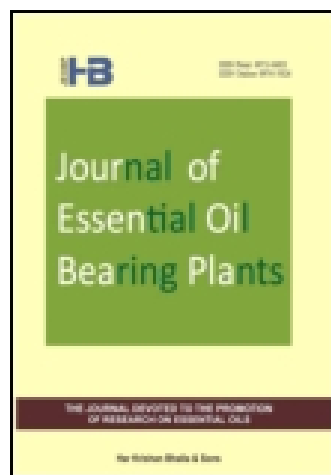


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Essential Oil Constituents of Leaf, Flower and Stem of *Melissa officinalis* L. Grown in Gonbad-Kavus (Iran)

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Abstract: The compositions of the essential oils of leaf, flower and stem of *Melissa officinalis* L. were analyzed by GC-MS. Twenty-seven volatile components in the leaf oil, twenty-eight components in the flower oil, and thirty five components in the stem oil were identified. The main constituents of the leaf oil were: β -caryophyllene oxide (27.8 %), geranial (21.3 %), neral (12.9 %), β -caryophyllene (8.0 %) and geranyl acetate (5.6 %); while the major components of the flower oil were: geranial (27.4 %), neral (18.0 %), β -caryophyllene (15.6 %), β -caryophyllene oxide (7.5 %) and *E*-cadina-1(6),4-diene (7.1 %). The main constituents of the stem oil were: n-hexadecanoic acid (47.4 %), (Z,Z)-9,12-octadecadienoic acid (14.9 %), dodecanoic acid (4.6 %), β -caryophyllene (4.2 %) and geraniol (2.2 %). Oils of the leaf and flower were almost completely composed of mono- and sesquiterpenoids, while oil of the stem is mainly consisted of the saturated and unsaturated fatty acids as well as some normal saturated hydrocarbons along with minor quantities of volatile terpenoids.

Key words: *Melissa officinalis*, Labiatae, essential oil constituents, β -caryophyllene oxide, geranial, β -caryophyllene, n-hexadecanoic acid.

Introduction

Melissa officinalis L., belongs to the Labiatae, is an herb native to Southern Europe, Asia Minor and North Africa, upright, up to 60 cm tall, lemon scented, with rough cordate, serrated leaves, bearing auxiliary whorls of white or pale pink flowers ¹. In Iran, it grows in Jangale-Golestan, Gonbad-Kavus, Amol, Tonukabon, Azarbaijan,

Bakhtaran, and Tehran ². It is cultivated in Gonbad-Kavus and Hamadan.

M. officinalis (Lemon balm) is carminative, antispasmodic, diaphoretic, and sedative ¹. It has been known as a heart tonic and a remedy for palpitation in the Iranian traditional medicine ³.

Analysis of the essential oil from *Melissa officinalis* L. grown in Turkey ⁴ and other parts

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of the world ⁵ as well as analysis of the essential oil of flowers of the same plant grown in Hamadan (Iran) ⁶ has been done by other workers. To the best of our knowledge, this is the first report of analysis of the stem oil of *Melissa officinalis* L. which has been done along with the analyses of leaf and flower oils of the same plant grown in Gonbad-Kavus (Golestan province) of Iran.

Experimental

Plant material

Aerial flowering parts of the plant were collected in July 2012 from a field of Zardband Company at Gonbad-Kavus (Iran). A voucher specimen of the whole plant has been deposited in the Herbarium of School of Traditional Medicine-Shahid Beheshti University of Medical Sciences, Tehran, Iran. The aerial parts of the plant were air-dried at ambient temperature in the shade.

Oil preparation

The powdered air-dried plant parts were subjected to hydro distillation for 4 h according to the British Pharmacopoeia ⁷. Pale yellow oils from the leaf (0.20 % v/w), flowers (0.10 % v/w) and stem (0.05 % v/w) were obtained. The oils were stored in sealed vials at low temperature before analysis.

Gas Chromatography-Mass Spectrometry analysis

Analysis of the volatile constituents was performed on an Agilent 7000, triple quad, GC 7890 A with Mass detector under the following conditions: injection volume, 1 μ L samples, HP-5 MS capillary column (30 m \times 0.25 mm ; film thickness 0.25 μ m); carrier gas He, flow rate 2 mL/min, injector temperature 250°C, temperature program: 50°-275°C at 4°C/min; mass spectra: electronic impact, ionization potential 70 eV, ion source temperature 230°C, ionization current 1000 μ A, resolution 1000, and mass range 25-1000.

Identification of the constituents was based on computer matching against the library spectra (Library Database NIST), their retention indices with reference to an n-alkane series in a temperature programmed run, interpreting their fragmentation pattern and comparison of the mass spectra with the literature data ⁸.

