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Review article: The use Of M. longifolia in the development of some medicines

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Abstract
Mentha longifolia (wild mint) is used in Iraq and other nations, it was used in medicinal purposes. Several studies have shown the plant's various pharmacological effects. Our objective in preparing this article is to showing M.longifolia conveintional purposes along with its pharmacological and treatment effects. Mint is characterized by its distinctive aromatic smell that belongs to the carvone compound, and mint was used since ancient times in alternative therapy in treatment of several cases. It is used as a laxative for the nervous system and in solving a number of digestive problems. Mint has been discovered to increase the development and function of salivary glands as well as digestive enzymes, which aids the digestive tract in the digestion process as well as the management of nausea. It is also used in the manufacture of toothpastes because of its role in fighting the bacteria that cause tooth decay, and its strong smell is important in opening the respiratory passages, so it helps relieve coughing and expel sputum, based on a review of some studies in this article, we can conclude that mint is a natural source for developing drugs.

Keywords: M.longifolia, antioxidant, Menthol, Apigenin.

1. Introduction

Wild mint (Mentha longifolia L. family Lamiaceae) is found through abundance in the Mediterranean, Australia, European and North African regions [1,2,3] . Plant with a mint fragrance is a variable perennial. It has been rhizome that creeps 40-120 cm high with straight to creeping stems. The leaves are thin to medium bushy, green to greyish-green at the top and white at the bottom, oblong-ovate to lanceolate. The blossoms are 3-5 mm long, purple, purple, or white, on long, branching and tapering spines, produced in bushy clusters. M. Longifolia is being utilised in tobacco, nutrients, pharmaceutical as well as cosmetic industries in particular. In traditional folk medicine, various segments of plant, includes its leaves, flowers, bark, stem and seed are so utilized as antibacterial, antispasmodic, carminative, stimulant, and used to treat a variety of illnesses including headaches and digestive problems.[4]

Sufficient indications exist for the various biological effects of in pharmacological study M. Longifolia [Table 1] and important oils contain chemical compounds.

Table 1: Pharmacological results of M.longifolia (L.)

system	Effect	Reference
Nervous	Protective effects against hydrogen-peroxide-induced toxicity in PC12 cells and antioxidant activity.	78
Muscular	*M. longifolia* (L.) leaf hydro alcoholic extract induces smooth muscles spasmolytic activity mainly through disturbance in calcium mobilization and party by potassium channels activation.	50
Gastrointestinal	Ethanolic and aqueous extracts of *M. longifolia* displayed significant anthelmintic activity against pinworms, Syphacia obvelata and Aspiculuriste traptera, in mice. *M. longifolia (L.)* leaf hydro alcoholic extract induces smooth muscles spasmolytic activity.	33 50
Immunity	Oil from *M. longifolia (L.)* very strong antibacterial activity, in particularly against E.coli strains and other bacteria.	6
Blood	Anti-hemolytic activity.	62

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Monoterpene is the main chemical compound contained in the essential oil of M. longifolia, according to studies. [Figure 1], Puglegone, isomenthone, menthone,1,8-cineole, borneol, menthol and piperitenone oxide are especially oxygenated.[5] Among them, the most essential ingredient responsible for most pharmacological effects of the plant is menthol.[6,7] A translucent or white crystalline waxy material that is stable At room temperature, even at moderately high temperatures, it melts. Some identifies of the mint family (Mentha spp.) also find peppermint in essential oils, such as horse mint and peppermint. Gas chromatography study-mass spectrometry showed that the primary compounds within the M. Longifolia essential oil are : menthone (20.7-28.8%), Menthol (19.4-32.5%), 1,8-cineole (5.6-10.8%), pulegone (7.8-17.8%), that have important players in the different impacts of plant.[8] The drug's pharmacological impact complete extract and the most active ingredient [Table 2] of are reviewed in this report. In traditional folk medicine, M. longifolia (menthol) and its applications

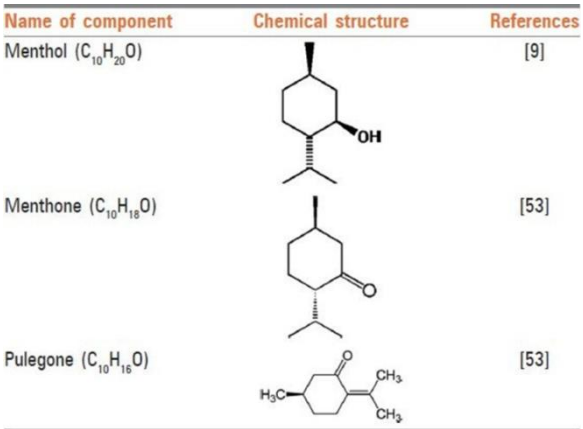

Figure 1. Structures of certain active Mentha longifolia constituents[9]

Table 2: Menthol's pharmacological impact

system	Effect	Reference
Organisms	Antimicrobial Fungicidal Antibacterial	6,8,15,20,78,79
Nervous	Antinociceptive	80,81
All	Antioxidant	7,82,83

2. Effects on the nervous system

The M. longifolia aqueous leaf extract has been shown to have antipyretic and antinociceptive properties in a sample. For the oral and intraperitoneal administration of plant extracts, relatively high LD values (50) were obtained, indicating the plants extract was non-toxic to mice.[10] additional research tested the potential protective effects of methanolic extracts of M.longifolia antioxidant activity (xanthine/xanthine oxidase methods and 2, 2'-azino-bis (3-ethylbenzothiazoline-6-sulfonic acid) [ABTS]) and monoamine oxidase A(MAO-A) neurochemical characteristics inhibition, acetylcholinesterase inhibition methods) in PC12 cells against toxicity caused by hydrogen peroxide.

