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Review Article

A Review on Comparative studies on Chemical Composition and Biological Properties of *Mentha piperita* L with Special Reference to Kurdistan, Iraq

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Abstract

People have been using plants in treating various diseases and obtaining successful results since old ages. Most of these plants have become natural medicines as a result of coincidences or curious practices. Different treatments by using different plants have been carried out and proven to be healing and plants have become significant and popular among people in a short period. Medicinal plants still play an important role in the Kurdish community. Iraq is home to a rich variety of plant species, including many with medicinal properties. However, only a limited number of fragmented ethnobotanical investigations focusing on the Kurdistan region have been documented in scientific publications. Therefore, exploring Kurdish ethnobotanical traditions is essential for gaining insight into local uses of medicinal plants and how these practices relate to those in neighboring regions. Among several plants, *Mentha piperita* L. (*M. piperita*, Peppermint) is one of the herbs most widely used in Iraq, with a long history of safe use in medicinal preparations. *M. piperita* is a medicinal plant that has received more attention from both food and pharmaceutical industries because of its health benefits for human society. *M. piperita* leaf is used as a remedy for common cold, inflammation of the mouth, pharynx, liver, as well as disorders in the gastrointestinal tract such as nausea, vomiting, diarrhea, cramps, flatulence and dyspepsia. Peppermint oil has the most uses, and use data on the oil are considered relevant to the leaf extract formulations as well. This herbal preparation is used in cosmeceuticals, personal hygiene products, foods, and pharmaceutical products for both its flavoring and fragrance properties. It also has a variety of therapeutic properties and is used in aromatherapy, bath preparations, mouthwashes, toothpastes, and topical preparations. The aim of this review is to show that several studies have demonstrated the presence of many different chemical compounds in *M. piperita* and their pharmacological effects in Iraq. Furthermore, we may say that *M. piperita* is a promising plant that may offer low-cost alternative strategy for the use in medicine and in food industry in Iraq.

Keywords: Medicinal plants, *Mentha piperita,* Peppermint, Iraq, Cosmeceuticals, Polyphenols

Introduction

Medicinal plants have received more attention because of their health benefits and Medicinal plants have long been used in traditional healing systems across the globe to manage a wide range of diseases and health conditions[1], and they continue to hold significant value in global commerce today[2]. The phrase "medicinal plants" typically refers to natural therapeutic agents, and their use is on the rise due to their widespread availability and cost-effectiveness, making them a vital option for delivering primary healthcare, especially in resource-limited settings[3].These medicinal plants can be considered as a valuable source of ingredients which can be used in drug development and pharmacological research [4-7]. On the other hand, medical plants significantly affected the human life across the entire world [4, 8-10]. The use of herbal medicine is leading modality, followed in Middle East, Europe and certain other advance countries, in order to treat of catastrophic human diseases [11]. Based on the WHO reports, the advanced countries have used medicinal plant for both clinical therapy and food industries significantly [11, 12]. Medicinal plants have significant potentials for human societies and consumed by people across the entire world. Although most of their health benefits have not investigated yet, their medical activities can be considered in the treatment of present or future diseases [8]. Currently, more than 80% of the world population uses the traditional medicine and medicinal plants (especially plant extracts and essential oils) for their primary health needs [13]. A wide range of nations across the globe, including Iraq [14–16], maintain distinctive traditional healing practices and frequently rely on indigenous remedies and folk medicine to address health issues. According to the WHO Traditional

Medicine (TM) Strategy 2014–2023, traditional healers, herbal therapies, and age-old treatment methods remain the primary—sometimes sole—source of healthcare for millions worldwide [3]. One of the main challenges in this field is evaluating these remedies and establishing systems to regulate and register them, ensuring their safety and effectiveness. Although the clinical, medicinal, and economic significance of traditional treatments is increasingly acknowledged, the level of recognition still differs considerably among nations [2]. In contemporary settings, medicinal plants are not only used in customary or regional healing practices but are also officially listed in pharmacopoeias as standardized medicinal products [17]. In many developing regions, however, traditional medical knowledge remains under-researched, underutilized, and poorly documented [18]. These ancient systems, often passed down orally through generations of traditional healers, face the threat of extinction due to a weakening transmission between older and younger generations [19–21]. Globally, it is estimated that 35,000 to 70,000 plant species serve medicinal purposes, with about 6,500 natives to Asia [22]. Iraq, owing to its ecological richness and climate diversity, hosts an abundance of wild plant species. The nation's heritage in traditional medicine dates back to ancient civilizations, beginning with the Sumerians (3000–1970 B.C.), followed by the Babylonians and Assyrians (1970–589 B.C.) [23]. Hopper and Field (1973) also documented several medicinal and useful plants from Iran and Iraq [24]. Iraq's wide-ranging habitats—from mountains and hills to valleys, plains, and lakes—support this botanical diversity. The rich cultural traditions and varied lifestyles in Iraq have fostered a complex system of local healthcare that relies heavily on the empirical knowledge and individualized practices of traditional healers who utilize natural materials to diagnose and treat ailments.

