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Comparison of essential oils of endemic *Salvia dichroantha* Stapf collected from Konya

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Abstract: In the Anatolia folk medicine, *Salvia* L. (Lamiaceae) species are used by many people in various villages and towns for the therapeutic value of their essential oils. *Salvia dichroantha* Stapf is an endemic plant of the Irano-Turanian phytogeographic region. Plant materials were collected during the flowering period from Konya Cihanbeyli (900 m) and Konya Taşkent (1800 m). In this study, water-distilled essential oil of *Salvia dichroantha* was analyzed. The analysis was performed by using a gas chromatography (GC-FID) and gas chromatography-mass spectrometry (GC-MS) systems, simultaneously. Eight compounds were identified from the oil of Taşkent representing 96.2 % of the total oil and nine compounds were identified from the oil of Cihanbeyli representing 98.3% of the total oil. The major components were found as caryophyllene oxide (38.6%), caryophyllenol I (16.7%), caryophyllenol II (15.6%) and caryophylladienol II (11.1%) for Taşkent; caryophyllene oxide (65.8%), caryophyllenol II (14.3 %) for the oil of Cihanbeyli.

Keywords: Essential oil, GC-FID, GC-MS, *Salvia dichroantha*

1. INTRODUCTION

Lamiaceae family has worldwide distribution and includes over 250 genera and about 7000 species. Also this family is known for its fine herbs like lavender, sage, basil, oregano, thyme, mint, rosemary and is a rich source of essential oils for the perfume and flavoring industry [1]. Lamiaceae is the third largest family in Turkish Flora. The morphologically diverse genus *Salvia* L. is one of the largest genus of the Lamiaceae family and includes about approximately 1000 species distributed all over the world. Anatolia is a major centre of diversity for the genus *Salvia* in Asia. The genus was represented by 86 species in the flora of Turkey [2]. Since its publication, some synonyms, some new species and records have been reported with the studies on *Salvia* species in Turkey. The total number of *Salvia* species in Turkey has been reached 99 and the ratio of endemism in the genus is approximately 50 % [3, 4].

Salvia species are known as "adaçayı" in Turkey where they grow and consumed as a hot drink. The name salvia, coming from the Latin word for health (salvare or heal). Common sage or garden sage (*Salvia officinalis* L.) is being an important medicinal and aromatic plant used

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in folk medicine for centuries. Earliest times, many species of *Salvia* use as a tonic, stimulant, carminative, antiseptic, spasmolytic, diuretic, herbal tea, spices, to treat inflammations in the mouth, antihydrotic and flavour food in cosmetics, perfumes and pharmaceutical industries are reported [5]. The plants of this genus are rich in essential oils and among their constituents, 1,8-cineol (eucalyptol) and guaiane mono and sesquiterpenes are very common [6].

As well as floral morphology, pollination biology and growth forms, the genus *Salvia* displays remarkable diversity in secondary compounds (essential oils and the phenolic derivatives) [5]. The secondary metabolites isolated from *Salvia* species possess a long list of medicinal uses [6]. Some of the essential oils and phenolic compounds of plants belonging to this genus have also shown excellent antimicrobial activity as well as antioxidant capacity and some are used as anticancer agents or have hypoglycemic effect [7-11]. Some members of this genus such as *Salvia officinalis* L, *S. tomentosa* Miller and *S. triloba* L. are of economic importance, since they are used as flavoring agents in perfumery and cosmetics. Many of wild growing *Salvia* species are also used in traditional medicine of different nations instead of sage or as an adulteration [12].

Salvia dichroantha Stapf is an endemic plant species of the Irano-Turanian phytogeographic region. It grows steppes, clearings in forest, roadsides of central, nort and soust west Anatolia and the flowering time is from July to september. *S. dichroantha* is a perennial herb. Stems are 25-55 cm length, ascending-erect, branched above or not. Leaves are simple, oblong to oblong-lanseolate. Verticillasters are 2-6 flowered, Calyx is tubular-campanulate, 5-7 mm and corolla is viole, 10-13 mm [2]. Prepared infusion from leaves of *S. dichroantha* used to external wound treatment in Niğde region.

Chemical constituents and biological activities of the essential oils of some *Salvia* species were investigated in Turkey (13-26). According to literature search, water-distilled essential oil of *S. dichroantha* was previously analysed using GC and GC–MS and caryophyllene oxide (22.4%) was found to be the main components in the oil [19]. In this study, we report chemical constituents of endemic *S. dichroantha* growing in Konya (Taşkent and Cihanbeyli).