This plant exhibited inhibition activity of antioxidants and MAO-A.[11] A greater central nervous system (CNS) depressant effect was exhibited by M.longifolia essential oil.[12] The effect on the CNS role of the crude ethanol extract of M.longifolia and apigenin glycoside-rich fractions, phenolic acids and Luteoline glycosides have also been studied. Notable spasmodic, choleretic and CNS simulative effects are found to be present in phenolic acids.[13]

3. Effects on the gastrointestinal tract

The leaves of Mentha Longifolia are utilized in herbal preparations utilize for digestive illnesses. Here, leaves of M. longifolia are boiled locally in cardamom seed water or green tea leaf powder for children. It is used, especially in cases of chronic diarrhea, as an antiemetic. As a carminative, M. Longifolia is used for gas problems and is eaten with butter to avoid diarrhea in the form of a special sauce in the summer. [14,15,16] Similarly, it is used to treat stomach pain.[17]

M.longifolia leaf extract has a soothing effect on the intestinal smooth muscle, consistent with conventional plant usage in the treatment of gastrointestinal disorders such as colic and diarrhea. Due to the existence of ingredients that block calcium channels, this plant exhibits antispasmodic activity mainly by Altered mobilization of calcium and partially by activation of potassium channels.[18,19] At doses of 100-1000 mg / kg, the crude extraction of M.longifolia provides 31-80% safety in the castor oil-induced diarrhea model, close to loperamide. Calcium channel blocking's effectiveness was also verified when M.longifolia crude extract was used as a tissue pretreatment. induced a change to the right in the curves of concentration-response of Ca++, close to verapamil. The fractionation directed by operation showed that the fraction of It was more petroleum spirit successful than the original essential oil and aqueous fraction.[18].

On the other hand, rat ileum displayed a dose-dependent relaxation effect only, and acetylcholine (ACh) induced contracture was decreased by tissue pre-incubated with the substance. Essence (1000 g/mL) substantially suppressed the influence of ACh, indicating the effect on smooth muscle can be mediated through cholinergic receptors. In a dosage-dependent and tissue-specific way, gastrointestinal smooth muscle contraction has improved

significantly.[20] Another research investigated the Impact of Oxide Piperitenone, that is major chemical material components of many Mentha spp. essential oils. On the guinea pig ileum, including M.spicata, M.longifolia, M.suaveolens, M.villosa and M.rotundifolia. Relaxed basal tonus of Oxide of Piperitenone (30-740 μg/ml) Potential without causing any changes to the resting membrane.[21]

4. ANTIMICROBIAL ACTIVITY

M. Longifolia is commonly used to treat inflammation of the throat and mouth, and sore throats.[10] Studies have revealed the plants mint genus have substantial antimicrobial activity[6], primarily due to the chemical composition of monoterpenes oxygenated.[22,23,24,25] Interesting antimicrobial activity against Salmonella typhimurium, Escherichia coli, [26] Aspergillus flavus, Listeria monocytogenes, Fusarium oxysporum, Botrytis cinerea, Aspergillus niger, Pseudomonas aeruginosa, [27] Microsporm canis, Trichophyton longifusus, [28] and Mucor ramamnianusus has been demonstrated in the essential oil of M.longifolia.[29] Penicillium ochrochloron, Cladosporium cladosporioides and Cladosporium fulvum and a lethal doses 2.5 μL/mL were shown to be the most susceptible micromycetes against the extract of this plant.[6]

A clinical analysis of M.longifolia important oil and methanolic extract found that, compared to methanolic extracst, the important oil is a higher with wider range of anti-microbial activity. The antiprotozoal activity of M.longifolia ethanolic extract against Giardia duodenalis trophozoites and Entamoeba histolytica was evaluated in another in vitro analysis.[30]

The essential oil of the plant demonstrated substantially greater activity of fungicides and fungicides than the more costly bifonazole fungicide.[6] It has been shown that Menthol is an antifungal agent and antimicrobial against different forms of ringworm and other fungal infections.[23,24,25] The anti-candidate activity of menthol against Candida albicans is equivalent to amphotericin B (minimum inhibitory concentration (MIC): 125.0 μg/mL; inhibition range: 7.1-18.5 mm) (MIC: 7.8 μg/mL; inhibition range: 10.2 mm).

