Chapter

Study Biochemistry of *Mentha longifolia* (L.) Huds.: A Review

Sadeq Sabeeh Kareem Al-Taie and Noor Falah Mahde Al-Kenane

Abstract

The *Mentha longifolia* were found to be a rich source of phytochemical compounds like piperitone, piperitone oxide, piperitenone, pulegone, d-limonene, menthone, carvone, menthol, β-caryophyllene, 1,8-cineole, 5,7,4-trihydroxy-6,2,3-trimethoxyflavone, carvone, limonene, tripal, and oxathiane. *Mentha longifolia* possess antioxidant effect that could be attributed to the presence of phytosterosls, unsaturated fatty acids, phenolic compounds, and specific volatile constituents and antimicrobial and interfere in the treatment of many diseases.

Keywords: biochemistry, *Mentha longifolia* (L.) Huds, essential oils, antioxidant activity

1. *Mentha* Linnaeus, Sp. Pl. 2: 576.1753

Mentha species belong to the family Lamiaceae (Labiatae) and are widely distributed in Asia, Africa, Europe, North America, and Australia [1].

Mentha is classified into 42 species including subspecies, varieties, cultivar, as well as several of hybrid species. There are five sections of *Mentha* genus: *Audibertia*, *Mentha*, *Eriodontes*, *Preslia*, and *Pulegium* [2]; this is classified according to genetic, cytological, and morphological features. The species of *Mentha grow in numerous and different environments.*

Mentha extracts have several traditional properties; it is used in foods and medicinal drugs. Literature search reported antioxidant, antimicrobial, antifungal, as well as effects against yeasts, and anti-inflammatory and sedative [3]. *Lamiaceae* species are carminative, treating of colds and flu, diuretic, respiratory tract problems, stomachache gastralgia, hemorrhoids and antispasmodic [4]. Phytochemical studies of *Mentha* showed the presence of phenolic compounds. Essential oil such as (limonene, carvone, β-caryophyllene, terpinen-4-ol, piperitenone, pulegone, 1,8-cineole, and menthol), terpenes, flavonoids, ascorbic acid [5].

2. Morphological character

Mentha longifolia (Linnaeus) Hudson (**Figure 1**).

Mentha longifolia is a creeping rhizomatous, perennial herb, opposite, two leaves per node. Sessile, it grows 30–100 cm tall, either hairless or hairy on the stems; the leaves are round, simple, lanceolate to oblong lanceolate, toothed, 1–3 cm long,

Figure 1.
Morphology of Mentha longifolia.

and 1.5–3 cm broad, smooth, or wrinkled with sharply serrate margin. The stem is erect, square-shaped, and light green to reddish green. Inflorescence, slender spikes produces pink, white, or lavender flowers in disrepute terminal spikes; bisexual, calyx short tubular, 1–2.5 mm, calyx short tubular, 1–2.5 mm, glabrous; corolla short tubular, 2–4 mm, with 5 lobes, white to pink, four stamens, subequal, pistil with a single style, exserted, the fruit is nutlets, dry, ovoid, and tuberculate, ovary smooth [6–9].

3. Phytochemistry of *Mentha longifolia* (Linnaeus) Hudson

The oils of *M. longifolia* are known to contain numerous monoterpenoids with piperitone oxide, piperitone, piperitenone, β-caryophyllene, d-limonene, carvone, menthone, pulegone1,8-cineole, and menthol as dominating compounds [5].

The phytochemical compounds of the essential oil of *M. longifolia* are studied by Moroccan [4] and reported that piperitenone oxide and piperitone oxide are the

main compounds in the plant. In addition, five flavonoids and some non-volatile compounds are found such as *trans*-piperitone oxide, luteolin 7-*O*-glucoside and hesperidin, and piperitenone oxide luteolin. These compounds are used as antibacterial and against gastric problems and intraditional medicine [10, 11]. The essential oil of *M. longifolia* is represented by the oxygenated monoterpene group; this group includes 1,8-cineole, pulegone, piperitenone oxide [12, 13], and some other compound found in trace amounts such as sabinene, isomenthone, borneol, menthol, piperitenone, α-pinene, γ-terpineol, menthone, β-caryophyllene, isopulegone, and β-pinene.

