



Chemical compositions of the essential oil from peppermint (*Mentha piperita* L.) cultivated in Isfahan conditions

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ABSTRACT

Background & Aim: Peppermint (*Mentha piperita* L.) oil is one of the most popular and widely used as an essential oil. The aim of this study was to identify of the chemical components of peppermint cultivated in Isfahan climatic conditions.

Experimental: The aerial parts of the plants were collected from a field in Meymeh, Isfahan province in 2012. The essential oil was extracted by a Clevenger approach and analyzed using GC/MS.

Results & Discussion: In total, 29 compounds were identified in the essential oil from the aerial parts peppermint. The results obtained in our study indicated that the major components in the oil were camphane (14.01%), menthone (13.89%), menthol (12.37%) β -pinene (7.62%), pulegone (6.41%), β -cubebene (4.95%), α -pinene (4.743%), γ -terpinene (4.08%), delta-carane (3.81%) and piperitone (3.04%).

Recommended applications/industries: The oil contents of peppermint varied slightly from year to year mostly due to variations in yearly growing weather conditions.

1. Introduction

Peppermint (*Mentha piperita* L.) belongs the family Lamiaceae, is one of the most important medicinal plants which used in food, sanitary and cosmetic industries. The leaves of peppermint are strongly scented due to the presence of essential oils. Peppermint is widely used for its medicinal properties such as anti-spasmodic, anti-sickness, anti-helminthic, carminative, and stomachic, etc.

Peppermint cultivated in the temperate, Mediterranean and subtropical regions of the world (Nostro *et al.*, 2000 ; Ormancey *et al.*, 2001). Peppermint (*Mentha*

piperita L.) which is tetraploid (2n=72), is a sterile natural hybrid of *M. aquatica* L. (2n=96) and *M. spicata* L. (2n = 48) (Tucker, 1992). The plant is a perennial with 50-60 cm tall. The square stems are usually reddish-purple and smooth. The leaves are short, oblong-ovate and serrate. The flowers are purple-pinkish and appear in the summer months. The plant has runners above and below ground (Mozaffarian, 1996; Yazdani *et al.*, 2003). The essential oil of peppermint is between 1 to 2.5% in the leaves dried which is mostly made up from menthol (50%), menthone (10 to 30%), menthyl esters (up to 10%) and further monoterpene derivatives (pulegone, piperitone, and menthofurane) (Murray, 1995). Derwich *et al.* (2010) reported 29 compounds identified in the leaves

oil. In addition they reported the yield of essential oil of *Mentha piperita* was 1.02% and the major compound in were menthone (29.01%), followed by menthol (5.58%), menthyl acetate (3.34%), menthofuran (3.01%), 1,8-cineole (2.40%), isomenthone (2.12%), limonene (2.10%), α -pinene (1.56%), germacrene-D (1.50%), β -pinene (1.25%), sabinene (1.13%), and pulegone (1.12%). A report by Ka et al. (2005) on the chemical composition of *M. piperita* essential oil indicated that the major constituents were menthol (18 mg/g) and neo-menthol (0.72 mg/g), as well as menthol (28-42 %), menthone (19-27 %), and 1,8-cineole (4-5 %) (Isfan et al., 2002). The aim of this study was to identify of chemical components in the essential oil from peppermint (*Mentha piperita* L.) cultivated in Isfahan province.

2. Materials and Methods

2.1. Plants materials

The aerial parts of the plant samples of *Mentha piperita* L. were collected from a field of the center of Iran, Meymeh is a city in and the capital of Meymeh district, in Shahin Shahr and Meymeh county, Isfahan province, (latitude. 33°, 26' N, longitude. 51°, 10' E, altitude 1965 m above sea level), during summer 2012. Climate in this province varies from semi-dry. The soil of the field was clay loam with pH 7.45, contains total N (0.81%), total P₂O₅ (39 ppm) and total K₂O (465 ppm) with an EC of 4.74(dS/m).

2.2. Essential oil extraction

The fresh aerial of *M. piperita* were dried inside for six days at room temperature (25 ± 5 °C), and the ground to fine a powder using Moulinex food processor. The essential oil was extracted from 50 g of ground tissue in 1 L of water contained in a 2 L flask and heated by heating jacket at 100 °C for 3 h in a Clevenger-type apparatus, according to producers outlined British Pharmacopoeia. The collected essential oil was dried over anhydrous sodium sulphate and stored at 4 °C until analyzed.

