

Review

Mentha: Nutritional and Health Attributes to Treat Various Ailments Including Cardiovascular Diseases

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

Special Issue

Phytochemistry and Biological Properties of Medicinal Plants

Edited by







Prof. Dr. Rudolf Bauer and Dr. Jelena S. Katanic Stankovic



<https://doi.org/10.3390/molecules27196728>

Review

Mentha: Nutritional and Health Attributes to Treat Various Ailments Including Cardiovascular Diseases

Saddam Saqib ¹, Fazal Ullah ², Muhammad Naeem ³, Muhammad Younas ¹, Asma Ayaz ⁴, Sajid Ali ^{5,*}
and Wajid Zaman ^{6,*}

¹ Department of Biotechnology, Mohi-ud-Din Islamic University, Nerian Sharif 12080, AJ&K, Pakistan

² State Key Laboratory of Grassland Agro-Ecosystems, School of Life Sciences, Lanzhou University, Lanzhou 730000, China

³ China Sinovita Bioengineering Group, Jinan 250000, China

⁴ State Key Laboratory of Biocatalysis and Enzyme Engineering, School of Life Sciences, Hubei University, Wuhan 430062, China

⁵ Department of Horticulture and Life Science, Yeungnam University, Gyeongsan 38541, Korea

⁶ Department of Life Sciences, Yeungnam University, Gyeongsan 38541, Korea

* Correspondence: drsajid@yu.ac.kr (S.A.); shangla123@gmail.com (W.Z.)

Abstract: 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. However, the available literature lacks a thorough overview of *Mentha* phytochemicals' effects for reducing malnutritional risks against cardiovascular diseases. In this context, we aimed to review the recent advances of *Mentha* phytochemicals and future challenges for reducing malnutritional risks in cardiovascular patients. Current studies indicated that *Mentha* species phytochemicals possess unique antimicrobial, antidiabetic, cytotoxic, and antioxidant potential, which can be used as herbal medicine directly or indirectly (such as food ingredients) and are effective in controlling and curing cardiovascular diseases. The presence of aromatic and flavor compounds of *Mentha* species greatly enhance the nutritional values of the food. Further interdisciplinary investigations are pivotal to explore main volatile compounds, synergistic actions of phytochemicals, organoleptic effects, and stability of *Mentha* sp. phytochemicals.

Keywords: phytoconstituents; herbal medicine; antidiabetic; cytotoxic; organoleptic



Citation: Saqib, S.; Ullah, F.; Naeem, M.; Younas, M.; Ayaz, A.; Ali, S.; Zaman, W. *Mentha*: Nutritional and Health Attributes to Treat Various Ailments Including Cardiovascular Diseases. *Molecules* **2022**, *27*, 6728. <https://doi.org/10.3390/molecules27196728>

Academic Editor: Riccardo Petrelli

Received: 30 August 2022

Accepted: 6 October 2022

Published: 9 October 2022

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Copyright: © 2022 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

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 [1,8–10]. 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 [23–26]. 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].

We compiled the main characteristics of genus *Mentha* extracts which should be considered as food additives and preservatives to help in diabetes and obesity control due to synthetic food additives and preservatives. In addition, we highlighted the challenges, techniques, and opportunities to improve flavor and textural properties to maintain the needs of taste and aroma of the individual. We concluded that the genus *Mentha* species possess potential phytochemicals and flavoring agents, which can be used in daily diet products to improve food quality cost-effectively and sustainably. Furthermore, an investigation of other medicinal and aromatic plants should be considered, specifically their potential as food additives and dietary supplements and ability to control lethal disorders such as diabetes and obesity via daily dietary products.

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 pubescent 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].

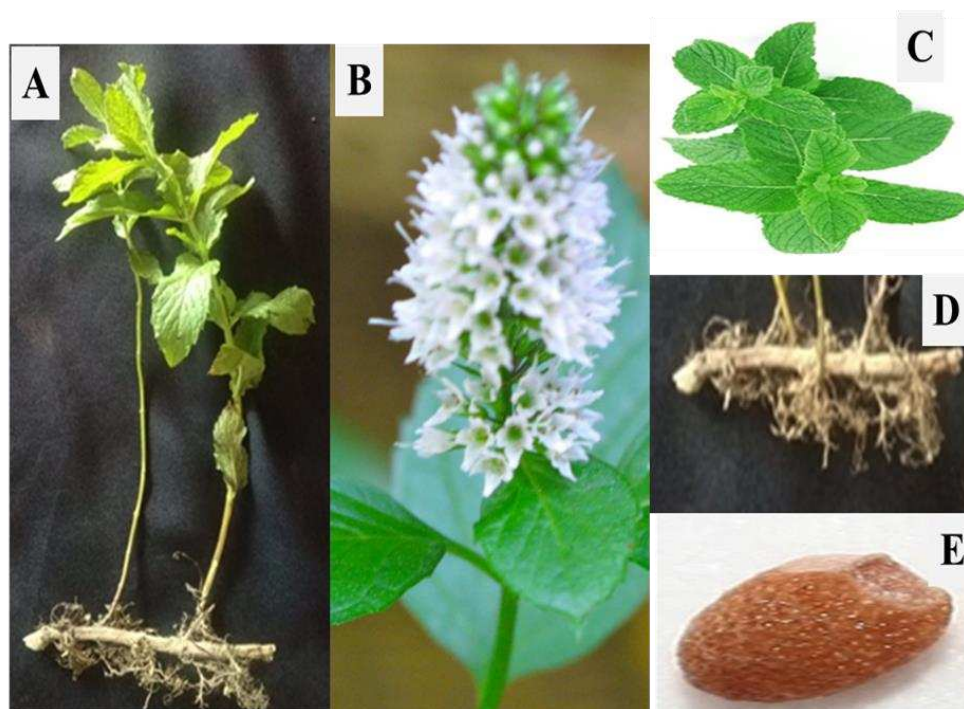


Figure 1. Morphology of *Mentha arvensis* L. (A) Shoot structure; (B) Flower; (C) Leaves; (D) Rhizome; (E) Seed.

2.2. Systematics

Mentha was depicted by Carl Linnaeus from a plant specimen collected from Sweden, who named it *M. canadensis* L. Bentham pursued Linnaeus in keeping *M. canadensis* L. as a subglabrous assortment (var. *glabrata* Benth.) and a villose one (var. *villosa* Benth.) [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]. Piperitone (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.

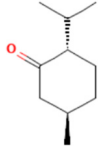
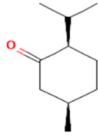
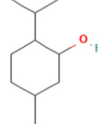
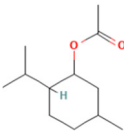
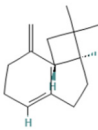
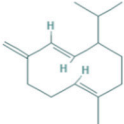
Species Name	Essential Oil	Chemical Composition	Composition (%)	Structure	Source	Activities	Reference
<i>M. × piperita</i> L.	Monoterpenoids	1-menthone	7.32–18.32		Aerial parts	Antiinflammatory, antibacterial, neuroprotective, antifatigue, and antioxidant properties	[50]
		Isomenthone	0–6.75		Aerial 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]
	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]

Table 1. Cont.

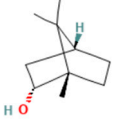
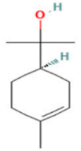
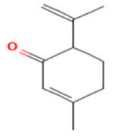
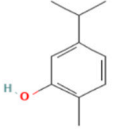
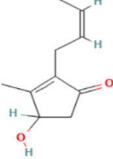
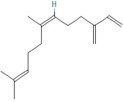
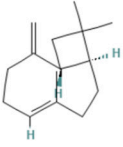
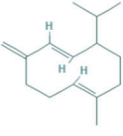
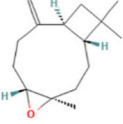
Species Name	Essential Oil	Chemical Composition	Composition (%)	Structure	Source	Activities	Reference
<i>M. longifolia</i> L.	Monoterpenoids	Endo-Borneol	1.12–6.02		Aerial parts	Cytotoxicity and anticancer properties	[54]
		α -Terpineol	0–0.28		Aerial parts	Antioxidant and anti-COX-2 activity	[54]
		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]
		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]

Table 1. Cont.

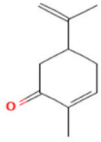
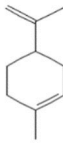
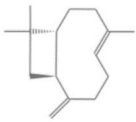
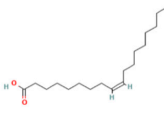
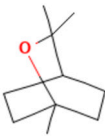
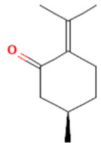
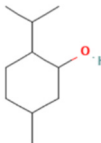
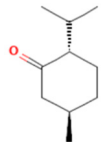
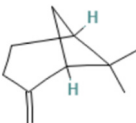
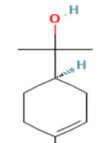
Species Name	Essential Oil	Chemical Composition	Composition (%)	Structure	Source	Activities	Reference
<i>M. pulegium</i> L.	Oxygenated Monoterpenes	Carvone	56.1		Aerial parts	Antimicrobial, antioxidant, diuretic, analgesic, and antiseptic properties	[57]
		Limonene	15.1		Aerial parts	Antimicrobial, antioxidant, 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]
<i>M. arvensis</i> L.	Monoterpene	Pulegone	54.3		Aerial parts	Antioxidant and antimicrobial properties	[58]
		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]
		β -pinene	7.28		Leaf	Antimicrobial properties	[53]
		α -terpineol	7.08		Leaf	Antiproliferative activity	[60]

Table 1. Cont.

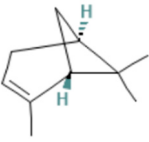
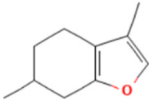
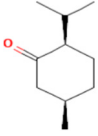
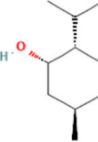
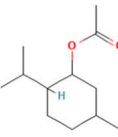
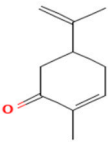
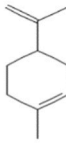
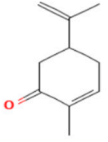
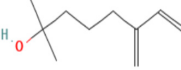
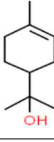
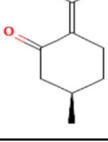
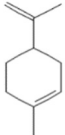
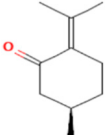
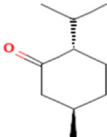
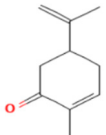
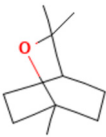
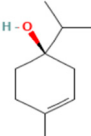
Species Name	Essential Oil	Chemical Composition	Composition (%)	Structure	Source	Activities	Reference
<i>M. pulegium</i> L.		α -pinene	6.35		Leaf	Antiproliferative activity	[60]
		Menthofuran	5.85		Leaf	Antioxidant, antimicrobial, cytotoxic, analgesic	[61]
		Iso-menthone	4.53		Leaf	Antiviral, scolicidal, immunomodulatory, antitumor, and antioxidant properties	[51]
		Neo-menthol	4.36		Leaf	Antioxidant properties and antimicrobial activity	[51]
<i>M. spicata</i> L.		Menthyl acetate	3.26		Leaf	Antimicrobial properties and flavoring agent	[50]
	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]
<i>M. suaveolens</i> L.	Terpenoids	Carvone	64.31		Leaf	Antimicrobial, antioxidant, diuretic, analgesic, and antiseptic properties	[57]
		Myrcenol	5.88		Leaf	Antioxidants, antifungal, and flavoring agents	[48]
	Monoterpenoid	Terpineol	5.61		Leaf	Antimutagenic potency	[62]
		Pulegone	3.81		Whole plant	Antibacterial and antifungal properties	[63]

Table 1. Cont.

