



Chemical composition of the Essential oil from stems, leaves and flowers of *Salvia verticillate* L.

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ABSTRACT

The water- distilled essential oil from stems, leaves and flowers of *salvia verticillate* L. Were analyzed by GC and GC/MS. the major component of the flowers oil were β -gurjunene(14.56%), δ -Elemene(9.01%), and 1,8- cineol(7.36%). the main component in The leaves oil were 1,8-cineol(20.14%), α -pinene(16.3%), δ -Elemene(10.38%), β -pinene (9.13%) and β -gurjunene(5.36%). The main constituent of the oil obtained from stems of the plant were 1,8-cineol(35.60%) and β -pinen(6.87%) .

1.Introduction

The genus *Salvia*, composed of more than 900 species worldwide distributed(Rechinger,1982), The flora of Iran comprises 58 species of *salvia* of which 17 are endemic (1,2,3,4) . Members of the genus *Salvia* and especially the most well-known species *S. officinalis* have been shown to possess a significant array of biological and pharmacological properties such as spasmolytic, astringent and antiseptic. Is well known for its various uses, including therapeutic ones. Many species within the genus exhibit activities such as antioxidant, antiinflammatory, antimicrobial etc. The chemical composition of these species include polyphenols, flavonoids, terpenes, which induce such activities. *Salvia mirzayanii* , a native plant to Iran, is shown to have immunomodulatory effects on lymphocyte proliferation.(4) investigation on *salvia verticillata* showed that ethanolic extracting this plant decreased serum glucose, triglycerides, cholesterol, uric acid AST and ALT whereas it increased serum insulin levels in treated diabetic as compared with control diabetic rats.(5) In this study, antimicrobial activity of essential oil, ethyl acetate and ether extracts of *S. urmiensis* Bunge were screened against some species of bacteria and fungi . (6).

Salvia mirzayani Rech (labiatae) is a medicinal plant that is used for diabetes in local medicine. Bicyclogermacrene (31.3%), α -pinene (13.2%), β -pinene (10.3%) and sabinene (11.7%) are main component

of *salvia* oil (7). The essential oil obtained by hydrodistillation of the aerial parts of *Salvia limbata* C.A. Mey. (Lamiaceae) was analyzed by GC/MS. Among the forty-two constituent, forty components were characterized representing 98.6% of the total component which were detected. Bicyclogermacrene (21.1%), α -pinene (15.5%), 1,8-cineole (11.0%), sabinene (10.6%), β -pinene (9.2%), spathulenol (8.2%), β -caryophyllene (5.3%) and δ -elemene (5.1%) were found to be the major constituents (8). *S. verticillata* subsp. *Amasiaca* had high levels of Germacrene D (36.6%), β -caryophyllene (7.6%), hexadecanoic acid (6.7%), and β -copene (5.7%).The major constituents of *S. wiedemannii* were determined as α -pinene (36.2%), β -pinene (13.3%) and 1,8-cineole(14.2%)(9).

Most of the *Salvia* plants are rich in essential oils and among their constituents guaiane-sesquiterpenes are the most common (10, 11, 12).

2.Experimental

2.1. Plant material

The stems, leaves and flower of *salvia verticillate* L.(*Salvia amasiaca* Freyn & Bornm. and E. Lilac sage) were collected from saghez, province of Kurdistan, Iran, in July 2012 Voucher specimens have been deposited at the Herbarium of the Research Institute Of Forests and Rangelands (TARI), Tehran, Iran.

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2.2. Extraction of the oils

The flowers, leaves and stems (80 g, 100g and 120g, respectively) of the plant were subjected to separate hydrodistillation using a Clevenger-type apparatus for 3h. After decanting and drying over anhydrous Sodium sulfate, the corresponding yellowish colored oils were recovered, (in a yield of 0.5%, 0.6% and 0.4% (w/w), respectively).

2.3. Analysis: GC

analysis were performed on a Shimadzu 15 A gas chromatograph equipped with a split / splitless (ratio 1:30), injector (250 °C) and a flame ionization detector (250 °C). N₂ was used as carrier gas (1 ml/min) and the capillary column

used was DB-5 (50 m x 0.2 mm, film thickness 0.32 µm). The column temperature was kept at 60 °C for 3 min and then heated to 220 °C with a 5 °C/min rate and kept constant at 220 °C for 5 min. Relative percentage amounts were calculated from peak area using a Shimadzu C-R4A chromatopac without the use of correction factors.