Dzamic et al. [3] studied the *M. longifolia* in terms of its antioxidant and antifungal activity. They found that the constituents of the essential oils are about 35 chemical compounds. The highest compound was trans-dihydrocarvone (23.64%), and the lowest compound was cis-carveol and β-gurjunene (0.10%). As for minimal inhibitory (MIC) of *M. longifolia* essential oil (μl/ml), the values of some fungi were as follows:

1. 10 MIC in *Aspergillus flavus*, *A. ochraceus* and *Trichoderma viride*.

2. 5 MIC in *Alternaria alternate* and *Trichophyton mentagrophytes*.

3. 2.5 MIC in *Aspergillus niger*, *A. versicolor*, *Cladosporium fulvum*, *Fusarium tricinctum*, *F. sporotrichioides*, *Penicillium funiculosum*, *P. ochrochloron* and *Candida albicans*.

4. 1 MIC in *Cladosporium cladosporioides*.

The values of fungicidal concentrations (MFC) of *M. longifolia* essential oil (μl/ml) are as follows:

1. 10 MFC in *Alternaria alternate*, *Aspergillus niger*, *A. ochraceus*, *A. flavus*, *A, versicolor*, *Fusarium tricinctum*, *F. sporotrichioides*, *Penicillium funiculosum* and *Trichoderma viride*.

2. 5 MFC in *Trichophyton mentagrophytes* and *Candida albicans*.

3. 2.5 MFC in *Cladosporium cladosporioides*, *C. fulvum*, and *Penicillium ochrochloron*.

They also illustrate antioxidant activity of *M. longifolia* essential oil as shown in **Figure 2**.

The major components in the polish *M. longifolia* oil are limonene (5.8%), carvone (7.9%), 1,8-cineole (5.4%). and piperitone (4.8%) [14].

According to Khani and Asghari [15], the major volatile compounds were oxathiane (9.3%), tripal (14.3%), piperitenone (43.9%), piperitone oxide (5.9%), and d-limonene (4.3%) in *M. longifolia*.

The major volatile compounds of the Iranian *M. longifolia* oil were piperitone (43.9%), limonene (13.5%), and trans-piperitol (12.9%) [16]. Essential oil of *M. longifolia* showed some major component as; pulegone (21.90%), 1,8-cineole (11.58%), piperitone oxide (42.51%), and caryophyllene oxide (3.64%) [17].

The most abundant components in the essential oil of *M. longifolia* from Pakistani flora were borneol (5.96%), piperitenone (24.9%), piperitenone oxide

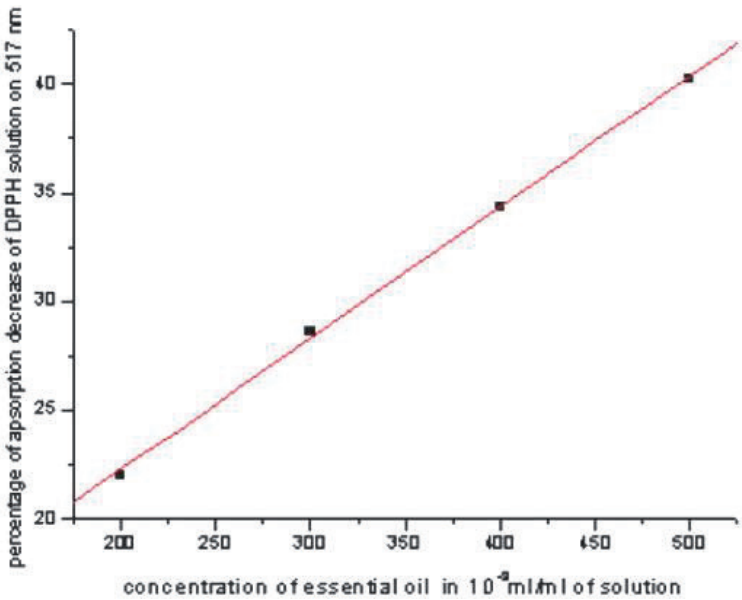

Figure 2.
Antioxidant activity of M. longifolia *essential oil [3].*

(28.3%), germacrene D (8.16%), and β-caryophyllene (5.94%), and the analyzed essential oil mainly consisted of oxygenated monoterpenes (67.24%) followed by sesquiterpene hydrocarbons (17.19%), monoterpene hydrocarbons (7.31%), and oxygenated sesquiterpenes (5.05%) [18].

