Thu Dau Mot University Journal of Science
ISSN 2615 - 9635
journal homepage: ejs.tdmu.edu.vn

A review on water mint (*Mentha aquatica* L.): Phenolic compounds and essential oils

by ***Vi Nguyen Phuong Truong, Nhan Thi Thanh Vo, Tram Thi My Pham***
(*Thu Dau Mot University)*

Article Info*: Received Jan.26th,2022, Accepted Mar. 3rd,2022, Available online Mar.15th,2022*
Corresponding author: tramptm@tdmu.edu.vn
https://doi.org/10.37550/tdmu.EJS/2022.01.278

ABSTRACT

Mentha aquatica L. *(water mint) is a medicinal plant with many novel compositions. The phenolic compounds and essential oils in Mentha aquatica* L. *played an important role in many types of diseases treatments such as flatulence, anorexia, indigestion, ulcerative colitis, etc. However, there are still little data concerning these compounds and their functions. This study aimed to review the biological activities, phenolic compounds, and essential oils in Mentha aquatica L.*

Keywords*: biological activities, essential oil, herbal plant, Mentha aquatica* L.*, phenolic compound, water mint*

1. Introduction

Medicinal plants and their derived compounds (phytochemicals) have been used for 60,000 years. Plants have become responsible for more than 30% of all medicines. Plant materials play an important role in primary care or disease treatment (Tafrihi et al., 2021).

Anticancer pharmaceuticals, antibiotics, and immunomodulatory drugs are only a few of the many drugs developed from plants. Herbs also have a pleasant flavor and can be used as flavoring, seasoning, and food in the kitchen (Tafrihi et al., 2021).

Mentha is a genus of aromatic and medicinal plants that belongs to the Lamiaceae family (El Hassani, 2020). There are around 42 species of *Mentha*, 15 hybrids, and hundreds of subspecies and cultivars (Salehi et al., 2018).

For example, *Mentha arvensis* L., *Mentha aquatica* L., *Mentha spicata* L., *Mentha longifolia* L., and *Mentha suaveolens* Ehrh., have produced 11 hybrids (Mamadalieva et al., 2020).

Many essential oils and biologically active substances are found in the epidermal glands of *Mentha* plants, including phenolics, tannins, terpenes, terpenoids, quinones, coumarins, flavonoids, alkaloids, sterols, and saponins (El Hassani, 2020).

Mentha aquatica L. is a perennial herbaceous rhizomatous plant that belongs to the Lamiaceae family. *Mentha aquatica* L. is known as a medicinal plant and is a therapy for many types of disorders (Do et al., 2015). Although this plant has many novel compositions for the food, pharmaceutical, and cosmetic industries, there are still little data concerning its phenolic composition, essential oil, and other constituents. The main objective of this review is to introduce *Mentha aquatica* L. with its biological characteristics, phenolic compounds, and essential oil.

2. Biological characteristics

Mentha aquatica L. is a perennial plant in the *Mentha* genus that can be found in Europe, Northwest Africa, and Southwest Asia (Boz et al., 2013; Do et al., 2015). It grows in temperature and humid areas (Safaiee et al., 2019). It also grows along the banks of running water and in lakes (Boz et al., 2013).

The rhizomes have fibrous roots and spread widely. The stems which bear leaves are green or purple and spread on the ground. Flowers are tiny, dense, tubular, and pinkish to lilac in color (Do et al., 2015).

Mentha aquatica L. is a member of the section *Mentha*, genus *Mentha*, family Lamiaceae, subfamily Nepetoideae, order Lamiales (Harley,1963; Takhtadzhian et al., 1997), according to a survey of Mentha species conducted by Sanja Carva et al. (2021).

Because of features such as phenotypic plasticity, genetic variability, and due to most species can produce hybrids by crossing, the fact that it is difficult to identify species in the *Mentha* genus (Harley and Brighton, 1977). According to Harley and Brighton (1977) and Chambers and Hummer (1994), most species in the genus *Mentha* are polyploid, only five of which are diploid. The chromosome of *Mentha aquatica* L. is octaploid, which is one of the most common ploidy levels in this species (Bunsawatt, 2002).