2.4. GC/MS analysis was performed using a Hewlett-Packard 5973 with a Hp-5MS Column (30 m x 0.25 mm, film thickness 0.25 µm). The column temperature was kept at 60 °C for 3 min and programmed to 220 °C at a rate of 5 °C/min and kept constant at 220 °C for 5 min. The flow rate of He as carrier gas was (1 ml/min).

MS were taken at 70 eV. Identification of the constituents of each oil was made by comparison of their mass spectra and retention indices (RI) with those given in the literature and those of authentic samples (13).

3. Result and Discussion

The percentage composition of the oils is given in Table I in order of their elution from the DB-5 column.

thirty-six compounds were identified in flower oil of *S. verticillata* representing 87.7% of the oil composition. The main compounds were β-gurjunen (14.6%), germacrene D (9.58%), δ-elemene (9.0%) and 1,8-cineole (7.4%). Other notable constituents were E-β-cimene (5.65%) and δ-cadinen (5.25%).

In the leaf oil, 35 compounds were identified representing 93.22% of the oil composition. The main compounds were 1,8-cineole (20.14%), α-pinene (16.3%), Δ-elemene (10.38%) and β-pinene (9.13%), while β-gurjunen (5.36%) and spathulenol (3.05%) were found in large amounts.

Sixty-three compounds were identified in the stems oil representing 86.28% of the oil composition. The main compounds were 1,8-cineole (35.6%) and β-pinene (6.86%). Other notable constituents were n-

decane (5.22%), β-cubabene (5.01%), bicyclogermacrene (4.64%) and germacrene D (4.34%).

Some earlier works have been reported on the essential oils of various *Salvia* species. *persepolitana* Benth Manool (37.3%) was the main component among the twenty-three constituents characterized. *S. rhytidea* was characterized by higher amounts of terpinolene (27.0%), sabinene (17.5%) and limonene (14.9%). [60] *Salvia lereifolia* Benth. was analyzed using GC (retention indices) and GC/MS. Twenty-two components representing 93.4% of the oil were characterized. The major constituents found were β-pinene (23.7%), 1,8-cineole (16.2%), α-pinene (13.8%) and α-cadinol (9.0%). (14)

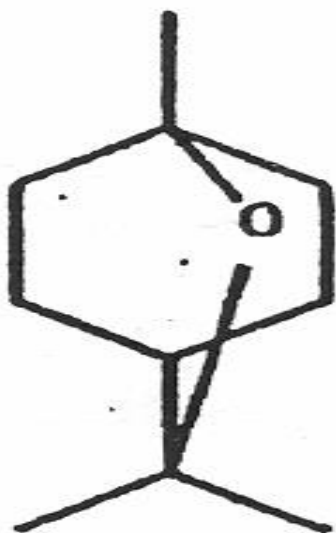
The essential oil obtained from flowering shoots of *Salvia multicaulis* Vahl (Labiatae) was analyzed by GC/MS. Twenty-nine components were identified representing 99–5% of the oil with bornyl acetate (18.1%), β-caryophyllene (16.5%), α-pinene (15.6%), 1,8-cineole (8.3%) and limonene (8.3%) as major constituents. (15) The content and composition of essential oil in the leaves and flowers of 11 populations of *Salvia officinalis* L. native in Montenegro (nine populations) and Serbia (two populations) have been studied. The yield of oils was generally higher in the leaves than the flowers. The Serbian populations proved to be the richest in leaf oil (average content 1.66%). Montenegro specimens showed significant interpopulation variation and the yields averaged 1.41% for the leaves and 1.13% for the flowers. The main compounds in the leaves were oxygenated monoterpenes α-thujone (15.79 ± 4.9%), β-thujone (3.49 ± 1.21%), 1,8-cineol (12.09 ± 3.5%), camphor (11.49 ± 7.69%), borneol (4.17 ± 2.23%) and bornyl acetate (2.19 ± 1.22%). Among the dominant sesquiterpenes were: α-humulene (7.70 ± 3.12%), viridiflorol (13.19 ± 5.17%) and manool (7.67 ± 2.98%). In the flowers, percentages of α-thujone and camphor were significantly lower than in the leaves and averaged 9.97 ± 1.49% and 5.82 ± 5.6%, respectively, whereas the ratios of borneol (6.35 ± 2.47%) and sesquiterpenes particularly manool (13.48 ± 3.56%), were higher. Great variation was found in the proportions of the major compounds between the populations examined. (16).

