Original Article

Essential Oil Composition of Some Sage (*Salvia spp.*) Species Cultivated in İzmir (Turkey) Ecological Conditions

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ABSTRACT

Background: *Salvia* L., the largest genus of Lamiaceae, includes about 1000 species, widespread throughout the world. This genus is represented, in Turkish flora, by 99 species and 113 taxa, 58 of which are endemic. Some members of this genus are of economic importance since they have been used as herbal tea, flavouring agents in perfumery and cosmetics. Some sage (*Salvia* L.) species has been credited with a long list of medicinal uses: e.g. spasmolytic, antiseptic, astringent. **Objective**: In present study, essential oil composition of some sage (*Salvia* L.) species cultivated in Izmir (Turkey) was investigated. Sage species have recently become more common in Turkey and sage cultivation is increasing especially in the Aegean Region. **Material and Methods:** The species of *Salvia fruticosa* Mill., *Salvia officinalis* L., *Salvia sclarea* L., hybrid (*Salvia fruticosa* Mill. x *Salvia officinalis* L.) and *Salvia dichroantha* L. were used in the study. Essential oils were extracted according to hydro distillation method with clevenger type apparatus and analyzed using GC-FID and GC-MS system. **Results:** Essential oil contents of *Salvia fruticosa* Mill. was 3.86%, *Salvia officinalis* L. 2.42%, *Salvia sclarea* L. 0.5%, *Salvia fruticosa* Mill. x *Salvia officinalis* L. 2.84% and *Salvia dichroantha* L. 0.19%. The number of components in essential oils were detected 22, 16, 14, 20 and 16 respectively. The chemical composition of the essential oils in *Salvia fruticosa* Mill. 1,8-cineole (57.18%), *Salvia officinalis* L. β-thujone (34.59%), *Salvia sclarea* L. linalyl acetate (46.77%), *Salvia fruticosa* Mill. x *Salvia officinalis* L. 1,8-cineole (21.42%) and β-thujone (18.37%) and *Salvia dichroantha* L. β- caryophyllene (23.11%) and sabinyl acetate (21.87%).

Key words: *Salvia spp.,* Sage, Cultivation, Essential oil, Chemcial composition.

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INTRODUCTION

Plant species have been utilized as a source of food, fragrance and medicine for millennia throughout the world. The family Lamiaceae has been extensively known to have immense medicinal, pharmacological and industrial properties. Many of these species within the Lamiaceae family has a potential of possessing essential oils which can be supplied to industry as raw material for different application in preparation of insecticides, antiseptics, perfumes, spices and many other commodities.[1]

The genus *Salvia* L. is the largest genus in the Lamiaceae, comprising nearly 1000 species. *Salvia* L. has radiated extensively in three regions of the world, Central and South America (500 spp.), West (200 spp.) and East Asia (100spp.).[2] This genus is represented, in Turkish flora, by 99 species and 14 subspecies totally 113 taxa, 58 of which are endemic.[3] Some members of this genus are of economic importance since they have been used as herbal tea, flavouring agents in

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perfumery and cosmetics. Some sage (*Salvia* L.) species has been credited with a long list of medicinal uses: e.g. spasmolytic, antiseptic, astringent. Since ancient times, species of *Salvia* L. have been used in folk medicine for the treatment of diabetes and skin diseases such as psoriasis and eczema. Numerous species of the genus *Salvia* L. have been used since ancient times in folk medicine and subjected to extensive pharmacognosic research intended to identify biologically active compounds. *Salvia* L. species contain various secondary metabolites such as sterols, flavonoids, sesquiterpenoids, sesterpenoids, diterpenoids, triterpenoids, essential oils, and flavonoids.[4]

The analysis of the essential oil composition of several *Salvia* L. species indicates that 1,8-cineole (eucalyptol), α and β-thujone, α and β-pinene and borneol are its main constituents. However, several authors have documented significant species specific variations in the concentration of these compounds and/or presence of others in high concentrations.[2] Moreover, the essential oil composition of *Salvia* L. species, as occurs with other medicinal and aromatic plants, is highly influenced by genetic and environmental factors.[4] *Salvia* L. taxa of Turkey were classifed by according to main components in their respective essential oils as 1,8-cineole/camphor group: *Salvia fruticosa* Mill., thujone group: *Salvia officinalis* L., linalyl acetate/linalool group: *Salvia sclarea* L. and β-caryophyllene group: *Salvia dichroantha* L.[5]

Experimental

Plant material

Plants were harvested during the flowering period from field experiment area of Aegean Agricultural Research Institute. Plant samples which included leaves and flowers were collected to the two years old plants.