Species Name	Essential Oil	Chemical Composition	Composition (%)	Structure	Source	Activities	Reference
<i>M. suaveolens</i> L.	Oxygenated Monoterpenes	Limonene	1.24		Leaf	Antidiabetic, antioxidant, and antibacterial properties	[64]
<i>M. aquatica</i> L.	Monoterpene	Pulegone	39.36		Leaves	Antioxidant and antibacterial properties	[65]
		Menthone	27.69		Leaves	Antioxidant and antibacterial properties	[65]
<i>M. viridis</i> L.	Oxygenated Monoterpenes	Carvone	37.26		Leaves	Antioxidant, antidiabetic, dermatoprotective, antidermatophyte, and antibacterial properties	[3]
		1.8-Cineole	11.82		Leaves	Antioxidant, antidiabetic, dermatoprotective, antidermatophyte, and antibacterial properties	[3]
		Terpinen-4-ol	08.72		Leaves	Antioxidant, antidiabetic, dermatoprotective, antidermatophyte, and antibacterial properties	[3]

Note: The structures were obtained from <https://pubchem.ncbi.nlm.nih.gov/> (Accessed on 15 August 2022).

The essential oils of *Mentha* are using in aromatherapy. Many food and beverages industries are using *Mentha* as food additive and flavoring agent. Due to aromatic compounds and secondary metabolites, fresh or dried leaves of *Mentha* are used in chewing tobacco, confectionaries, analgesic balm, perfumes, candies, and the tobacco industry [66]. Some researchers found potential antidiabetic effects of *Mentha* [67,68]. The use of *Mentha* in food 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 medica in London Pharmacopeia [70]. In the 18th century, it was commonly used as a medicinal herb [71,72]. Various health benefits of *Mentha* species have been reported [50,64]. *Mentha* species have shown analgesic activity during in vivo experiments on mice [61]. *Mentha* species showed antibacterial and antifungal activities against different bacterial and fungal strains [73]. *Mentha* species have traditionally used against various diseases and have the potential to be used for cardiovascular diseases [68]. Several studies have indicated that *Mentha* species contain free radical species and nonradical species, e.g., hydrogen peroxide, which is harmful for molecules of

microbes, such as proteins, lipids, nucleic acids, and carbohydrates. Extracts and essential oils of *Mentha* species have shown several health benefits (Figure 2) [74,75].

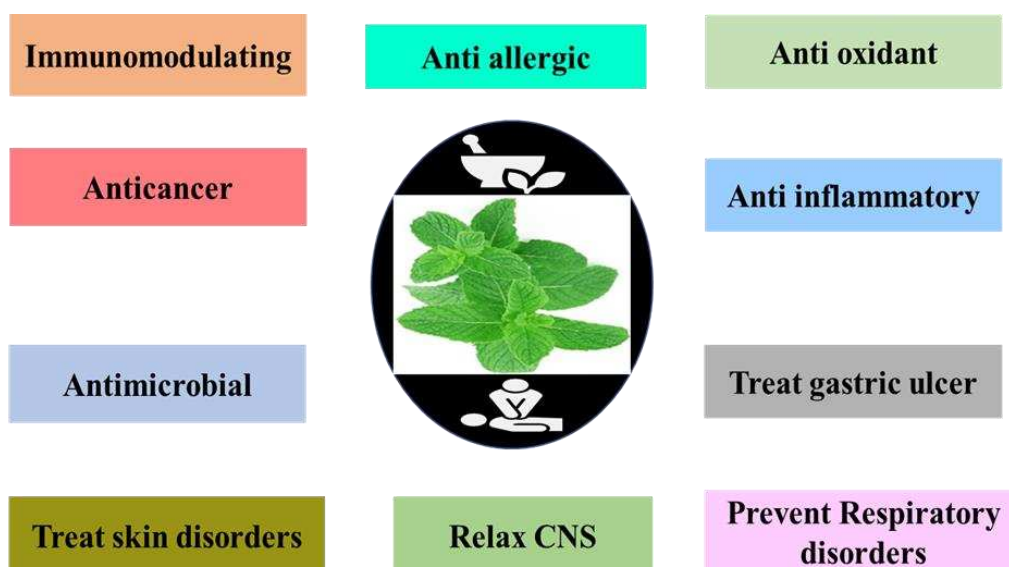


Figure 2. Traditional therapeutic uses of some species of *Mentha* against a variety of ailments.

Some studies found that mint enable lungs surfactants to filter the air and perform better pulmonary action. Methanol from the mint stimulates respiratory muscle strength and increases the end tidal oxygen rate in the human body [76,77]. *Mentha* plants contain constituents with cytotoxic properties, and could be used in developing anticancer agents; for example, *M. longifolia*, *M. arvensis*, and *M. × piperita* were found to possess cytotoxic activity against breast cancer in humans [78,79] and human laryngeal epidermoid carcinoma [80]. The direct application of *Mentha* on the skin shows excellent analgesic activity, producing a cooling effect on the skin. Mint oil stimulates blood receptors on the skin and expands blood vessels, resulting in a cold sensation and relaxation [69]. *Mentha* sp. possesses various secondary metabolites which are useful against different disorders (Table 1). These can be used in the food industry to reduce malnutritional risks in diabetic and cardiovascular patients.

5. Biological Activities of *Mentha*

A detailed survey of the biological activities of *Mentha* is a prerequisite to explore its potential for the treatment of diseases.

5.1. Antimicrobial Activity of *Mentha*

Mentha exhibits a strong antimicrobial potential, which is why it is considered as one of the most industrially, medicinally, and economically important plant genera. *Mentha* has shown a significant antibacterial resistance against the epidemic bacterium Chlamydia. Additionally, *Mentha* helps fight pneumonias associated with respiratory disease [81]. A study conducted by Hussain et al. [82] reported a strong antibacterial potential of various *Mentha* species. Another study found *Mentha* extracts to have an effective inhibition activity against various strains of bacteria, including *Pseudomonas aeruginosa*, *Shigella flexneri*, *Klebsellia pneumoniae*, and *Styphylococcus aureus* (do Nascimento, Rodrigues, Campos, & da Costa, 2009). Mimica-Dukić et al. [83] isolated secondary metabolites from *Mentha* and tested them against *Escherichia coli* and *Shigella sonei*; they showed significant antibacterial activity. Furthermore, using *Candida albicans* and *Trychophyhton tonsurans*, studies have shown that *Mentha* extracts have strong antifungal properties. Another study by López et al. [84] reported the potential of *Mentha* extracts against *Rhizopus tolonifera*. Apart from this, various species of *Mentha* have been shown to possess potential antimicrobial activity

against resistant pathogens (Table 2), indicating that metabolites of *Mentha* species are highly active against pathogenic organisms. The antimicrobial mechanism of *Mentha* extracts involve the production of antioxidant agents which disrupt the microbial membrane, and subsequently, damage the cellular organelles. The strong antimicrobial potential of *Mentha* extracts proved it as a highly essential preservative in the food industry. Further studies are required to find which kinds of extracts and which elements are important for the production of health-oriented food.

Table 2. Antimicrobial activity of some *Mentha* species.

Species Name	Sample Used	Microorganisms	Activities	References
<i>M. aquatica</i> L.	Essential oil	<i>Staphylococcus aureus</i> , <i>Escherichia coli</i> , <i>Bacillus</i> sp., and <i>Candida</i> sp.	Showed activity against <i>S. aureus</i> , <i>E. coli</i> , and <i>Bacillus</i> sp., but no result against <i>Candida</i> sp.	[65]
<i>M. arvensis</i> L.	Ethanol extract	<i>Acinetobacter baumannii</i>	Results showed 34.5 mm inhibition use at 100 µg/mL	[85]
<i>M. erveine</i> L.	Essential oil, pulegone, isomenthone and menthone was used	<i>S. aureus</i> , <i>S. caprae</i> , <i>Enterococcus faecalis</i> , <i>E. faecium</i> , <i>E. hirae</i> , <i>E. coli</i> , <i>Salmonella braenderup</i> , <i>S. typhimurium</i> , <i>S. choleraesuis</i> , <i>Klebsiella pneumoniae</i> , <i>Acinetobacter baumannii</i> , <i>Pseudomonas aeruginosa</i> , and <i>Listeria monocytogenes</i> strains	Showed variation in activity against Gram positive and Gram-negative strains, but overall inhibition activity was significant as compared to control	[86]
<i>M. arvensis</i> var. <i>piperascens</i> Malinv. ex Holmes	Essential oil	<i>Salmonella enteritidis</i> , <i>E. coli</i> , <i>Clostridium Perfringens</i> , <i>Campylobacter jejuni</i> , and <i>Salmonella</i> species	Significant antibacterial activity against all strains specifically <i>Salmonella</i> species and <i>C. jejuni</i> (inhibition zones more than 40 mm)	[87]
<i>M. × piperita</i> L.	Essential oil	<i>Aeromonas</i> spp.	High antibacterial activity was shown by the essential oils, ranging from 1.250 to 16.67 µL/mL	[88]
<i>M. longifolia</i> L.	Essential oils, Menthone, carvone Menthol, and piperitenone oxide	<i>S. aureus</i> , <i>E. coli</i> , <i>B. subtilis</i> , <i>Aspergillus flavus</i> , <i>Alternaria solani</i> , <i>Aspergillus niger</i> , <i>Alternaria alternata</i> , <i>Rhizopus solani</i> , <i>Fusarium solani</i> , and <i>Rhizopus</i> sp.	Among these, menthol showed high antimicrobial activity, with the inhibition zone ranging from 19–33 mm	[82]
<i>M. itrata</i> Ehrh.	Essential oils	<i>E. coli</i> , <i>K. pneumoniae</i> , <i>Salmonella typhimurium</i> , <i>Staphylococcus epidermidis</i> , <i>Streptococcus mutans</i> , <i>P. aeruginosa</i> , and <i>S. aureus</i>	Average activity was recorded from between 10–15 mm inhibition zone against different strains, but essential oil showed an inhibition zone of more than 15 mm against <i>S. epidermidis</i>	[89]
<i>M. haplocalyx</i> Briq.	Methanol extract	<i>E. coli</i>	Potential activity against <i>E. coli</i>	[90]
<i>M. pulegium</i> L.	Essential oil	<i>S. aureus</i>	Significant activity was observed as compared to control	[91]
<i>M. requienii</i> Bentham	Essential oil	<i>Aspergillus fumigatus</i> , <i>C. albicans</i> , <i>Fusarium</i> spp., and <i>Rhodotorula</i> sp.	Revealed sufficient inhibition against molds and yeasts, ranging from 40 mm to 70 mm	[92]