2. MATERIAL and METHODS

2.1. Plant material

Salvia dichroantha was collected during the flowering period (July, 2009-2013) from Konya (Taşkent and Cihanbeyli) province of Turkey. Voucher specimens are deposited in the Herbarium of the Faculty of Education of Necmettin Erbakan University in Konya, Turkey (NEÜ Herb.).

2.2. Isolation of essential oil

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

2.3. GC–MS analysis

The GC-MS analysis was carried out with an Agilent 5975 GC-MSD system. Innowax FSC column (60 m x 0.25 mm, 0.25 μm film thickness) was used with helium as carrier gas (0.8 ml/min). GC oven temperature was kept at 60°C for 10 min and programmed to 220°C at a rate of 4°C/min, and kept constant at 220°C for 10 min and then programmed to 240°C at a rate of 1°C/min. Split ratio was adjusted at 40:1. The injector temperature was set at 250°C. Mass spectra were recorded at 70 eV. Mass range was from *m/z* 35 to 450.

2.4. GC analysis

The GC analysis was carried out using an Agilent 6890N GC system. FID detector temperature was 300°C. To obtain the same elution order with GC-MS, simultaneous auto-injection was done on a duplicate of the same column applying the same operational conditions. Relative percentage amounts of the separated compounds were calculated from FID chromatograms. The analysis results are given in Table 1.

2.5. Identification of components

Identification of the essential oil components were carried out by comparison of their relative retention times with those of authentic samples or by comparison of their relative retention index (RRI) to series of *n*-alkanes. Computer matching against commercial (Wiley GC/MS Library, Adams Library, MassFinder 3 Library [27,28] and in-house "Başer Library of Essential Oil Constituents" built up by genuine compounds and components of known oils, as well as MS literature data [29, 30] was used for the identification.

3. RESULTS and DISCUSSIONS

The essential oils of the aerial parts of *S. dichroantha* collected from Konya Taşkent and Cihanbeyli were obtained by hydrodistillation, in 0.01% and 0.02 (w/w) oil yields respectively. The essential oils of plants were analysed by GC-FID and GC-MS. Taşkent samples were collected from 1800 m while Cihanbeyli samples were collected from 900 m. The compounds identified from the essential oils along with their relative percentages are listed in Table 1. A total of 8 and 9 compounds were identified from the essential oils of Taşkent and Cihanbeyli, respectively, which represented 96.2 and 98.3% of the oils. Components of the oils can be grouped into two (Taşkent) or three (Cihanbeyli) main chemical classes, sesquiterpene hydrocarbones, oxygenated sesquiterpenes and diterpenes. The oil isolated from taşkent was dominated by oxygenated sesquiterpenes (92.6%), caryophyllene oxide (38.6%), caryophyllenol I (16.7%), caryophyllenol II (15.6%) and caryophylladienol II (11.1%) being the main compounds. The oil of cihanbeyli was characterized by a high content of oxygenated sesquiterpenes (95.1 %), caryophyllene oxide (65.8%), caryophyllenol II (14.3 %) were found as the main compounds.

According to Table 1, oxygenated sesquiterpenes are present in almost equal amounts in the oils of Taşkent and Cihanbeyli. However, diterpenes in the oil of Taşkent are more than oil of Cihanbeyli and sesquiterpene hydrocarbons in oil of Taşkent is absent. The essential oil composition of sixty-four *Salvia* taxa from Turkey has already been studied [25]. Monoterpene hydrocarbones (1) (α/β-Pinene), oxygenated monoterpenes (2) (1,8-cineole/camphor, linalyl acetate/linalool, carvacrol), sesquiterpene hydrocarbons (3) (β-caryophyllene, germacrene D), oxygenated sesquiterpenes (4) (spathulenol) and (5) phenylpropanoid (methylchavicol) reported as the main groups of constituents in *Salvia* oils. According to our results, *S. dichroantha* had many oxygenated sesquiterpenes. So this plant could be categorized in fourth. In another our studies, sesquiterpene hydrocarbones and oxygenated sesquiterpenes were dominated in the essential oil isolated from *S. viscosa* Jacq. [26] and *Salvia glutinosa* L. [22], and caryophyllene oxide were found as the main compounds.

Russo et al. (2016) studied essential oils of *Salvia aurea* L., *Salvia judaica* Boiss. and *Salvia viscosa* Jacq. and they reported all rich in sesquiterpenes, particularly oxygenated sesquiterpenes, with caryophyllene oxide as main compound for all three oils [7]. