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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 filed 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 piperiton (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) (Murrray, 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 constitutes 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 %) (Iscan *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 P_2O_5 (39 ppm) and total K_2O (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 µm 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%), *delta*-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.

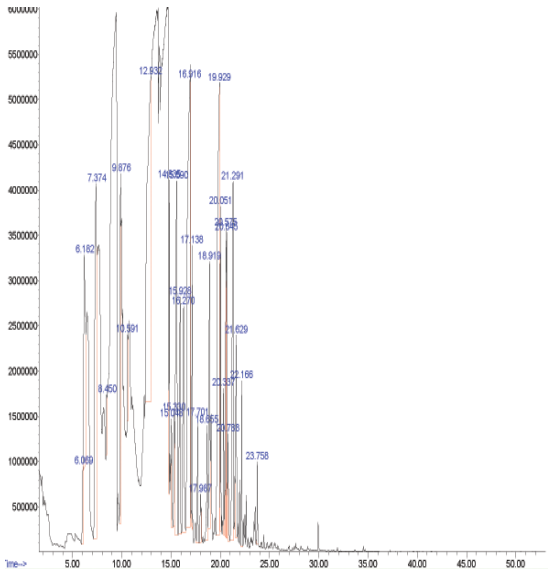

Fig 1. TIC of the essential oil from *Mentha piperita* L.

Jaimand et al. (2001) reported the main compinents 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
n-Valeric acid cis-3-hexenyl ester	15.330	0.965
Pulegone	15.590	6.415
Piperiton	15.928	3.047
delat-Carane	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- Cuvebene	20.337	1.050
α-Caryophyllene	20.575	2.351
β-Farnesene	20.645	1.560
(+)-*Epi*-bicyclosesquiphellandrene	20.788	1.011
β-Cubebene	21.291	4.950
α-Amorphene	21.629	2.457
delta-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 (Arldogan *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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