Mentha aquatica L. is a species of wide distribution. This species is native to much of Europe, southwest Asia, northwest Africa and was introduced to Australia, Madeira, South, and North America (Bunsawatt, 2002; Hamed Karami, 2017). It is a fast-growing, invasive, and distributed pattern along river banks, on the banks of flowing waters, ponds, and lakes, and in wet habitats nearby, but prefers calcareous soils (Guşuleac, 1961; Andro Anca Raluca, 2011; Ivan A. Schanzer, 2012).

TABLE 1. Traditional classification schemes of Mentha aquatica L. (Bunsawatt, 2002)

Briquet (1897)	Harley & Brighton (1977)
Genus Mentha L.	Genus Mentha
Subgenus Menthastrum Coss	
Sect. Capitatae L.	Sect. Mentha
Mentha aquatica L.	Mentha aquatica L.

Mentha aquatica L. is a perennial herbaceous rhizomatous plant with a height of up to 90cm. The stems have a square cross-section, are purple or green, smooth or hairy, and are frequently branching at the base. Rhizomes expand widely, rooting at lower nodes and bearing fibrous roots. The opposing, green, or purplish leaves are oblong to oval-lanceolate, 2 to 6cm long and 1 to 4cm wide, toothed, and hairy to nearly hairless (Mastelic, 2001; Do et al., 2015). Flowers are tiny white or purplish, pinkish to lilac in hue, tubular, densely crowded, in single or branched clusters, with 5-6 flowers each ring, flowering from mid to late summer (Mastelic, 2001; Do et al., 2015).

3. Phenolic compounds

Phenolic compounds are secondary metabolites found mostly in plant species with a wide range of structural diversity (Huyut et al., 2017; Alara et al., 2021). They are mainly polymerized or monomer structures and can be found as glycosides or aglycones (Brahmi et al., 2017), matrix, or free-bound molecules (Alara et al., 2021). Furthermore, these chemicals are not evenly distributed in plants, and their stability varies (Alara et al., 2021). (Oluwaseun Ruth Alara et al., 2021).

Phenolic is found mainly in fruits, vegetables, tea, wine, legumes, and coffee (Riachi et al., 2015; Alara et al., 2021) and is responsible for the organoleptic properties of plant foods (Alara et al., 2021). They comprise an important group of natural antioxidants (Huyut et al., 2017). Among the plants, the classes of phenolics include 53% flavonoids, 42% phenolic acids, 2.5% lignans, and stilbenes (Riachi and De Maria, 2015)**.** The most abundant phenolics are rosmarinic acid (caffeate dimer) (Ćavar Zeljković et al., 2021), eriocitrin, eriodictyol-glycopyranosyl-rhamnopyranoside, and luteolin 7-O-rutinoside (Riachi and De Maria, 2015; Brahmi et al., 2017).

The genus *Mentha* is particularly rich in phenolic compounds (Huyut et al., 2017), especially in phenolic acids and flavonoids (Fialová et al., 2015; Bahadori et al., 2018; Mamadalieva et al., 2020). Regarding phenolic acids, caffeic acid and its derivatives, chlorogenic and rosmarinic acid are abundant. Flavonoids are flavones, flavanones, flavonols, flavanols, anthocyanins, and isoflavones. In *Mentha* plants, flavonoids are mainly in flavones and flavanones (Brahmi et al., 2017; Alara et al., 2021).

Luteolin and its derivatives are the main flavones in *Mentha* species. The components

eriocitrin, naringenin-7-O-glucoside, luteolin-7-O-glucoside isorhoifolin, luteolin, eriodictyol, and apigenin were identified in the extracts from *Mentha* species. Areias et al. reported that the main ingredient in *Mentha* aqueous extract was the glycoside eriocitrin (Brahmi et al., 2017). External lipophilic methylated flavonoids have been recovered from dried leaves of *Mentha aquatica* L. in a previous study (Brahmi et al., 2017), and the study demonstrates that this plant was also rich in flavanones based on ethanol extraction.

