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Examination of the changes in components of the volatile oil from Abyssinian sage, Musk sage and Medical sage [*Salvia aethiopis* L., *Salvia sclarea* L. and *Salvia officinalis* L. (hybrid)] growing in different locations

H.B. Karayel[a, ✉] and M. Akçura[b]

[a]Dumlupınar University. Gediz Vocational Shool, Medical and Aromatic Plants Department. Kütahya, Türkiye.
[b]Çanakkale 18 Mart University, Faculty of Agriculture, Field Crops Department, Çanakkale, Turkey mevlut_akcura@yahoo.com
✉Corresponding author: kbasri23@hotmail.com

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SUMMARY: This study was conducted simultaneously in different locations in Çanakkale, Balıkesir and Kütahya in order to determine the effect of location on the volatile oil components, volatile oil rate and volatile oil quality of Abyssinian sage, Musk sage and Medical sage (*Salvia aethiopis* L., *Salvia sclarea* L. and *Salvia officinalis* L. (hybrid)) plants from the 2015 growing season. Field experiments were carried out in 3 replicates according to the randomized block design. These plants' volatile oils were obtained by the hydrodistillation method (GC-MS/FID) and the volatile oil rates in three different locations were measured as 0.53%, 0.21%, 0.20%, respectively. The basic components of the volatile oil were determined as follows: β -caryophyllene 36.22%, 30.46%, 35.96%, α-copaene 15.06%, 16.46%, 16.58%, germacrene-D 13.23%, 20.01%, 15.20%, β-cubebene 5.62%, 7.04%, 6.93%, α–humulene 8.68%, 7.40%, 8.54%, caryophylleneoxide 7.40%, 1.82%, 3.53%. No volatile oil was acquired from *Salvia sclarea* L. except for the Çanakkale location which was only 0.02% and the main components in this volatile oil were measured as germacrene-D 20.78%, and phytol 17.81%. The best volatile oil contents from Abyssinian sage and Musk sage were obtained from the Çanakkale location with 0.53% and 0.02%, respectively. The rates of volatile oils from Medical sage (*Salvia officinalis* L. (hybrid)) were 1.00%, 1.40% and 0.96%, respectively, in the three locations. The main components in this volatile oil were measured as α-thujone 46,00%, 44.53%, 35.78%, β-thujone 5.05%, 6.31%, 8.61%, camphor 10.73%, 19.15%, 18.68%, 1.8-cineole 8.99%, 7.23%, 5.06%, viridiflorol 1.85%, 2.28%, 4.23%. The highest volatile oil rate in Medical sage was reached at the Balıkesir location at a rate of 1.40%. As a result of this study it was found that volatile oil components are comparatively richer in terpenes and the amount of volatile oil differs according to ecological factors.