5.2. Antioxidant Activity of *Mentha*

The antioxidant activity of the plants and its extracts is of great importance in fundamental science and applied science. Various species of *Mentha* have shown significant antioxidant activity both in vitro and in vivo. One study reported on the antioxidant activity of *M. longifolia* oil, with an IC₅₀ value of 0.659 mL/mL of solution [93]. The antioxidant activity of the five *Mentha* species, including *M. longifolia*, *M. × piperita*, *M. spicata*, *M. rotundifolia*, and *M. pulegium*, was tested by diphenylpicrylhydrazyl (DPPH) and 2,2'-azinobis (3 ethylbenzothiazoline 6 sulfonic acid) radical (ABTS0+). This study revealed that *M. × piperita* exhibits the most strongest DPPH scavenging activity [94]. The methanolic extracts of six *Mentha* species, which included *M. villosa* Huds., *M. arvensis*, *M. pulegium*, *M. × piperita*, *M. rotundifolia* (L) Huds., and *M. aquatica*, were tested. The overall results showed extraordinary antioxidant activity, but *M. aquatica* showed the highest antioxidant potential, with an IC₅₀ value of 7.50 µg/mL [95]. Ethanolic extract of *M. pulegium* improved the catalase, glutathione, and peroxidase level after induced toxicity of CCl₄ intraperitoneal injection in rats [96]. Another study reported on the antioxidant potential of *M. × piperita* by examining various extracts, such as chloroform, ethanol, and aqueous and essential oils,

showing 73 to 91% antioxidant capacity at 734 nm and 70.3 to 92.6% free radical scavenging activity [66]. These findings suggest that species of *Mentha* exhibit significant antioxidant potential, and therefore, they are ideal sources for the medicine and food industry to fight cardiovascular diseases.

5.3. Antidiabetic Activity of *Mentha*

Diabetes is one of the main factors of cardiovascular diseases. Therefore, potential resources of a natural origin are required to help in the reduction of diabetic and cardiovascular diseases. *Mentha* oils and extracts exhibit a strong antidiabetic potential, as reported by several researchers. The essential oil of *M. viridis* was assessed by the inhibition of α -glucosidase and α -amylase. The results showed that essential oils of *M. viridis* exhibit $IC_{50} = 101.72 \pm 1.86 \mu\text{g/mL}$ inhibitory potential against α -amylase and $IC_{50} = 86.93 \pm 2.43 \mu\text{g/mL}$ against α -glucosidase [3]. Antidiabetic activity of *M. arvensis* L. was determined by in vitro and in vivo experiments in rats. The methanolic extract of *M. arvensis* revealed more than 50% α -amylase and more than 68% α -glucosidase inhibition. Additionally, in rats, significant postprandial hyperglycemia inhibition was observed [97]. Essential oils of *M. suaveolens* were found to be very active against α -glucosidase and α -amylase, indicating an inhibitory potential of $IC_{50} 141.16 \pm 0.2$ and $94.30 \pm 0.06 \mu\text{g/mL}$, respectively [64]. Bayani et al. [98] reported on the antidiabetic effect of aqueous extract prepared from *M. spicata* leaves. The LD_{50} of the extract was more than 1500 mg/kg. The application of the extract showed a significant reduction in cholesterol, low density lipoprotein cholesterol, and triglyceride in diabetic rats as compared to commercially available antidiabetic drug (glebenclamide), indicating that the plant extract possesses a high antidiabetic activity. Thus, it is clear that the use *Mentha* species directly or indirectly can help to reduce the risk of diabetes, and ultimately, reduce the risk of cardiovascular diseases. Based on the literature review, further research is required to screen *Mentha* sp. against specific diseases. Additionally, the search for medicinally important compounds in *Mentha* extracts is also necessary if *Mentha* is to be used as a source of producing and preserving health-oriented food to control diabetes and cardiovascular diseases.

6. Cardioprotective Potential of *Mentha* by Its Antiinflammatory Effect

The *Mentha* species that exhibit effective antioxidant compounds (Polyphenolic) play an important role in reducing the risk of cardiovascular diseases by the suppression of inflammation. One of the species of *Mentha* genus, *M. arvensis*, has shown a cardioprotective potential via inhibition of inflammation [99]. Another species, *M. × piperita*, revealed antiinflammatory activity against chronic and acute inflammation [100]. The mechanism involves suppression of tumor necrosis factor-alpha (TNF- α), fibroblast growth factor-2 (FGF-2), and vascular endothelial growth factor (VEGF) [101]. As cardiovascular patients have high inflammation, the inflammatory activity of *M. × piperita* may be responsible for reducing risks of cardiovascular diseases. The cardiovascular effects of *M. × piperita* were also reported by Badal et al. [102]. Another species of *Mentha* genus, *M. pulegium*, plays role in the reduction of IL-6, TNF- α , and MCP-1 secretion in murine RAW 264.7 macrophages [103,104]. Moreover, other biological properties, such as the antioxidant, cytotoxic, antidiabetic, and antimicrobial potential of *Mentha*, also improve the cardioprotective potential of *Mentha*. Adding *Mentha* compounds and extracts in food products can facilitate the design of functional foods possessing beneficial health effects.

Mechanism of Active Compounds with Cardioprotective Effects

Mentha plants possess a variety of bioactive compounds with cardioprotective and other medicinal properties, among them carvacrol, rosmarinic acid, quercetin, baicalein, and apigenin. These compounds have cardioprotective effects by regulating numerous molecules, such as growth factors, enzymes, kinases, inflammatory molecules, transcriptional factors, apoptosis, etc. (Figure 3). Menthol from *M. arvensis* exhibits activity against ischemic heart disease [105]. Phenolic compound quercetin extracted from the leaves of

M. pulegium was reported to have cardioprotective effects [106]. Similarly, Pulegone and menthofuran isolated from *M. longifolia* and *M. aquatica* possess antiinflammatory effects, which eventually help in reducing the risk of different diseases in the body [107]. Studies also revealed various functions of *Mentha* species exhibiting cardioprotective effects, decreased toxicity, antiarrhythmic effects, heart rate normalization, and antihypersensitive effects (Table 3) [108–111].

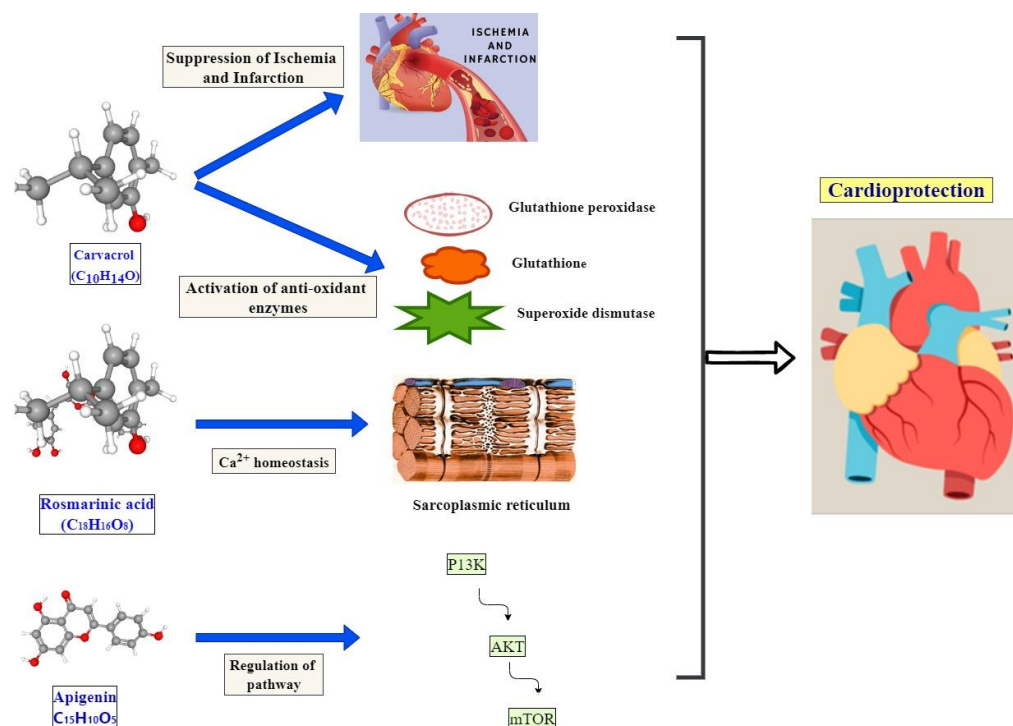


Figure 3. Mode of action of phytochemicals in cardioprotection. This figure was created with <https://app.diagrams.net/> (accessed on 15 August 2022).

Carvacrol is a phytochemical, also reported from *Mentha longifolia*, which exhibits a cardioprotective effect through various mechanisms. It suppresses the myocardial ischemic damage in rats of acute myocardial infarction. The compound reduces the infarct size and myocardial enzymes, such as lactate dehydrogenase, creatine kinase, and cardiac troponin T [105]. Carvacrol also increases activities of antioxidant enzymes, including glutathione peroxidase, glutathione, and superoxide dismutase, and reduces malondialdehydes, which facilitate heart protection from cardiac disorders. Carvacrol also promotes the activation of the Akt/eNOS pathway in cardiomyocytes, helping in cardioprotection [112].