Pereir et al. (2012) figured that there were 50% eriodictyol-7-O-rutinoside (MW 594 Da), 15% hesperitin-7-O-rutinoside (MW 610 Da), and 8% naringenin-7-O-rutinoside (MW 580 Da) of the total quantified phenolic compounds in *Mentha aquatica* L. (Pereira et al., 2012). Additionally, other flavonoids have been identified in *Mentha aquatica* L. which names 5-hydroxy-6,7,8,4′-tetramethoxyflavone (gardenin B) (Brahmi et al., 2017). In another research, the major extracted phenolic compounds from this plant are luteolin-7-O-glucoside, eriocitrin, and rosmarinic acid, whereas hesperidinin, luteolin-7-O-glucoside, eriocitrin (Alu'datt et al., 2018).

In some previous studies, they focused on the effects of phenolic extracts on biological properties (Alu'datt et al., 2018). It has been reported that phenolic and flavonoid compounds play an important role in antioxidants to treat antiallergic, antidiabetic, antithrombotic antimicrobial, antipathogenic, anti-inflammatory, antiviral, and vasodilatory effects and prevent diseases such as cancer, heart problems, and Alzheimer's (Dhifi et al., 2011; Salehi et al., 2018). In addition, the phenolic compounds have been shown to reduce chronic diseases by reducing the oxidative damage of DNA, lipids, and proteins (Alu'datt et al., 2018).

Moreover, rosmarinic acid displayed superior antioxidant activity compared to other phenolic acids (Gonçalves et al., 2020), for example, 20% of rosmarinic acid in *Mentha aquatica* L. was found in Europe (Pereira et al., 2012). In another study, rosmarinic acid and eriodictyol-O-rutinoside which considered the major phenolic compounds of this plant in Portugal were 68 ± 7μg/mg and 145 ± 2μg.mg, respectively (Pereira et al., 2019). These different phenolic components are probably responsible for their different antioxidant properties. In various researches, *Mentha aquatica* L. extract exhibited high antioxidant activity in chemical models (Dhifi et al., 2011; Pereira et al., 2019).

Even though *Mentha aquatica* L. is one of the most important *Mentha* species, little is known about its essential oil composition and other constituents such as phenolic compounds. In traditional South African medicine, dried leaves of this plant are used to treat colds and respiratory issues. They are also utilized as astringent, stimulant, and emetic (Dhifi et al., 2011). The chemical composition and biological activity of *Mentha aquatica* L. are shown in Table 2.

TABLE 2. The chemical composition and biological activities of Mentha aquatica L. (Mamadalieva et al., 2020)

Chemical contents	**Documented biological activities of the plant used**
Phenolics and flavonoids: Apigenin, acacetin, and luteolin (Zaidi, 1998), 5,6-dihydroxy-7,8,3′,4′-tetramethoxyflavone, 5-O-desmethylnobiletin, apigenin, acacetin, xanthomicrol, pebrellin, salvigenin, gardenin, 6- and 4′-O-methylated derivatives of sorbifolin, and thymusine (Voirin, 1999); caffeic acid, eriocitrin, luteolin-7-O-glucoside, isorhoifolin, rosmarinic acid, eriodictyol, luteolin, and apigenin (Dorman, 2003).	Antimicrobial, antioxidant, allergenic, analgesic, antipyretic, antiseptic, antispasmodic, anxiolytic, carminative, decongestant, deodorant, diaphoretic, digestive, diuretic, antiemetic, insecticides, sedatives, stimulatory, and vermifuge actions (Dorman, 2003; Getahun, 2008; Andro, 2013; Do et al., 2015; Golestan, 2016; Park, 2016)

4. Essential oils

Essential oils are natural secondary compounds and are highly volatile, aromatic, and composed of many complex compounds. Many species of *Mentha* are grown for the production of essential oils. Indeed, essential oils from mint species are the most used in the world with their production value exceeding 400 million per year (Brahmi et al., 2017).

