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Chemical Constituents of the Essential Oils of Aerial Part of the *Stachys lavandulifolia* Vahl. and *Stachys inflata* Benth. from Iran

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The essential oil of the aerial parts of *Stachys lavandulifolia* Vahl. (Lamiaceae) and *Stachys inflata* were isolated by hydrodistillation. The chemical composition of volatile oil was analyzed by capillary GC and GC/MS. The main components were found to be: α-pinene (25.66 %, 2.6 %), myrcene (17.33 %, 2.8 %), β-phellandrene (21.96 %, 0 %), β- caryophylene (14.3 %, 1.78 %), germacrene D (3.91 %, 32.9 %), bicyclogermacrene (1.81%, 7.3 %), respectively.

Key Words: *Stachys lavandulifolia*, *Stachys inflata* Lamiaceae, Essential Oil, GC-MS.

INTRODUCTION

The subcosmopoltion genus *Stachys* L. comprises more than 270 species[1] and is justifiably considered as one of the largest genera of the Labiates. In the old World area there are two main centers of diversity for the genus, as assessed by the number and distribution of the species. One is confined to South and East Anatolia, Caucasia, North West Iran and North Iraq, the other to the Balkan Peninsula[2]. In Iran, 34 species of the this genus are present, among which, 13 are endemic[3]. The plant is known as Chaye-kuhi in Iran and is a native plant, which has been used as an anxiolytic and sedative in Iranian folk medicine[4]. In the present studies the comparative study of essential oil compositions aerial parst of the plant *S. lavandulifolia* and *Stachys inflata* has been reported.

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EXPERIMENTAL

The plant material was collected in March (flowering stage) 2006 from the Zagruse mountain in Lorestan state in south west of Iran. The voucher specimen has been deposited in the Herbarium of the Faculty of Pharmacy, Shaheed Beheshti University of Medical Sciences .

The oils were obtained by hydro-distillation using a Clevenger-type apparatus for about 2 h and dried over sodium sulfate. The yield of the oil obtained from *S. lavandulifoila* 1.25 % and *Stachys inflata* were 1.11 %. The gas chromatography analysis of the oil was conducted using a Varian CP-3800 instrument equipped with a DB-1 fused silica column (60 m × 0.25 mm i.d., film thickness 0.25 μm). Nitrogen was used as the carrier gas at the constant flow of 1.1 mL/min. The oven temperature was held at 60ºC for 1 min, then programmed to 250ºC at a rate of 4ºC /min and then held for 10 min. The injector and detector (FID) temperatures were kept at 250 and 280ºC, respectively. GC-MS analysis was carried out on a Thermo quest-Finnegan Trace and DB-Wax columns under the same conditions. GC-MS instrument equipped with a DB-1 fused silica column (60 m × 0.25 mm i.d., film thickness 0.25 μm). The oven temperature was raised from 60 to 250ºC at a rate of 5ºC/min and then held at 250ºC for 10 min; transfer line temperature was 250ºC. In this case, the oven temperature was raised from 40 to 250ºC at a rate of 4ºC/min and then held at 250ºC for 10 min with the transfer line temperature adjusted at 250ºC. Helium was used as the carrier gas at a flow rate of 1.1 mL/min; split ratio was, 1/50. The quadrupole mass spectrometer was scanned over the 45-465 amu with an ionizing voltage of 70 eV and an ionization current of 150 μA. The constituents of the oil were identified by calculation of their retention indices under temperature-programmed conditions for identification of individual *n*-alkanes (C_6-C_{24}). The oil on DB-1 compounds was made by comparison of their mass spectra with those of the internal reference mass spectra library (Wiley 7.0) or with authentic compounds and confirmed by comparison of their retention indices with authentic compounds or with those of reported in the literature[5-7]. Quantitative data was obtained from FID area percentages without the use of correction factors. The list of compounds identified in the oil of *S. lavandulifolia* and *Stachys inflata* can be seen in Table-1.