Rosmarinic acid shows cardioprotection effects through the regulation of antioxidant enzymes and gene expression of sarcoplasmic reticulum Ca²⁺ ATPase 2 (SERCA₂) and ryanodine receptor-2 (RyR₂), which play a role in Ca²⁺ homeostasis [113]. Another study revealed that rosmarinic acid provides protection against cardiac fibrosis through the regulation of AMPK α , nuclear translocation of Smad3, and suppression of phosphorylation. It also induces peroxisome proliferator-activated receptors (PPAR- γ) to constrict cardiac fibrosis [114]. Apigenin present in *Mentha* tissues facilitate cardiac protection by regulating PI3K/AKT/mTOR pathway and inhibited adriamycin-induced cardiotoxicity in rats [115]. Quercetin also showed in vitro and in vivo cardioprotection activities. It inhibits MAPK and focal adhesion kinase activities regulated by thrombin in endothelial cells, leading to cardioprotection [116]. Baicalein promotes the downregulation of the phosphorylation of Ca²⁺/calmodulin-dependent protein kinase II (CaMKII) with the expression of Na⁺/Ca²⁺ exchangers (NCX1), which leads to protection from cardiovascular disorders [117]. *Mentha* species possess numerous bioactive compounds that facilitate cardioprotection from lethal disorders (Table 2). The isolation and applications of these bioactive compounds can

facilitate the food industry in the production of functional foods that can protect from cardiovascular disorders.

Table 3. Cardioprotecting effects of active constituents of *Mentha* species.

Species Name	Compounds	Cardioprotecting Effect	References
<i>Mentha arvensis</i> L.	Phenolic compounds, Menthol	Ischemic heart disease	[105]
<i>Mentha x piperita</i> L.	Aqueous extract	Antiinflammatory	[100]
<i>Mentha pulegium</i> L.	Phenolic compounds, Quercitin	Cardioprotective effects	[106]
<i>Mentha aquatica</i> L.	Menthofuran	Antiinflammatory	[107]
	D-carvone	Decrease toxicity	[118]
<i>Mentha canadensis</i> L.	Menthol	Reduce lipid peroxidation	[119]
	Menthone	Reversible cardiac depression	[119]
	Pulegone	Antiinflammatory effect	[108]
<i>Mentha cardiaca</i> J. Gerard ex Baker	Carvone	Decrease toxicity	[118]
	Limonene	Antiarrhythmic effects	[109]
<i>Mentha cervina</i> L.	Pulegone	Antiinflammatory effect	[108]
	Limonene	Antiarrhythmic properties	[109]
<i>Mentha diemenica</i> Spreng.	Pulegone	Antiinflammatory	[108]
	Menthone	Reversible cardiac depression	[119]
	Menthone	Reduce cardiac depression	[119]
<i>Mentha longifolia</i> L.	Pulegone	Antiinflammatory	[108]
	Piperitone	Induce changes in mean aortic pressure and heart rate	[110]
<i>Mentha pulegium</i> L.	Pulegone	Suppress the NLRP3 inflammasome	[120]
	Piperitone	Normalize heart rate	[110]
	Carvone	Antioxidant	[121]
<i>Mentha spicata</i> L.	Cis-carveol	Antihypersensitive, Antioxidant	[122]
	Piperitenone	Antiinflammatory	[111]
	Limonene	Antiarrhythmic properties	[109]

7. Utility of *Mentha* in Food Industry

Mentha is a widely cultivated crop, and several species are used in industry. Currently, phytochemicals of *Mentha* plants are used to improve the flavor in food beverages. Mint has different flavors and is the third most demanded flavor on the world food market [123].

Mentha oils are commonly connected with flavors used in chewing gums and dental pastes; however, they have many other flavors, which are used in the food industry, ranging from candies, dairy products, sauces, and alcoholic and nonalcoholic beverages [124]. *Mentha* plants are also used to preserve, improve the quality, and extend the life of food.

The peppermint flavor of *Mentha* is basically menthol. Menthol causes a cooling effect in the oral cavity and activates cold-sensitive receptors [125]. This molecule also has a sensation of bitterness, so it stimulates both taste and aroma receptors. It releases its minty flavor to food products and other daily life essentials, e.g., tooth paste and mouth fresheners, causing a physiological cooling effect [126]. The essential oils of *Mentha* are used in aromatherapy. Many food and beverages industries use fermented *Mentha* as a flavoring agent. Due to aromatic compounds and secondary metabolites, fresh or dried leaves of *Mentha* are used in the chewing tobacco, confectionaries, analgesic balm, perfumes, candies,

and tobacco industries [127]. Large-scale cultivation, isolation, and characterizations can facilitate the food industry to utilize *Mentha* extracts for different purposes (Figure 4). However, there are still significant knowledge gaps, especially regarding the differing potential of the various composition extracts of different plants; these gaps should be filled to ensure cost effective, compatible ways for the production of foods that include *Mentha*. It is important to compare extracts of *Mentha* with other aromatic and medicinal plant extracts, in order to determine which plant extracts are significant for the herbal medicine industry and nutraceutical industries.

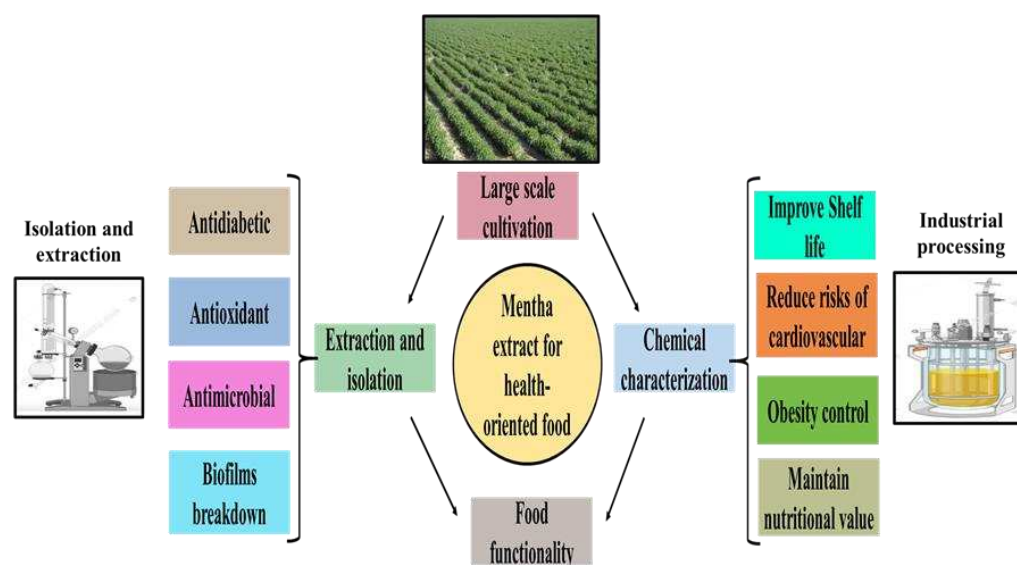


Figure 4. Large-scale cultivation, isolation, and characterizations of *Mentha* phytoconstituents to reduce the malnutritional risks of cardiovascular diseases. This figure was created with Microsoft PowerPoint (accessed on 15 August 2022).

8. Current Challenges and Implementations

Many mint derivatives and their active compounds have been approved by the European commission and the United States Food and Drug Administration for their proposed use as flavoring agents in food products. Plant extracts have numerous intrinsic and extrinsic challenges, which has hindered their applications in the food industry [128,129]. The exiguity of raw materials, chemotypic diversity, inconsistent efficacy, unexplored molecular mechanism of action, adverse effects on food taste, low water solubility, high cost, and threat to biodiversity loss are some leading challenges to *Mentha* use in the food industry [130]. Moreover, plant collection and identification are difficult due to the close resemblance of different *Mentha* species, in addition to the deficiency in the quality assessment of raw materials. Moreover, there is a scarcity in the quantity of extracts from the raw materials of *Mentha* for industrial applications. After mixing with a food matrix, i.e., fat, protein, carbohydrates, salt contents, pH, moisture, etc., together with extrinsic factors (temperature, gaseous composition, and microbial diversity), the antimicrobial potential of *Mentha* extracts is reduced [131]. The excessive aroma present in plant extracts may negatively influence the organoleptic properties (flavor, color, taste, and texture) of food items, leading to a reduction in consumer demand [132]. Due to the abovementioned challenges, the interest in plant-based preservatives has been gradually declining in the past decade.

9. Conclusions and Future Perspective

Mentha species and their compounds have long been used in folk medicines and as flavoring agents. The plants and their extracts are used against digestive, nausea, fevers, headache, tumors, and skin diseases. Numerous essential oils and phytochemicals

are reported from *Mentha* species, which possess different biological activities. These essential oils and their antioxidant, antidiabetic, and antimicrobial potential demonstrate that *Mentha* species could be an extraordinary source for the prevention of cardiovascular diseases. In order to utilize plant extracts to their complete application, there are several avenues that must be explored further. First, future research should focus on the modes of action of the natural compounds present in the extracts. Second, the metabolic pathways which help keep the food taste and aroma alive should be identified. These are important research questions to explore the core substances necessary for the control of diabetes and cardiovascular diseases via *Mentha* species compounds in food or in medicine. Advances in the research of medicinal plants will help in determining the quantity and quality of plant extracts required as food additives and preservatives against a specific disease. A final future potential for *Mentha* extracts does not lie in their potential medicinal values directly, but in their possible use as synergist compounds and processing mechanisms. The applications of natural antidiabetic and cardioprotective agents are likely to grow steadily in the future because of consumer demand for food containing naturally derived preservatives with good taste and aroma, such as *Mentha*.