The aim of this study was to compile chemical diversity, components and activity of *M. piperita* cultivated in Iraq region. Peppermint or mint (*M. piperita*), a perennial aromatic herb belonging to the *Lamiaceae* (*Labiatae*) family, is a natural hybrid between spearmint (*Mentha spicata* L.) and water mint (*Mentha aquatic* L.) [25, 26] is one of the important species of mint in Iraq. It is herbaceous and perennial considered as a medical and aromatic plant and were produced extensively for the medicinal and food product industries [27, 28]. Originally native to the Mediterranean region, this genus is now grown globally due to its wide-ranging applications in culinary flavoring, perfumery, traditional medicine, and pharmaceutical industries [29]. Members of the *M. piperita* genus are characterized by their volatile oils which are of great economic importance [30]. Generally, it is extensively cultivated in soils with high water holding capacity; it requires a daytime length of 15-16 Hrs [31, 32]. Its leaf is used as a remedy for common cold, inflammation of the mouth, pharynx, liver, as well as disorders in the gastrointestinal tract such as nausea, vomiting, diarrhea, cramps, flatulence and dyspepsia. It is also used as antioxidant, antimicrobial, antiviral, anti-inflammatory, and anti-carcinogenic [33-41]. *M. piperita* is the most well-liked flavor that is often used in tea and intended for flavoring chewing gum, toothpaste, ice cream, and confectionery. *M. piperita* can also be found in particular soaps, skin care products as well as shampoos. *M. piperita* leaves were found to be a good source of volatile oils (menthol, menthone, menthofuran, menthyl acetate, cineol, and limonene), phenolic acids (caffeic, chlorogenic and rosmarinic acid), flavonoids (menthoside, isorhoifolin, flavonones and luteolin), and tannins. Other reported constituents, azulene and minerals [42]. Peppermint oil is obtained from the leaves of the perennial herb, *M. piperita* is a colorless, pale green or pale-yellow liquid that has strong, penetrating odor and a pungent taste that is followed by a sensation of cold when air drawn into the mouth[32] and freely soluble in ethanol (70%). The solution may show opalescence [43]. The oil is found on the undersides of the leaves, is extracted by steam distillation and is generally followed by rectification and fractionation before use[44]. It is generally used to relieve or treat symptoms such as nausea, vomiting, morning sickness, anorexia, abdominal pain, indigestion, and flatulence. Skin preparations having peppermint oil are used for treatment of headache, toothache, muscle pain, nerve pain, joint conditions, allergic rash, pruritus and repelling of mosquitos[45]. *M. piperita* leaf, as well as *M. piperita* oil commonly have been employed internally (upper-gastrointestinal tract and bile ducts) to relieve diarrhea, irritable bowel syndrome, crohns disease, and ulcerative colitis, catarrh of the respiratory tract, and inflammation of the oral mucosa[46]. Or it is further used as a flavoring agent in cosmetic and pharmaceutical industries throughout the world. It primarily consists of menthol and menthone, along with several lesser components such as pulegone, menthofuran, and limonene. The chemical profile of this plant can differ depending on its growth stage, geographic origin, and methods of processing [47-49]. Naturally, menthol appears as a colorless crystalline substance or powder and is mainly responsible for the antispasmodic properties of peppermint[50-51]. Research has shown that menthol promotes bile secretion, lowers esophageal sphincter pressure aiding in belching, and exhibits antibacterial effects [52-54]. Globally, India stands as the leading producer, exporter, and consumer of mint oil, while China has become one of its primary importers [55-57].