Results and discussion

Twenty-seven volatile components in the leaf oil, twenty-eight components in the flower oil, and thirty five components in the stem oil were identified (Table 1). The main constituents of the leaf oil were: β -caryophyllene oxide (27.8 %), geranial (21.3 %), neral (12.9 %), β -caryophyllene

Table I. Percentage composition of the leaf, flower and stem oils of *Melissa officinalis* L.

Components	RI	% Leaf oil	% Flower oil	% Stem oil
Linalool	1097	0.6	0.1	-
Nonanal	1102	-	0.2	-
Citronellal	1152	tr*	0.4	tr
Nerol oxide	1154	0.4	-	-
Nerol	1227	1.1	tr	-
Neral	1240	12.9	18.0	1.1
Geraniol	1252	2.0	tr	2.2
Geranial	1269	21.3	27.4	-
Thymol	1288	0.6	-	-
Carvacrol	1297	0.8	-	-
2E,4E-Decadienal	1308	-	-	0.2
Methyl geranate	1321	0.8	1.1	0.9
α -Ylangene	1372	tr	0.3	tr
Geranyl acetate	1380	5.6	1.5	1.3

table 1. (continued).

Components	RI	% Leaf oil	% Flower oil	% Stem oil
β-Elemene	1388	tr	0.4	0.5
α-Cedrene	1409	-	-	0.1
β-Caryophyllene	1417	8.0	15.6	4.2
α-Humulene	1453	0.4	1.8	0.6
Khusimene	1455	-	0.4	0.2
<i>E</i> -Cadina-1(6),4-diene	1476	0.8	7.1	1.9
<i>E</i> -β-Ionone	1486	0.2	tr	0.3
Curzerene	1496	-	-	1.0
δ-Amorphene	1514	0.5	1.4	0.6
Dodecanoic acid	1563	tr	tr	4.6
Germacrene D-4-ol	1573	tr	1.7	tr
β-Caryophyllene oxide	1583	27.8	7.5	0.1
n-Hexadecane	1600	-	-	0.5
Humulene epoxide II	1605	2.3	0.6	-
Caryophylla-4(14),8(15)-dien-5. β-ol	1636	1.9	0.9	0.4
epi-α-Muurolol	1639	-	2.1	0.4
α-Muurolol	1643	-	0.4	-
α-Cadinol	1648	0.9	4.4	0.7
Cedr-8(15)-en-10-ol	1651	1.2	-	-
C ₁₅ H ₂₄ O	1666	5.3	0.8	-
Ledene oxide II	1678	0.8	1.0	tr
Limonen-6-ol pivalate	1686	-	-	0.3
Tetradecanoic acid	1752	-	-	1.7
n-Octadecane	1800	-	-	0.2
Pentadecanoic acid	1852	-	-	0.9
n-Hexadecanol	1868	-	-	0.1
n-Nonadecane	1900	-	-	0.1
9-Hexadecenoic acid	1930	-	-	0.4
n-Hexadecanoic acid	1970	-	0.4	47.4
13- <i>epi</i> -Dolabradiene	2001	-	-	1.0
(<i>Z,Z</i>)-9,12-Octadecadienoic acid	2130	-	-	14.9
(<i>Z,Z,Z</i>)-8,11,14-Eicosatrienoic acid	2142	-	-	0.9

*tr = trace (less than 0.1 %)

(8.0 %) and geranyl acetate (5.6 %); while the major components of the flower oil were: geranial (27.4 %), neral (18.0 %), β-caryophyllene (15.6 %), β-caryophyllene oxide (7.5 %) and *E*-cadina-1(6),4-diene (7.1 %).

Sum of percentages of identified linalool, geranial, neral, citronellal, geranyl acetate, β-caryophyllene, and β-caryophyllene oxide in the leaf and flower oils of the examined plant in this

work were 76.2 % and 70.5 % respectively. However, the sum of percentages of the above mentioned seven volatiles in different oil samples of *M. officinalis* L. which were analyzed by Tittel *et al*⁵ are ranging between 68.7 % and 93.8 %.

The main constituents of the stem oil were: n-hexadecanoic acid (47.4 %), (*Z,Z*)-9,12-octadecadienoic acid (14.9 %), dodecanoic acid (4.6 %), β-caryophyllene (4.2 %) and geraniol (2.2 %).

On comparing the three analyzed oil constituents shown in Table I, it can be concluded that oils of the leaf and flower are almost completely composed of mono- and sesquiterpenoids, while oil of the stem is mainly consisted of the saturated and unsaturated fatty acids as well as some normal saturated hydrocarbons along with minor quantities of volatile terpenoids.

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