Health Benefits of *Mentha*

Subjects: Plant Sciences

Contributor: Saddam Saqib , Fazal Ullah , Muhammad Naeem , Muhammad Younas , Asma Ayaz , Sajid Ali , Wajid Zaman

A poor diet, resulting in malnutrition, is a critical challenge that leads to a variety of metabolic disorders, including obesity, diabetes, and cardiovascular diseases. *Mentha* species are famous as therapeutic herbs and have long served as herbal medicine. Recently, the demand for its products, such as herbal drugs, medicines, and natural herbal formulations, has increased significantly.

phytoconstituents herbal medicine antidiabetic Mentha Plants

1. Introduction

Mentha is a perennial, aromatic, and curative herb which has extensive global distribution. Genus *Mentha* belongs to the family Lamiaceae and comprises 25–30 known species. *Mentha* grows vigorously at low temperatures but could undergo a wide range of environmental conditions. Normally, it can reach a height of 10 to 20 cm or more. This genus emerged from Midland countries and progressively expanded worldwide by either artificial or natural genesis [1]. They are now predominantly found in Eurasia, Australia' South Africa, and North America. According to various studies, *Mentha* plants have superabundant ingredients of phenolic compounds distinctly phenols, flavonoids, terpenes, quinines, and polysaccharides [2][3]. These phytochemicals paved the way for significant utilization in the production of pharmaceuticals food and beverage industry [1][4][5]. Numerous species of *Mentha* are used as spices and for herbal teas. Generally, every part, for instance, the leaves, stems, and roots of *Mentha*, have been used in tribal and traditional medicines [6][7]. Economically, highly important species are *Mentha aquatica* L. (*M. aquatica*), *Mentha longifolia* L. (*M. longifolia*), *Mentha* × *piperita* L. (*M.* × *piperita*), *Mentha spicata* L. (*M. spicata*), and *Mentha arvensis* L. (*M. arvensis*). All these species possess potential phytochemicals, such as iso-menthol, iso-menthone, cineol, limonine, piperitone, carvacrol, dipentene, linalool, thujone, piperitenone oxide, and phellandrene, which play an important role in pharmacy, food, flavor, ointment, and associated industries [1][8][9][10]. The utilization of *Mentha* sp. in the food industry will provide a cost-effective and biocompatible route to control diabetes and obesity [11]. Diabetes is a sort of metabolic disorder accrued due to hyperglycemia with raising of glucose levels in the blood, caused by a lack of insulin or a reduction in the insulin level [12]. The extensive use and economic importance of *Mentha* are due to its nutritional value and ability to replace sugar [6][13][14]. The application of *Mentha* phytoconstituents in food items as preservatives and additives will help to reduce the risk of diabetes and cardiovascular diseases.

The frequency of diabetes and cardiovascular diseases are increasing across the world due to diets consisting of high-fat foods and less exercise [15]. The high amount of triglycerides, flavors, and synthetic preservatives in food

reduces food nutritional values and leads to diabetes, obesity, and other chronic diseases [16][17]. It has been reported that 30–80% of people are at risk of diabetes and obesity due to dietary habits and lack of physical activities [18]. Various approaches, such as insulin pills and the utilization of sugar-free food, are adopted to control diabetes and obesity [19][20]. These approaches adversely affect patients' nutrition status and food enjoyment and severely decline the patient's quality of normal life. Consequently, it intensifies the utilization of natural products, such as phytoextracts and essential oils, to boost the nutritional values of food and reduce the risk of diabetes and obesity [21][22]. In the last two decades, continuous efforts have been made to control metabolic disorders via natural routes, such as ingestion of dietary products. Several chemical drugs are used in food processing, but research has revealed adverse side effects, encouraging the use of active natural compounds [23][24][25][26]. Plant-derived extracts, in pure form or adulterated form, provide endless opportunities as healthy and biocompatible food products [27][28]. Currently, epidemiological researchers suggested many medicinal and aromatic plants for their nutritional and preservative abilities [29][30]. The aqueous extracts of medicinal plants can be used in dietary products to provide plant-based food nutrition to human beings [31][32]. Aqueous extracts are usually obtained from the aqueous phase through a physical process that does not influence their composition [33]. However, prior to the use of these extracts at mass scale, thorough investigations, such as cytotoxicity, antioxidant, antidiabetic activities, and lipid oxidation potential, are necessary to ensure their efficacy and safety through proof-of-concept research for potential health claims [34][35]. *Mentha* is a medicinal and economically important plant that is regularly used for the treatment of vomiting and nausea, its antiallergic effects, its antifungal and antibacterial effects, its antidiabetic effects, the treatment of obesity, the treatment of gastrointestinal diseases, its anticarcinogenic effects, and pain relief [1][36][37].