Nomenclature, botany and cultivation

M. piperita was first described in 1753 by Carl Linnaeus from specimens that had been collected in England; he treated it as a species [58], but it is now universally agreed to be a hybrid[59]. *M. piperita* **is** known by over 101 distinct local names across various countries (Table 1), reflecting its widespread recognition [60–62]. The naming conventions for mint are typically influenced by the cultural traditions and linguistic practices of each region. The species *Mentha piperita* is the most commonly used scientific designation for peppermint[63]. The genus *Mentha* includes 25 to 30 species[64] include *Mentha arvensis* (Japanese Peppermint), *M. asiatica* (asian mint), *M. australis* (Australian mint), *M. cervina*

(Hart's Pennyroyal), *M. citrato* (bergamot mint), *M. crispata* (wrinkled leaf mint), *Mentha aquatica* (commonly known as water mint), *Mentha laxiflora* (forest mint), *Mentha longifolia* or *Mentha sylvestris* (horse mint), *Mentha pulegium* (pennyroyal), *Mentha requienii* (Corsican mint), *Mentha sachalinensis* (garden mint), *Mentha satureioides* (native pennyroyal), *Mentha spicata* or *Mentha cordifolia* (spearmint), *Mentha suaveolens* (apple mint), and *Mentha vagans* (gray mint) represent notable species within the *Mentha* genus. Among the hybrids, the most significant is *Mentha piperita* (peppermint), which is a natural cross between *Mentha aquatica* (water mint) and *Mentha spicata* (spearmint), as well as the variety known as ginger *M.gracilis* a cross between *M. arvensis* and *M.spicata* (spearmint)[65,66]. It is an herbaceous rhizomatous perennial plant that grows to be 30-90 cm (12-35 in) tall, with smooth stems, square in cross section. The rhizomes are wide-spreading, fleshy and bear fibrous roots. The leaves can be 4-9 cm (1.6-3.5 in) long and 1.5-4 cm (0.59-1.57 in) broad. They are dark green with reddish veins and they have an acute apex and coarsely toothed margins. The leaves and stems are usually slightly fuzzy. The flowers are purple, 6-8 mm (0.24-0.31 in) long, with a four-lobed corolla about 5 mm (0.20 in) diameter; they are produced in whorls (verticillasters) around the stem, forming thick, blunt spikes. Flowering season lasts from mid- to late summer. The chromosome number is variable, with 2n counts of 66, 72, 84, and 120 recorded [67-69]. *M. piperita* is a fast-growing plant; once it sprouts, it spreads very quickly. The most commercially and medicinally significant mint species are outlined in Table 2. *Mentha piperita* thrives especially in soils that retain moisture well[62]. Since all commercially cultivated mint types are sterile and do not produce viable seeds, propagation is done through underground stolons (also known as runners or root segments) from mature plants [70]. However, these stolons have a limited storage life, as they are prone to quick degradation from heat or moisture loss [70]. Overall, mint plants are adaptable and capable of growing under diverse environmental conditions, including full sunlight exposure[71].

Table 1: The most plentiful local names of *Mentha piperita* around the world

Country	Local name
Iran	Nanafelfeli
Brazil	Nortela pimento
USA	Lab Mint, mint
Norway	Peppermynte
Poland	Pepparmunta
Spain	Mentainglesa
Portugal	Hortelana pimentosa
Swedish	Pepparmynt
China	Po Ho
India	Mint, Pudina, Pudyana, Puthina
Turkey	Nana
Russia	Myata perechnaya
Uruguay	Menta
French	Menthe
Iraq	Nana
Bogota	Yerba Beuna
Denmark	Pebermynte
Germany	Peppermint
England	Brandy Mint
Mexico	Menta piperita

Table 2: The list of the most plentiful mint species and their functions

Species	Usage
Mentha spicata L.	Medicine
Mentha suaveolens	Ornamental use
Mentha requienii Benth.	Ornamental use
Mentha pulegium L.	Medicine
Mentha citrata Ehrh	Medicine
Mentha longifolia L	Medicine, Commercial
Mentha cardiaca	Medicine
Mentha arvensis	Medicine
Mentha canadensis	Weed
Mentha flavouring	Ornamental use, Medicine
Mentha piperita L.	Medicine, Ornamental use, commercial

Phytochemicals

Irrespective of the plant species, the phytochemicals present in the various species of mentha are the same while their ratios may alter [65,66,72]. Differences in the chemical makeup of these plants can be attributed to several factors such as physiological traits, environmental influences, geographical location, and genetic diversity[73]. *M. piperita* plants contain over 40 distinct chemical compounds Fig. 1. *M. piperita* leaves were found to be a good source of volatile oils, The essential oil of peppermint is mostly made up of menthol, menthone, menthyl esters, 3-carene, carvone, *cis*-carane, *cis*pinane, isomenthone, limonene, caryophyllene, menthanol, Mentha piperita comprises a wide range of compounds, including myrcene and monoterpene-based derivatives such as pulegone, piperitone, menthofuran, trans-cinnamic acid, oleanolic acid, p-cymene, physcion, terpinolene, and ursolic acid. Additionally, it features constituents like α-pinene, β-pinene, cineole, jasmone, ledol, limonene, neomenthol, viridiflorol, and again, piperitone and pulegone. This plant is also rich in various terpenoids and flavonoids, including acacetin, chrysoeriol, diosmin, eriocitrin (eriodictyol-7-O-rutinoside), hesperidin, hesperidoside, isorhoifolin, linarin, luteolin, menthoside, kaempferol 7-O-rutinoside, methyl rosmarinate, rutin, tilianin, luteolin-7-O-rutinoside, 5,7-dihydroxychromone-7-O-rutinoside, narirutin, and nodifloretin.

