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Volatile Constituents of the Flower, Leaf and Stem of *Lathyrus vernus* (L.) Grown in Turkey

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The essential oils obtained from the flower, leaf and stem of *Lathyrus vernus* (L.) Bernh have been studied. Total 52 compounds were identified, constituting over 97.3, 95.3 and 98.0 % of whole oil composition, respectively. Carboxylic acids were shown to be the main constituents of the flower and stem part in the ratio of 34.2 and 35.3 %, respectively. But, the major components in the leaf oil were found to be alcohols (59.3 %).The main compounds identified in the essential oil of the flower, leaf and stem of *L. vernus* were palmitic acid (34.2-35.3 %) and 1-octen-3-ol (49.8 %), respectively.

Key Words: *Lathyrus vernus* (L.) Bernh, Essential oil, GC-FID, GC-MS.

INTRODUCTION

The genus *Lathyrus* L. (Leguminosae) is represented with 61 native species including 71 intraspecific taxa, 18 of them is endemics, in Turkey[1,2]. Many *Lathyrus* species such as *L. sativus* L. and *L. cicera* L. have been cultivated and used mainly forage and rarely as a food[3,4]. *L. vernus* (L.) Brenh. is a perennial herb with purple flowers and it is grown in forests, scrub and rock stony places. It is a Euro-Siberian element and mainly distributed in NE Anatolia among[1]. *Lathyrus* species contains some toxic substances especialy in the seed[5]. It is highly dangerous for human and can cause lathyrism by affecting the central nervous system[6].

A literature review revealed a headspace solid phase microextraction (HS-SPME) on the flower of *L. vernus* and myrecene and limonene were detected as the main fragrance components[7]. Previous studies on the essential oils from *Lathyrus* included *Lathyrus rotundifollus* Wild.[8] and *Lathyrus odoratus*[9]. The major compounds in the aerial parts of *L. rotundifollus* were germacrene-D (50.4 %), germacrene-D (18.7 %), γ-elemene (9.5 %) and myrecene (7.4 %)[6]. (Z)-β-ocimene (6.7 %), (E)-β-ocimene (35.3 %), linalool (20.7 %), phenylacetaldehyde (6.5 %), nerol (5.1 %)

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and geraniol (5.9 %) were major constituents in the floral volatiles of *L. odoratus*. In our best of knowledge, no reports on the chemical analysis of the essential oils of the flower, leave and stem of *L. vernus* are available in literature.

EXPERIMENTAL

Plant material of *L. vernus* (L.) Bernh was collected in May 2008 from Sis mountain, Besikdüzü, A8 Trabzon (at heights of *ca.* 1800 m) in the northeastern part of Turkey. The plant was authenticated by Assoc. Prof. K. Çöskunçelebi[1,2]. Voucher specimen was deposited in the Herbarium of the Department of Biology, (KTUB-552a), Karadeniz Technical University, Turkey.

Isolation of the essential oils: The fresh plant materials were separated into flower, leaf and stem parts and they were freezed with liquid nitrogen and then grounded into small pieces. The essential oils from fresh aerial parts (*ca.* 125 g, each) of *L. vernus* were isolated by hydrodistillation in a Clevenger-type apparatus[9-12] with cooling bath (-15 ºC) system (4 h) (yields: 0.12, 0.08 and 0.06 % (v/w), respectively). The obtained oils were extracted with HPLC grade *n*-hexane (0.5 mL) and dried over anhydrous sodium sulphate and stored at 4-6 ºC in a sealed brown vial.

Gas chromatography (GC): The capillary GC-FID analysis was performed using an Agilent-5973 Network System, equipped with a FID (supplied with air and hydrogen of high purity) and a split inlet. The chromatographic column used for the analysis was HP-5 capillary column (30 m × 0.32 mm i.d., film thickness 0.25 µm). Helium was used as carrier gas, at a flow rate of 1 mL/min. The injections were performed in splitless mode at 230 °C. One µL essential oil solution in hexane (HPLC grade) was injected and analyzed with the column held initially at 60 °C for 2 min and then increased to 240 °C with a 3 °C/min heating ramp. The identity of each compound was supported by comparing their retention indices (RI) with published values[10-16]. The sample was analyzed twice and the percentage composition of oil was computed from the GC peak areas without using correction factors.

Gas chromatography-mass spectrometry (GC/MS): GC-MS analysis was performed using an Agilent-5973 Network System. A mass spectrometer with an ion trap detector in full scan mode under electron impact ionization (70 eV) was used. The chromatographic column used for the analysis was HP-5 capillary column (30 m × 0.32 mm i.d., film thickness 0.25 µm). Helium was used as carrier gas, at a flow rate of 1 mL/min. The injections were performed in splitless mode at 230 °C. One µL essential oil solution in hexane (HPLC grade) was injected and analyzed with the column held initially at 60 °C for 2 min and then increased to 240 °C with a 3 °C/min heating ramp.