Menthol is effective toward dental bacteria.[10] It is widely stated that G +ve bacteria are high sensitive rather than G -ve bacteria to important oils from plants. [23,25,31,32] M.longifolia-isolated alkaloids, however, have strong effects on the growth of G -ve bacteria including E. From coli.[33,34] According to 1 report of 5 of the Flavonoids isolated extract of M.longifolia found that quercetin 3-O-glucoside would have the high antimicrobial Activity between flavonoids studied.[35] The typical dietary flavonoid found in Mentha spp. is apigenin. It does have many biological impacts, including antibacterial activities.[36,37,38] Other studies have demonstrated M.longifolia's antimicrobial activity against Saccharomyces and C. Cerevisiae Albicans (Inhibition areas of twenty five and twenty eight mm in diameter, respectively).[39,40,41] The anti-vibration effects against Vibrio spp. essential oils which are obtained from M.longifolia. This effect has been Found in the M. Longifolia administration in the event of gastrointestinal problems and extraintestinal disorders associated with inadequately cooked seafood intake or interaction with polluted seawater with strains of Vibrio parahaemolyticus, Vibrio alginolyticus, Vibrio fluvialis and Vibrio vulnificus.[42]

There is a study suggesting which M.longifolia piperetone lowering resistance of nitrofurantoin to intestinal bacterial strains and improves the importance of the nitrofurantoin antimicrobial activity used to treatment UTI.[43] The principal composition of M.longifolia against Klebsiella pneumoniae and against molds is known to be Pulegone.[5,44] For the plant species of Bacillus subtilis, the mixture of nisin and M.longifolia important oil had a major inhibitory effect on growth at 25°C. However, bacterial growth at 25 ° C was not specifically inhibited by the plant's sole essential oil.[45] In mice, ethanol and aqueous M.longifolia extracts demonstrated important anthelmintic action Pinworms, Aspiculuris tetraptera, and Syphacia obvelata are all pinworms.[46]

In one study, in spore germination tests against some fungi, M.longifolia was found to be highly successful (>88 percent).[47] The insecticidal activity of M.Longifolia also has been recorded in many studies. In Chrysolina herbacea, nytrition on this plant has been presented to cause death. The key component due to the plant's insecticidal behavior is piperitenoneoxide (LC50, 9.95 mg/L).[48] M.longifolia essential oil is similarly shown to have 100 percent repellence (10, 15, 20 days old) against Sitophilus zeamais and Castaneum Tribolium (25 days old). [49,50, 51] Two reports have been published confirmed the good activity of the ethanol against both the third and fourth larvae of M.longifolia of the domestic Culex pipiens is a type of mosquito (LC50-26.8 ppm) [61] and against Sitophilus oryzaee (24.2 percent repellency).[52]

5. Antioxidant activity

Gulluce et al have planned a research to assess the antioxidant activity of methanol extract and The important oil of M. Longifolia.[7]. Assays used for antioxidant activity, for example, Inhibition of the free radical β-carotene/linoleic acid and 2, 2-diphenyl-1-picrylhydrazyl (DPPH) systems, The extract outperformed the essential oil in terms of activity. Other studies have established phenolic compounds as the major cause of methanol extract's stronger antioxidant impact than essential oil.[28] A

positive association exists between the capacity for antioxidant activity and the number of phenolic compounds.[41]

Apigenin derivatives are known as antioxidant molecules in some studies. [56,57,58] The free radical scavenging potential (1, 1-diphenyl-2-picrylhydrazyl scaving activity) was used for 9 species of mint in another study. Evaluating and discovering possible new sources of natural antioxidants has been investigated. The antioxidant activity was carried out after various times periods with an incubation periods of thertty minute. There was important antioxidant activity in the methanol extracts of M.longifolia (79 percent).[59] Berselli et al.[60] Efficacy of 1 h pre-incubation with the highest non-toxic M.longifolia extract dose characterized (80 µg/mL) has been demonstrated to Guard human keratinocytes (NCTC2544) toward oxidative stress caused by chemicals (500 µM H2O2 for 2, 16, and 24 hour). In the shorter stages of oxidative stress induction, mint, which limited DNA damage and protein, retained glutathione, and reduced lipid peroxidation and superoxide dismutase activity, significantly protected cellular viability. A mixture of four plant extracts (M.longifolia, Alchemilla vulgaris, Cuminum cyminum and Olea europaea) The antioxidant properties used in traditional Islamic and Arabic medicine and in European herbal medicine were very low in absorption (10 mcg/mL). As determined by the technique of lipid peroxidation.[61]

In another analysis, monoterpine ketones (Isomenton and Menthon) have been shown to be the most effective scavenging complexes found in M.longifolia essential oils.[6] When various extraction methods are used, the antioxidant effect of the plant's material differs. For example, in one study, Extracts obtained herbs that have been dried naturally (2.76 ± 0.15 m/mol Fe2+/Mg dry extract and EC50 = 0.022 ± 0.001 mg/ml) due to highest general phenolic contents (113.8 ± 2.0 mg flavonoids/g dry extract and gallic acid/g dry extract) were assigned a higher antioxidant activity calculated by ferric-decreasing antioxidant properties DPPH and FRAP assays. The lowest antioxidant activity, on the other hand, was produced from herbal extracts dried in a laboratory furnace (EC50 = 0.033 ± 0.001 mg/mL and 1.13 ± 0.11 m/mol Fe2+/mg dry extract)[62,63]. This illustrates the significance of the procedure through which the plant is dried even before extracts are prepared. In several laboratory test regimes, including DPPH root scavenging system, hydrogen peroxide scavenging system, linoleic acid type, Fe2 + chelating ability, and nitric oxide root scavenging system, this plant's aqueous alcoholic extract has shown strong antioxidant activity.[64] The antioxidant function the extract of M.longifolia was investigated in another study using four different methods, including Power Reduction Assay , ABTS radical, FRAP, and DPPH. Compared to DPPH and FRAP, M.longifolia displayed the greatest behavior as an ABTS scavenger.[65] The high tissue antioxidant activity of several variants of M.longifolia native to Israel was shown to benefit in part from rosmarinic acid antioxidant activity (RA).[66,67]