The phenolic acids present are caffeic acid, cinamic acid, narigenin-7-oglucoside chlorogenic, lithospermic acid, rosmarinic acid, protocatechuic acid, protocatechuic aldehyde, phytosterols, eriodictyol glucopyranosyl-rhamnopyranoside, β-sitosterol and daucosterol; the anthraquinones aloe-emodin, chrysophanol, emodin, and tannins Fig. 1. Other reported constituents, azulene and minerals[42,65,72]. Various constituents of peppermint oil as per monographs of International Pharmacopoeia are limonene (1.0-5.0%), cineole (3.5-14.0%), menthone (14.0-32.0%), menthofuran (1.0 -9.0%), isomenthone (1.5-10.0%), menthyl acetate (2.8-10.0%), isopulegol (max. 0.2%), menthol (30.0-55.0%), pulegone (max. 4.0%) and carvone (max. 1.0%)[74].The essential oil contents and composition of *M. piperita* leaves shows variation in plants of different geographical origin. The chemical composition of the essential oil from *M. piperita* was analyzed by GC/FID and GCMS in different geographical locations are summarized in Table 3.

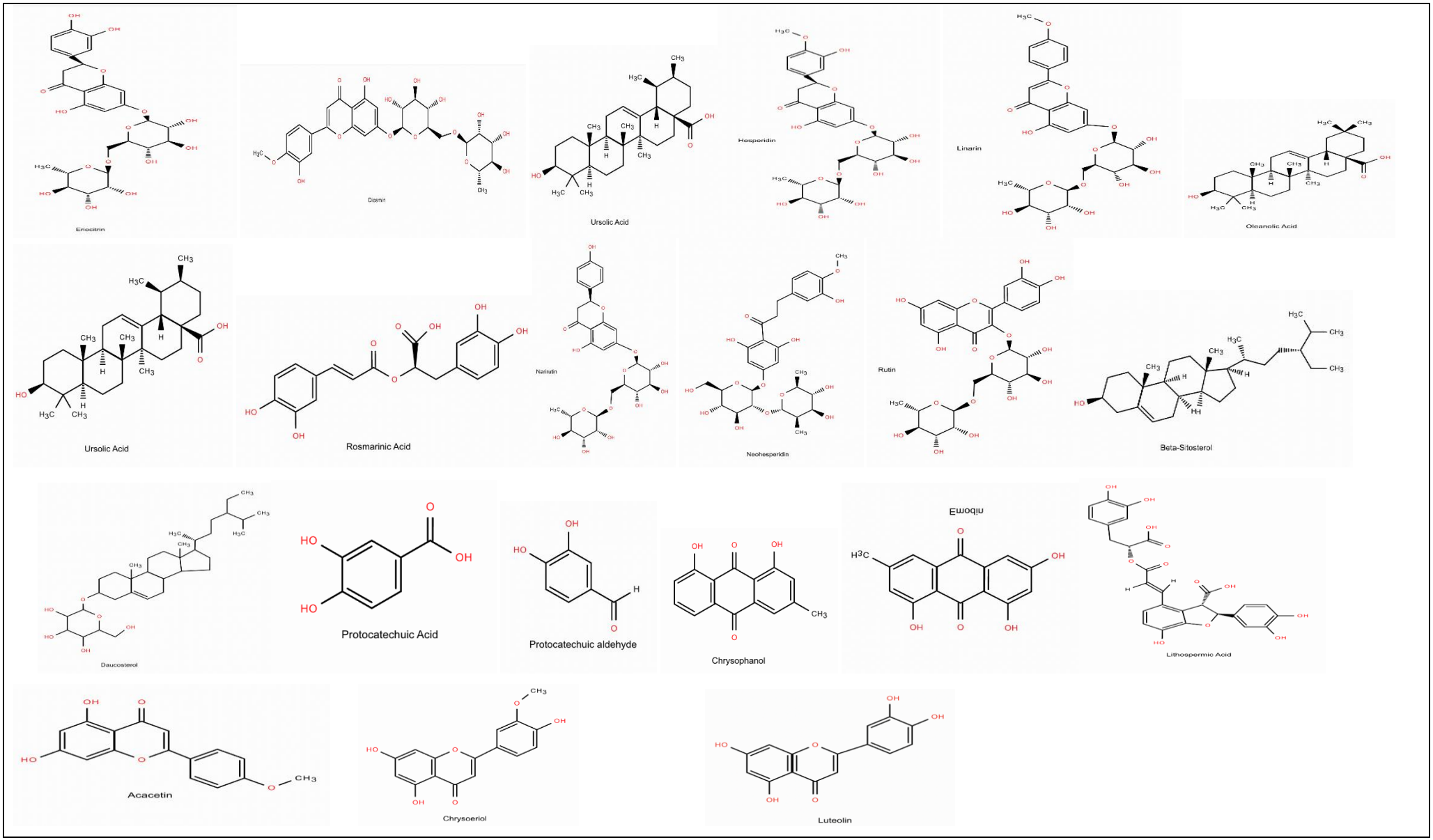

Figure 1: Chemical structure of some phytochemicals present in *M. piperita*

Table 3: Comparative chemical composition of *M. piperita* essential oil

Country	Major components	Ref.
Turkey	Menthone (44.1%), menthol (29.5%), menthyl acetate (3.8%) and menthofuran (0.9%);	75
	(+)-Menthol (38.06%), menthol (35.64%), neomenthol (6.73%) and cineole (3.62%).	76
Bulgarian	Menthol (35.2-46.2%) and menthone (8.7- 25.9%).	77
Morocco	Menthone (29.01%), menthol (5.58%), menthyl acetate (3.35%), menthofuran (3.01%), 1,8-cineole (2.4%), isomenthone (2.12%), limonene (2.1%), α-pinene (1.56%), germacrene-D (1.5%),β-pinene (1.25%), sabinene (1.13%), and pulegone (1.12%);	78
	Menthol (46.32%), menthofuran (13.18%), menthyl acetate (12.10%), menthone (7.42%), and 1,8-cineole (6.06%)	100
Korea	Linalyl acetate (28.2%), menthol (33.4%), 1,8-cineole (32.1%);	79
	Menthol (4.30%), caryophyllene (5.50%) and eucalyptol (62.16%).	90
Sudan	Menthone (47.38%), menthofuran (9.79%), menthol (8.58%), pulegone (7.92%), 1,8-cineole (5.29%), isomenthone (4.64%) and limonene (2.73%).	80
Brazil	Menthol (12-92.7%), mentone (2.2-56.9%), neomenthol (2.9-12.1%);	81