Author Contributions: Conceptualization, methodology, data collection, S.S., F.U., M.Y., M.N., S.A. and A.A.; data analysis, writing—original draft, W.Z. and W.Z.; writing—review and editing, A.A., S.A., W.Z. and S.S.; supervision and monitoring W.Z. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgments: We are thankful to department of Biotechnology Mohi-ud-Din Islamic University Nerian Sharif, AJ&K, Pakistan for providing basic facilities.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Salehi, B.; Stojanović-Radić, Z.; Matejić, J.; Sharopov, F.; Antolak, H.; Kregiel, D.; Sen, S.; Sharifi-Rad, M.; Acharya, K.; Sharifi-Rad, R. Plants of genus *Mentha*: From farm to food factory. *Plants* **2018**, *7*, 70. [[CrossRef](#)] [[PubMed](#)]
2. Hadi, M.Y.; Hameed, I.H.; Ibraheem, I.A. *Mentha pulegium*: Medicinal uses, Anti-Hepatic, Antibacterial, Antioxidant effect and Analysis of Bioactive Natural Compounds: A Review. *Res. J. Pharm. Technol.* **2017**, *10*, 3580–3584. [[CrossRef](#)]
3. Bouyahya, A.; Lagrouh, F.; El Omari, N.; Bourais, I.; El Jemli, M.; Marmouzi, I.; Salhi, N.; Faouzi, M.E.A.; Belmehdi, O.; Dakka, N. Essential oils of *Mentha viridis* rich phenolic compounds show important antioxidant, antidiabetic, dermatoprotective, antidermatophyte and antibacterial properties. *Biocatal. Agric. Biotechnol.* **2020**, *23*, 101471. [[CrossRef](#)]
4. Zaman, W.; Ye, J.; Ahmad, M.; Saqib, S.; Shinwari, Z.K.; Chen, Z. Phylogenetic exploration of traditional Chinese medicinal plants: A case study on Lamiaceae (angiosperms). *Pak. J. Bot.* **2022**, *54*, 1033–1040. [[CrossRef](#)]
5. Tafrihi, M.; Imran, M.; Tufail, T.; Gondal, T.A.; Caruso, G.; Sharma, S.; Sharma, R.; Atanassova, M.; Atanassov, L.; Valere Tsouh Fokou, P. The wonderful activities of the genus *Mentha*: Not only antioxidant properties. *Molecules* **2021**, *26*, 1118. [[CrossRef](#)] [[PubMed](#)]
6. Mikaili, P.; Mojaverrostami, S.; Moloudizargari, M.; Aghajanshakeri, S. Pharmacological and therapeutic effects of *Mentha Longifolia* L. and its main constituent, menthol. *Anc. Sci. Life* **2013**, *33*, 131. [[PubMed](#)]
7. Asghar, M.; Younas, M.; Arshad, B.; Zaman, W.; Ayaz, A.; Rasheed, S.; Shah, A.; Ullah, F.; Saqib, S. Bioactive potential of cultivated *Mentha arvensis* L. for preservation and production of health-oriented food. *J. Anim. Plant Sci.* **2022**, *32*, 835–844.
8. Kalakoti, M.; Kumar, A.; Mehra, S.; Joshi, A. Analysis of phytoconstituents present in *Mentha piperita*. *Indian J. Biotechnol. Pharm. Res.* **2014**, *2*, 25–31.
9. Jäger, A.K.; Almqvist, J.P.; Vangsøe, S.A.; Stafford, G.I.; Adersen, A.; Van Staden, J. Compounds from *Mentha aquatica* with affinity to the GABA-benzodiazepine receptor. *S. Afr. J. Bot.* **2007**, *73*, 518–521. [[CrossRef](#)]
10. Gulluce, M.; Sahin, F.; Sokmen, M.; Ozer, H.; Daferera, D.; Sokmen, A.; Polissiou, M.; Adiguzel, A.; Ozkan, H. Antimicrobial and antioxidant properties of the essential oils and methanol extract from *Mentha longifolia* L. ssp. *longifolia*. *Food Chem.* **2007**, *103*, 1449–1456. [[CrossRef](#)]

11. Brahmi, F.; Khodir, M.; Mohamed, C.; Pierre, D. Chemical composition and biological activities of *Mentha* species. *Aromat. Med. Plants-Back Nat.* **2017**, *10*, 47–79.
12. Association, A.D. 6. Glycemic targets: Standards of medical care in diabetes-2018. *Diabetes Care* **2018**, *41*, S55. [[CrossRef](#)] [[PubMed](#)]
13. Quintin, D.; Garcia-Gomez, P.; Ayuso, M.; Sanmartin, A. Active biocompounds to improve food nutritional value. *Trends Food Sci. Technol.* **2019**, *84*, 19–21. [[CrossRef](#)]
14. de Melo, A.N.F.; de Souza Pedrosa, G.T.; da Cruz Almeida, E.T.; Cao, G.; Macarasin, D.; Schaffner, D.W.; de Souza, E.L.; Magnani, M. Successive exposure to *Mentha piperita* L. essential oil affects the culturability and induces membrane repair in a persisting epidemic *Salmonella* Typhimurium PT4. *Microb. Pathog.* **2020**, *149*, 104264. [[CrossRef](#)] [[PubMed](#)]
15. Ghanemi, A.; Melouane, A.; Yoshioka, M.; St-Amand, J. Exercise and High-Fat Diet in Obesity: Functional Genomics Perspectives of Two Energy Homeostasis Pillars. *Genes* **2020**, *11*, 875. [[CrossRef](#)] [[PubMed](#)]
16. Das, A.K.; Nanda, P.K.; Bandyopadhyay, S.; Banerjee, R.; Biswas, S.; McClements, D.J. Application of nanoemulsion-based approaches for improving the quality and safety of muscle foods: A comprehensive review. *Compr. Rev. Food Sci. Food Saf.* **2020**, *19*, 2677–2700. [[CrossRef](#)]
17. Farag, M.A.; Abib, B.; Ayad, L.; Khattab, A.R. Sweet and bitter oranges: An updated comparative review of their bioactives, nutrition, food quality, therapeutic merits and biowaste valorization practices. *Food Chem.* **2020**, *331*, 127306. [[CrossRef](#)]
18. Bijani, A.; Cumming, R.G.; Hosseini, S.-R.; Yazdanpour, M.; Rahimi, M.; Sahebani, A.; Ghadimi, R. Obesity paradox on the survival of elderly patients with diabetes: An AHAP-based study. *J. Diabetes Metab. Disord.* **2018**, *17*, 45–51. [[CrossRef](#)] [[PubMed](#)]
19. Westman, E.C.; Tondt, J.; Maguire, E.; Yancy, W.S., Jr. Implementing a low-carbohydrate, ketogenic diet to manage type 2 diabetes mellitus. *Expert Rev. Endocrinol. Metab.* **2018**, *13*, 263–272. [[CrossRef](#)]
20. Hopkins, B.D.; Goncalves, M.D.; Cantley, L.C. Insulin–PI3K signalling: An evolutionarily insulated metabolic driver of cancer. *Nat. Rev. Endocrinol.* **2020**, *16*, 276–283. [[CrossRef](#)] [[PubMed](#)]
21. Dutra, K.; Wanderley-Teixeira, V.; Guedes, C.; Cruz, G.; Navarro, D.; Monteiro, A.; Agra, A.; Neto, C.L.; Teixeira, Á. Toxicity of Essential Oils of Leaves of Plants from the Genus *Piper* with Influence on the Nutritional Parameters of *Spodoptera frugiperda* (JE Smith) (Lepidoptera: Noctuidae). *J. Essent. Oil Bear. Plants* **2020**, *23*, 213–229. [[CrossRef](#)]
22. Gatti, R.; Lotti, C.; Morigi, R.; Andreani, A. Determination of octopamine and tyramine traces in dietary supplements and phytoextracts by high performance liquid chromatography after derivatization with 2, 5-dimethyl-1H-pyrrole-3, 4-dicarbaldehyde. *J. Chromatogr. A* **2012**, *1220*, 92–100. [[CrossRef](#)]
23. Paoli, A.; Cenci, L.; Fancelli, M.; Parmagnani, A.; Fratter, A.; Cucchi, A.; Bianco, A. Ketogenic diet and phytoextracts. *Sci. Advis. Board* **2010**, *21*, 24.
24. Mench, M.; Schwitzguébel, J.-P.; Schroeder, P.; Bert, V.; Gawronski, S.; Gupta, S. Assessment of successful experiments and limitations of phytotechnologies: Contaminant uptake, detoxification and sequestration, and consequences for food safety. *Environ. Sci. Pollut. Res.* **2009**, *16*, 876. [[CrossRef](#)] [[PubMed](#)]
25. Mohan, K.; Ganesan, A.R.; Muralisankar, T.; Jayakumar, R.; Sathishkumar, P.; Uthayakumar, V.; Chandirasekar, R.; Revathi, N. Recent insights into the extraction, characterization, and bioactivities of chitin and chitosan from insects. *Trends Food Sci. Technol.* **2020**, *105*, 17–42. [[CrossRef](#)] [[PubMed](#)]
26. Naeem, M.; Muqarab, R.; Waseem, M. The *Solanum melongena* COP1 delays fruit ripening and influences Ethylene signaling in tomato. *J. Plant Physiol.* **2019**, *240*, 152997. [[CrossRef](#)]
27. Corrêa, R.C.; Peralta, R.M.; Haminiuk, C.W.; Maciel, G.M.; Bracht, A.; Ferreira, I.C. New phytochemicals as potential human anti-aging compounds: Reality, promise, and challenges. *Crit. Rev. Food Sci. Nutr.* **2018**, *58*, 942–957. [[CrossRef](#)] [[PubMed](#)]
28. Niggli, U.; Slabe, A.; Schmid, O.; Halberg, N.; Schlüter, M. *Vision for an Organic Food and Farming Research Agenda 2025. Organic Knowledge for the Future*; IFOAM Regional Group European Union (IFOAM EU Group): Brussels, Belgium; International Society of Organic Agriculture Research (ISOFAR): Bonn, Germany, 2008.
29. Ritota, M.; Manzi, P. Natural Preservatives from Plant in Cheese Making. *Animals* **2020**, *10*, 749. [[CrossRef](#)] [[PubMed](#)]
30. Ng, K.R.; Lyu, X.; Mark, R.; Chen, W.N. Antimicrobial and antioxidant activities of phenolic metabolites from flavonoid-producing yeast: Potential as natural food preservatives. *Food Chem.* **2019**, *270*, 123–129. [[CrossRef](#)]
31. Hever, J. Plant-based diets: A physician’s guide. *Perm. J.* **2016**, *20*, 15–082. [[CrossRef](#)]
32. Barnard, N.D.; Goldman, D.M.; Loomis, J.F.; Kahleova, H.; Levin, S.M.; Neabore, S.; Batts, T.C. Plant-based diets for cardiovascular safety and performance in endurance sports. *Nutrients* **2019**, *11*, 130. [[CrossRef](#)] [[PubMed](#)]
33. Pipitone, G.; Zoppi, G.; Bocchini, S.; Rizzo, A.M.; Chiaramonti, D.; Pirone, R.; Bensaid, S. Aqueous phase reforming of the residual waters derived from lignin-rich hydrothermal liquefaction: Investigation of representative organic compounds and actual biorefinery streams. *Catal. Today* **2020**, *345*, 237–250. [[CrossRef](#)]
34. Franco, R.R.; Alves, V.H.M.; Zabisky, L.F.R.; Justino, A.B.; Martins, M.M.; Saraiva, A.L.; Goulart, L.R.; Espindola, F.S. Antidiabetic potential of *Bauhinia forficata* Link leaves: A non-cytotoxic source of lipase and glycoside hydrolases inhibitors and molecules with antioxidant and antiglycation properties. *Biomed. Pharmacother.* **2020**, *123*, 109798. [[CrossRef](#)] [[PubMed](#)]
35. Das, G.; Patra, J.K.; Debnath, T.; Ansari, A.; Shin, H.-S. Investigation of antioxidant, antibacterial, antidiabetic, and cytotoxicity potential of silver nanoparticles synthesized using the outer peel extract of *Ananas comosus* (L.). *PLoS ONE* **2019**, *14*, e0220950. [[CrossRef](#)]