2. Genus *Mentha*: Morphology and Systematics

2.1. Morphology

Mentha L. is a perennial herb, spread through long slender rhizomes. The rhizomes spread rapidly, and consequently, various populations of this species comprise a progression of clones. The rhizomes sections spread especially along wetlands and riverbanks, resulting in vegetative multiplication and dispersal [38]. The plant has broad ovate leaves rounded or sometimes lanceolate at the base with pubescents and thick-veined leaves (**Figure 1**). The flowers are arranged in a large whorl with a triangular teeth calyx, and anthers exerting from the corolla. The flowers are mostly protandrous, and usually, self-pollination occurs [1][38].

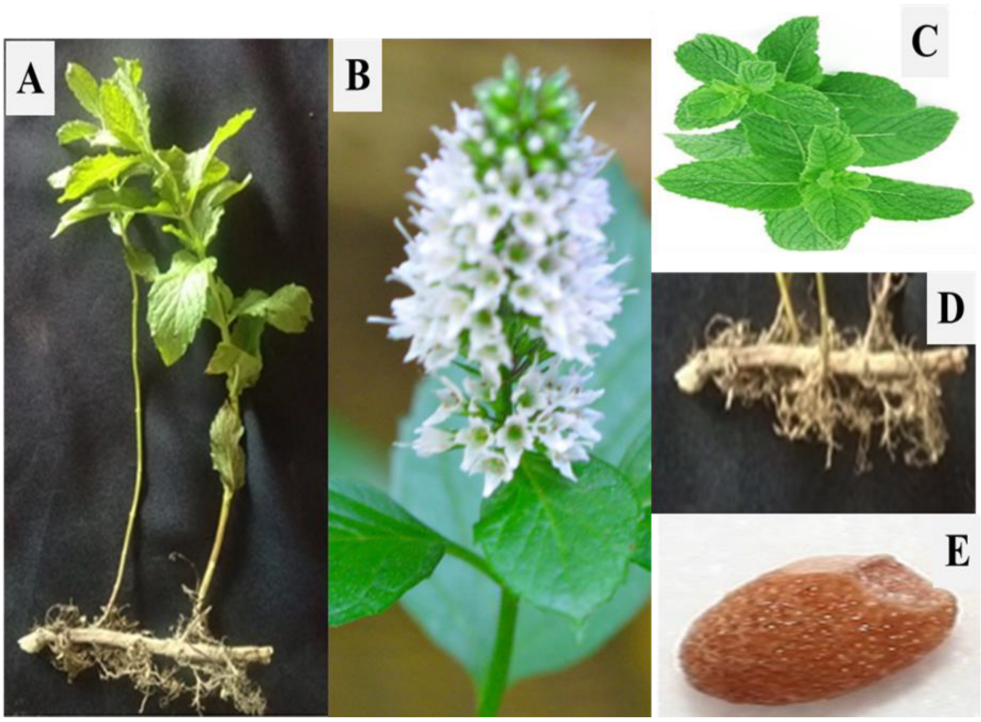


Figure 1. Morphology of *Mentha arvensis* L. (**A**) Shoot structure; (**B**) Flower; (**C**) Leaves; (**D**) Rhizome; (**E**) Seed.