***KEY WORDS*:** α-*thujone; GC-MS*/*FID;* Salvia officinalis *L. (hybrid); Volatile oil*

RESUMEN: ***Cambios en los componentes del aceite volátil de salvia abisinia, salvia de almizcle y salvia médica [*Salvia aethiopis *L., Salvia sclarea L. y Salvia officinalis L. (híbrida)] que crecen en diferentes localizaciones*.** Este estudio se llevó a cabo simultáneamente en las ubicaciones de Çanakkale, Balikirir y Kütahya para definir el efecto de la ubicación en los componentes del aceite volátil, la cantidad de aceite y su calidad en salvia abisinia, salvia de almizcle y salvia médica [(*Salvia aethiopis* L., *Salvia sclarea* L. y *Salvia officinalis* L. (híbrida)] en la temporada de crecimiento 2015. Los experimentos de campo se repitieron 3 veces y de acuerdo con el diseño de bloques al azar. Los aceites volátiles de estas plantas se obtuvieron por el método de hidrodestilación (GC-MS/ FID) y las cantidades en las tres ubicaciones fueron de 0,53%, 0,21% y 0,20%. Los componentes básicos del aceite fueron: β-cariofileno 36,22%, 30,46%, 35,96%, α-copaeno 15,06%, 16,46%, 16,58%, germacreno-D 13,23%, 20,01%, 15,20%, β-cubebene 5,62%, 7,04%, 6,93%, α-humuleno 8,68%, 7,40%, 8,54% y cariofilenóxido 7,40%, 1,82%, 3,53%. No se consiguió aceite volátil de *Salvia sclarea* L. a excepción de la ubicación de Çanakkale que fue solo de 0,02% y los componentes principales en este aceite fueron germacrene-D 20,78%, y fitol 17,81%. El mayor contenido de aceite volátil de salvia abisinia y salvia de almizcle se obtuvo en la ubicación de Çanakkale con 0,53% y 0,02% respectivamente. Las cantidades de aceite de salvia médica (*Salvia officinalis* L. (híbrida) fueron de 1,00%, 1,40% y 0,96%, respectivamente, en las tres ubicaciones. Los componentes principales de estos aceites fueron: α-tujona 46,00%, 44,53%, 35,78%, β-tujona 5,05%, 6,31%, 8,61%, alcanfor 10,73%, 19,15%, 18,68%, 1,8-cineole 8,99%, 7,23%, 5,06% y viridiflorol 1,85%, 2,28%, 4,23%. La cantidad de aceite más alta de salbia médica se obtuvo en la ubicación de Balıkesir con una cantidad del 1,40%. Como resultado, se concluye que los componentes volátiles del aceite son comparativamente más ricos en terpenos y la cantidad de aceite volátil varía según los factores ecológicos.

PALABRAS CLAVE: α-*tujona; Aceite volatile; GC-MS | FID;* Salvia officinalis *L. (híbrido)*

ORCID ID: Karayel HB https://orcid.org/0000-0002-4271-0540, Akcura M https://orcid.org/0000-0001-7828-5163

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1. INTRODUCTION

In addition to being the center of many plant genes, Turkey has some geographical areas where endemic species grow. People have used plants to treat diseases for centuries and the use of plants for treatment has continued until today. Another development is the understanding of the flavor, smell, taste and appetizing properties of these plants in terms of nourishment and the spread of their use. Natural remedies constitute a significant part of drugs used for treating disease. The rate of the use of natural drugs is 60% in developed countries and 4% in developing countries (Tulukcu, 2005). The Salvia genus, which belongs to the Lamiaceae family, contains over 986 species all over the world, spread to the Mediterranean and Central Europe, especially in the tropics and subtropics. 106 of these species are naturally distributed in Turkey and 58 of them are endemic (Arslan *et al*., 1995).

Although sage is an ecologically warm plant, it can be easily grown in continental climate conditions. Sage must be watered regularly in the first year. In the second year, it does not need much water. Cultivation can be done in high calcareous soils (Zeybek *et al*., 1994). The phytochemical compounds that have been obtained from studies about the Salvia species around the world and in Turkey can be grouped into "polyphenolic compounds, terpenes and others" according to their chemical structure (Topçu *et al*., 2003).