36. Caro, D.C.; Rivera, D.E.; Ocampo, Y.; Franco, L.A.; Salas, R.D. Pharmacological evaluation of *Mentha spicata* L. and *Plantago major* L., medicinal plants used to treat anxiety and insomnia in Colombian Caribbean coast. *Evid. -Based Complement. Altern. Med.* **2018**, *2018*, 5921514. [[CrossRef](#)]
37. Eftekhari, A.; Khusro, A.; Ahmadian, E.; Dizaj, S.M.; Hasanzadeh, A.; Cucchiari, M. Phytochemical and nutra-pharmaceutical attributes of *Mentha* spp.: A comprehensive review. *Arab. J. Chem.* **2021**, *14*, 103106. [[CrossRef](#)]
38. Shinwari, Z.K.; Sultan, S.; Mehmood, T. Molecular and morphological characterization of selected *Mentha* species. *Pak. J. Bot.* **2011**, *43*, 1433–1436.
39. Akram, M.; Uzair, M.; Malik, N.S.; Mahmood, A.; Sarwer, N.; Madni, A.; Asif, H. *Mentha arvensis* Linn.: A review article. *J. Med. Plants Res.* **2011**, *5*, 4499–4503.
40. Vining, K.J.; Hummer, K.E.; Bassil, N.V.; Lange, B.M.; Khoury, C.K.; Carver, D. Crop wild relatives as germplasm resource for cultivar improvement in mint (*Mentha* L.). *Front. Plant Sci.* **2020**, *11*, 1217. [[CrossRef](#)] [[PubMed](#)]
41. Lawrence, B.M. *Mint: The Genus Mentha*; CRC Press: Boca Raton, FL, USA, 2006.
42. Zahra, N.B.; Shinwari, Z.K.; Qaiser, M. Dna barcoding: A tool for standardization of Herbal Medicinal Products (HMPS) of Lamiaceae From Pakistan. *Pak. J. Bot.* **2016**, *48*, 2167–2174.
43. Wilson, A.E.; Sparks, D.L.; Knott, K.K.; Willard, S.; Brown, A. Implementing solid phase microextraction (SPME) as a tool to detect volatile compounds produced by giant pandas in the environment. *PLoS ONE* **2018**, *13*, e0208618. [[CrossRef](#)]
44. Massawe, V.C.; Hanif, A.; Farzand, A.; Mburu, D.K.; Ochola, S.O.; Wu, L.; Tahir, H.A.S.; Gu, Q.; Wu, H.; Gao, X. Volatile compounds of endophytic *Bacillus* spp. have biocontrol activity against *Sclerotinia sclerotiorum*. *Phytopathology* **2018**, *108*, 1373–1385. [[CrossRef](#)] [[PubMed](#)]
45. Mohammadhosseini, M.; Venditti, A.; Mahdavi, B. Characterization of essential oils and volatiles from the aerial parts of *Mentha pulegium* L. (Lamiaceae) using microwave-assisted hydrodistillation (MAHD) and headspace solid phase microextraction (HS-SPME) in combination with GC-MS. *Nat. Prod. Res.* **2021**, 1–5. [[CrossRef](#)] [[PubMed](#)]
46. Sonam, K.A.; Kumar, V.; Guleria, I.; Sharma, M.; Kumar, A.; Alruways, M.; Khan, N.; Raina, R. Antimicrobial Potential and Chemical Profiling of Leaves Essential Oil of *Mentha* Species Growing under North-West Himalaya Conditions. *J. Pure Appl. Microbiol.* **2021**, *15*, 2229–2243. [[CrossRef](#)]
47. Fidan, H.; Stankov, S.; Iliev, I.; Gandova, V.; Stoyanova, A.; Dincheva, I. Chemical composition of essential oils from different *Mentha* ssp. In Proceedings of the 2022 8th International Conference on Energy Efficiency and Agricultural Engineering (EE&AE), Ruse, Bulgaria, 30 June–2 July 2022; pp. 1–4.
48. Aldogman, B.; Bilel, H.; Moustafa, S.M.N.; Elmassary, K.F.; Ali, H.M.; Alotaibi, F.Q.; Hamza, M.; Abdelgawad, M.A.; El-Ghorab, A.H. Investigation of Chemical Compositions and Biological Activities of *Mentha suaveolens* L. from Saudi Arabia. *Molecules* **2022**, *27*, 2949. [[CrossRef](#)] [[PubMed](#)]
49. Camele, I.; Gruľová, D.; Elshafie, H.S. Chemical composition and antimicrobial properties of *Mentha × piperita* cv. 'Kristinka' essential oil. *Plants* **2021**, *10*, 1567. [[CrossRef](#)] [[PubMed](#)]
50. Zhao, H.; Ren, S.; Yang, H.; Tang, S.; Guo, C.; Liu, M.; Tao, Q.; Ming, T.; Xu, H. Peppermint essential oil: Its phytochemistry, biological activity, pharmacological effect and application. *Biomed. Pharmacother.* **2022**, *154*, 113559. [[CrossRef](#)]
51. Cosentino, M.; Bombelli, R.; Conti, A.; Colombo, M.L.; Azzetti, A.; Bergamaschi, A.; Marino, F.; Lecchini, S. Antioxidant properties and in vitro immunomodulatory effects of peppermint (*Mentha piperita* L.) Essential oils in human leukocytes'. *J. Pharm. Sci. Res.* **2009**, *1*, 33–43.
52. Fidy, K.; Fiedorowicz, A.; Strzadala, L.; Szumny, A. β -caryophyllene and β -caryophyllene oxide—Natural compounds of anticancer and analgesic properties. *Cancer Med.* **2016**, *5*, 3007–3017. [[CrossRef](#)] [[PubMed](#)]
53. de Sousa Barros, A.; de Moraes, S.M.; Ferreira, P.A.T.; Vieira, Í.G.P.; Craveiro, A.A.; dos Santos Fontenelle, R.O.; de Menezes, J.E.S.A.; da Silva, F.W.F.; de Sousa, H.A. Chemical composition and functional properties of essential oils from *Mentha* species. *Ind. Crops Prod.* **2015**, *76*, 557–564. [[CrossRef](#)]
54. Mahmoud, E.A.-M.; Al-Askalany, S.A.; Hanafy, E.A. Antioxidant, antibacterial and cytotoxic effect of *Cymbopogon citratus*, *Mentha longifolia*, and *Artemisia absinthium* essential oils. *Egypt. J. Chem.* **2022**, *65*, 287–296.
55. Bai, X.; Aimila, A.; Aidarhan, N.; Duan, X.; Maiwulanjiang, M. Chemical constituents and biological activities of essential oil from *Mentha longifolia*: Effects of different extraction methods. *Int. J. Food Prop.* **2020**, *23*, 1951–1960. [[CrossRef](#)]
56. Singh, S.; Das, S.S.; Singh, G.; Perotti, M.; Schuff, C.; Catalán, C. Comparative study of chemistry compositions and antimicrobial potentials of essential oils and oleoresins from dried and fresh *Mentha longifolia* L. *J. Coast. Life Med.* **2015**, *3*, 987–991. [[CrossRef](#)]
57. Baali, F.; Boumerfeg, S.; Napoli, E.; Boudjelal, A.; Righi, N.; Deghima, A.; Baghiani, A.; Ruberto, G. Chemical composition and biological activities of essential oils from two wild Algerian medicinal plants: *Mentha pulegium* L. and *Lavandula stoechas* L. *J. Essent. Oil Bear. Plants* **2019**, *22*, 821–837. [[CrossRef](#)]
58. Sarikurcu, C.; Eryigit, F.; Cengiz, M.; Tepe, B.; Cakir, A.; Mete, E. Screening of the antioxidant activity of the essential oil and methanol extract of *Mentha pulegium* L. from Turkey. *Spectrosc. Lett.* **2012**, *45*, 352–358. [[CrossRef](#)]
59. Batool, I.; Nisar, S.; Hamrouni, L.; Jilani, M.I. Extraction, production and analysis techniques for menthol: A review. *Int. J. Chem. Biochem. Sci.* **2018**, *14*, 71–76.
60. Lampronti, I.; Saab, A.M.; Gambari, R. Antiproliferative activity of essential oils derived from plants belonging to the Magnoliophyta division. *Int. J. Oncol.* **2006**, *29*, 989–995. [[CrossRef](#)]