2.2. Systematics

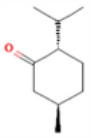
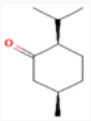
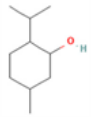
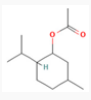
Mentha was depicted by Carl Linnaeous from a plant specimen collected from Sweden, who named it *M. canadensis* L. Bentham pursued Linnaeous in keeping *M. canadensis* L. as a subglabrous assortment (var. glubrata Benth.) and a villose one (var. villosaBenth.) [39]. However, recent information based on physiological, anatomical, and molecular attributes have demonstrated that *Mentha* can be grouped into 42 species, hundreds of subspecies, varieties, and cultivars, and 15 hybrids [40]. The scientific classification of *Mentha* is exceptionally unpredictable and there is no consensus. *Mentha* is generally classified into five sections, i.e., *Eriodontes*, *Mentha*, *Preslia*, *Audibertia*, and *Pulegium* [41]. Recently, Zahra et al. [42] reported that phylogenetically, *M. arvensis*, *M. spicata*, and *M.* × *piperita* show 98% identity when using *matK* sequencing.

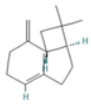
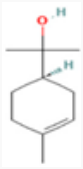
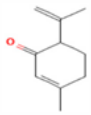
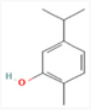
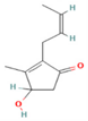
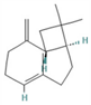
3. Essential Oil and the Chemical Composition of the Studied Species of *Mentha*

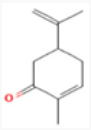
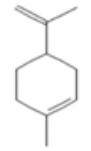
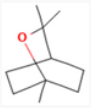
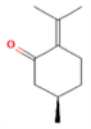
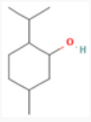
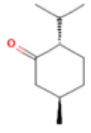
In a true sense, essential oils are not really oils; they are in fact volatile chemicals, produced by living organisms, and are mostly extracted by distillation [43][44]. *Mentha* species contain essential oils with different chemical compositions; for example, in *M. pulegium* L., natural compounds have been reported to account for 96.9% of the chemical profile, including oxygenated monoterpenes, monoterpenes hydrocarbons, oxygenated sesquiterpenes, and non-terpene hydrocarbons. The essential oils separated from leaves of *M. pulegium* contain carvone (56.1%), limonene (15.1%,) E-caryophyllene (3.6%,), oleic acid (3.2%), and 1,8-cineole (2.4%) [45]. Variations in the essential oil composition and its chemical composition were also observed in some species of *Mentha*. Major compounds in *M.* × *piperita* were observed, including 1-menthone, isomenthone, menthol, menthyl acetate,