2.3. GC/MS analysis

GC/MS analysis was carried out with an Agilent 5975 GC-MSD system. HP-5MS column (30 m x 0.25 mm, 0.25 μ m film thickness) was used with helium as

carrier gas with flow rate of 1.0 mL/min. The oven temperature was kept 20 °C at 50 °C for 4 min and programmed to 280 °C at a rate of 5 °C /min, and kept 20 °C constant at 280 °C for 5 min, at split mode. The injector temperature was at 20°C at 280 °C. Transfer 20 line temperatures 280 °C. MS were taken at 70 eV. Mass range was from m/z 35 to 450.

3. Results and discussion

Results of GC/MS indicated that 29 compounds were identified in the essential oil from the aerial parts of peppermint. The results indicated that the major components were camphane (14.01%), menthone (13.89%), menthol (12.37%) β -pinene (7.62%), pulegone (6.41%), β -cubebene (4.95%), α -pinene (4.743%), γ -terpinene (4.08%), δ -carane (3.81%), and piperiton (3.04%) (Table 1 & Fig. 1). The components of peppermint oil vary slightly from year to year. This may be mostly due to changes in climate conditions and the effect of climate on chemotypes of mints. Yazdani et al. (2003) reported the highest of menthol content in essential oil of *Mentha piperita* L. in different origin cultivated in Iran, was (56.4%) from Sari province. The highest of menthol content from the dried leaves was (1.49%) from Kerend-e Gharb, Kermanshah province.

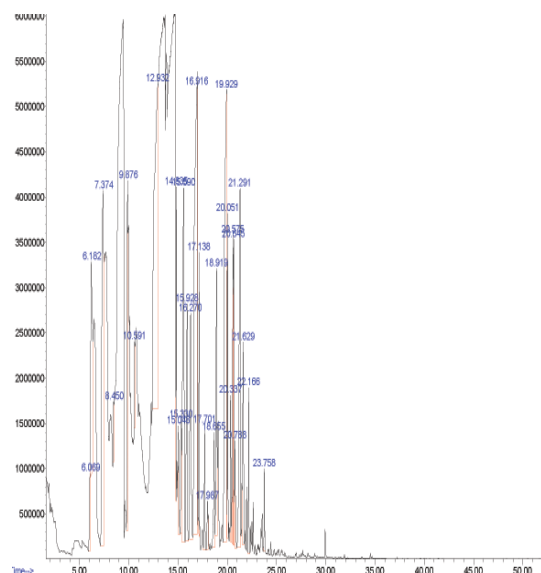


Fig 1. TIC of the essential oil from *Mentha piperita* L.

Jaimand et al. (2001) reported the main components of the oils from two cultivars of *M. piperita* were neo-menthol (42.62%), 1,8-cineole (16.51%), and

piperitone (12.25%) in sample-1, and L-menthol (37.55%), L-menthone (19.13%), 1,8-Cineole (11.48%), and menthofuran (4.45%) in sample-2. Soltani *et al.* (2009) reported the main constituents of the oil were menthone, menthol, menthofuran, pulegone, 1,8-cineole, and menthyl acetate for first harvested and whereas the main constituents of the oil at second harvest were menthol, menthone, neo-menthone, 1,8-cineole and menthyl acetate.

Mirza *et al.* (2011) reported the major constituents of essential oils in *M. piperita* at early, full and after flowering stages were menthol (27/7%, 26/9%, and 27/0%), menthon (37/0%, 21/9%, and 17/2%), and menthofuran (16/0%, 22/0%, and 25/3%), respectively.

Table 1. Chemical composition of the essential oil from *Mentha piperita* L.