Isolation of the Essential Oils

The essential oils from air-dried plant materrials were isolated by hydrodistillation for 3 h, using a clevenger-type apparatus.[6] The obtained oils were dried over anhydrous sodium sulphate and stored at +4°C in the dark until analysed and tested.

GC-MS analysis

The essential oil composition of samples was analyzed by gas chromatography (Agilent 5975C) coupled to flame ionization detector and mass spectrometry (Agilent 5975C) using capillary column (HP Innowax Capillary; 60.0 m × 0.25 mm × 0.25 µm). Essential oils were diluted 1:50 ratio with hexane. GC-MS/FID analysis was carried out at split mode of 50:1. Injection volume and temperature were adjusted as 1 µl and 250°C, respectively. Helium (99.9%) was the carrier gas at a constant flow rate of 1 ml/ min. The oven temperature was programmed as follows: 60°C for 10 min, increased at 20°C/min to 250°C, and held at 250°C for 8 min. MS spectra were monitored between 35 and 450 amu and the ionization mode used was electronic impact at 70 eV.

Identification of Compounds

The relative percentage of the components was calculated from GC-FID peak areas, and components were identified by Wiley 7n, Nist 05 and Flavour and Fragrance Natural and Synthetic Compounds (ver. 1.3) Libraries.

RESULTS AND DISCUSSION

The essential oil yield of five *Salvia* L. species were studied in this study is summarized in Table 1. The essential oil yield of *Salvia fruticosa* Mill., *Salvia officinalis* L., *Salvia sclarea* L., hybrid (*Salvia fruticosa* Mill. x *Salvia officinalis* L.) and *Salvia dichroantha* L. were obtained 3.86%, 2.42%, 0.5%, 2.84% and 0.19% respectively. In our study the highest yield of essential oil was obtained in *Salvia fruticosa* Mill. (3.86%) and the lowest in *Salvia dichroantha* L. (0.19%). The essential oil yield of *Salvia fruticosa* Mill. were found between 1.14%-4.58% in different studies in the Flora of Turkey.[7-10] *Salvia fruticosa* Mill. essential oil yield has been previously studied in different countries. *Salvia fruticosa* Mill. essential oil yield were obtained; in 1986, Putievsky *et al.*[11] 1.4%-3.8% in Israel, in 1993, Cao *et al.*[12] 2-3%, in Italy, in 1997, Karousou and Kokkini[13] 1%-5.5% in Crete and in 2011, Mossi *et al.*[14] 0.98% in Brasil. In our study we found *Salvia officinalis* L. essential oil yield was 2.42%. The essential oil of common sage (*Salvia officinalis* L.) has been previously studied. They reported; in 1987, Ceylan *et al.*[15] 0.85%-2.13%, in 1991, Bernath *et al.*[16] 1.5%-2.5%, *Salvia officinalis* L. essential oil in different studies. When we focused on *Salvia sclarea* L., we found 0.5% essential oil while in 1986, Şarer,[17] in 2005, Fraternale *et al.*[18] and in 2012, Sharopov *et al.*[19] reported that *Salvia sclarea* L. was included 0.25%, 0.15% and 0.30% essential oil. Hybrid sage (*Salvia fruticosa* Mill. × *Salvia officinalis* L.) was improved in our Institute and it contains 2.84% essential oil. The last species is *Salvia dichroantha* L. and we obtained 0.19% of essential oil. In 1986, Şarer[17] and in 2002, Başer[5] reported that *Salvia dichroantha* L. included 0.2% and 0.15% essential oil. It is known that genetic constitution and environmental conditions influence the yield and composition of volatile oil produced by medicinal plants.[20]

We identified 22, 16, 14, 20 and 16 components in essential oils belong to *Salvia fruticosa* Mill., *Salvia officinalis* L., *Salvia sclarea* L., hybrid (*Salvia fruticosa* Mill. × *Salvia*

Table 1: The composition of the essential oil of Cutivated Sage Species (*Salvia spp*.).