Many mono- and sesquiterpenes are found in the essential oils isolated from *Mentha aquatica* L. (Jäger et al., 2007). It seems that the essential oil in this plant exhibits variations in chemical composition depending on the nutrition, different parts of the plant, and county origin of it (Castro et al., 2010; Do et al., 2015) This is due to differences in environmental factors: altitude, temperature, light, soil, interactions between plants and animals, and anthropogenic factors that can affect the metabolic pathways of the plant (Agostini et al., 2009).

Morteza-Semnani et al. (2006) identified 29 oil components in the flowering aerial portions of *Mentha aquatica* L. collected in Iran, accounting for 99.3% of the total composition. The essential oil of this plant is rich in monoterpenoids (64%), followed by sesquiterpenoids (33.6%) and non-terpenoids (1.7%). 1,8-cineole (27.2%), menthofuran (23.2%), β-caryophyllene (12.8%), and limonene (5.2%) were the main components of the essential oil (Morteza-Semnani et al., 2006).

Nextly, Getahun et al. (2008) identified 34 essential oil compounds (accounting for 99.4%) of the essential oil of *Mentha aquatica* L. growing in Ethiopia with the main compounds as menthofuran (70.5%), limonene (9.2%), and p- menthone (7.2%) (Getahun et al., 2008). Similarly, in Corsica, 35 essential oil compounds (31 monoterpenes and 4 sesquiterpenes), accounting for 97.0% of the essential oil, were identified in wild-growing *Mentha aquatica* L. Among them, menthofuran (50.7%) was considered to be the major component of the essential oil. 1,8-cineole (5.9%), limonene (5.3%), and borneol (3.5%) were present in smaller amounts (Sutour et al., 2011). In

contrast, in the study by Agostini et al. (2009), menthone (77.76%) was the major compound in the essential oil extract of *Mentha aquatica* L. growing in Southern Brazil, followed by pulegone (14.39%), linalool (2.01%), and 1,8-cineole (1.49%) (Agostini et al., 2009). In 2014, the result recorded 43 oil components corresponding to 97.8 % of the total oil in *Mentha aquatica* L. The major compound in the essential oil of this plant is linalyl acetate (26.1 %), followed by α-pinene (22.7 %), linalol (13.755%), α-terpeneol (3.42%), and geranyl butyrate (3.39%) (Chaker et al., 2014).

The composition of essential oils also varies with different parts of the plant. In the stem essential oil of *Mentha aquatica* L. from Iran, β-caryophyllene (22.4%), viridiflorol (11.3%), and 1, 8-cineole (10.9%) were recognized as the main component whereas the major compounds of the leaf oil of this plant were piperitenone oxide (25.7%), β-caryophyllene (12.0%), and 1.8-cineole (10.3%) (Esmaeili et al., 2006).

At variant times of the growing cycle, the compound of the essential oil in *Mentha aquatica* L. can also be different. Boz et al. (2013) extracted essential oils from this plant at three different growth stages and the research indicated that 41 essential oil compounds were identified, of which 20 were common in all samples collected in all three periods. The main substances were limonene (5.94 to 12.06%), menthofuran (51.26 to 58.59%), ledol (3.01 to 4.06%), trans-β-ocimene (5.59 to 6.10%), and β-caryophyllene (2.923 to 3.557%) (Boz et al., 2013).

The essential oil of *Mentha aquatica* L. has many remarkable properties such as antioxidant, antibacterial, fungicidal, and skin-protective activities (Mimica-Dukić et al., 2003; Chang et al., 2019). In the study of Getahun et al. (2008), the essential oil had significant antibacterial activity against gram-positive bacteria such as *Staphylococcus aureus* 29737, *S. aureus* ML267, *Sarcina luteus* 9341, and *Bacilus pumilus* 8241 with minimum inhibitory concentration (MIC) values less than 5 μg/mL. This essential oil also has good free radical scavenging by 2,2-diphenyl-1-picrylhydrazyl (DPPH) and deoxyribose degradation tests (IC_{50} was 11.2 and 3.74 μl/mL, respectively) (Getahun et al., 2008).