Identification of constituents: Retention indices of all the components were determined by Kovats method using *n*-alkanes (C_6-C_{32}) as standards. The constituents of the oils were identified by comparison of their mass spectra with those of mass

spectral libraries (NIST and Wiley 7NL), authentic compounds (limonene, linalool, α-terpineol, undecane, tricosane, pentacosane and hexacosane) and with data published in the literature[10-16].

RESULTS AND DISCUSSION

The compositions of the essential oils from the flower, leaf and stem of *L. vernus* were identified by GC and GC-MS with HP-5 column. Altogether, 52 components were identified in the three essential oils, accounting for 97.3, 95.3 and 98.0 % of the whole oils, respectively. The components of the oils, the percentage of each constituent and the retention indices are summarized in Table-1. Forty-two components were identified in the flower oil. The major compounds of the flower oil were palmitic acid (34.2 %), (2E,4E)-decadienal (9.6 %), hexahydrofarnesyl acetone (6.9 %), farnesane (5.4 %) and 2-pentyl furan (5.2 %). The leaf oil was revealed the presence of 44 components. The main constituents of the essential oil of the leaf (Table-1) were 1-octen-3-ol (49.8 %), (2E)-hexenal (9.9 %), 3-octanol (9.5 %), 3-octanone (4.6 %) and linalool (3.8 %). Forty-two compounds were found in the stem oil and the major compounds were palmitic acid (35.3 %), 1-octen-3-ol (16.2), 3-octanone (6.9 %), linalool (6.5 %) and 2-pentyl furan (5.3%).

TABLE-1
IDENTIFIED COMPONENTS IN THE ESSENTIAL OILS OF *L. vernus*

RI[a,b]	Compound	Area (%)		
		Flower	Leaf	Stem
858	(2E)-Hexenal	1.6	9.9	4.8
960	(2E)-Heptenal	0.4	0.1	0.2
962	Benzaldehyde	0.1	0.1	0.5
983	1-Octen-3-ol	-	49.8	16.2
988	3-Octanone	2.3	4.7	6.9
993	2-Pentyl furan	5.2	1.6	5.3
997	3-Octanol	-	9.5	-
997	(2E,4Z)-Heptadienal	1.7	-	0.9
1013	(2E,4E)-Heptadienal	1.3	-	-
1030	Limonene[c]	-	0.4	0.1
1043	Phenyl acetaldehyde	0.2	0.1	0.1
1051	β-Ocimene	-	0.1	0.1
1061	(2E)-Octenal	1.4	0.7	1.1
1073	(3E,5Z)-Octadien-2-one	0.4	0.8	0.7
1089	α-Terpinolene	0.3	0.1	0.3
1094	(3E,5E)-Octadien-2-one	0.2	0.1	0.1
1100	Linalool[c]	-	3.8	6.5
1101	Undecane[c]	0.4	-	-
1103	Nonanal	3.0	0.9	0.3
1109	Hotrienol	1.4	-	-
1112	(2E,4E)-Octadienal	-	0.2	0.1
1156	(2E,6Z)-Nonadienal	0.3	0.3	0.5
1162	(2E)-Nonenal	1.0	0.4	1.9

1191	α-Terpineol[c]	0.4	0.5	0.8
1197	Safranal	-	0.1	-
1214	(2E,4E)-Nonadienal	0.9	0.1	0.2
1221	β-Cyclocitral	0.9	0.4	0.4
1258	2,6,6-Trimethyl-1-cyclohexene acetaldehyde	0.1	0.6	0.1
1273	Perilla aldehyde	0.1	0.2	0.4
1291	Dihydroedulan I	0.6	0.6	0.9
1293	(2E,4Z)-Decadienal	1.9	0.2	0.6
1308	Undecanal	0.6	-	-
1316	(2E,4E)-Decadienal	9.6	0.1	1.9
1385	β-Damascenone	0.5	0.2	0.2
1395	*cis*-Jasmone	-	-	0.1
1408	Dodecanal	0.2	-	-
1412	β-Damascone	-	0.3	-
1455	Geranyl acetone	0.2	0.2	0.1
1463	Farnesane	5.4		-
1488	β-Ionone	1.2	1.5	0.9
1613	Tetradecanal	0.2	0.1	0.1
1714	Pentadecanal	1.8	1.5	1.0
1847	Hexahydrofarnesyl acetone	6.9	0.2	-
1891	Ethyl linoleolate	2.4	3.2	1.2
1919	Farnesyl acetone	0.5	0.1	0.2
1924	Methyl palmitate	0.6	0.1	0.1
1984	Palmitic acid	34.2	0.1	35.3
2095	Methyl linoleate	1.8	0.1	2.5
2098	Methyl linolenate	0.8	0.7	3.8
2299	Tricosane[c]	2.0	0.2	0.1
2499	Pentacosane[c]	2.3	0.2	0.2
2600	Hexacosane[c]	-	0.2	0.3
	Total isolate	97.3	95.3	98.0

[a]RI calculated from retention times relative to that of *n*-alkanes (C_6-C_{32}) on the non-polar HP-5 column. [b]Percentages obtained by FID peak-area normalization. [c]Identified by authentic samples.