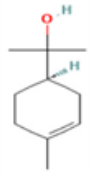
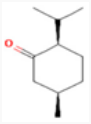
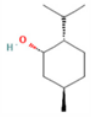
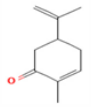
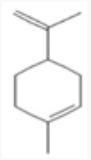
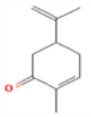
caryophyllene, and germacrene-D. The study reported a sufficient amount of oil composition, varying from 0.63% germacrene-D to 51% menthol. This indicates that *Mentha* species contain menthol in maximum quantity [46]. Therefore, the plant has the potential to be used as a medicinal ingredient in the food industry to reduce the risk of cardiovascular diseases. The same study reported 12 essential oil compounds in *M. longifolia* with different concentrations of oil compounds from April to July. Another study reported pulegone (86.64%) as a major constituent from *M. pulegium*, possessing antioxidant, quorum sensing, antiinflammatory and antimicrobial activities, indicating that the plant has the potential to reduce the risk of cardiovascular diseases [46]. The chemical composition of Peppermint oil was reported to include oxygen-containing substances, such as menthone (20%), menthol (45–50%), and sesquiterpenes about 3% [47]. It has been reported that *M. spicata* contains major essential oil compounds, including oxygenated monoterpenes (approximately 67%), sesquiterpenes hydrocarbons (7.5%), monoterpene hydrocarbons (approximately 20%), oxygenated sesquiterpenes (1.2%), and other compounds (1.7%) [47]. Piperitrone (81.18%) and piperitenone oxide (94.8%) were also reported from *M. spicata* [47]. Detailed information of the essential oils and its composition is provided in **Table 1** of some common *Mentha* species (**Table 1**). The presence of essential oils indicate that *Mentha* exhibit high antioxidant, antiinflammatory, and antimicrobial potential, which would help to control the risk of cardiovascular diseases by using *Mentha* species compounds in food products [48][49].

Table 1. Essential oil composition and biological activities of some *Mentha* species.

Species Name	Essential Oil	Chemical Composition	Composition (%)	Structure	Source	Activities	Reference
M. × *piperita* L.	Monoterpenoids	1-menthone	7.32–18.32		Aerial parts	Antiinflammatory, antibacterial, neuroprotective, antifatigue, and antioxidant properties	[50]
		Isomenthone	0–6.75		Aerial parts	Antiviral, scolicidal, immunomodulatory, antitumor, and antioxidant properties	[51]
		Menthol	18.03–58.42		Aerial parts	Antitumor, neuroprotective, antifatigue, and antioxidant properties	[51]
		Menthyl acetate	0.72–6.89		Aerial parts	Antimicrobial and flavoring agent	[50]

Species Name	Essential Oil	Chemical Composition	Composition (%)	Structure	Source	Activities	Reference
M. longifolia L.	Sesquiterpenes	Caryophyllene	0.05–1.54		Aerial parts	Anticancer and analgesic properties	[52]
		Germacrene-D	0.63–1.89		Aerial parts	Antioxidant and immunomodulatory effects	[53]
		Endo-Borneol	1.12–6.02		Aerial parts	Cytotoxicity and anticancer properties	[54]
		α-Terpineol	0–0.28		Aerial parts	Antioxidant and anti-COX-2 activity	[54]
	Monoterpenoids	Isopiperitenone	0.07–0.36		Aerial parts	Antimicrobial properties	[55]
		Carvacrol	0–1.06		Aerial parts	Antimicrobial and Cytotoxic properties	[54]
		Cinerolon	0.08–0.25		Aerial parts	Antimicrobial properties	[55]
		Cis-a-Farnescene	1.03–1.97		Aerial parts	Antimicrobial properties	[55]
	Sesquiterpene	Caryophyllene	2.72–7.03		Aerial parts	Anticancer and analgesic properties	[56]
		Germacrene D	0.98–3.22		Aerial parts	Antioxidant and immunomodulatory effects	[56]
		Caryophyllene oxide	0.12–0.79		Aerial parts	Anticancer properties	[56]

Species Name	Essential Oil	Chemical Composition	Composition (%)	Structure	Source	Activities	Reference
M. pulegium L.	Oxygenated Monoterpenes	Carvone	56.1		Aerial parts	Antimicrobial, antioxidant, diuretic, analgesic, and antiseptic properties	[57]
		Limonene	15.1		Aerial parts	Antimicrobial, antioxidant, diuretic, analgesic, and antiseptic properties	[57]
		(E)-caryophyllene	3.6		Aerial parts	Anticancer and analgesic properties	[57]
		Oleic acid	3.2		Aerial parts	Antioxidant and antimicrobial properties	[58]
		1,8-cineole	2.4		Aerial parts	Antimicrobial, antioxidant, diuretic, analgesic, and antiseptic properties	[57]
	Monoterpene	Pulegone	54.3		Aerial parts	Antioxidant and antimicrobial properties	[58]
M. arvensis L.		Menthol	30.35		Leaf	Antiseptic, antibacterial properties, antioxidant, antimicrobial, anticancer, and antiinflammatory activities	[59]
		Menthone	20.50		Leaf	Antiseptic, antibacterial properties, antioxidant, antimicrobial, anticancer, and antiinflammatory activities	[59]