Mentha aquatica L. essential oil showed that suppressor activity against skin carcinogenesis by suppression of keratin 14 and COX-2 overexpression in 7,12-dimethylbenz[a]anthracene/12-*O*-tetradecanoylphorbol-13-acetate (DMBA/TPA)-induced two-stage carcinogenesis mouse models (Chang et al., 2019).

Mentha aquatica L. essential oils reduced the *Staphylococcus aureus* viable count below 5 log CFU g^{-1} after 4 days; however, the population of *Lactobacillus reuteri*, *Bifidobacterium animalis* and *Clostridium perfringens* decreased < 1 log CFU g^{-1} during the storage time. *Mentha aquatica* L. is related to the least deteriorative effect on the lactic acid bacteria. As the results of organoleptic studies, kashk samples containing *Mentha aquatica* L. EO at 1500 and 2500 ppm were the most preferred samples (Golestan et al., 2016).

5. Conclusion

The main purpose of this review was to introduce the promising of *Mentha aquatica* L. in the pharmaceutical, food, and cosmetic industries. In general, the use of antioxidant properties is mainly due to their phenolic compounds and essential oil. Antioxidant capabilities may play a role in antibacterial, fungicidal, and skin-protective properties, as well as cancer, heart disease, and Alzheimer's disease (Mimica-Duki et al., 2003; Dhifi et al., 2011; Salehi et al., 2018; Chang et al., 2019). Future work should therefore focus on the application of *Mentha aquatica* L. in food additives or functional foods.

Conflict of interest

The authors declared that the present study was performed in absence of any conflict of interest.

Acknowledgment

The authors would like to thank Thu Dau Mot University - Vietnam for supporting laboratory and research equipment.

References

Agostini F, Santos ACAD, Rossato M, Pansera MR, Santos PLD, Serafini LA, Moyna P. (2009). Essential oil yield and composition of Lamiaceae species growing in Southern Brazil. *Brazilian Archives of Biology and Technology*, *52*, 473-478.

Alara OR, Abdurahman NH, Ukaegbu CI. (2021). Extraction of phenolic compounds: a review. *Current Research in Food Science*, *4*, 200-214.

Alu'datt MH, Rababah T, Alhamad MN, Gammoh S, Al-Mahasneh MA, Tranchant CC, Rawshdeh M. (2018). *Pharmaceutical, Nutraceutical, and Therapeutic Properties of Selected Wild Medicinal Plants: Thyme, Spearmint, and Rosemary. In Therapeutic*. Probiotic and Unconventional Foods. Academic Press.

Andro AR, Boz I, Zamfirache MM, Burzo I. (2011). Comparative research regarding the chemical composition of volatile oils from Mentha longifolia (L.) Huns. *Oltenia Journal for Studies in Natural Sciences*, 23-27.

Andro ARBM. (2013). Chemical composition of essential oils from Mentha aquatica L. at different moments of the ontogenetic cycle. *Journal of Medicinal Plants Research*, *7*(9), 470-473.

Bahadori MB, Zengin G, Bahadori S, Dinparast L, Movahhedin N. (2018). Phenolic composition and functional properties of wild mint (Mentha longifolia var. calliantha (Stapf) Briq.). *International journal of food properties, 21*(1), 183-193.

Boz I, Zamfirache MM, Burzo I. (2013). Chemical composition of essential oils from Mentha aquatica L. at different moments of the ontogenetic cycle. *Journal of Medicinal Plants Research*, *7*(9), 470-473.

Brahmi F, Khodir M, Mohamed C, Pierre D. (2017). Chemical composition and biological activities of Mentha species. *Aromatic and medicinal plants-Back to nature 10*, 47-79.

Bunsawatt J, 2002. *Mentha (Lamiaceae) Phylogenetic Analysis Using Chloroplast TRNL-TRNF and Nuclear Ribosomal DNA ITS Sequences* (Masters Theses & Specialist Projects 621).