The chemical composition of the essential oils of *Salvia verticillata*, *S. verbenaca*, *S. glutinosa* and *S. candidissima*, growing wild in Greece, were analysed by GC and GC-MS. Twenty-eight components were characterized for *S. verticillata*, with β-pinene (30.7%), p-cymene (23.0%) and isopropyl ester of lauric acid (16.8%) as the dominating constituents. (17) Previous chemical investigation on different species of *Salvia* with Iranian origin have been shown also the presence of sesquiterpene lactones (37, 38) and essential oils (18-36).

Table I .Chemical composition (%) of essential oil from stems, flowers and leaves of <i>Salvia verticillate</i>				
Number of compound	KI	Flower (%)	Leaf (%)	Stem (%)
Heptanal	902	--	0/973	
ALPHA-PINENE*	931	2/305	16/300	0/476
Myrcene*	991	2/884	1/328	0/96
1,8-cineole*	1031	7/366	20/140	35/598
n-Decane	1000	--	1/606	5/220
E-beta-ocimene*	1050	5/653	0/310	1/388
Beta-pinene*	979	--	9/132	6/866
n-Decane	1000	--	1/606	3/259
Cis-Ocimene	1037	--	1/113	--
Gamma-terpinene	1060	1/319	0/362	--
Gis-sabinene hydrate	1070	0/302	--	--
Terpinolene	1089	0/730	0/283	--
Trans-Sabinene hydrate	1098	0/417	--	--
Ocimeneallo*	1132	3/494	2/973	--
Cis-verbenol	1141	0/254	--	0/82
1,5,5-Trimethyl-6-methylene-cyclohexane	1339	--	1/13	--
4-terpineol*	1177	2/110	--	0/778
Alpha-terpineol	1189	0/370	--	--
n-Dodecane	1200	0/303	0/330	0/623
Perilla aldehyde	1272	0/370	--	--
Elemene(delta-)*	1338	9/011	10/382	--
Alpha-cubebene	1351	1/303	0/607	0/566
Alpha-Ylangene	1375	0/296	--	--
Alpha-copaene	1377	1/370	0/340	0/652
Beta-Bourbonene	1388	1/591	0/524	0/919
Beta-cubabene*	1388	0/983	0/31	5/01
Alpha-Gurjunene	1410	0/263	--	--
Beta-Gurjunene*	1434	14/556	5/365	1/72
Germacrene-D*	1485	9/58	3/703	4/348
Aromadendrene	1441	0/399	--	--
Delta-cadinene*	1523	5/252	1/574	02/741
Spathulenol*	1578	3/040	3/059	1/585
Bicyclogermacrene*	1500	0/924	3/087	4/649
Gamma-cadinene	1514	2/21	0/987	1/09
Naphthalene 1,2,3,7-hexahydro-1,6-Dimethyl-4-(1-methylethyl)*	1537	0/43	--	2/08
Alpha-murolene	1561	0/31	--	--
Guaiol	1601	1/510	0/777	1/827
(+)-Epi-bicyclosequiphellandrene*	1647	3/13	0/26	--
cedrelanol	1674	1/87	--	--
Bulnesol	1672	0/472	--	--
valeranone	1679	1/27	--	--
Mintsulfide*	1741	--	2/105	--
6,10,14-trimethyl-2-pentadecanone	1863	0/71	--	--
Cadilva-1,4-diene	1535	--	0/28	--
Alpha-cadinol*	1654	--	2/404	2/776
Caryophyllene Oxide	1583	--	0/936	--
Isobutyl phthalate	1873	--	0/27	--
Total (%)		93/569	90/444	85/951