61. Biswas, N.N.; Saha, S.; Ali, M.K. Antioxidant, antimicrobial, cytotoxic and analgesic activities of ethanolic extract of *Mentha arvensis* L. *Asian Pac. J. Trop. Biomed.* **2014**, *4*, 792–797. [[CrossRef](#)]
62. Diop, S.M.; Guèye, M.T.; Ndiaye, I.; Ndiaye, E.H.B.; Diop, M.B.; Heuskin, S.; Fauconnier, M.-L.; Lognay, G. Chemical composition of essential oils and floral waters of *Mentha longifolia* (L.) Huds. from Senegal. *Am. J. Essent. Oils Nat. Prod.* **2016**, *4*, 46–49.
63. Oumzil, H.; Ghoulami, S.; Rhajaoui, M.; Ildrissi, A.; Fkih-Tetouani, S.; Faïd, M.; Benjouad, A. Antibacterial and antifungal activity of essential oils of *Mentha suaveolens*. *Phytother. Res. Int. J. Devoted Pharmacol. Toxicol. Eval. Nat. Prod. Deriv.* **2002**, *16*, 727–731. [[CrossRef](#)] [[PubMed](#)]
64. Al-Mijalli, S.H.; Assaggaf, H.; Qasem, A.; El-Shemi, A.G.; Abdallah, E.M.; Mrabti, H.N.; Bouyahya, A. Antioxidant, Antidiabetic, and Antibacterial Potentials and Chemical Composition of *Salvia officinalis* and *Mentha suaveolens* Grown Wild in Morocco. *Adv. Pharmacol. Pharm. Sci.* **2022**, *2022*, 2844880. [[CrossRef](#)] [[PubMed](#)]
65. Dhifi, W.; Litaïem, M.; Jelali, N.; Hamdi, N.; Mnif, W. Identification of a new chemotype of the plant *Mentha aquatica* grown in Tunisia: Chemical composition, antioxidant and biological activities of its essential oil. *J. Essent. Oil Bear. Plants* **2011**, *14*, 320–328. [[CrossRef](#)]
66. Singh, R.; Shushni, M.A.; Belkheir, A. Antibacterial and antioxidant activities of *Mentha piperita* L. *Arab. J. Chem.* **2015**, *8*, 322–328. [[CrossRef](#)]
67. Figueroa-Pérez, M.G.; Gallegos-Corona, M.A.; Ramos-Gomez, M.; Reynoso-Camacho, R. Salicylic acid elicitation during cultivation of the peppermint plant improves anti-diabetic effects of its infusions. *Food Funct.* **2015**, *6*, 1865–1874. [[CrossRef](#)] [[PubMed](#)]
68. Trevisan, S.C.C.; Menezes, A.P.P.; Barbalho, S.M.; Guiguer, É.L. Properties of *Mentha piperita*: A brief review. *World J. Pharm. Med. Res.* **2017**, *3*, 309–313.
69. Balakrishnan, A. Therapeutic uses of peppermint—a review. *J. Pharm. Sci. Res.* **2015**, *7*, 474.
70. Mackonochie, M.; Heinrich, M. Materia medica chests: Investigating the 19th century use of botanicals by different medical professions. *J. Herb. Med.* **2019**, *16*, 100255. [[CrossRef](#)]
71. Harley, R.; Brighton, C. Chromosome numbers in the genus *Mentha* L. *Bot. J. Linn. Soc.* **1977**, *74*, 71–96. [[CrossRef](#)]
72. Pereira, O.R.; Cardoso, S.M. Overview on *Mentha* and *Thymus* polyphenols. *Curr. Anal. Chem.* **2013**, *9*, 382–396. [[CrossRef](#)]
73. Shai, L.; Magano, S.; Lebelo, S.; Mogale, A. Inhibitory effects of five medicinal plants on rat alpha-glucosidase: Comparison with their effects on yeast alpha-glucosidase. *J. Med. Plants Res.* **2011**, *5*, 2863–2867.
74. Dorman, H.D.; Koşar, M.; Kahlos, K.; Holm, Y.; Hiltunen, R. Antioxidant properties and composition of aqueous extracts from *Mentha* species, hybrids, varieties, and cultivars. *J. Agric. Food Chem.* **2003**, *51*, 4563–4569. [[CrossRef](#)] [[PubMed](#)]
75. Dwivedy, A.K.; Prakash, B.; Chanotiya, C.S.; Bisht, D.; Dubey, N.K. Chemically characterized *Mentha cardiaca* L. essential oil as plant based preservative in view of efficacy against biodeteriorating fungi of dry fruits, aflatoxin secretion, lipid peroxidation and safety profile assessment. *Food Chem. Toxicol.* **2017**, *106*, 175–184. [[CrossRef](#)] [[PubMed](#)]
76. Al-Zyadi, Q.A. Effect of planting and harvesting dates on the growth and essential oil content of peppermint (*Mentha piperita* L.). *Plant Arch.* **2019**, *19*, 319–322.
77. Kozlovich, S.; Chen, G.; Watson, C.J.; Blot, W.J.; Lazarus, P. Role of l- and d-Menthol in the Glucuronidation and Detoxification of the Major Lung Carcinogen, NNAL. *Drug Metab. Dispos.* **2019**, *47*, 1388–1396. [[CrossRef](#)]
78. Jeya Shree, T.; Gowri Sree, V.; Poompavai, S.; Sieni, E.; Sgarbossa, P.; Camarillo, I.; Sundararajan, R. Inhibition of Proliferation of HeLa Cells by Pulsed Electric Field Treated *Mentha piperita* (Mint) Extract. *IETE J. Res.* **2019**, *68*, 858–868. [[CrossRef](#)]
79. Sevindik, M. Pharmacological Properties of Mentha Species. *J. Tradit. Med. Clin. Naturop.* **2018**, *7*, 2. [[CrossRef](#)]
80. Sheikh, B.Y.; Sarker, M.M.R.; Kamarudin, M.N.A.; Ismail, A. Prophetic medicine as potential functional food elements in the intervention of cancer: A review. *Biomed. Pharmacother.* **2017**, *95*, 614–648. [[CrossRef](#)]
81. Roulis, E.; Polkinghorne, A.; Timms, P. Chlamydia pneumoniae: Modern insights into an ancient pathogen. *Trends Microbiol.* **2013**, *21*, 120–128. [[CrossRef](#)]
82. Hussain, A.I.; Anwar, F.; Nigam, P.S.; Ashraf, M.; Gilani, A.H. Seasonal variation in content, chemical composition and antimicrobial and cytotoxic activities of essential oils from four *Mentha* species. *J. Sci. Food Agric.* **2010**, *90*, 1827–1836. [[CrossRef](#)]
83. Mimica-Dukić, N.; Božin, B.; Soković, M.; Mihajlović, B.; Matavulj, M. Antimicrobial and antioxidant activities of three *Mentha* species essential oils. *Planta Med.* **2003**, *69*, 413–419.
84. López, V.; Akerreta, S.; Casanova, E.; García-Mina, J.M.; Cavero, R.Y.; Calvo, M.I. In vitro antioxidant and anti-rhizopus activities of Lamiaceae herbal extracts. *Plant Foods Hum. Nutr.* **2007**, *62*, 151–155. [[CrossRef](#)] [[PubMed](#)]
85. Zhang, L.; Xu, S.-g.; Liang, W.; Mei, J.; Di, Y.-y.; Lan, H.-h.; Yang, Y.; Wang, W.-w.; Luo, Y.-y.; Wang, H.-z. Antibacterial activity and mode of action of *Mentha arvensis* ethanol extract against multidrug-resistant *Acinetobacter baumannii*. *Trop. J. Pharm. Res.* **2015**, *14*, 2099–2106. [[CrossRef](#)]
86. Rodrigues, L.; Duarte, A.; Figueiredo, A.C.; Brito, L.; Teixeira, G.; Moldao, M.; Monteiro, A. Chemical composition and antibacterial activity of the essential oils from the medicinal plant *Mentha cervina* L. grown in Portugal. *Med. Chem. Res.* **2012**, *21*, 3485–3490. [[CrossRef](#)]
87. Wannissorn, B.; Jarikasem, S.; Siriwangchai, T.; Thubthimthed, S. Antibacterial properties of essential oils from Thai medicinal plants. *Fitoterapia* **2005**, *76*, 233–236. [[CrossRef](#)] [[PubMed](#)]
88. Chagas, E.C.; Majolo, C.; Monteiro, P.C.; Oliveira, M.R.d.; Gama, P.E.; Bizzo, H.R.; Chaves, F.C.M. Composition of essential oils of *Mentha* species and their antimicrobial activity against *Aeromonas* spp. *J. Essent. Oil Res.* **2020**, *32*, 209–215. [[CrossRef](#)]

89. Verma, S.K.; Goswami, P.; Verma, R.S.; Padalia, R.C.; Chauhan, A.; Singh, V.R.; Darokar, M.P. Chemical composition and antimicrobial activity of bergamot-mint (*Mentha citrata* Ehrh.) essential oils isolated from the herbage and aqueous distillate using different methods. *Ind. Crops Prod.* **2016**, *91*, 152–160. [[CrossRef](#)]
90. Espiritu, A.G.; Doma, B.T., Jr.; Wang, Y.-F.; Masim, F.C.P. Efficacy of methanol extracts of *Mentha haplocalyx* Briq. and *Paeonia suffruticosa* Andr. for potential antibacterial activity. *Sustain. Environ. Res.* **2014**, *24*, 319–324.
91. Bekka-Hadji, F.; Bombarda, I.; Touati, A. Antibacterial activity against methicillin-resistant *Staphylococcus aureus* of five essential oils from Algerian medicinal plants (Lamiaceae). *J. Essential Oil Res.* **2016**, *28*, 518–527. [[CrossRef](#)]
92. Chessa, M.; Sias, A.; Piana, A.; Mangano, G.S.; Petretto, G.L.; Masia, M.D.; Tirillini, B.; Pintore, G. Chemical composition and antibacterial activity of the essential oil from *Mentha requienii* Benth. *Nat. Prod. Res.* **2013**, *27*, 93–99. [[CrossRef](#)]
93. Džamić, A.M.; Soković, M.D.; Ristić, M.S.; Novaković, M.; Grujić-Jovanović, S.; Tešević, V.; Marin, P.D. Antifungal and antioxidant activity of *Mentha longifolia* (L.) Hudson (Lamiaceae) essential oil. *Bot. Serbica* **2010**, *34*, 57–61.
94. Nikavar, B.; Ali, N.A.; Kamalnezhad, M. Evaluation of the antioxidant properties of five *Mentha* species. *Iran. J. Pharm. Sci.* **2008**, *7*, 203–209.
95. Benabdallah, A.; Rahmoune, C.; Boumendjel, M.; Aissi, O.; Messaoud, C. Total phenolic content and antioxidant activity of six wild *Mentha* species (Lamiaceae) from northeast of Algeria. *Asian Pac. J. Trop. Biomed.* **2016**, *6*, 760–766. [[CrossRef](#)]
96. Jain, S.; Jain, D.K.; Balekar, N. In-Vivo Antioxidant activity of ethanolic extract of *Mentha pulegium* leaf against CCl₄ induced toxicity in rats. *Asian Pac. J. Trop. Biomed.* **2012**, *2*, S737–S740. [[CrossRef](#)]
97. Agawane, S.B.; Gupta, V.S.; Kulkarni, M.J.; Bhattacharya, A.K.; Koratkar, S.S. Chemo-biological evaluation of antidiabetic activity of *Mentha arvensis* L. and its role in inhibition of advanced glycation end products. *J. Ayurveda Integr. Med.* **2019**, *10*, 166–170. [[CrossRef](#)] [[PubMed](#)]
98. Bayani, M.; Ahmadi-Hamedani, M.; Javan, A.J. Study of hypoglycemic, hypocholesterolemic and antioxidant activities of Iranian *Mentha spicata* leaves aqueous extract in diabetic rats. *Iran. J. Pharm. Res. IJPR* **2017**, *16*, 75.
99. Zaidi, S.F.; Muhammad, J.S.; Shahryar, S.; Usmanghani, K.; Gilani, A.-H.; Jafri, W.; Sugiyama, T. Anti-inflammatory and cytoprotective effects of selected Pakistani medicinal plants in *Helicobacter pylori*-infected gastric epithelial cells. *J. Ethnopharmacol.* **2012**, *141*, 403–410. [[CrossRef](#)]
100. Atta, A.; Alkofahi, A. Anti-nociceptive and anti-inflammatory effects of some Jordanian medicinal plant extracts. *J. Ethnopharmacol.* **1998**, *60*, 117–124. [[CrossRef](#)]
101. Modarresi, M.; Farahpour, M.-R.; Baradaran, B. Topical application of *Mentha piperita* essential oil accelerates wound healing in infected mice model. *Inflammopharmacology* **2019**, *27*, 531–537. [[CrossRef](#)]
102. Badal, R.M.; Badal, D.; Badal, P.; Khare, A.; Shrivastava, J.; Kumar, V. Pharmacological action of *Mentha piperita* on lipid profile in fructose-fed rats. *Iran. J. Pharm. Res. IJPR* **2011**, *10*, 843.
103. Brahmi, F.; Nury, T.; Debbabi, M.; Hadj-Ahmed, S.; Zarrouk, A.; Prost, M.; Madani, K.; Boulekbache-Makhlouf, L.; Lizard, G. Evaluation of antioxidant, anti-inflammatory and cytoprotective properties of ethanolic mint extracts from Algeria on 7-ketocholesterol-treated murine RAW 264.7 macrophages. *Antioxidants* **2018**, *7*, 184. [[CrossRef](#)]
104. Caputo, L.; Cornara, L.; Raimondo, F.M.; De Feo, V.; Vanin, S.; Denaro, M.; Trombetta, D.; Smeriglio, A. *Mentha pulegium* L.: A plant underestimated for its toxicity to be recovered from the perspective of the circular economy. *Molecules* **2021**, *26*, 2154. [[CrossRef](#)] [[PubMed](#)]
105. Yu, W.; Liu, Q.; Zhu, S. Carvacrol protects against acute myocardial infarction of rats via anti-oxidative and anti-apoptotic pathways. *Biol. Pharm. Bull.* **2013**, *36*, 579–584. [[CrossRef](#)]
106. Taamalli, A.; Arráez-Román, D.; Abaza, L.; Iswaldi, I.; Fernández-Gutiérrez, A.; Zarrouk, M.; Segura-Carretero, A. LC-MS-based metabolite profiling of methanolic extracts from the medicinal and aromatic species *Mentha pulegium* and *Origanum majorana*. *Phytochem. Anal.* **2015**, *26*, 320–330. [[CrossRef](#)] [[PubMed](#)]
107. Irina, B.; Maria-Magdalena, Z.; Ioan, B. Chemical composition of essential oils from *Mentha aquatica* L. at different moments of the ontogenetic cycle. *J. Med. Plants Res.* **2013**, *7*, 470–473.
108. Roy, A.; Park, H.-J.; Abdul, Q.A.; Jung, H.A.; Choi, J.S. Pulegone Exhibits Anti-inflammatory Activities through the Regulation of NF- κ B and Nrf-2 Signaling Pathways in LPS-stimulated RAW 264.7 cells. *Nat. Prod. Sci.* **2018**, *24*, 28–35. [[CrossRef](#)]
109. Nascimento, G.A.d.; Souza, D.S.d.; Lima, B.S.; Vasconcelos, C.M.L.d.; Araújo, A.A.d.S.; Durço, A.O.; Quintans-Junior, L.J.; Almeida, J.R.G.d.S.; Oliveira, A.P.; Santana-Filho, V.J.d. Bradycardic and antiarrhythmic effects of the D-limonene in rats. *Arq. Bras. De Cardiol.* **2019**, *113*, 925–932. [[CrossRef](#)]
110. Lahlou, S.; Carneiro-Leão, R.F.L.; Leal-Cardoso, J.H.; Toscano, C.F. Cardiovascular effects of the essential oil of *Mentha x villosa* and its main constituent, piperitenone oxide, in normotensive anaesthetised rats: Role of the autonomic nervous system. *Planta Med.* **2001**, *67*, 638–643. [[CrossRef](#)] [[PubMed](#)]
111. Mogosan, C.; Vostinaru, O.; Oprean, R.; Heghes, C.; Filip, L.; Balica, G.; Moldovan, R.I. A comparative analysis of the chemical composition, anti-inflammatory, and antinociceptive effects of the essential oils from three species of *Mentha* cultivated in Romania. *Molecules* **2017**, *22*, 263. [[CrossRef](#)]
112. Chen, Y.; Ba, L.; Huang, W.; Liu, Y.; Pan, H.; Mingyao, E.; Shi, P.; Wang, Y.; Li, S.; Qi, H. Role of carvacrol in cardioprotection against myocardial ischemia/reperfusion injury in rats through activation of MAPK/ERK and Akt/eNOS signaling pathways. *Eur. J. Pharmacol.* **2017**, *796*, 90–100. [[CrossRef](#)] [[PubMed](#)]