	Menthol (42.32%), menthyl acetate (35.01%), menthofuran (4.56%), menthone (4.05%) and 1,8 cineole (5.56%)	86
Taiwan	Menthol (30.35%), menthone (21.12%) and trans-carane (10.99%).	82
Iran	Menthol (38.33%), menthone (21.45%) and methyl acetate (12.49%);	83
	Menthol (36.9%), menthone (28.8%), methyl acetate (4.5%) carveone (3.8%), neomenthol (3.8%), 1,8-cineole (3.8%) and limonene (3.29%)	84
	Hydrodistillation method: menthol (45.34%), menthone (16.04%), menthofuran (8.91%), cis-carane (8.70%), 1,8-cineole (4.46%), neo-menthol (4.24%), and limonene (2.22%).	
	HS/SPME method: menthol (29.38%), menthone (16.88%), cis-carane (14.39%), menthofuran (11.38%), 1,8-cineole (9.45%), trans-caryophyllene (2.76%), neo-menthol (2.37%), β-Pinene (2.26%), α-Pinene (1.55%), germacrene-D (1.41%), trans-sabinene hydrate (1.28%), and neoisomenthyl acetate (1.02%).	110
Sudan (Khartoum North)	Menthone (57.7%), menthofuran (7.2%), 1,8- cineole (5.5%), isomenthone (3.8%), menthyl acetate (2.3%), Pulegone (1.7%) Isomenthol (1.5%) and limonene (1.6%).	85
England	Menthol (49.79%), menthone (19.08%), and menthyl acetate (5.08%).	87
Burkina Faso	Menthol (39.3%), menthone (25.2%), menthofuran (6.8%) and menthyl acetate (6.7%).	88
Serbia	Menthol (37.40%), menthyl acetate (17.37%), menthone (12.70%), and menthofuran (6.82%).	89
Colombia	Isomenthol (7.23%), Isomenthone (26.15%), pulegone (44.54%) and Chrysanthenone (8.07%).	91
Saudi Arabia	Menthol (36.02), menthone (24.56), menthyl acetate (8.95) and menthofuran (6.88%).	92
Egypt	Menthol (50.85%), menthone (20.50%), carvone (10.94%) and 1,8-cineole (6.87%);	93
	Menthol (37.62%), menthone (20.98%), carvone (11.76%), dihydro carveol acetate (11.23%), cineol (5.89%), β-caryophyllene (2.94), limonene (2.78%) and iso-menthone (2.39).	95
India	Menthol (58.80%), pulegone (6.62 %), isomenthne (6.42 %),menthyl acetate (3.94 %),	94
	Menthofuran (3.11 %),neomenthone (2.64 %), propylene glycol (13.27%), benzyl alcohol (7.95%), p- Menthone (28.33%), menthol (33.35%), naphthalene (7.43%).	98
Tunisia	Menthol (33.59%), iso-menthone (33.00%), limonene (8.00%), piperitone(3.20%),iso-pulegol(2.40%).	96

Ouargla (Algeria)	Carvone (51.04%), limonene (36.37%), β-Pinene (1.66%), Trans- dihydrocarvone (1.52%), β-myrcene(1.5%); Limonene oxide (23,3), followed by 7- Oxabicyclo[4,1,0]heptane,1-methyl-4-(methylethenyl)-(14,6), Cis-(-)-1,2-Epoxy-p-menth-8-ene (5,72), and Bicyclo[2.2.1] heptane-2,5-diol,1,7,7-trimethyl-,(2-endo,5-exo)-(4,04).	97 104
Romania	Plant: Menthone (25.4%), eucalyptol (17.7%) and menthol (12.1%; oil: (99.6%). Menthol (46.8%) and menthone (25.6%); Menthol (39.695%), menthone (15.742%), and isomenthone (7.735%), estragole (0.929%).	99 106
Sri Lanka	Menthol (41.2%), Menthone (24.3%), b-Caryophyllene (5.1%), Menthyl acetate (2.0%), Limonene (1.1%), a-Pinene (1.1%).	101
Pakistan	Menthone (28.13 and 25.54%), Menthyl acetate (9.51 and 9.68%), limonene (7.58 and 7.73%), isomenthone (4.04 and 7.63%), summer and winter, respectively; P-mentha-6, 8-dien-2-one (46.434%), *p*-menthan-3-ol (25.749%), borneol (8.865%), d-limonene (5.516%), 2-isopropylidenecyclohexanone (4.838%), 7-oxabicyclo [4.1.0] heptan-2-one-6-methyl-3-(1-methylethyl) (2.039%).	102 108
China	Menthol (30.69), menthone (14.51) and menthy acetate (12.86).	103
Isfahan province, Iran	Camphane (15.203%), menthone (12.013%), menthol (11.406%), β-Pinene (7.62%), pulegone (6.42%), β-Cubebene (4.95%), α-Pinene (4.012%), γ-Terpinene (4.081%), carane (3.82%) and piperiton (3.05%).	105
Montenegro	Menthol (33.15%), menthon (19.61%), 1,8 cineole (6.37%) and methyl acetate (5.63%).	107
Macapa, Brazil	inalool (51.8%), Sesquiphellandrene (9.4%), Cadinene (4%),*β*-Pinene (3.8%)and epoxyocimene (19.3%).	109
Uzbekistan	(C, %) Menthol (6,46),5-methyl-2-(1-methylpropyl) cyclohexanone (0,98), 3,7-dimethyl-2,6-octadien-1-ol (1,76)	111
Iraq	Alkaloids (0.12%), saponins (6%), simple phenolic acid (0.92%), flavonoids (2.2%)	112

M. piperita in traditional medicine

Mentha piperita is widely recognized for its efficacy in relieving digestive ailments and is a prominent remedy in traditional and folk medicine systems across Europe, China, Arabia, and the Indian subcontinent. Its leaves exhibit carminative properties and are employed in the management of various gastrointestinal disorders, including dyspepsia (such as spasmodic discomfort of the upper gastrointestinal tract), bacillary dysentery, flatulence, gastritis, and enteritis. Additionally, it functions as a cholagogue, emmenagogue, vermifuge, galactagogue (lactation enhancer), and mild sedative. The foliage is also therapeutically valuable in treating bronchitis, diabetes, diarrhea, fevers, hypertension, jaundice, nausea, pain, and infections of the respiratory and urinary tracts [65, 66].

