptol)	1–13%
	Menthofuran	0.3–14%
	Isomenthone	2–5%
	Neomenthol	3-4%
	Limonene	0.1-6%
2.	Sesquiterpenes:	9%
	ß-caryophyllene	1.6-1.8%
3.	Aldehydes	9%
4.	Aromatic hydrocarbons	9%
5.	Miscellaneous	8%
6.	Lactones	7%
7.	Alcohols	6%

3. What is spearmint (*Mentha spicata*)?

Botanical name: *Mentha spicata*.

Synonyms: *Mentha sylvestris*, *Mentha longifolia* var. *mollissima*, *Mentha viridis*, *Mentha longifolia* var. *undulata*, *Mentha cordifolia*, *Mentha longifolia*.

Family: Lamiaceae (Labiatae).

Common Name: bush mint, English mint, French: Menthe crepue; German: Krauseminz; Italian: Menta crispa; Spanish: Menta crespa and in Egypt: Baladi mint.

Rhizomatous and perennial, spearmint can reach heights of 30 to 100 cm. The entire plant smells strongly and sweetly like mint. The stems have four angles, are grooved, glabrous, erect, and branching. The leaves are pointed at the ends and rounded at the bases with toothed edges. They are ovate to lanceolate, 2 to 7 cm long and 5 to 25 mm broad. Although they may have hair on the major veins of the lower surfaces, they are mainly glabrous. Their petioles are shorter than 3 mm, or they are sessile, (Fig., 3).

Dense, terminal inflorescences that are 3–12 cm long and 5–10 mm broad. Despite their whorled appearance, flowers emerge from the axils of subtending, opposing bracts (Fig., 4). The petals are 2 to 4 mm long, fused, tubular, four-lobed, and pale lavender to white. The 1.5 to 2 mm long, glabrous calyxes have hairy, toothed edges and are often glandular. The bracts are either the same length as the bloom or shorter, ranging from linear to lanceolate. Each flower yields four nutlets. According to DiTomaso and Healy (2007) and Nair (2022), nutlets are oval and dark brown.

Used parts of spearmint:

It is well known that many different traditional medicines are employed in different countries. Since ancient times, traditional medicine has utilized spearmint to treat a variety of conditions, including diarrhea, stomach problems, digestive problems, diabetes, jaundice, arthritis, respiratory disorders, intestinal weakness, colds, sinusitis, headaches, and flatulence. *M. spicata* leaves have been suggested for the treatment of flatulence and digestive issues by traditional Iranian medical practitioners (Babaeian *et al*., 2015 and Mahboubi, 2021). Spearmint essential oil has been utilized in traditional Arabic Palestinian medicine to treat a variety of conditions, including fever, asthma, colds, coughs, obesity, and digestive issues (Ali-Shtayeh *et al*., 2019).

Fig. 3. Vegetative of spearmint.

Fig. 4. flowering of spearmint.

In Arabian countries, they used stem, leaves and flowering parts of spearmint depending on each country. Uses for treating anthelmintic, Hypertension and cardiac disease, Flatulence and Digestive and carminative. Also, it cultivated in gardens throughout much of the world as food herbs and medicinal herbs (Abbaszadeh, 2009).

Mentha spicata leaves are high in volatile oil, phenols [Rosmarinic acid, Caffeic acid, p-Coumaric acid, Syringic acid (Cinnamic acid, Ferulic acid, Gallic acid, Oleanolic acid, Sinapic acid, Phloretic acid, Vanillic acid), Chlorogenic acid and Hydroxybenzoic acid], Flavonoids are one of the major dietary polyphenols and are sorted into six groups, including flavonols, flavanones, anthocyanins, flavonols, isoflavones and flavones (Pandey and Rizvi, 2009). and lignans (spicatolignan A and spicatolignan B).

Leaves, stems and flowers of spearmint are the sources of essential oil. The essential oil of *M. spicata* contains between 0.04 and 2.1% (v/w). It used as antibacterial activity (*Staphylococcus spp.*, *Acinetobacter spp.*, *Escherichia coli*, *Proteus mirabilis*, *Pseudomonas aeruginosa*, *Salmonella spp*., *Kluyvera spp*., *Klebsiella spp*., *Trichophyton rubrum* SNB-TR, *Bacillus subtilis* and *Micrococcus flavus*), antifungal activities (*Trichophyton rubrum*, *Trichosporon beigelii*, *Fusarium oxysporum*, *Aspergillus spp*., *Trichophyton rubrum* CECT, *Candida albicans* and *Microsporum audouinii*), antioxidant activities capacity isolated (S-

carvone and linoleic acid), larvicidal activity, anti-diabetic activity, anticancer activity, anti-inflammatory and anti-nociceptive activity, hepatoprotective activity, antipyretic activity, psychopharmacological evaluation, improvement of learning and memory effects, antigenotoxic potential, and antiandrogenic activity.

According to Sinha and Singh (1982) and Deepak *et al*. (2010), native field mint (*Mentha arvensis*) can be mistaken with peppermint and spearmint. It differs from peppermint and spearmint by having flowers that are produced in large, widely spaced clusters in the axils of the leaves and stems that end in leaves. In contrast to peppermint and spearmint, field mint frequently has hairy leaves and stems.

According to Bardaweel *et al*. (2018), 44 compounds were found, accounting for 98.40% of the total oil. The most common constituents were carvone (49.5%), limonene (16.1%), 1,8-cineole (8.7%), cis-dihydrocarvone (3.9%), β-caryophyllene (2.7%), germacrene D (2.1%), and β-pinene (1.1%). The oxygenated monoterpenes (67.2%) constituted the most prevalent chemical structure among the constituents, trailed by the monoterpene hydrocarbons (20.8%), sesquiterpene hydrocarbons (7.5%), and oxygenated sesquiterpenes (1.2%).

Yield of the oil was 1.04% per 100 g plant material and its chemical compositions were listed in Table (4).

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Table 4. *Mentha spicata* essential oil fractions.

Contents	% area	Contents	% area	Contents	% area
α-pinene	0.7	Linalool	0.2	β-elemene	0.3
Sabinene	0.6	Nonanal	0.1	(Z)-jasmone	0.3
β-pinene	1.1	cis-p-menth-2-en-1-ol	0.2	β-caryophyllene	2.7
Myrcene	0.8	δ-terpineol	0.5	β-copaene	0.2
3-octanol	0.3	4-terpineol	1.5	aromadendrene	0.1
α-terpinene	0.3	α-terpineol	0.3	α-humulene	0.2
p-cymene	0.2	cis-dihydrocarvone	3.9	cis-muurola-4(14),5-diene	0.3
Limonene	16.1	trans-carveol	0.2	germacrene D	2.1
1,8-cineole	8.7	(Z)-3-hexenyl isovalerate	0.9	bicyclogermacrene	0.7
(Z)-β-ocimene	0.3	Pulegone	0.5	germacrene A	0.7
(E)-β-ocimene	0.3	Carvone	49.5	δ-cadinene	0.2
γ-terpinene	0.4	dihydroedulan IA	0.1	spathulenol	0.2
cis-sabinene hydrate	0.8	isodihydrocarvyl acetate	0.6	caryophyllene oxide	0.3
Terpinolene	0.2	cis-carvyl acetate	0.3	1,10-di-epi-cubenol	0.2

Source: Bardaweel *et al*. (2018)

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دراسة مقارنة بين نوعين من النعناع

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لم يكتسب النعناع أهميته من استخداماته الطبية فحسب، بل اكتسبها أيضاً من قدرته على النمو في الأراضي حديثة الإستصلاح، مثل محافظة الوادي الجديد. ولذلك، كان هذا النبات الحيوي بحاجة إلى تقييم احتياجاته الغذائية في ظل الأراضي المستصلحة حديثاً. سنناقش في هذه المقالة المرجعية التركيب النباتي والكيميائي واستخدامات نوعين من نباتات النعناع وهما: النعناع البلدي (*Mentha spicata*) والنعناع الفلفلي (*Mentha* × *piperita*). يلخص هذا المقال معلومات شاملة بشأن الإستخدامات التقليدية، والكيمياء النباتية، والأنشطة الدوائية لنوعي النعناع.