The usable parts of the sage plant are its herb, leaves and volatile oil. The chemical composition of the essential oils obtained from these plants show great variability in relation to the geographical characteristics of the area they grow in (Kilic, 2016). The active substances derived from the Salvia species are used in the treatment of certain diseases as the main raw material for various drugs (Kandemir, 2003). The Lamiaceae family, which generally contains fragrant plants, is important in terms of pharmaceutical, food and perfumery industrial applications because they contain essential oil. The species belonging to this family are grown as bright and decorative ornamental plants due to their beautiful flowers as well as the essential oils and medicinal properties they provide (Seçmen, 2000). Seed fatty acids of *Salvia aethiopis* L. and their effects on some microorganisms were investigated. As a result, seed fatty acids were found to be rich in linoleic acid and to show different levels of antimicrobial activity against microorganisms (Morteza-Semnani *et al*., 2005b). The characteristics of the leaves and flowers of this plant, which is a common species in Turkey, have been known since ancient times as stomach relieving and stimulant (Baytop, 1999). In the Bolu region its name can be translated as "redness" and is used as an ointment for wound healing (Sezik *et al*., 1999). *S. sclarea* L. is known as "hairy sage or musk sage" in Turkey. The essential oil from the plant's flowering branch tips and leaves is used as a folk medicine for abdominal pain and constipation. At the same time, *Salvia officinalis* L. and *Salvia sclarea* L. have important economic value for the perfume and cosmetic industry. These species have an important place in world trade (Lahlou, 2004). *S. sclarea* L. is a plant of economic importance. Its essential oil is a valuable volatile oil used in the production of expensive perfumes, in the cosmetics and pharmaceutical industries and in the food industry. The use of medical sage (*Salvia officinalis* L.) is extensive. It is used in medicine, food, drink, perfume and cosmetic industries (Demirci *et al*., 2002; Pesic, 2003). The salvia species in general are the plants which include antibacterial, antiseptic, analgesic, antioxidant activities and biological activities such as insecticide. However, the chemical composition of the essential oils obtained from these plants exhibits great variability in relation to the geographic characteristics of the area where they grow. It is known that the biological activity of the essential oil is directly related to the major components in the composition of the essential oil (Baydar, 2007; Dweck, 2000). This study was carried out to determine the amount of essential oil and the essential components in the essential oil in the sage grown in different locations. It is also a study of comparison of *Salvia* L. species it terms of essential oil composition and evaluation of essential oils.

2. MATERIALS AND METHODS

2.1. Climatic and soil properties of trial sites

The seeds used in this study were obtained from the Department of Field Crops of the Faculty of Agriculture of Ankara University. The seeds were grown in the Kütahya Municipality in December, 2014 by planting seedlings at Hekim Sinan Medicinal Plants Botanical Garden. Studies were carried out simultaneously in 2015 and in 3 different locations: The Çanakkale Onsekiz Mart University Faculty of Agriculture Dardanos Campus test site,

The Balıkesir Edremit Kale Natürel A.Ş. Medical Plants Garden and The Kütahya Municipality Physician Sinan Medical Plants Botanical Garden. Since 180 plants were needed at each location, 216 plants were moved to the trial site, taking into consideration the greenhouse conditions and subsequent failures in the field. The plant seedlings were watered at regular intervals with a strainer bucket. Seed germination lasted 20-25 days. The fiddling roots began to be transferred to the field from April of 2015. The seedlings were given water right after the transfer.

The field trials were carried out in 3 replicates, according to the random block trial design. Planting frequency was arranged according to 50 cm horizontal, 30 cm vertical distances and each parcel contained 3 rows. The same order was established in all locations and the start of flowering was established as harvest time because the flowers have highest proportion of essential oil.

2.2. Distillation and analysis of the essential oils

Air-dried aerial parts were cut in small pieces and 50 g of each sample were submitted to hydrodistillation for 2 hours using a Clevenger-type apparatus. The volatiles were trapped in 5 ml GC grade n-pentane, according to standard procedure and dried over anhydrous sodium sulphate and kept in closed, air-tight Pyrex containers at -4 °C. Essential oil yield was expressed in $ml \cdot 100^{-1}$ g d.w. The composition of the volatile constituents was established by GC-MS analyses.