6. CYTOTOXIC ACTIVITY

Using the Escherichia coli WP2 genotoxicity assay, 3 flavonoids, apigenin-7-O-rutinoside, apigenin-7-O-glucuronide, and apigenin-7-O-glucoside have been isolation from M.longifolia. And use the same genotoxicity assay, the anti-mutagenic and mutagenic characteristics of each flavonoid have been evaluated. Apigenin-7-O-rutinoside, apigenin-7-O-glucuronide, and apigenin-7-O-glucoside have been shown to have important mutagenic antimutagenic activity toward 2-AF and N-methyl-N-nitro-N'nitrosoguanidine. Dose-dependent responses has been between 59.0% (apigenin-7-O-rutinoside without S9-2.0 µM/plate) and 25.3% (apigenin-7-O-glucoside with S9-2.0 µM/plate) and 59.0% (apigenin-7-O-rutinoside without S9-2.0 µM/plate) of inactivation rates.

Apigenin derivatives at tested concentrations may be considered genetically stable since they have not demonstrated mutagenic activity.[68] Cell lines for breast cancer (MCF-7) and prostate cancer (LNCaP) were tested for the cytotoxicity of M.longifolia essential oil with seasonal variation using the MTT assay. For the summer and winter samples, the cytotoxicity of the natural products toward MCF-7 was 45.2 and 50.6 µg/mL IC50, respectively, the LNCaP-compared IC50 values were 43.5 and 52.0 µg/mL, respectively.[69] The highest TA1537 strain activation rates for luteolin 7-O-rutinoside, luteolin 7-O-glucuronide and luteolin 7-O-glucuronide and luteolin 7-O-glucuronide and luteolin 7-O-glucuronide were 87.63%, 67.77% and 84.03%, respectively, were found in another study to evalution the mutagenic and anti-mutagenic activity of M.longifolia-isolated luteolin derivatives (luteolin 7-O-rutinoside, luteolin 7-O-glucuronide and luteolin 7-O-glucuronide) using the Ames Salmonella test (TA 1535 and TA1537 strains). During the antimutagenicity tests conducted with the TA1535 strain, rates of inhibition for luteolin 7-O-rutinoside and luteolin 7-O-glucoside were 23.76 percent and 23.86 percent, respectively.[70]

In the eukaryotic cell system of S.cerevisiae RS112e, The potential antimutagenicity of apigenin 7-O-rutinoside (A7R) against acridine (AC) and ethyl methane sulfonate (EMS) mutagens has been investigated. The findings showed that A7R had varying levels of inhibition toward EMS and AC-produced mutations. The characteristics of A7R are therefore of pharmacological excesses value and may be helpful in reducing risk of disease associated with ROS.[71] additional study looked at the mutagenic

and antimutagenic properties of RA, M.longifolia contains a phenolic compounds, investigated the potential antimutagenic ability of RA towar EMS and AC in S.cerevisiae RS112. In the highest concentrations used, a mutagenic effect was demonstrated by only one concentration of RA. Lower RA concentrations substantially subdued mutations caused by EMS and AC. The highest inhibition concentrations ranged from 10 per cent (4 μM/mL concentration in DEL events induced by EMS) to 63.3 per cent (2 μM/mL concentration in DEL events induced by AC) in the yeast DEL assay.[72]

7. NUTRITIONAL USAGE

In Iraq, Mentha longifolia leaves are broadly used as a folk remedy for relief of several cases Sore throats, mild mouth-throat pain, aches, sprains, and nasal decongestants are all things that nasal decongestants can help with. as well as stomach problems, and intestinal disorder [73]. They are also used for nutritional purposes and consumed as a green vegetables or food additive whilst the dry or fresh leaves of this plant are added to the tea as a flavor. Furthermore, it has been reported that Mentha longifolia and its phytochemicals have pharmacological properties, and biological activities [74].

The Van Herby Cheese is fermented dairy products that include local herb members in Turkey eastern. Among herbs present in the cheese, M.longifolia had greatest concentration of 1.69 mg/kg. [75] One research investigated the effects of 0, 50, 150 and 300 ppm concentrations of M.longifolia essential oil and *Lactobacillus casei* (108-109 CFU/mL) on growth of *L.monocytogenes* and *S.aureus* during the manufacture, maturation and storage of Iranian white-brined cheese. In normal cheese processing and storage conditions, pathogen production the ethylene oxide was importantly reduced ($P < 0.01$) by both (EO) 50ppm concentration and probiotic concentration and their blend. In addition, medication containing 150 ppm of this EO in combination with probiotics had a beneficial the growth-inhibiting properties of various Pathogenic micro-organisms were among the most important effective sensory assessment therapy.[76] It has also been shown that M.longifolia essential oil has a relationship with L.casei's Viability and cellular ultrastructure during probiotic Feta cheese ripening and storage. At concentrations ranging from 0.0 percent to 0.03 percent, the essential oil was tested: the 0.03 percent the procedure resulted with highest viability and lowest pH of *L.casei* compared to other managements ($P < 0.05$). Electron microscopy revealed that *L.case* did not suffer any harm from the essential oil. These data show that M.longifolia has a positive impact on the better maintenance of *L.case* at the end of the cheese storage periods.[77]

8. CONCLUSION

This review discusses the chemical components of its antimicrobial and antioxidant properties, as well as its use in alternative therapies in various parts of the world

The plant's essential oils as well as other chemical substances, like roots, leaves, and flowers, are natural remedies that were used in a wide range of applications in medication, cosmetic, agriculture, and bioavailability.