Piperitone oxide and piperitenone oxide were the major components in the essential oil of *M. longifolia* from the middle Black Sea Region of Turkey [19].

In Egypt, a study prepared from *M. longifolia* aerial parts [20] found fatty acid content of the petroleum ether extracts of *M. longifolia* oil (the percentage of total fatty acids palimitic 1.63%, stearic 4.20%, linoleic 6.97%, and behenic 1.65%, total saturated fatty acids 7.488%, total unsaturated, fatty acids 6.97%), Gas liquid chromatography (GLC) analysis of unsaponifiable matter of M. longifolia oil (as percentage of total unsaponifiable matter) (hydrocarbon [higher alkanes], pentadecane 0.24%, hexadecane 0.03%, heptadecane 0.16%, octadecane 1.51%, nonadencane 15.94%, heneicosane 3.62%, docosane 10.548%, tetracosane 1.73%, hexacosane 0.576%, octacosane 4.09%, total hydrocarbon 38.47%, phytosterols [campesterol 3.37%, stigmasterol 1.87%, β-sitosterol 4.65%, total phytosterols 9.90%]) and chemical composition of hydrodistilled *M. longifolia* essential oil are α-pinene, sabinene, β-pinene, β-myrcene, limonene 1,8-cineole, linalool oxide, linalool, menthone, borneol, piperitone oxide, terpinehe-4-ol, α-terpineol, transcarveol, thymole, piperitenone, piperitenone oxide, β-caryophyllene, humulene, D-germacrene, caryophyllene oxide, cedrol, α-cadinol, monoterpenes, oxygenated monoterpenes, sesquiterpene hydrocarbons, oxygenated sesquiterpene hydrocarbons.

M. longifolia essential oil belongs to oxygenated monoterpene group, which include pulegone, piperitenone oxide, and 1,8-cineole [12, 13] Beyond these, carvone, limonene, sabinene, α-pinene, isomenthone, borneol, menthol, menthone, piperitenone, dihydrocarvone eucalyptol, γ-terpineol, β-caryophyllene, isopulegone, cadinene, and β-pinene were also recorded as meaningful compounds from *M. longifolia* essential oil.

Component	Reference
Piperitone	[22]
Pulegone	[23, 24]
Cis-piperitone epoxide	[25]

Table 1.
The essential oils of M. longifolia *described in the literature.*

Identified chemical compounds	Reference
g, rosmarinic, salvianolic acid L	[26]
5-Hydroxy-6,7,3′,4′-tetramethoxyflavone	[3]

Table 2.
Major constituents of the phenolic composition and flavonoids of M. longifolia *described in the literature.*

The chemical compounds of some species of the genus Mentha are explained in [21], and the Mentha longifolia was among them, mentioning the essential oils as shown in **Table 1** and the phenolic compounds as shown in **Table 2** in the *M. longifolia*.

4. Phytochemistry in other species of the *Mentha* L.

As for the other species of the genus *Mentha*, it was rich in some chemical compounds, and it has a large antimicrobial role, including the *Mentha piperita* L. rich in caffeine, p-coumaric, ferulic, and rosmarinic acids that have an anti-*Staphylococcus aureus* and antiproliferative activity against two cancerous cell lines (MDA-MB-231), breast carcinoma cell line, and (A375) human melanoma cell line [27].

Patil et al. [28] reported that *Mentha piperita* is rich in chemical compounds such as diterpenes, tannins, flavonoids, cardiac glycosides, and stimulants, alkalis, phenols, coumarin, and saponins. These compounds have high activity as a microbial antibody.

Authors [29–31] also recorded menthofuran as an aromatic oil that ranges between 11 and 70.5% of the total content of the *Mentha aquatic*.

In *Mentha cervina* L. [32, 33], two compounds are mentioned; pulegone and isomenthone are the main components identified.

The *Mentha diemenica* essential oil in Australia was neomenthyl acetate, pulegone, and menthone, while the essential oil of the same species from Canada had significantly higher amounts of menthone, isomenthone and pulegone [34].

As mentioned by [13, 17], *Mentha spicata* L. essential oils are carvone and limonene.

Guedes *et al.* [35] found some chemical compounds in *Mentha arvensis* L. and *M. piperita* L. as shown in **Figure 3**.