2.3. Determination of essential oil composition by GC-MS

The analysis of the essential oil components were carried out at the Research Laboratory of the Western Mediterranean Agricultural Research Institute. Samples were diluted with 1% hexane and injected into gas Chromatography in 1 µl with 40:1 split ratios. Agilent 7890A Capillary columns (HP InnowaxCapillary; 60.0 m x 0.25 mm x 0.25 µm) were used to separate the components. The column was split into two fractions at a rate of 1:1 using a splitter in the FID and mass spectrometry detector (Agilent 5975C). Helium was used as carrier gas at a flow rate of 0.8 ml/min. The injector temperature was maintained at 250 °C, the column temperature program was 10 minutes at 60 °C, raised at 4 °C/minute (40 minutes) at 60 °C and 220 °C and 10 minutes at 220 °C. The detector was set for 60 minutes. The scan range (m/z) for the mass detector was 35-450 atomic mass units and the electron bombardment ionization energy was 70 eV. The data from the FID detector were used for the volatile oil component ratios (Özek *et al*., 2010).

3. RESULTS AND DISCUSSION

Variation in volatile oil content and composition of the *Salvia species* examined in this study according to their growing location. The total essential oil lield from *Salvia aethiopis* L. was measured as 0.53% in Çanakkale; 0.21% in Balıkesir - Edremit and 0.20% in Kütahya. In the analysis of the essential oil from the *Salvia aethiopis* L.'s parts which are above the soil, 15, 14 and 14 different components were identified, respectively, in Çanakkale, Balıkesir and Kütahya. This constituted 99.98%, 100% and 100% of the total. The amounts of the essential oil components are listed in Table 1. The main components of the essential oil have been identified according to locations as; β-caryophyllene 36.22%, 30.46%, 35.96%, α-copaene 15.06%, 16.46%, 16.58%, germacrene-D 13.23%, 20.01%, 15.20%, β-cubebene 5.62%, 7.04%, 6.93%, α–humulene 8.68%, 7.40%, 8.54%, caryophylleneoxide 7.40%, 1.82%, 3.53%, respectively.

Similar to our study, another study reported the main components of the essential oil from *S. aethiopis* L. species as follows: germacrene D (29.0%), α-copaene (19.8%), β-cubebene, β-eleme (9.9%), bicyclogermacrene (9.3%). The essential oil content of *S. aethiopis* L. in the Elazig region was found to be 0.3%, while the main constituents of the essential oil were as follows: α-copaene (21.1%), β-cubebene (8.1%), germacrene-D (26.3%) and bicyclogermacrene (24.1%) (Bagci *et al*., 2007). The highest volatile oil content of *Salvia aethiopis* L. was found as 0.14% and the main components of the essential oil were α-copaene and β-caryophyllene (Şenkal *et al*., 2012). In March 2001, *Salvia aethiopis* L. essential oil collected from the yellow suburb of Iran was analyzed by GC and GC / MS. Among the 28 components identified in this oil, β-caryophyllene (17.0%), α-copaene (16.3%), germacrene-D (13.8%), β-cubebene (9.7%), spathulenol (8%), 3), δ-cadinene 7,7% and α-humulene (6.9%) were found to be the most prominent components (Morteza-Semnani *et al*., 2005b). The volatile oil ratios of *Salvia sclarea* and *Salvia aethiopis* L. species in Iran were found as 0.07% and 0.71%. A total of 73 components were analyzed in the essential oil and the main components obtained were linalool (0.6-51.58%), linalool acetate (0-52.61%), e-caryophylen (3.08-60.58%), germacten-D (0-25.16%) spathulenol (0-35.4%) and caryophyll-oxide (0-37.89%) (Rajabi Zahra *et al*., 2014a). The main components of the essential oil of *S. aethiopis* L. ranged from β-caryophyllene (24.6%), α-copaene (15.5%) and germacrene-D (13.5%) (Rustaiyan, Abdolhossein *et al*., 1999). In a study on the essential oils obtained from various organs of *S. aethiopis* L. species the main components of the essential oil obtained from the leaves were α-copaene (23.8%), β-caryophyllene (23.3%) and

Table 1. Analysis results of *Salvia aethiopis* L. in terms of essential oil components according to location