113. Javidanpour, S.; Dianat, M.; Badavi, M.; Mard, S.A. The cardioprotective effect of rosmarinic acid on acute myocardial infarction and genes involved in Ca²⁺ homeostasis. *Free Radic. Res.* **2017**, *51*, 911–923. [[CrossRef](#)] [[PubMed](#)]
114. Lu, Y.; Feng, Y.; Liu, D.; Zhang, Z.; Gao, K.; Zhang, W.; Tang, H. Thymoquinone attenuates myocardial ischemia/reperfusion injury through activation of SIRT1 signaling. *Cell. Physiol. Biochem.* **2018**, *47*, 1193–1206. [[CrossRef](#)]
115. Mahajan, U.B.; Chandrayan, G.; Patil, C.R.; Arya, D.S.; Suchal, K.; Agrawal, Y.O.; Ojha, S.; Goyal, S.N. The protective effect of apigenin on myocardial injury in diabetic rats mediating activation of the PPAR- γ pathway. *Int. J. Mol. Sci.* **2017**, *18*, 756. [[CrossRef](#)]
116. Moon, S.-K.; Cho, G.-O.; Jung, S.-Y.; Gal, S.-W.; Kwon, T.K.; Lee, Y.-C.; Madamanchi, N.R.; Kim, C.-H. Quercetin exerts multiple inhibitory effects on vascular smooth muscle cells: Role of ERK1/2, cell-cycle regulation, and matrix metalloproteinase-9. *Biochem. Biophys. Res. Commun.* **2003**, *301*, 1069–1078. [[CrossRef](#)]
117. Shi, R.; Wei, Z.; Zhu, D.; Fu, N.; Wang, C.; Yin, S.; Liang, Y.; Xing, J.; Wang, X.; Wang, Y. Baicalein attenuates monocrotaline-induced pulmonary arterial hypertension by inhibiting vascular remodeling in rats. *Pulm. Pharmacol. Ther.* **2018**, *48*, 124–135. [[CrossRef](#)]
118. Abbas, M.M.; Kandil, Y.Í.; Abbas, M.A. R-(-)-carvone attenuated doxorubicin induced cardiotoxicity in vivo and potentiated its anticancer toxicity in vitro. *Balk. Med. J.* **2020**, *37*, 98. [[CrossRef](#)] [[PubMed](#)]
119. Cantanhêde, S.M.; Amado, L.L.; da Costa, B.M.P.A.; Barbas, L.A.L.; Torres, M.F.; Hamoy, A.O.; da Paz, C.A.; da Silva Ferreira, C.B.; Lima, G.O.; de Sousa, J.R. Menthol exposure induces reversible cardiac depression and reduces lipid peroxidation in the heart tissue of tambaqui *Colossoma macropomum*. *Aquaculture* **2021**, *541*, 736847. [[CrossRef](#)]
120. Yang, Q.; Luo, J.; Lv, H.; Wen, T.; Shi, B.; Liu, X.; Zeng, N. Pulegone inhibits inflammation via suppression of NLRP3 inflammasome and reducing cytokine production in mice. *Immunopharmacol. Immunotoxicol.* **2019**, *41*, 420–427. [[CrossRef](#)] [[PubMed](#)]
121. Pombal, S.; Hernández, Y.; Diez, D.; Mondolis, E.; Mero, A.; Moran-Pinzon, J.; Guerrero, E.I.; Rodilla, J.M. Antioxidant activity of carvone and derivatives against superoxide ion. *Nat. Prod. Commun.* **2017**, *12*, 1934578X1701200502. [[CrossRef](#)]
122. de Lima Serafim, C.A.; Araruna, M.E.C.; Júnior, E.B.A.; Silva, L.M.O.; Silva, A.O.; Da Silva, M.S.; Alves, A.F.; Araujo, A.A.; Batista, L.M. (-)-Carveol prevents gastric ulcers via cytoprotective, antioxidant, antisecretory and immunoregulatory mechanisms in animal models. *Front. Pharmacol.* **2021**, *12*, 736829. [[CrossRef](#)]
123. Johnson, A.J.; Miles, C. Chewing gum and context-dependent memory: The independent roles of chewing gum and mint flavour. *Br. J. Psychol.* **2008**, *99*, 293–306. [[CrossRef](#)]
124. Spence, C.; Ngo, M.K. Assessing the shape symbolism of the taste, flavour, and texture of foods and beverages. *Flavour* **2012**, *1*, 12. [[CrossRef](#)]
125. Gracindo, L.; Grisi, M.; Silva, D.; Alves, R.; Bizzo, H.; Vieira, R. Chemical characterization of mint (*Mentha* spp.) germplasm at Federal District, Brazil. *Embrapa Recur. Genéticos Biotecnol. -Artig. Periódico Indexado (ALICE)* **2006**, *8*, 5–9.
126. Kapp, K.; Orav, A.; Roasto, M.; Raal, A.; Püssa, T.; Vuorela, H.; Tammela, P.; Vuorela, P. Composition and antibacterial effect of mint flavorings in candies and food supplements. *Planta Med.* **2020**, *86*, 1089–1096. [[CrossRef](#)] [[PubMed](#)]
127. Bhoora, H.S.G.; Srivastava, N.G.; Gargi, B.; Joshi, M. Comparative study of antibacterial assay of *Mentha piperita* (in vivo and in vitro cultured) leaves extract on enveloped human pathogenic bacteria and its phytochemical screening. *J. Pharmacogn. Phytochem.* **2020**, *9*, 15–19.
128. Mohamed, L.; Chakraborty, S.; Aruljothi, K.; Mabasa, L.; Sayah, K.; Costa-Lotufo, L.V.; Jardine, A.; Prince, S. *Galenia africana* plant extract exhibits cytotoxicity in breast cancer cells by inducing multiple programmed cell death pathways. *Saudi Pharm. J.* **2020**, *28*, 1155–1165. [[CrossRef](#)] [[PubMed](#)]
129. Eichelbaum, S.; Abood, S.; Acuña, L.; Ahumada, M.; Veisaga, M.-L.; Barbieri, M.A. Challenges and Considerations in the Preparation of Novel Antibiotic Phytochemicals. *Eur. J. Med. Plants* **2020**, *31*, 14–28. [[CrossRef](#)]
130. Zeb, A. Concept, mechanism, and applications of phenolic antioxidants in foods. *J. Food Biochem.* **2020**, *44*, e13394. [[CrossRef](#)] [[PubMed](#)]
131. Falleh, H.; Jemaa, M.B.; Saada, M.; Ksouri, R. Essential Oils: A Promising Eco-Friendly Food Preservative. *Food Chem.* **2020**, *330*, 127268. [[CrossRef](#)] [[PubMed](#)]
132. Caracciolo, F.; El-Nakhel, C.; Raimondo, M.; Kyriacou, M.C.; Cembalo, L.; De Pascale, S.; Roupheal, Y. Sensory Attributes and Consumer Acceptability of 12 Microgreens Species. *Agronomy* **2020**, *10*, 1043. [[CrossRef](#)]