Peppermint longifolia has a broad spectrum of antibacterial properties toward bacteria, yeasts, insects, and other pathogens. The antimicrobial activity of the essential oil is greater than that of the aqueous-alcoholic extract. It also has anti-inflammatory and carminative properties. It has been established that the plant is not entirely risk-free. Even at the lowest doses, M. longifolia can increase liver function in rats. The two most dangerous compounds found in the plant were pulegone and menthone .

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10. References

1. Krzyzanowska J, Janda B, Pecio L, Stochmal A, Oleszek W, Czubacka A. Determination of polyphenols in Mentha longifolia and M. piperita field-grown and in vitro plant samples using UPLC-TQ-MS. Journal of AOAC International. 2011;94(1):43-50
2. Gulluce, Medine, et al. "Antimicrobial and antioxidant properties of the essential oils and methanol extract from Mentha longifolia L. ssp. longifolia." Food chemistry 103.4 (2007): 1449-1456.
3. Stamenkovic V. Revised and Expanded. 2nd ed. Leskovac: NIGP Trend; 2005.
4. Naghibi F, Mosaddegh M, Motamed SM, Ghorbani A. Labiatae family in folk medicine in Iran: From ethnobotany to pharmacology. Iran J Pharm Res.;4:63–79 (2005).
5. Mkaddem M, Bouajila J, Ennajar M, Lebrihi A, Mathieu F, Romdhane M. Chemical composition and antimicrobial and antioxidant activities of Mentha (longifolia L. and viridis) essential oils. J Food Sci. 2009;74:M358–63.
6. Patil, Maheshkumar Prakash, et al. "Antibacterial potential of silver nanoparticles synthesized using Madhuca longifolia flower extract as a green resource." Microbial pathogenesis 121 (2018): 184-189.
7. Al-Bayati, Firas A. "Isolation and identification of antimicrobial compound from Mentha longifolia L. leaves grown wild in Iraq." Annals

of clinical microbiology and antimicrobials 8.1 (2009): 1-6.
8. Hajlaoui H, Snoussi M, Ben Jannet H, Mighri Z, Bakhrouf A. Comparison of chemical composition and antimicrobial activities of Mentha longifolia L. ssp. longifolia essential oil from two Tunisian localities (Gabes and Sidi Bouzid) Ann Microbiol. 2008;58:513–20.
9. Farzaei, Mohammad Hosein, et al. "Pharmacological activity of Mentha longifolia and its phytoconstituents." Journal of Traditional Chinese Medicine 37.5 (2017): 710-720.
10. Patil, Maheshkumar Prakash, et al. "Antibacterial potential of silver nanoparticles synthesized using Madhuca longifolia flower extract as a green resource." Microbial pathogenesis 121 (2018): 184-189.
11. López, Víctor, et al. "Neuroprotective and neurochemical properties of mint extracts." Phytotherapy Research 24.6 (2010): 869-874.
12. Abdel-Gwad, N. M., Mahmoud, E. A. M., Al-Askalany, S. A., & Hanafy, E. A. (2021). Antioxidant, antibacterial and cytotoxic effect of Cymbopogon citratus, Mentha longifolia, and Artemisia absinthium essential oils. Egyptian Journal of Chemistry.
13. Pérez Raya MD, Utrilla MP, Navarro MC, Jiménez J. CNS activity of Mentha rotundifolia and Mentha longifolia essential oil in mice and rats. Phytother Res., 4:232–4 (1990).
14. Mimica-Dukiç N, Jakovljeviç V, Mira P, Gasiç O, Zabo A. Pharmacological study of Mentha longifolia phenolic extracts. Pharm Biol., 34:359–64 (1996).
15. Ahmed, S. M., Mohamed, S. A. E. M., El-Sadat, N. H., & Youssef, S. S. (2021). Comparison between the field plants and their micropropagated plants of four Mentha spp. using molecular markers and phytochemical analyses. Egyptian Journal of Chemistry..
16. Khan SW, Khatoon S. Ethnobotanical studies on some useful herbs of Haramosh and Bugrote valleys in Gilbit, Northern areas of Pakistan. Pak J Bot., 40:43–58 (2008).
17. Hussain K, Shahazad A, Zia-ul-Hussnain S. An ethnobotanical survey of important wild medicinal plants of Hattar District Haripur, Pakistan. Ethnobotanical Lealf., 12:29–35 (2008).
18. Shah, Abdul Jabbar, et al. "Calcium channel blocking activity of Mentha longifolia L. explains its medicinal use in diarrhoea and gut spasm." Phytotherapy Research 24.9 (2010): 1392-1397.
19. Shah AJ, Bhulani NN, Khan SH, Ur Rehman N, Gilani AH. Calcium channel blocking activity of Mentha longifolia L. explains its medicinal use in diarrhoea and gut spasm. Phytother Res., 24:1392–7 (2010).
20. Naseri MK, Naseri ZG, Mohammadian M, Birgani MO. Ileal relaxation induced by Mentha longifolia (L.) leaf extract in rat. Pak J Biol Sci., 11:1594–9 (2008).
21. Sousa, P. J. C., et al. "Effects of piperitenone oxide on the intestinal smooth muscle of the guinea pig." Brazilian Journal of Medical and Biological Research 30 (1997): 787-791.
22. Sousa PJ, Magalhães PJ, Lima CC, Oliveira VS, Leal-Cardoso JH. Effects of piperitenone oxide on the intestinal smooth muscle of the guinea pig. Braz J Med Biol Res., 30:787–91 (1997).
23. Hussain AI, Anwar F, Nigam PS, Ashraf M, Gilani AH. Seasonal variation in content, chemical composition and antimicrobial and cytotoxic activities of essential oils from four Mentha species. J Sci Food Agric., 90:1827–36 (2010).
24. Karaman I, Sahin F, Güllüce M, Ogütçü H, Sengül M, Adigüzel A. Antimicrobial activity of aqueous and methanol extracts of Juniperus oxycedrus L. J Ethnopharmacol., 85:231–5 (2003).
25. Kitic D, Jovanovic T, Ristic M, Palic R, Stojanovic G. Chemical composition and antimicrobial activity of the essential oil of Calamintha nepeta (L.) Savi ssp. glandulosa (Req.) P.W. Ball from Montenegro. J Essent Oil Res., 14:150–2 (2002).
26. Sahin F, Karaman I, Güllüce M, Ogütçü H, Sengül M, Adigüzel A, et al. Evaluation of antimicrobial activities of Satureja hortensis L. J Ethnopharmacol., 87:61–5 (2003).
27. Hafedh H, Fethi BA, Mejdi S, Emira N, Amina B. Effect of Mentha longifolia L. ssp longifolia essential oil on the morphology of four pathogenic bacteria visualized by atomic force microscopy. Afr J Microbiol Res., 4:1122–7 (2010).
28. Hajlaoui H, Trabelsi N, Noumi E, Snoussi M, Fallah H, Ksouri R, et al. Biological activities of the essential oils and methanol extract of tow cultivated mint species (Mentha longifolia and Mentha pulegium) used in the Tunisian folkloric medicine. World J Microbiol Biotechnol., 25:2227–38 (2009).
29. Khattak S, Rehman SU, Khan T, Shah HU, Shad AA, Ahmad M. In vitro screening for biological pharmacological effects of indigenous medicinal plants, Mentha longifolia and Aloe vera. J Chem Soc Pak., 26:248–51 (2004).
30. Sevindik, Mustafa, et al. "Determination of therapeutic potential of Mentha longifolia ssp. longifolia." Fresen Environ Bull 26.7 (2017): 4757-4763.