No	Component name	Çanakkale	Balıkesir-Edremit	Kütahya
1	Bicycloelemene	-	1.27±0.0023	-
2	Pentadecane	0.61±0.035	-	-
3	α-copaene	15.06±1.038	16.46±0.43	16.58±0.59
4	β-cubebene	5.62±0.023	7.04±0.32	6.93±0.09
5	β-ylangene	1.11±0.012	1.66±0.039	1.31±0.003
6	β-elemene	2.08±0.016	3.01±0.045	2.30±0.022
7	β-caryophyllene	36.22±2.56	30.46±1.76	35.96±2.02
8	α-humulene	8.68±0.87	7.40±0.72	8.54±0.073
9	Germacrene-D	13.23±1.03	15.20±1.02	20.01±1.27
10	β-bisabolene	-	-	0.78±0.034
11	Bicyclogermacrene	0.77±0.023	2.55±0.035	0.85±0.024
12	δ-cadinene	4.81±0.029	5.73±0.04	4.85±0.35
13	α-cubebene	0.79±0.021	0.81±0.014	0.88±0.017
14	cis-Muurol-5-en-4-beta-ol	1.27±0.035	1.00±0.021	1.06±0.022
15	Caryophylleneoxide	7.40±0.021	1.82±0.011	3.53±0.019
16	Humuleneepoxide II	1.07±0.002	-	-
17	Viridiflorol	-	0.80±0.023	-
18	Carvacrol	1.26±0.011	-	1.23±0.016
	TOTAL	**99.98**	**100.00**	**98.77**

*Each value in the table represents the mean ± standard deviation of triple analyses

germacrene-D (18%); in the flowers, the main components were β-caryophyllene (24.1%), germacrene-D (18.4%) and α-copaene (18.1%), α-copaene (24.9%), β-caryophyllene (20.9%) and germacrene-D (17.8% (Tajbakhsh *et.al*., 2007). In the data obtained by many researchers, the essential oil components of *Salvia aethiopis* L. species are similar.

No volatile oil was acquired from *Salvia sclarea* L. except from the Çanakkale location which was only 0.02%. The amounts of essential oil components are listed in Table 2. Germacrene-D was measured at 20.78% and Phytol was measured at 17.81% as the main components in the volatile oil from the Çanakkale location. The proportion of these main components constitued 99.99% for *Salvia sclarea* L. from Çanakkale.

In another study, the essence oil from *Salvia sclarea* L. was analyzed by GC and GC-MS. The main components of the essential oils were linalol (27.08%-62.51%), linalyl acetate (nil-43.01%), α-terpineol (0.12%-0.25%), geriline (0.74%). 4.84%, (E)-β-osimene (1.19%-4.83%) and geranyl acetate (0.36%-3.11%) (Verma, 2010). Sharopov *et al*., (2012), analyzed the essential oil from *Salvia sclarea* L. by gas chromatography-mass spectrometry and reported the main components to be linalyl acetate (39.2%), linalool (12.5%), germagen-D (11.4%), p-terpineol (5.5%), geranilacetate (3.5%) and (E)-charyophilin (2.4%) (Sharopov *et al*., 2012). In a study in Iran, the rates of essential oils of *Salvia sclarea* L. and *Salvia aethiopis* L. species

Table 2. Analysis results of *Salvia sclarea* L. in terms of essential oil components according to location

No	Component	Çanakkale
1	Tetradecane	5.00±0.058
2	α-thujone	3.12±0.04
3	Octen-3-ol	2.41±0.037
4	β-thujone	2.00±0.023
5	Pentadecane	6.92±0.026
6	Camphor	2.38±0.024
7	Linalool	1.91±0.062
8	β-ylangene	1.69±0.052
9	Hexadecane	5.11±0.089
10	β-caryophyllene	3.06±0.07
11	Octadecane	1.43±0.032
12	Germacrene-D	20.78±1.23
13	β-bisabolene	5.04±0.033
14	Bicyclogermacrene	2.69±0.067
15	δ-cadinene	1.68±0.032
16	Caryophyllene oxide	3.34±0.037
17	Spathulenol	3.65±0.036
18	Valeranone	2.50±0.027
19	Carvacrol	2.11±0.033
20	Sclareoloxide	5.36±0.021
21	Phytol	17.81±1.23
	TOTAL	**99.99**