Fig 1. *Salvia verticillate*



1,8-Cineole

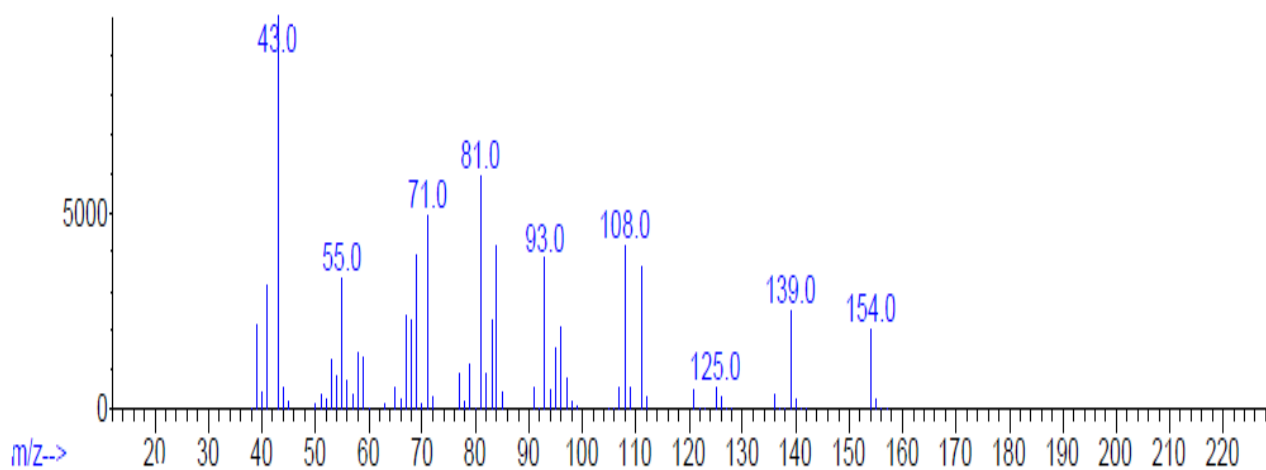
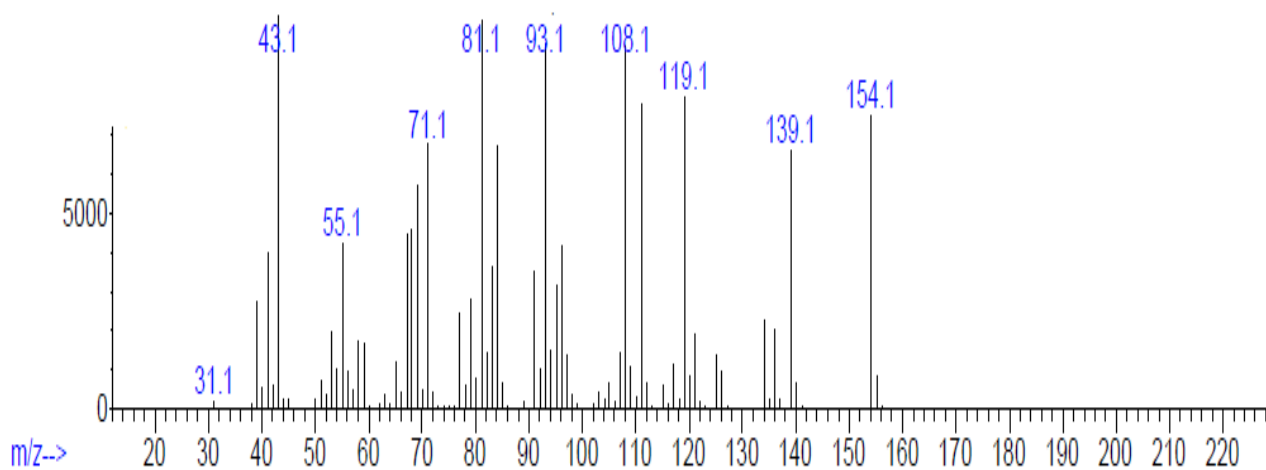
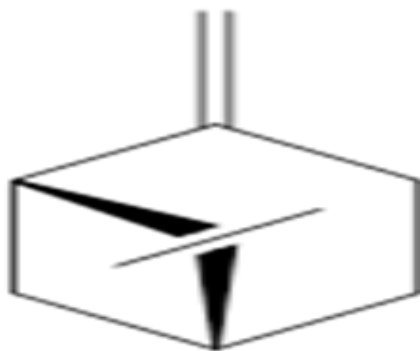


Chart. 1 GC/MS Reference spectrum (up) , GC/MS sample spectrum (down)