31. El-Badry AA, Al-Ali KH, El-Badry YA. Activity of Mentha longifolia and Ocimum basilicum against Entamoeba histolytica and Giardia duodenalis. Sci Parasitol., 11:109–17 (2010).
32. Mann CM, Cox SD, Markham JL. The outer membrane of Pseudomonas aeruginosa NCTC 6749 contributes to its tolerance to the essential oil of Melaleuca alternifolia (tea tree oil) Lett Appl Microbiol., 30:294–7 (2000).
33. Cosentino S, Tuberoso CI, Pisano B, Satta M, Mascia V, Arzedi E, et al. In-vitro antimicrobial activity and chemical composition of sardinian thymus essential oils. Lett Appl Microbiol., 29:130–5 (1999).
34. Al-Younis NK, Argushy ZM. Antibacterial evaluation of some medicinal plants from Kurdistan region. J Duhok Univ., 12:256–61 (2009).
35. Akroum S, Bendjeddou D, Dand S, Lalaoui K. Antibacterial activity and acute toxicity effect of flavonoids extracted from Mentha longifolia. Am Eurasian J Sci Res., 4:93–6 (2009).
36. Matsuda H, Morikawa T, Ando S, Toguchida I, Yoshikawa M. Structural requirements of flavonoids for nitric oxide production inhibitory activity and mechanism of action. Bioorg Med Chem., 11:1995–2000 (2003).
37. Miyazawa M, Hisama M. Antimutagenic activity of flavonoids from Chrysanthemum morifolium. Biosci Biotechnol Biochem., 67:2091–9 (2003).
38. Xiao M, Shao YD, Yan WD, Zhang ZZ. Measurement and correlation of solubilities of apigenin and apigenin7-O-rhamnosylglucoside in seven solvents at different temperatures. J Chem Thermodyn., 43:240–3 (2011).
39. Sarac N, Ugur A. Antimicrobial activities and usage in folkloric medicine of some Lamiaceae species growing in Mugla, Turkey. Eurasian J Bio Sci., 4:28–37 (2007).
40. Yigit D, Yigit N, Ozgen U. An investigation on the anticandidal activity of some traditional medicinal plants in Turkey. Mycoses., 52:135–40 (2009).
41. Gursoy N, Sihoglu-Tepe A, Tepe B. Determination of in vitro antioxidative and antimicrobial properties and total phenolic contents of Ziziphora clinopodioides, Cyclotrichium niveum, and Mentha longifolia ssp. typhoides var. typhoides. J Med Food., 12:684–9 (2009).
42. Snoussi M, Hajlaoui H, Noumi E, Usai D, Sechi LA, Zanetti S, Bakhrouf A. In vitro anti-Vibrio spp. activity and chemical composition of some Tunisian aromatic plants. World J Microbiol Biotechnol., 24:3071–6 (2008).
43. Shahverdi AR, Rafii F, Tavassoli F, Bagheri M, Attar F, Ghahraman A. Piperitone from Mentha longifolia var. chorodictya Rech F. reduces the nitrofurantoin resistance of strains of enterobacteriaceae. Phytother Res., 18:911–4 (2004).
44. Lang G, Buchbauer G. A review on recent research results (2008-2010) on essential oils as antimicrobials and antifungals. A review. Flavour Fragr J., 27:13–39 (2011).
45. Pajohi MR, Tajik H, Farshid AA, Basti AA, Hadian M. Effects of Mentha longifolia L. essential oil and nisin alone and in combination on Bacillus cereus and Bacillus subtilis in a food model and bacterial ultrastructural changes. Foodborne Pathog Dis., 8:283–90 (2011).
46. Kozan E, Küpeli E, Yesilada E. Evaluation of some plants used in Turkish folk medicine against parasitic infections for their in vivo anthelmintic activity. J Ethnopharmacol., 108:211–6 (2006).
47. Abou-Jawdah Y, Sobh H, Salameh A. Antimycotic activities of selected plant flora, growing wild in Lebanon, against phytopathogenic fungi. J Agric Food Chem., 50:3208–13 (2002).
48. Cordero C, Zebelo SA, Gnavi G, Griglione A, Bicchi C, Maffei ME, et al. HS-SPME-GC×GC-qMS volatile metabolite profiling of Chrysolina herbacea frass and Mentha spp. leaves. Anal Bioanal Chem., 402:1941–52 (2012).
49. Odeyemi OO, Masika P, Afolayan AJ. Insecticidal activities of essential oil from the leaves of Mentha longifolia L. subsp. capensis against Sitophilus zeamais (Motschulsky) (Coleoptera: Curculionidae) Afr Entomol., 16:220–5 (2008).
50. Kumar A, Shukla R, Singh P, Singh AK, Dubey NK. Use of essential oil from Mentha arvensis L. to control storage moulds and insects in stored chickpea. J Sci Food Agric., 89:2643–9 (2009).
51. Pascual-Villalobos MJ, Robledo A. Screening for anti-insect activity in Mediterranean plants. Ind Crops Prod., 8:183–94 (1998).
52. Cetin H, Cinbilgel I, Yanikoglu A, Gokceoglu M. Larvicidal activity of some Labiatae (Lamiaceae) plant extracts from Turkey. Phytother Res., 20:1088–90 (2006).
53. Saljoqi AU, Afridi MK, Khan SA, Rehman S. Effects of six plant extracts on rice weevil Sitophilus oryzae L. in the stored wheat grains. J Agric Biol Sci., 1:1–5 (2006).
54. Sousa PJ, Magalhães PJ, Lima CC, Oliveira VS, Leal-Cardoso JH. Effects of piperitenone oxide on the intestinal smooth muscle of the guinea pig. Braz J Med Biol Res., 30:787–91 (1997).
55. Stanfill SB, Calafat AM, Brown CR, Polzin GM, Chiang JM, Watson CH, et al. Concentrations of nine alkenylbenzenes,

coumarin, piperonal and pulegone in Indian bidi cigarette tobacco. Food Chem Toxicol., 41:303–17 (2003).
56. Nagy M, Krizková L, Mucaji P, Kontseková Z, Sersen F, Krajcovic J. Antimutagenic activity and radical scavenging activity of water infusions and phenolics from ligustrum plants leaves. Molecules., 14:509–18 (2009).
57. Romanová D, Vachálková A, Cipák L, Ovesná Z, Rauko P. Study of antioxidant effect of apigenin, luteolin and quercetin by DNA protective method. Neoplasma., 48:104–7 (2001).
58. Baris O, Karadayi M, Yanmis D, Guvenalp Z, Bal T, Gulluce M. Isolation of 3 flavonoids from Mentha longifolia (L.) Hudson subsp. longifolia and determination of their genotoxic potentials by using the E. coli WP2 test system. J Food Sci., 76:T212–7 (2011).
59. Ahmad N, Fazal H, Ahmad I, Abbasi BH. Free radical scavenging (DPPH) potential in nine Mentha species. Toxicol Ind Health., 28:83–9 (2012).
60. Berselli PV, Zava S, Montorfano G, Corsetto PA, Krzyzanowska J, Oleszek W, et al. A mint purified extract protects human keratinocytes from short-term, chemically induced oxidative stress. J Agric Food Chem., 58:11428–34 (2010).
61. Saljoqi AU, Afridi MK, Khan SA, Rehman S. Effects of six plant extracts on rice weevil Sitophilus oryzae L. in the stored wheat grains. J Agric Biol Sci. 2006;1:1–5.
62. Stanisavljevic DM, Stojicevic SS, Đorcevic SM, Zlatkovic BP, Veličkovic DT, Karabegovic IT, et al. Antioxidant activity, the content of total phenols and flavonoids in the ethanol extracts of Mentha longifolia (l.) Hudson dried by the use of different techniques. Chem Ind Chem Eng Q., 18:411–20 (2012).
63. Khan FA, Khan A, Hussain J, Khattak MR, Shah SM, Hassan M. Assessment of antioxidant and antibacterial activities of Mentha longifolia. J Pharm Res., 4:2338–9 (2011).
64. Ebrahimzadeh MA, Nabavi SM, Nabavi SF. Antioxidant and antihemolytic activities of Mentha longifolia. Pharmacologyonline. 2010;2:464–71.
65. Raj JX, Bajpjpai PK, Kumar PG, Murugan PM, Kumar J, Chaurasia OP, et al. Determination of total phenols, free radical scavenging and antibacterial activities of Mentha longifolia Linn. Hudson from the cold desert, Ladakh, India. Pharmacogn J., 2:470–5 (2010).
66. Dudai N, Segey D, Haykin-Frenkel D, Eshel A. Genetic variation of phenolic compounds content essential oil composition and antioxidative activity in Israel-grown Mentha longifolia L. ISHS Acta Hortic., 709:69–78 (2006).
67. Odeyemi OO, Yakubu MT, Masika PJ, Afolayan AJ. Toxicological evaluation of the essential oil from Mentha longifolia L. subsp. capensis leaves in rats. J Med Food., 12:669–74 (2009).
68. Baris, Ozlem, et al. "Isolation of 3 flavonoids from Mentha longifolia (L.) Hudson subsp. longifolia and determination of their genotoxic potentials by using the E. coli WP2 test system." Journal of food science 76.9 (2011): T212-T217..
69. Asekun OT, Grierson DS, Afolayan AJ. Effects of drying methods on the quality and quantity of the essential oil of Mentha longifolia L. subsp. Capensis. Food Chem., 101:995–8 (2007).
70. Orhan F, Baris Ö, Yanmis D, Bal T, Güvenalp Z, Güllüce M. Isolation of some luteolin derivatives from Mentha longifolia (L.) Hudson subsp. longifolia and determination of their genotoxic potencies. Food Chem., 135:764–9 (2012).
71. Al-Bayati FA. Isolation and identification of antimicrobial compound from Mentha longifolia L. leaves grown wild in Iraq. Ann Clin Microbiol Antimicrob, 8: 20 (2009).
72. Farzaei, H.M., Bahramsoltani, R., Farzaei, F., Najafi, F. Pharmacological activity of Mentha longifolia and its phytoconstituents. Journal of Traditional Chinese Medicine; 37(5): 710-720 (2017).
73. Gulluce M, Orhan F, Adiguzel A, Bal T, Guvenalp Z, Dermirezer LO. Determination of antimutagenic properties of apigenin-7-O-rutinoside, a flavonoid isolated from Mentha longifolia (L.) Huds. ssp. longifolia with yeast DEL assay. Toxicol Ind Health., 29:534–40 (2013).
74. Gulluce M, Yanmis D, Orhan F, Bal T, Karadayi M, ªahin F. Determination of antimutagenic properties of rosmarinic acid, a phenolic compound isolated from Mentha longifolia ssp. longifolia with yeast DEL assay. Microbes Appl Res., 107:526–30 (2011).
75. Tuncturk M, Tuncturk R, Sekeroglu N, Ertus MM, Ozgokce F. Lead concentrations of herbs used in Van Herby cheese. Nat Prod Commun., 6:1473–4 (2011).
76. Ehsani A, Mahmoudi R. Effects of Mentha longifolia L. essential oil and Lactobacillus casei on the organoleptic properties and on the growth of Staphylococcus aureus and Listeria monocytogenes during manufacturing, ripening and storage of Iranian white-brined cheese. Int J Dairy Technol., 66:70–6 (2012).
77. Mahmoudi R, Tajik H, Ehsani A, Farshid AA, Zare P, Hadian M. Effects of Mentha longifolia L. essential oil on viability and cellular