*Each value in the table represents the mean ± standard deviation of triple analyses

were found to be 0.07% and 0.71%. A total of 73 components were analyzed in the essential oil and the main components obtained were linalol (0.6-51.58%), linalool acetate (0-52.61%), e-caryophylline (3.08%-60.58%), germactan-D (0-25.16%) spathulenol (0-35.4%) and caryophyll-oxide (0-37.89%) (Rajabi Zahra *et al*., 2014a). The essential oil components of *Salvia sclarea* L. species collected in two natural flora in Greece were investigated. Sixty-six compounds representing 93.26% to 98.19% of the essential oils were identified. The main components were linalyl acetate (19.75%-31.05%), linalool (18.46%-30.43%), geranyl acetate (4.45%-12.1%) and α-terpineol (5.08%-7.56%) (Rozalski *et al*., 2007). In the results obtained by many researchers, the volatile oil components of *Salvia sclarea* L. species are similar.

In our study, total volatile oil yield was measured as Çanakkale 1.00%, Balıkesir- Edremit 1.40%, Kütahya 0.96%. The amounts of essential oil components are listed in Table 3. 21 – 20. 16 different coponents from *Salvia officinalis* L. (hybrid) were analyzed and these numbers constituted 97.31%-97.83% and 97.61% of all the total fat in all locations. The main component values for the valatile oils were determined, respectively, as follows: *Salvia officinalis* L., α-thujone 46.00%, 44.53%, 35.78%, β-thujone 5.05%, 6.31%, 8.61%, camphor 10.73%, 19.15%, 18.68%, 1.8-cineole 8.99%, 7.23%, 5.06%, viridiflorol 1.85%, 2.28%, 4.23%. The rates of these main components constitute 72.62%, 79.5% and 72.36% of the total fat amount in the 3 locations (Çanakkale, Balıkesir-Edremit and Kütahya), respectively. Researchers obtained the essential oil from *S. officinalis* L. collections grown in the temperate climate of India by GC / MS. It was determined that the essential oil content of *S. officinalis* L. ranged from 1.11% to 2.76% on a dry weight basis and its major components were as follows: α-thujone (21.43% to 40.10%), β-thujone (2.06% to 7.41%), camphor (11.31% to 37.67%), 1.8-cineole

Table 3. Analysis results of *Salvia officinalis* L. (hybrid) in terms of essential oil components according to location

No	Component name	Çanakkale	Balıkesir -Edremit	Kütahya
1	α-pinene	4.82±0.06	2.19±0.06	5.83±0.04
2	Camphene	3.63±0.016	4.56±0.045	3.72±0.063
3	β-pinene	2.05±0.021	1.81±0.032	2.11±0.012
4	cis-salvene	-	-	-
5	Myrcene	1.17±0.04	1.08±0.213	1.20±0.011
6	Limonene	1.58±0.06	1.55±0.022	1.67±0.016
7	1,8-cineole	8.99±0.08	7.23±0.214	5.06±0.013
8	γ-terpinene	0.43±0.032	0.44±0.016	-
9	α-terpinolene	-	-	-
10	β-Cymene	0.41±0.02	0.34±0.0134	-
11	α-thujone	46.00±0.87	44.53±2.10	35.78±1.34
12	β-thujone	5.05±0.81	6.31±0.89	8.61±0.95
13	Transsabinenhydrate	-	0.27±0.014	-
14	Camphor	10.73±0.058	19.15±0.96	18.68±1.22
15	Linalool	0.30±0.013	-	-
16	Bornylacetate	0.34±0.017	0.52±0.029	-
17	Terpinen-4-ol	0.44±0.04	0.26±0.024	-
18	β-caryophyllene	4.12±0.03	0.81±0.019	2.43±0.028
19	α-humulene	1.97±0.027	1.53±0.013	2.85±0.043
20	para cymene	-	-	-
21	Borneol	1.07±0.054	1.61±0.0075	2.07±0.014
22	Caryophylleneoxide	0.32±0.003	-	-
23	Humuleneepoxide II	1.02±0.004	0.52±0.024	0.53±0.018
24	Viridiflorol	1.85±0.0024	2.28±0.036	4.23±0.027
25	Manool	1.02±0.016	0.74±0.018	2.22±0.013
26	β-ocimene			
27	3-thujanol			
	TOTAL	**97.31**	**97.83**	**97.61**