Compounds ^a	RT ^b	%
α -Thujen	6.069	0.746
α -Pinene	6.182	4.743
β -Pinene	7.374	7.621
(+)-4-Carene	8.450	0.486
γ -Terpinene	9.876	4.081
α -Terpinolene	10.591	0.529
Menthone	12.932	13.893
α -Terpineol	14.835	1.491
Formaldehyde	15.048	0.902
<i>n</i> -Valeric acid cis-3-hexenyl ester	15.330	0.965
Pulegone	15.590	6.415
Piperiton	15.928	3.047
δ -Caryophyllene	16.270	3.816
Camphane	16.916	14.017
Menthyl acetate	17.138	1.640
Camphene	17.701	1.087
α -Cubebene	17.987	0.430
α -Copaene	18.655	1.293
β -Caryophyllene	18.919	3.422
Menthol	19.929	12.371
Germacrene-D	20.051	1.952
β -Cubebene	20.337	1.050
α -Caryophyllene	20.575	2.351
β -Farnesene	20.645	1.560
(+)-Epi-bicyclosquiphellandrene	20.788	1.011
β -Cubebene	21.291	4.950
α -Amorphene	21.629	2.457
δ -Cadinene	22.166	1.139
Viridiflorol	23.758	0.535

^a Compounds listed in order of elution

^b RT (retention time)

The Menthol content in peppermint of Chinese origin was lower whereas limonene was higher than USA origin (Aflatuni *et al.*, 2000). The major components of *M. piperita* essential oil analyzed in Serbia were menthol (37.4%), menthyl acetate (17.4%) and menthone (12.7%) (Iscan *et al.*, 2002). Menthol and menthone were the main components of *M. piperita* (Sokovic *et al.*, 2009). Menthol (64.0%), Menthyl acetate (9.2%) and Menthofuran were dominant in *M. piperita* collected from Italy (Ashok *et al.*, 1999). Menthanol (36.24%) and menthone (32.42%) also were the major compounds of the *M. piperita* essential oil collected from Karaj (Iran) province (Behnam *et al.*, 2006). Similarly, menthon (44.1%), menthol (29.5%), menthylacetate (3.8%) and menthofuron (0.9%) were the major compounds of *M. piperita* from Turkey (Arlidogan *et al.*, 2002). However, the leaves of *M. piperita* grown in Korea had linalyl acetate (28.2%), menthol (33.4%), 1,8-cineole (46.1%), limonene (64.5 to 94.2%), and *p*-menth-2-en-ol (34.5%) (Seun-Ah *et al.*, 2010). The main components of the oils of *M. piperita* from east- Azerbaijan (Iran) province were α -terpinene (20.11%), pipertitinone oxide (17.10%), and *trans*-carveol (19.48%) (Eteghad *et al.*, 2009). The chemical composition of *M. piperita* L essential oil from Tehran (Iran) province, contained α -terpinene (19.7%), isomenthone (10.3%), *trans*-carveol (14.5%), pipertitinone oxide (19.3%), and β -caryophyllene (7.6%) as the major compounds (Yadegarinia *et al.*, 2006). Intensive research on the chemical characteristics has been conducted on this species (Carla & Decorti, 2009). Different medicinal plant species show a marked variation in active ingredients during different seasons; these have been widely attributed to variations in environmental variables such as temperature and rainfall (Ahmad *et al.*, 2009).

4. Conclusion

A comparison of our results with different reports, differences in the volatile composition of the plants could be attributed to genetic (genus, species, and ecotype), chemotype, distinct environmental and climatic conditions, seasonal sampling periods, geographic origins, plant populations, vegetative plant phases, and extraction and quantification methods.