Chemical distributions of the essential oils of the constituents are summarized in Table-2. The carboxylic acid was the major constituents of the flower and stem part of the plant in the ratio of 34.2 and 35.3 %, respectively. The major component of the leaf was alcohols in the ratio of 59.3 %. The terpene hydrocarbons were less represented, both as number of derivatives (13, 16 and 14 components) and the percentage (18.5, 9.3 and 11.1 %) (Table-2) in the essential oil of the flower, leaf and stem oils. It could be concluded that the compositions of the volatile oils extracted from the flower, leaf and stem were similar and all parts of the oils were rich in non-terpenoid components mainly straight-chain carboxylic acids, alcohols, aldehydes, esters, ketones and hydrocarbons. These results are significantly different from the reported chemical composition of *L. vernus*, *L. rotundifollus* and *L. odoratus*[7-9] which can be explained by the environmental factors, the subspecies and the parts of the plant used.

TABLE-2
CHEMICAL DISTRIBUTION IN THE ESSENTIAL OILS OF *L. vernus*

Compound class	Flower		Leaf		Stem	
	% Area	NC[a]	% Area	NC[a]	% Area	NC[a]
Terpenoids						
Monoterpene hydrocarbons	0.3	1	0.6	3	0.5	3
Oxygenated monoterpene	2.8	4	5.0	5	8.1	4
Sesquiterpene hydrocarbon	5.4	1	-	-	-	-
Terpene related compounds	10.0	7	3.7	8	2.5	7
Alcohols	-	-	59.3	2	16.2	1
Aldehydes	26.2	17	14.7	14	14.2	15
Aromatics	5.2	1	1.6	1	5.3	1
Carboxylic acids	34.2	1	0.1	1	35.3	1
Esters	5.6	4	4.1	4	7.6	4
Hydrocarbons	4.7	3	0.6	3	0.6	3
Ketones	2.9	3	5.6	3	7.7	3

[a]NC = Number of compounds.

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REFERENCES

1. P.H. Davis, Flora of Turkey and The East Aegean Islands, Edinburgh University Press, Edinburgh, Vol. 3 (1970).
2. A. Güner, N. Özhatay, T. Ekim and K.H.C. Baser, Flora of Turkey and The East Aegean Islands, Edinburgh University Press, Edinburgh, Vol. 11 (2000).
3. H. Genç and A. Sahin, *Süleyman Demirel University, Fen Bilimleri Dergisi*, **5**, 98 (2001).
4. U. Basaran, Z. Acar, Ö. Önalasci, H. Mut and I. Ayan, *J. Fac. Agric., OMU*, **22**, 139 (2007).
5. A. Fikre, L. Korbu, Y.H. Kuo and F. Lambein, *Food Chem.*, **110**, 422 (2008).
6. N. Zeybek and U. Zeybek, Farmasotik Botanik, Ege Üniversitesi Basim Evi, Izmir (1994).
7. P. Bartak, P. Bednar, L. Cap, L. Ondrakova and Z. Stransky, *J. Sep. Sci.*, **26**, 715 (2003).
8. T. Mahmood, M.A. Khalilzadeh and H.A. Dabiri, *J. Essen. Oil Res.*, **20**, 119 (2008).
9. A.E.A. Porter, D.W. Griffiths, G.W. Robertson and R. Sexton, *Phytochemistry*, **51**, 211 (2005).
10. K. Akpinar, N. Yildirim, O. Üçüncü, N. Yayli, S. Terzioglu and N. Yayli, *Asian J. Chem.*, **21**, 1225 (2009).
11. C.G. Albay, M. Albay, N. Yayli, N. Yildirim, K. Çoskunçelebi and N. Yayli, *Asian J. Chem.*, **21**, 1425 (2009).
12. N. Yayli, A. Yasar, C. Güleç, A. Usta, S. Kolayli, K. Çoskunçelebi and S. Karaoglu, *Phytochemistry*, **66**, 1741 (2005).
13. N. Yayli, C. Güleç, O. Üçüncü, A. Yasar, S. Ülker, K. Çoskunçelebi and S. Terzioglu, *Turk. J. Chem.*, **30**, 71 (2006).
14. G. Figuérédo, P. Cabassu, J.C. Chalchat and B. Pasquier, *Flav. Frag. J.*, **20**, 164. (2005).
15. O.T. Asekun, E. Olusegun and O. Adebola, *Flav. Frag. J.*, **22**, 21 (2007).
16. R.P. Adams, Identification of Essential Oil Components by Gas Chromatography-Mass Spectroscopy, Allured, Carol Stream, IL, USA (2004).

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