RESULTS AND DISCUSSION

Chemical compositions of the hydro-distillated oils of both species are shown in Table-1. 37 and 32 Compounds were identified, respectively, in these species with major compounds being: α-pinene (27.25 %, 2.6 %), sabinene (1.69 %, 0.7 %), β-pinene (2.91 %, 2.5 %), myrcene (17.33 %, 2.8 %), β-phellandrene (21.96 %, 0 %), β-caryophylene (14.3 %, 1.7 %), germacrene-D (3.91 %, 32.9 %), caryophyllene oxide (2.21 %, 0.3 %), respectively.

TABLE-1
COMPOSITION OF THE ESSENTIAL OIL OF *Stachys lavandulifolia* Vahl. AND *Stachys inflata*

Compound	RI	SL (%)	SI (%)	Compound	RI	SL (%)	SI (%)
α-Thujene	926	0.82	0.3	β-Cubebene	1382	0.33	-
α-Pinene	936	27.25	2.6	β-Elemene	1392	0.18	1.7
1-Octen-3-ol	962	-	-	β-Caryophyllene	1429	14.3	-
Sabinen	969	1.69	0.7	*Z*-β-Farnsene	1448	0.06	-
β-Pinene	977	2.9	2.5	*E*-β-Farnsene	1452	0.17	-
Myrcene	984	17.33	2.8	Aromadendrene	1453	-	0.3
n-Decane	999	-	-	α-Humulene	1460	0.21	-
α-Phellandrene	1001	0.48	0.4	Germacrene D	1486	3.91	32.9
δ-3-Carene	1008	-	3.0	Bicyclogermacrene	1501	1.81	7.3
o-Cymene	1011	-	0.4	β-Bisadolene	1505	0.05	-
α-Terpinene	1013	0.05	-	δ-Cadinene	1522	0.55	0.4
p-Cymene	1016	0.07	1.3	*E*-β-Disabolene	1536	0.06	-
Limonene	1024	-	15.6	Aromadendrene oxide	1564	-	0.4
β-Phellandrene	1027	21.96	-	Spathulenol	1575	0.54	7.5
Z-β-Ocimene	1038	0.18	0.6	Caryophyllene oxide	1582	2.21	0.3
γ-Terpinene	1052	0.11	0.8	Verdilorol	1593	-	-
cis-Sabinene hydrate	1058	t	-	Epiglobulol	1605	0.1	-
Terpinolene	1081	0.05	1.6	Tau-cadinol	1630	-	0.4
Linalool	1083	0.06	-	Epi-α-cadinol	1636	0.06	-
Perilene	1088	0.05	-	α-Cadinol	1647	0.06	0.9
α-Capholenal	1109	0.09	-	α-Copan-11-ol	1661	-	-
α-Terpinolene	1117	-	1.3	α-Bisabolol	1672	0.8	-
Allo-ocimene	1119	0.05	-	Neoclonenoxid alchol	1673	-	1.42
trans-Verbenol	1133	0.05	-	Leden oxid	1678	0.07	0.6
Cryptone	1164	-	-	Benzyl benzoat	1735	-	-
Terpin-4-ol	1167	0.08	0.3	6,10,14-Trimethyl-2-pentadecanone	1827	0.06	-
Linalyl propionate	1175	-	0.5	Palmetic acid	1940	0.07	-
Bicycloelemene	1336	-	0.6	Eicosane	2021	-	3.0
δ-Elemene	1339	0.15	-	Phytol	2104	0.13	3.9
α-Copaene	1379	-	0.7				

SL = *Stachys lavandulifolia*; SI = *Stachys inflata*

The oil of *S. lavandulifolia* Vahl. consisted mainly of monoterpene hydrocarbons (43.4 %), oxygenated monoterpenes (f. : 0.68), sesquiterpene hydrocarbons(f. :16.09 %), oxygenated sesquiterpenes (1.42 %), oxygenet diterpene (0.52 %). Previous studies on volatile oil of members of the *Stachys* shows various components.

β-caryophyllene, one of the main components of *S. aleurites*[8]. α-Copaene was detected as the dominat fraction in the oil of *S. byzanthin*[9]. α-Pinene and β-caryophyllene are the major component of *S. lavandulifolia* Vahl. were collected from Tehran of Iran and Turkey, respectively[10]. In the oils of *S. oblique*[11], *S. laxa* Boiss[12], cretica, *S. scardica*, *S. germanica*[13], germacrene-D are recorded as the major constituent.

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