The major component of essential oil in *M. arvensis* was menthol in the stem (78.16%), but it was (43.7%) in stolon (runner). Menthol is the major component of all the oils in *M. arvensis*, with the highest percentage in shoot stem oil (78.16%) and the lowest in stolon (runner) stem oil (43.7%). β-Caryophyllene oxide was

the major component present in stem and leaf, while limonene, α-phellandrene, menthone, pulegone, and terpinolene are found in stolon [36].

Al-Okbi et al. [20] studied chemical content *Mentha citrate* shown in **Tables 3**, **4** and **5**.

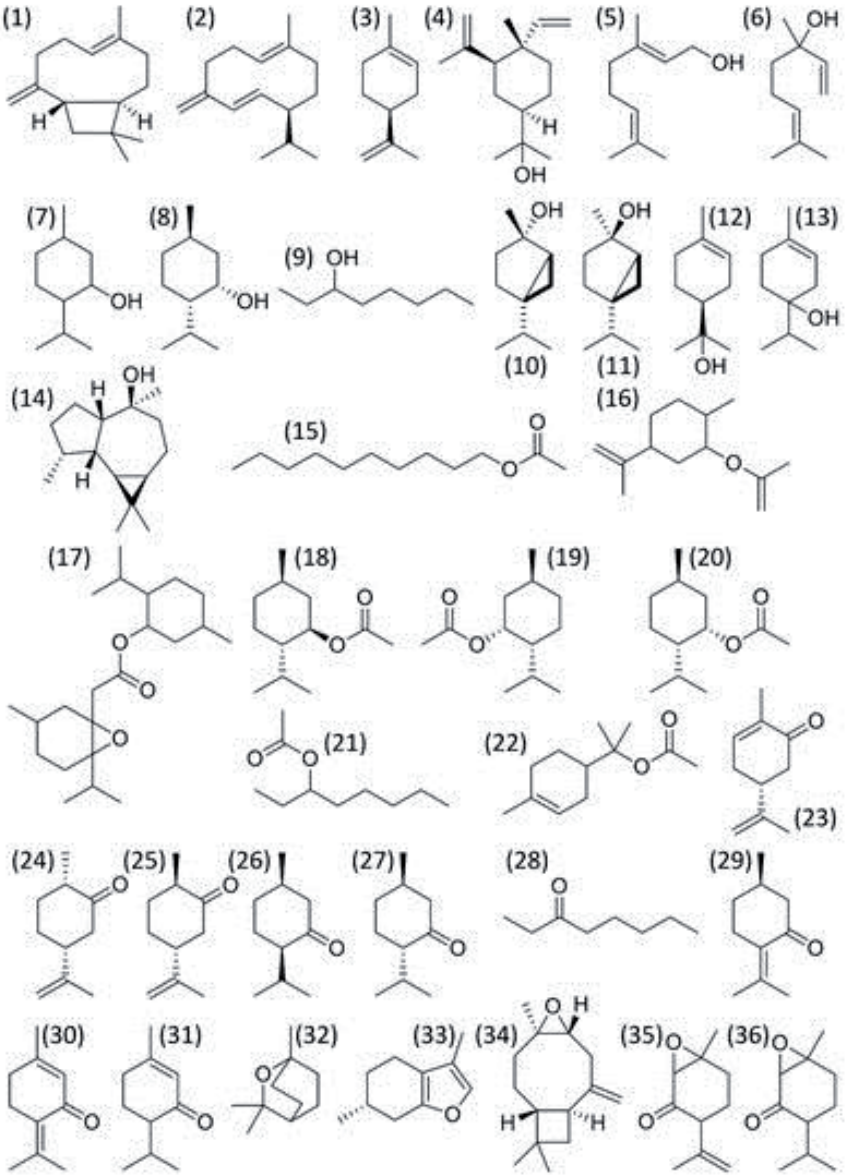

Figure 3.
Main components of Mentha *species essential oils: (1) β-caryophyllene, (2) germacrene D, (3) limonene, (4) elemol, (5) geraniol, (6) linalool, (7) menthol, (8) neomenthol, (9) 3-octanol, (10) cis-sabinene hydrate, (11) trans-sabinene hydrate, (12) α-terpineol, (13) terpinen-4-ol, (14) viridoflorol, (15) decyl acetate, (16) dihydrocarvyl acetate, (17) 1,2-epoxyneomenthyl acetate, (18) menthyl acetate, (19) neoisomenthyl acetate, (20) neomenthyl acetate, (21) 3-octyl acetate, (22) α-terpinyl acetate, (23) carvone, (24) cis-dihydrocarvone, (25) trans-dihydrocarvone, (26) isomenthone, (27) menthone, (28) 3-octanone, (29) pulegone, (30) piperitenone, (31) piperitone, (32) 1,8-cineole, (33) menthofuran, (34) caryophyllene oxide, (35) piperitenone oxide, and (36) piperitone oxide [35].*

Fatty acids	**%**
Palmitic	11.645
Stearic	8.437
Oleic	25.706
Linoleic	8.986
Behenic	3.777
Total saturated fatty acids	23.859
Total unsaturated fatty acids	34.692

Table 3.
Fatty acids' content of the petroleum ether extracts of Mentha citrata *oils (as percentage of total fatty acids) [20].*

Hydrocarbon and sterols	**%**
Hydrocarbon (higher alkanes)	
Hexadecane	0.005
Heptadecane	0.231
Octadecane	0.256
Nonadecane	0.527
Icosane	0.663
Heneicosane	0.142
Docosane	0.423
Tricosane	24.715
Tetracosane	1.816
Pentacosane	0.266
Hexacosane	4.217
Octacosane	6.792
Total hydrocarbon	40.053
Phytosterols	
Campesterol	4.284
Stigmasterol	0.341
β-Sitosterol	5.748
Total phytosterols	14.657

Table 4.
GLC analysis of unsaponifiable matter Mentha citrata *oils (as percentage of total unsaponifiable matter) [20].*

Components	**%**
Linalool	20.99
Isopulegol	0.17
Menthol	0.25
Phenyl ethylalcohol	1.32
α-Terpineol	2.89

Components	%
1,8-Cineole	2.82
β-Ocimene	1.01
α-Terpinolene	0.53

Table 5.