Castro LWP, Deschamps C, Biasi LA, Scheer AP, Bona C. (2010). *Development and essential oil yield and composition of mint chemotypes under nitrogen fertilization and radiation levels*. Proceedings of the 19th World Congress of Soil Science: Soil solutions for a changing world. Symposium 3.3. 2 Molecular biologies and optimizing crop nutrition. Brisbane, Australia.

Ćavar Zeljković S, Šišková J, Komzáková K, De Diego N, Kaffková K,Tarkowski P. (2021). *Phenolic Compounds and Biological Activity of Selected Mentha Species. Plants 10*(3), 550.

Chaker AN, Boukhebti H, Sahraoui R, Ramdhani M. (2014). Essential oils and morphological study of Mentha aquatica. *Pharmacognosy Communications 4*(2), 34.

Chang CT, Soo WN, Chen YH, Shyur LF. (2019). Essential Oil of Mentha aquatica var. Kenting water mint suppresses two-stage skin carcinogenesis accelerated by BRAF inhibitor vemurafenib. *Molecules 24*(12), 2344.

Dhifi W, Litaiem M, Jelali N, Hamdi N, Mnif W. (2011). Identification of a new chemotype of the plant Mentha aquatica grown in Tunisia: chemical composition, antioxidant and biological activities of its essential oil. *Journal of Essential Oil Bearing Plants*, *14*(3), 320-328.

Do ND, Tran DT, Essien EE, Oladimeji O. (2015). Study on essential oil of Mentha aquatica L. from Vietnam. *American Journal of Essential Oils and Natural Products*, 12-16.

Dorman HJ. (2003). Antioxidant properties and composition of aqueous extracts from Mentha species, hybrids, varieties, and cultivars. *Journal of Agricultural and Food Chemistry*, *51*, 4563-4569.

El Hassani FZ. (2020). Characterization, activities, and ethnobotanical uses of Mentha species in Morocco. *Heliyon 6*(11), e05480.

Esmaeili A, Rustaiyan A, Masoudi S, Nadji K. (2006). Composition of the essential oils of Mentha aquatica L. and Nepeta meyeri Benth. from Iran. *Journal of Essential oil Research*, *18*(3), 263-265.

Fialová S, Tekeľová D, Rendeková K, Klinčok J, Kolárik M, Kurucová K, Grančai D. (2015). Phenolic compounds variation in Mentha L. species in the course of four years. *Acta Facultatis Pharmaceuticae Universitatis Comenianae 62*(9), 2-7.

Getahun ZA. (2008). Essential oil composition antibacterial and antioxidant activities of Mentha aquatica growing in Ethiopia. *Ethiopian Pharmaceutical Journal*, 26, 9-16.

Getahun Z, Asres K, Mazumder A, Bucar F. (2008). Essential oil composition, antibacterial and antioxidant activities of Mentha aquatica growing in Ethiopia. *Ethiopian Pharmaceutical Journal, 26*(1), 9-16.

Golestan L, Seyedyousefi L, Kaboosi H, Safari H. (2016). Effect of Mentha spicata L. and Mentha aquatica L. essential oils on the microbiological properties of fermented dairy product, kashk. *International journal of food science & technology, 51*(3), 581-587.

Gonçalves S, Mansinhos I, Romano A. (2020). Aromatic plants: a source of compounds with antioxidant and neuroprotective effects. Oxidative Stress and Dietary Antioxidants in Neurological Diseases. *Academic Press*, 155-173

Guşuleac M. (1961). Labiate in Flora Republicii Populare Române. Ed. *Academiei RPR. Bucureşti*, *8*(82), 394.

Hamed Karami MR. (2017). Effect of Drying Temperature and Air Velocity on the Essential Oil Content of Mentha aquatica L. *Journal of Essential Oil Bearing Plants, 20*(4), 1131-1136.

Harley RM, Brighton CA. (1977). Chromosome numbers in the genus Mentha L. *Botanical Journal of the Linnean Society 74*, 71-96.

Harley RM. (1963). *Taxonomic studies in the genus Mentha (Ph.D. Thesis)*. Oxford University, England.