Species Name	Essential Oil	Chemical Composition	Composition (%)	Structure	Source	Activities	Reference
		β-pinene	7.28		Leaf	Antimicrobial properties	[53]
		α-terpineol	7.08		Leaf	Antiproliferative activity	[60]
		α-pinene	6.35		Leaf	Antiproliferative activity	[60]
		Menthofuran	5.85		Leaf	Antioxidant, antimicrobial, cytotoxic, analgesic	[61]
		Iso-menthone	4.53		Leaf	Antiviral, scolicidal, immunomodulatory, antitumor, and antioxidant properties	[51]
		Neo-menthol	4.36		Leaf	Antioxidant properties and antimicrobial activity	[51]
		Menthyl acetate	3.26		Leaf	Antimicrobial properties and flavoring agent	[50]
M. spicata L.	Terpenoids	Carvone	58.22		Leaf	Antimicrobial, antioxidant, diuretic, analgesic, and antiseptic properties	[57]
	Oxygenated Monoterpenes	Limonene	19.54		Leaf	Antimicrobial, antioxidant, diuretic, analgesic, and antiseptic properties	[57]
M. suaveolens L. [66]	Terpenoids	Carvone	64.31		Leaf	Antimicrobial, antioxidant, diuretic, analgesic, and antiseptic properties	[57]

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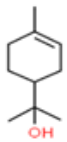
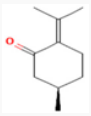
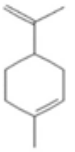
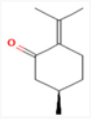
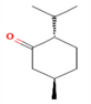
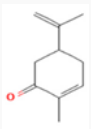
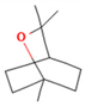
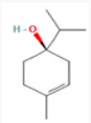
industry will open new avenues for epidemiologists to control diabetes and cardiovascular diseases.

4. Health Benefits of *Mentha*

Mentha is a much desired and demanded herb due to its medicinal and therapeutic use. The use of *Mentha* species has been reported in China since the rule of Ming [69]. *Mentha* became an official item of Materia medical in

Species Name	Essential Oil [70]	Chemical Composition	Composition (%) [50][64]	Structure	Source	Activities [71][72]	Reference
M. aquatica L.	Monoterpenoid [61] [73]	Myrcenol	5.88		Leaf	Antioxidants, antifungal, and flavoring agents	[48]
		Terpineol [68]	5.61		Leaf	Antimutagenic potency	[62]
		Pulegone [74][75]	3.81		Whole plant	Antibacterial and antifungal properties	[63]
	Oxygenated Monoterpenes	Limonene	1.24		Leaf	Antidiabetic, antioxidant, and antibacterial properties	[64]
	Monoterpene	Pulegone	39.36		Leaves	Antioxidant and antibacterial properties	[65]
		Menthone	27.69		Leaves	Antioxidant and antibacterial properties	[65]
		Carvone	37.26		Leaves	Antioxidant, antidiabetic, dermatoprotective, antidermatophyte, and antibacterial properties	[3]
M. virdis L.	Oxygenated Monoterpenes [76][77]	1.8-Cineole	11.82 [78][79]		Leaves	Antioxidant, antidiabetic, dermatoprotective, antidermatophyte, and antibacterial properties	[3] [80]
		Terpinen-4-ol	08.72		Leaves	Antioxidant, antidiabetic, dermatoprotective, antidermatophyte, and antibacterial properties	[3]

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