ultrastructure of Lactobacillus casei during ripening of probiotic Feta cheese. Int J Dairy Technol., 66:77–82 (2012).
78. Silva dos Santos, Jessica, et al. "The Pharmacological Action of Kaempferol in Central Nervous System Diseases: A Review." Frontiers in Pharmacology 11 (2021): 2143.
79. Ghoulami S, Il Idrissi A, Fkih-Tetouani S. Phytochemical study of Mentha longifolia of Morocco. Fitoterapia., 72:596–8 (2001).
80. Rasooli I, Rezaei MB. Bioactivity and chemical properties of essential oils from Zataria multiflora Boiss and Mentha longifolia (L.) Huds. J Essent Oil Res., 14:141–6 (2002).
81. Santos FA, Rao VS. Antiinflammatory and antinociceptive effects of 1,8-cineole a terpenoid oxide present in many plant essential oils. Phytother Res., 14:240–4 (2000).
82. Galeotti N, Di Cesare Mannelli L, Mazzanti G, Bartolini A, Ghelardini C. Menthol: A natural analgesic compound. Neurosci Lett., 322:145–8 (2002).
83. Yassin, M. T., Mostafa, A. A., & Al-Askar, A. A. (2020). Anticandidal and anti-carcinogenic activities of Mentha longifolia (Wild Mint) extracts in vitro. Journal of King Saud University-Science, 32(3), 2046-2052.
84. Sohrab, Sayed Sartaj, and Ihsanullah Daur. "Identification of a monopartite begomovirus associated with yellow vein mosaic of Mentha longifolia in Saudi Arabia." 3 Biotech 8.2 (2018): 1-8.