Fresh or dried peppermint leaves are commonly consumed as herbal tea—either alone or blended with other botanicals in tisanes or infusions. Beyond its medicinal applications, *M. piperita* is extensively utilized as a flavoring agent in ice cream, confectioneries, fruit preserves, alcoholic drinks, chewing gum, toothpaste, as well as in select shampoos, soaps, and skincare formulations[113]. Peppermint oil is clinically applied for short-term management of irritable bowel syndrome and remains a traditional remedy for minor health conditions. When used topically, the oil provides a cooling sensation that alleviates muscle and nerve pain, soothes itching, and serves as a natural fragrance. However, high oral intake (around 500 mg) may lead to mucosal irritation and symptoms resembling heartburn[114–116].

These therapeutic uses are supported by scientifically validated studies.

Scientific studies have shown that *M. piperita* and its essential oil exerts its antispasmodic effects by inhibiting smooth muscle contractions, primarily through calcium channel blockade. This mechanism helps relax gastrointestinal smooth muscles by limiting calcium influx into cells. Menthol, the key active component, has been shown to exhibit antibacterial activity, promote bile secretion, lower esophageal sphincter tension, support belching, and function as a carminative agent. Additionally, *M. piperita* demonstrates neuromodulatory effects and potential to enhance physical performance. Its oil influences calcium-dependent mechanisms in intestinal, neural, and cardiac tissues. Furthermore, it alleviates motion sickness, stimulates bile production, and aids in digestion. Research findings suggest that *M. piperita* exhibits chemopreventive activity against oral cancers induced by shamma in hamster cheek pouch models and

lung tumors caused by benzo[a]pyrene in mice. Clinical trials also support its efficacy in treating a range of gastrointestinal conditions, particularly for managing irritable bowel syndrome and alleviating symptoms of digestive disorders such as dysentery, bloating, and gastritis [117].

Reported activity of *M. piperita in* Kurdistan region, Iraq

1. ***Sahib et al*** determined the probable anti-angiogenic activity of *Mentha piperita* leaves extracts. The *ex vivo* rat aorta ring assay was employed to screen activity; free radical scavenging ability was done by DPPH Assay. Both of these extracts of *Mentha piperita* leaves showed a significant dose dependent anti–angiogenesis action with IC_{50} of 22.126µg/ml for methanol extract and 30.608µg/ml for chloroform extract were compared to the DMSO data (negative control) ($P<0.001$). In addition, methanol and chloroform sample extracts revealed a significant scavenging activity for the free radical ($P<0.05$) with IC_{50} (3.51µg/ml and 3.7µg/ml) respectively [118].

2. ***Addai*** investigated the presences of phytochemicals, antibacterial and antioxidant activities of *Syzygium aromaticum, Mentha piperita, Cinnamomum verum, Pimpinella anisum* and *Zingiber purpurea*. The extracts were evaluated for antibacterial activity using the disc diffusion method, while antioxidant activities were measured using ferric reducing/antioxidant power (FRAP) and 2,2-diphenyl-1-picrylhydrazyl (DPPH) and phytochemical screening was performed using a standard method. *Syzygium aromaticum* fruit extract exhibited the most activity in the test antioxidants and antibacterial activity when compared with other medicinal plants. Phytochemical analysis revealed that alkaloids, flavonoids, triterpenoids, tannin, and carbohydrates were present in the extracts of all plants [119].

3. ***Adham*** evaluated quantitatively antimicrobial activity of *Mentha piperita, Mentha longifolia* and *Ocimum basilicum*, compare between them and to evaluate the type of interaction between them by microbroth dilution method and calculation of fractional inhibitory concentration. *Mentha piperita* demonstrated the lowest minimum inhibitory concentration (MIC), ranging from 1.5 to <0.1 mg/mL, followed by *Mentha longifolia* and *Ocimum basilicum*, both with MIC values ranging between 3 and <0.1 mg/mL. The corresponding minimum bactericidal concentration (MBC) values ranged from 6 to 0.1875 mg/mL. When *M. piperita* was combined with *M. longifolia*, the MIC was further reduced, ranging from 0.1875 to <0.05 mg/mL. Similarly, the combination of *M. longifolia* and *O. basilicum* exhibited MIC values between 0.75 and <0.05 mg/mL.Among the tested bacterial strains, *Streptococcus mitis* exhibited the highest sensitivity to all individual and combined leaf extracts. Notably, the synergistic combination of *M. piperita*, *M. longifolia*, and *O. basilicum* showed enhanced antibacterial activity against most of the tested bacteria. However, an antagonistic interaction was observed between *M. longifolia* and *O. basilicum* against *Staphylococcus aureus*[120].