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6. References

- Aflatuni, A., Heikkinen, K., Tomperi, P., Jalonen, J. and Laine, K. 2000. Variation in the extract composition of mints of different origin cultivated in Finland. *Journal of essential oil Research.*, 12: 462-466.
- Ahmad, I., Ahmad, M.S.A., Hussain, M., Hameed, M., Ashraf, M.Y. and Koukab, M.Y. 2009. Spatio-temporal effects on species classification of medicinal plants in Soone Valley of Pakistan. *International Journal of Agriculture & Biology.*, 11: 64-68.
- Arldogan, B.C., Baydaf, H., Kaya, S., Demirci, M., Ozbaw, D. and Mumcu, E. 2002. Antimicrobial activity and chemical composition of some essential oils. *Archives of Pharmacal Research.*, 25(6): 860-864.
- Ashok, K., Chandra, S., Dutt, P., Lal Kaul, B., Tava, A. and Avato, P. 1999. Essential oil composition of *Mentha piperita* L. from different environments of north India. *Journal of Agriculture & Biology* 14(1): 5-8.
- Behnam, S., Farzaneh, M., Ahmadzadeh, M. and Tehrani, A. S. 2006. Composition and antifungal activity of essential oils of *Mentha piperita* and *Lavendula angustifolia* on post-harvest phytopathogens. *Communications in Agricultural and Applied Biological Sciences.*, 71(3): 1321-6.
- Carla, D. and Decorti, D. 2009. Ultrasound-assisted extraction coupled with under vacuum distillation of flavour compounds from spearmint (carvone-rich) plants: Comparison with conventional hydro-distillation. *Ultrasonics Sonochemistry.*, 16: 795-799.
- Derwich, E., Benziane, Z., Taouil, R., Senhaji, O. and Touzani, M. 2010. Aromatic plants of morocco: GC/MS analysis of the essential oils of leaves of *Mentha piperita*. *Advances in Environmental Biology.*, 4(1): 80-85.
- Eteghad, S., Mirzaei, H., Pour, S. F. and Kahnemui, S. 2009. Inhibitory Effects of Endemic *Thymus vulgaris* and *Mentha piperita* essential oils on *Escherichia coli* O157: H7. *Research Journal of Biology Science.*, 4(3): 340-344.
- Iscan, G., Demirci, F., Kirimer, N., Kurkcuoglu, M. and Baser, K.H.C. 2002. Antimicrobial screening: *Mentha piperita* essential oil. *Journal of Agriculture and Food Chemistry.*, 50: 3943- 3946.
- Jaimand, K., Rezaii, M.B. and Asgari, F. 2001. Comparative of two distillation methods and plant growth stages on the essential oil content and composition of *Mentha piperita* L. *Iranian Journal of Medicinal and Aromatic Plants.*, 18: 11-21.
- Ka, M.H., Choi, E.H., Chun, H.S. and Lee, K.G. 2005. Antioxidative activity of volatile extracts isolated from *Angelica tenuissima* roots, peppermint leaves, pine needles, and sweet flag leaves. *Journal of Agriculture and Food Chemistry.*, 53: 4124 - 9.
- Mirza, M., Ghoraiishi, F. and Bahadori, A. 2011. Effect of harvesting time on essential oils content and composition of *Salvia officinalis* L. and *Mentha piperita* L. in Khuzestan province. *Iranian Journal of Medicinal and Aromatic Plants.*, 26(4): 531-543.
- Mozaffarian, V. 1996. *A Dictionary of Iranian Plant Names*. Farhang Moaser, Tehran, Iran. pp. 542.
- Murray, M.T. 1995. The healing power of herbs: the enlightened person 's guhde to the wonders of medicinal plants. Rocklin, CA: Prima Pub., xiv, 410.
- Nostro, N., Germano, M., Angelo, V.D. and Cannatelli, M. 2000. Extraction methods and bioautography for evaluation of medicinal plant antimicrobial activity. *Letters in Applied Microbiology.*, 30: 379-384.
- Ormancey, X., Sisalli, S. and Coutiere, P. 2001. Formulation of essential oils in functional perfumery. *Parfums Cosmetiques, Actualites.*, 157: 30-40.
- Seun-Ah, Y., Sang-Kyung, J., Eun-Jung, L., Chang-Hyun, S. and In-Seon, L. 2010. Comparative study of the chemical composition and antioxidant activity of six essential oils and their components. *National Products Research.*, 24(2): 140 - 151.
- Sokovic, M.D., Vukojevic, J. and Molecules, M. 2009. Chemical composition of essential oils of *Thymus* and *Mentha* species and their antifungal activities. *Journal Molecules.*, 14(1): 238-249.
- Soltani, F., Sharifi, M., Khajeh, K. and Yousefzadi, M. 2009. Study of essential oil composition, menthone reductase activity and antimicrobial activity of *Mentha piperita* in two stages of growth. *Iranian Journal of Medicinal and Aromatic Plants.*, 21(5): 62-70.
- Tucker, A.O. 1992. The truth about mints. *The Herb Companion.*, 4: 51-52.
- Yadegarinia, D., Gachkar, L., Rezaei M. B., Taghizadeh, M., Alipoor, S. and Rasooli, I. 2006. Biochemical activities of Iranian *Mentha piperita* L.

and *Myrtus communis* L. essential oils. *Journal Phytochemistry.*, 67: 1249–1255.

Yazdani, D., Jamshidi, A. H. and Mojab, F. 2003. Comparative essential oil and menthol of *Mentha piperita* L. different origin cultivated in Iran. *Iranian Journal of Medicinal and Aromatic Plants.*, 3; 73-78.

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