Some chemical compounds (%) isolated from M. citrata *[20].*

5. Antioxidant activity of *Mentha longifolia* (Linnaeus) Hudson

Iqbal et al. [18] showed dichloromethane and methanol extracts of *M. longifolia* to exhibit excellent antioxidant activity.

The antioxidant activity of methanol extract of *M. longifolia* is studied by Vladimir-Knezevid et al. [37], which they reported the presence of rosmarinic acid in the dried plants. Rosmarinic acid was found in the highest amount in most of *Mentha* species [38].

The antioxidant activity of *M. longifolia* methanol extract has been investigated in Saudi Arabia [39]. Phytochemical compounds and antioxidant activity of *M. longifolia* were studied by [36]. Essential oils have a high free radical scavenging capacity. So *M. longifolia* essential oil represented as a safe antiseptic addition in antioxidant and pharmaceuticals [40–43].

The antioxidant activity of *M. longifolia* in study [20] could be ascribed to the total phenolic contents that have been determined in methanol extract, along with the essential oil.

6. Traditional indications of *M. longifolia*

Have been used as [22, 25]:

1. Antimicrobial, anti-catarrhal, antispasmodic carminative, and antirheumatic

2. Antiemetic, sedative, diuretic, and aphrodisiac

3. Insect repellent and deworming

4. Treatment of headaches

5. Blood purifier

6. Digestive disorders, jaundice and gallstone

7. Dyspnea, common cold, asthma, and cough wound healing

8. And other uses

7. Conclusion

This review discusses the chemical constituent of *Mentha longifolia* and its antioxidant and antimicrobial effect and its role in alternative medicine in various regions of the world.

Essential oils and other chemical compounds in plant are natural products, which have been used for several applications in pharmaceutical, cosmetic, agricultural, and bioactivity example stems, leaves, and flowers.

Mentha genus encompasses several species used at medical, industrial, and nutritional levels. Most species contain essential oils and phenolic compound such as *M. longifolia, M. piperita, M. aquatic, M. cervina, M. diemenica, M. spicata*, and *M. arvensis* rich in essential oils and other compounds show activities of antioxidant and antimicrobial, and their essential oils and their derived extracts used as natural food preservatives.

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