Huyut Z, Beydemir Ş, Gülçin İ. (2017). Antioxidant and antiradical properties of selected flavonoids and phenolic compounds. *Biochemistry research international*, 1-10.

Ivan ASchanzer MV. (2012). Genetic diversity and natural hybridization in populations of clonal plants of Mentha aquatica L. (Lamiaceae). *Wulfenia*, 131-139.

Jäger AK, Almqvist JP, Vangsøe SAK, Stafford GI, Adsersen A, Van Staden J. (2007). Compounds from Mentha aquatica with affinity to the GABA-benzodiazepine receptor. *South African Journal of Botany, 73*(4), 518-521.

Jerkovic IMJ. (2001). Composition of free and glycosidically bound volatiles of Mentha aquatica L. *Croatica Chemica Acta, 74*, 431-439.

Mamadalieva NZ, Hussain H, Xiao J. (2020). Recent advances in genus Mentha: Phytochemistry, antimicrobial effects, and food applications. *Food Frontiers, 1*(4), 435-458.

Mastelic IJ. (2001). Composition of Free and Glycosidically Bound Volatiles of Mentha aquatica L. *Croatica Chemica Acta, 2*(74), 431-439.

Mimica-Dukić N, Božin B, Soković M, Mihajlović B, Matavulj M. (2003). Antimicrobial and antioxidant activities of three Mentha species essential oils. *Planta medica, 69*(5), 413-419.

Morteza-Semnani K, Saeedi M, Akbarzadeh M. (2006). The essential oil composition of Mentha aquatica L. *Journal of Essential Oil Bearing Plants, 9*(3), 283-286.

Oluwaseun RA, Nour HA, Chinonso IU. (2021). Extraction of phenolic compounds: A review. *Current Research in Food Science*, 200-214.

Park YJD. (2016). *Composition of volatile compounds and in vitro antimicrobial activity of nine Mentha spp*. Springer Plus. http://doi:10.1186/s40064-016-3283-1

Pereira OR, Domingues MRM, Cardoso SM. (2012). Mentha aquatica: source of flavanone glycosides. *7º Encontro Nacional de Cromatografia*.

Pereira OR, Macias RI, Domingues MR, Marin JJ, Cardoso SM. (2019). Hepatoprotection of Mentha aquatica L., Lavandula dentata L. and Leonurus cardiaca L. *Antioxidants, 8*(8), 267.

Riachi LG, De Maria CA. (2015). Peppermint antioxidants revisited. *Food chemistry, 176*, 72-81.

Safaiee P, Taghipour A, Vahdatkhoram F, Movagharnejad K. (2019). Extraction of phenolic compounds from Mentha aquatica: The effects of sonication time, temperature and drying method. *Chemical Papers, 73*(12), 3067-3073.

Salehi B, Stojanović-Radić Z, Matejić J, Sharopov F, Antolak H, Kręgiel D, Sharifi-Rad J. (2018). Plants of genus Mentha: From farm to food factory. *Plants, 7*(3), 70.

Sutour S, Tomi F, Bradesi P, Casanova J. (2011). Chemical composition of the essential oil from Corsican Mentha aquatica-combined analysis by GC (RI), GC-MS and 13C NMR spectroscopy. *Natural product communications, 6*(10), 1934578X1100601018.

Tafrihi M, Imran M, Tufail T, Gondal TA, Caruso G, Sharma S, Pezzani R. (2021). The wonderful activities of the genus Mentha: Not only antioxidant properties. *Molecules 26*(4), 1118.

Takhtadzhian AL, Takhtajan LA, Takhtajan A. (1997). *Diversity and classification of flowering plants*. Columbia University Press. New York

Voirin BB. (1999). Free flavonoid aglycones as markers of parentage in Mentha aquatica, M. citrata, M. spicata and M. x piperita. *Phytochemistry, 50,* 1189-1193.

Zaidi FV. (1998). Free flavonoid aglycones from leaves of Mentha pulegium and Mentha suaveolens (Labiatae). *Phytochemistry, 48,* 991-994.