Alpha pine

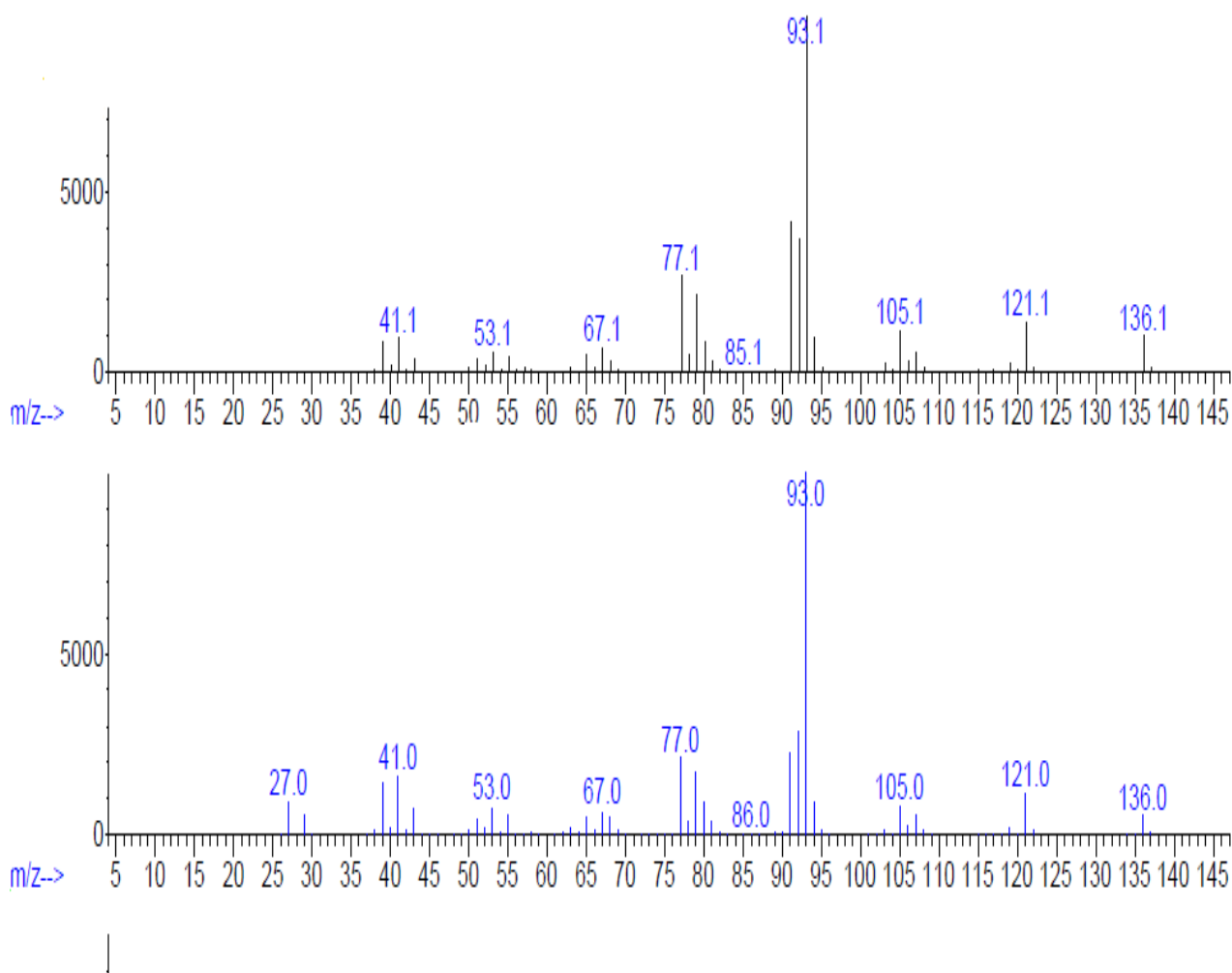


Chart. 2 GC/MS Reference spectrum (up) , GC/MS Sample spectrum (down)

4. Conclusions

As can be seen from the above information, the oils from leaves and stem of *salvia verticillate* are rich in regard to monoterpenes (53.06% and 47.52% respectively) and the

percentage of sesquiterpenes were (36.63% and 29.97% respectively). While the flowers oil was characterized by large amounts of sesquiterpenes (59.76%). As the while the percentage of monoterpenes was (27.55%).

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