4. ***Al-Sahlany*** detected *Vibrio* spp. in cheese manufacture and effect of essential oil of *Mentha piperita* on these bacteria. A 126 isolates of *Vibrio* spp. were isolated from 30 samples of two types of local cheeses. The samples were collected from 14 markets in Basrah city. 8 species from *Vibrio* genes was obtained and defined by microscopic and biochemical tests. *Vibrio parahaemclyticus* and *Vibrio cholera* were the highest percentage among other isolates. It was 33% and 25 % respectively. Essential oil of *Mentha piperita* was extracted from leaves. It was 2% (v:w) which used for *Vibrio* spp. isolates inhibition. *Vibrio logei* was most sensitive against 15 µl of Mentha *piperita* essential oil. The MIC of *Vibrio* spp. was.0035 ml excepted *V. cholera* was 0.0041 ml and V. *harveyi*, *V. logei* were 0.0027 ml [121].

5. Al-Kassie conducted a study to evaluate the growth performance of broiler chickens fed diets enriched with dried peppermint (*Mentha piperita L.*), used as a natural growth-promoting alternative. In total, 200 Hubbard broiler chicks were divided into groups and fed a basal diet supplemented with varying concentrations of peppermint—0.00%, 0.25%, 0.5%, 1.0%, and 1.5%—over a six-week period (42 days). The findings indicated that all groups receiving peppermint showed enhanced growth performance compared to the control. Notably, birds receiving 0.5% peppermint supplementation exhibited superior outcomes in terms of weekly weight gain, feed conversion efficiency, and carcass yield compared to those receiving 1.5%. No significant differences were observed in blood parameters (PCV%, RBC, Hb%, and WBC) across the treatments. However, liver weight varied significantly between treatment groups and the control, and a statistically significant variation in the heterophil/lymphocyte (H/L) ratio was also recorded among the treated groups when compared to the control[122].

6. ***Ahmed*** investigated ttraditional Medicinal Plant Usage Among Healers in Southern Kurdistan An ethnobotanical investigation was undertaken to record the indigenous knowledge of medicinal plant usage among traditional healers in Sulaymaniyah Province during the years 2014 and 2015. Information was gathered through structured interviews with 45 local healers (comprising 36 men and 9 women aged between 25 and 80 years) who maintain ancestral knowledge of herbal medicine. The study also included calculations of the use value (UV) for each plant species and the informant consensus factor (ICF) for the categories of ailments treated. Additionally, comparisons were made between the field data and existing ethnobotanical records from Kurdish literature.

The study identified 66 medicinal plant species, representing 63 genera across 34 botanical families, traditionally used to address 99 distinct diseases and health conditions. The family Lamiaceae was the most prominent, with 7 species reported, followed closely by Apiaceae, Asteraceae, and Fabaceae, each contributing 6 species.

Leaves were the plant part most commonly employed in remedies (46%), while flowers and seeds accounted for 15% and 10%, respectively. Decoction emerged as the primary method of preparation (68%), whereas a smaller number of species were consumed either as vegetables (13%) or in powdered form (10%).

The ailment group associated with respiratory conditions exhibited the highest ICF score (0.68), indicating strong agreement among healers. This was followed by treatments for inflammatory conditions (0.58) and women's health issues (0.54). Notably, the species with the highest UVs—indicating frequent use and perceived effectiveness—were Zingiber officinale (0.48), Matricaria chamomilla (0.37), Adiantum capillus-veneris, Thymus vulgaris, and Pimpinella anisum (each with 0.31)[123].

Conclusion

Plants have been used by people in alternative medicine for different purposes since old ages. Nutraceutical and functional foods help protect against a chronic illness, reducing illness effects. *Mentha piperita* is a popular and medicinal plant native to Iraq. The essential oil contents of leaves from *M. piperita* under investigation showed variation in constituents and composition from those obtained from other different geographical origin (locations). It was found that menthone is the main constituent in the essential oil under investigation, whereas menthol isomer, isomenthol was detected as a minor constituent. Some of the benefic biological effects show that this plant may play an important role as anti-oxidant, antinociceptive, anti-inflammatory, antimicrobial, anti-carcinogenic, antiviral, anti-allergic and antitumorigenic, indicating its utility in the prevention or treatment of several diseases. Furthermore, we may say that *Mentha piperita* is a promising plant that may offer low-cost alternative strategy for the use in Medicine and in food industry. It could be concluded that, *M. piperita* grown under Iraq climatic conditions contain many bioactive constituents but no reported document is available so we need more study on *M. piperita* to use in various disease.

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