RRI	Components	Species				
		SF*	SO*	SS*	SFxO*	SD*
1002	α-pınene	3,40	3,38	-	6,46	0,73
1006	α-thujene	0,52	-	-	-	-
1046	camphene	0,44	4,22	-	2,88	-
1090	β-pınene	8,20	4,10	-	8,70	-
1104	sabınene	0,43	-	-	-	-
1144	myrcene	5,66	0,99	0,85	1,93	-
1162	α-terpınene	0,55	-	-	0,59	-
1182	lımonene	1,12	1,09	-	1,14	-
1192	1,8-cıneole	57,18	4,02	-	21,42	-
1227	gamma-terpınene	1,33	0,59	-	1,36	-
1232	β-ocımene	-	-	-	0,65	-
1253	cymene	0,40	-	-	0,89	-
1264	α-terpınolene	0,29	-	-	-	-
1408	β-thujone	3,07	34,59	-	18,37	-
1428	α-thujone	1,48	12,60	-	4,11	-
1442	cıs-sabınene hydrate	0,61	-	-	-	-
1476	α-copaene	-	-	0,66	-	-
1502	β-bourbonene	-	-	-	-	0,62
1505	camphor	3,15	10,09	-	6,02	-
1517	lınalool	-	-	11,74	-	-
1532	lınalyl acetate	-	-	46,77	-	-
1563	bornyl acetate	-	1,08	-	-	-
1584	β-caryophyllene	4,83	3,45	1,53	11,26	23,11
1593	aromadendrene	0,95	-	-	-	
1629	sabınyl acetate	-	-	-	-	21,87
1656	α-humulene	2,85	5,72	-	2,34	1,82
1670	gamma-cadınene	-	-	-	-	0,85
1673	α-terpıneol	-	-	4,39	0,48	-
1679	borneol	0,35	4,45	-	3,40	-
1696	germacrene	-	-	16,27	-	7,29
1706	β-selınene	-	-	-	-	0,64
1720	neryl acetate	-	-	4,12	-	-
1721	bıcyclogermacrene	-	-	-	-	2,59
1737	delta-cadınene	-	-	-	-	1,13
1768	nerol	-	-	1,10	-	-
1812	geranıol	-	-	3,15	-	-
1980	caryophyllene oxıde	-	-	-	0,55	10,98
2063	guaıol	-	-	-	-	4,46
2066	vırıdıflorol	2,89	6,24	-	6,61	-
2104	spathulenol	0,33	-	-	-	11,55
2130	farnesol	-	-	0,86	-	-
2146	epıbıcyclosesquıphellandrene	-	-	1,18	-	-
2185	bulnesol	-	-	-	-	-
2199	8-cedren-13-ol	-	-	-	-	-
2273	caryophylla-4,8-dıen-5-beta-ol	-	-	-	-	-
2212	β-eudesmol	-	-	1,11	-	0,72
2244	sclareoloxıde	-	-	1,49	-	0,59
2636	13-epı manool	-	2,67	-	0,84	0,91
Total (%)		100	100	95,22	100	89,85
Essential Oil (%)		3,86	2,42	0,50	2,84	0,19

SF*= *Salvia fruticosa* Mill., SO*= *Salvia officinalis* L., SS*= *Salvia sclarea* L.,
SFxO*= *Salvia fruticosa* Mill. x *Salvia officinalis* L., SD*= *Salvia dichroantha* L.

officinalis L.) and *Salvia dichroantha* L.. These componets are representing 100%, 100%, 95.22% 100% and 89.85% of the total composition of essential oils respectively.

The chemical composition of *Salvia fruticosa* Mill. essential oil is summarized in Table 1. A total of 22 compounds were identified representing 100% of the total composition. The oil was dominated by the 1,8-cineole (57.18%) and the other major component was β-pinene (8.20%).

In 2002, Başer[15] studied on Turkish *Salvia* L. species and reported that *Salvia fruticosa* Mill. belong to 1,8-cineole and camphor group and their amount changed 35%-51% and 7%-13%. *Salvia fruticosa* Mill. essential oils were studied in different countries and they found the major component as 1,8-cineole and reported that its percentage between 15.28% and 80.80%.[16-17]

Composition of the essential oil obtained from *Salvia officinalis* L. is included three major components as β-thujone 34.59%, α-thujone 12.6% and camphor 10.09%. Chemical composition of the *Salvia officinalis* L. essential oil have been reported for several studies. Main components and their amonut of *Salvia officinalis* L. essential oil which mentioned studies were described as; in 2007, Ekren *et al.*[21] α-thujone 12.62%-39.29% and camphor 5.06%-30.97%, in 2000, Miladinovic and Miladinovic[22] α-thujone 24.88% and camphor 16.03%, in 2000, Salameh and Dordevic[23] α-thujone 29.9%, β-thujone 13.68% and camphor 15.74%, in 2000, Sagareishvili *et al.*[24] α-thujone 31.56%, β-thujone 17.55% and camphor 16.48%.

The chemical composition of *Salvia sclarea* L. essential oil is included of 14 compounds were identified representing 95.22% of the total composition. The oil was dominated by the linalyl acetate (46.77%), germacrene (16.27%) and linalool (11.74%). Previous studies have also yielded similar results.[17-19] Hybrid sage (*Salvia fruticosa* Mill. x *Salvia officinalis* L.) essential oil was included 20 compounds and the main constituens were 1,8-cineole (21.42%) and β-thujone (18.37). The compounds identified from the *Salvia dichroantha* L. essential oil along with its relative percentages are listed in Table 1. A total of 16 compounds were identified from the essential oil which represented 89.85% of the oil. The main components of *Salvia dichroantha* L. essential oil were found as β- caryophyllene (23.11%) and sabinyl acetate (21.87%). In 1986, Şarer[17] and in 2002, Başer[5] reported β-caryophyllene and sabinyl acetate as the main compounds of *Salvia dichroantha* L. from Turkey.

CONCLUSION

The yield and chemical composition of the essential oils were determined in *Salvia fruticosa* Mill. 3.86% 1,8-cineole (57.18%), *Salvia officinalis* L. 2.42% β-thujone (34.59%), *Salvia sclarea* L. 0.50% linalyl acetate (46.77%), *Salvia fruticosa* Mill. x *Salvia officinalis* L. 2.84% 1,8-cineole (21.42%) and β-thujone (18.37%) and *Salvia dichroantha* L. 0.19% β- caryophyllene (23.11%) and sabinyl acetate (21.87%).

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

ABBREVIATIONS

GC: Gas chromatography; **GC-MS:** Gas chromatography–mass spectrometry; **FID:** Flame Ionization Detector; **GC-FID:** Gas chromatography with Flame Ionization Detector; **RRI:** Relative retention indices.

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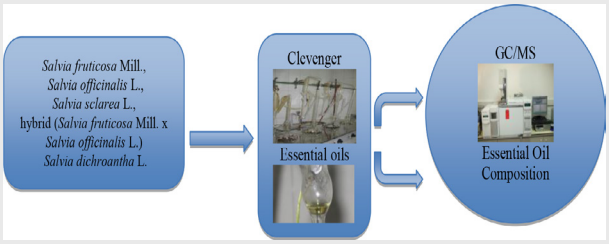
PICTORIAL ABSTRACT



SUMMARY

- The genus *Salvia* L. is the largest genus in the Lamiaceae, comprising nearly 1000 species. *Salvia* L. has radiated extensively in three regions of the world, Central and South America (500 spp.), West (200 spp.) and East Asia (100spp.). This genus is represented, in Turkish flora, by 99 species and 14 subspecies totally 113 taxa, 58 of which are endemic.
- Our objectives are to find out the composition of the essential oil from aerial parts of *Salvia* L. species cultivated in Turkey, using GC-FID and GC-MS.
- *Salvia fruticosa* Mill. 1,8-cineole (57.18%), *Salvia officinalis* L. β-thujone (34.59%), *Salvia sclarea* L. linalyl acetate (46.77%), *Salvia fruticosa* Mill. x *Salvia officinalis* L. 1,8-cineole (21.42%) and β-thujone (18.37%) and *Salvia dichroantha* L. β-caryophyllene (23.11%) and sabinyl acetate (21.87%) were found main components in the essential oils.

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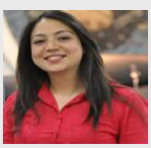

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