*Each value in the table represents the mean ± standard deviation of triple analyses

(9.17% to 4.47%), α-humulene (4.58% to 9.51%), camphene (1.89% to 7.04%), viridiflorol (2.14% to 5.56%), α-pinene (1.55% to 6.17%), β-pinene (1.68% to 3.49%) and β-caryophyllene (1.06% to 5.59%) (Raina *et al*., 2013). In another study, the volatile oil composition of *Salvia officinalis* L. grown in Cuba was analyzed by GC / MS. Among the 43 compounds identified, germacrene-D (32.9%), β-caryophyllene (31.8%) and caryophylleneoxide (23.2%) were defined as the main components (Pino *et al*., 2002). The essential oil composition of *Salvia officinalis* L. grown in North India was investigated using gas chromatography (GC/FID) and GC-mass spectrometry (GC/MS). The required oil yield varied between 0.22-0.43% and 0.15-0.60%, respectively, depending on harvest season and processed plant parts. Sixty components were determined corresponding to 95.5-99.2% of the fat compositions. The main constituents of the essential oil were determined as follows: cis-thujone (19.8-42.5%), (E)-caryophyllene (1.2-16.1%), manool (3.6-15.1%), viridifluorol (%3.1-12.8), 1.8-cineole (2.8-13.8%), camphor (1.4-22.1%), borneol (0.9-4.8%), α-humulene (1.5-4.5%), β-pinene (0.7-4.1%), and trans-thujone (1.4-3.7%) (Verma *et al*., 2015). Four essential oils from *Salvia officinalis* L. grown in Spain were analyzed by GC / MS to determine their relative and absolute compounds. The main components were α-thujone (22,8-41,7%), Camphor (10,7-19,8%), 1,8-cineole (4,7-15,6%) and β-thujone (6,1-15,6%) (Cutillas *et al*., 2017). The results of these investigators are consistent with our research findings. The amount of essential oil and the changes in the main components in the essential oil varies depending on genetic and environmental factors. In this study, differences in terms of essential components and proportions of essential oils of plant species have been tested and compared to other studies. The reasons for these differences can be explained by the variability in volatile oil composition due to the flowering time of the salvia plant along with geographic and climatic factors. In addition, the variety and amount of bioactive substances present in medicinal and aromatic plants may also vary according to the part of the plant used, post-harvest processes, the method of obtaining the essential oil and the methods of analysis (Rajabi Zahra *et al*., 2014a). In 2015, the highest value for volatile oil was from *Salvia officinalis* L. (hybrite) at 1.40% in Balıkesir. In our research, it has been determined that different species adaptat differently to their environment. The main components of Salvia officinalis L. were recorded as α-thujone, Camphor, 1,8-cineole and in all regions the same components were found as α-thujone, Camphor, 1,8-cineole. The main components of *Salvia aethiopis* were recorded as α-copaene, β-caryophyllene, Germacrene-D, Caryophylleneoxide and in all regions the same components were found as α-copaene, β-caryophyllene, Germacrene -D, Caryophylleneoxide. The main components of *Salvia sclarea* were recorded as Germacrene - D, Spathulenol, Sclareoloxide and in all regions the same components were found as Germacrene - D, Spathulenol, Sclareoloxide.

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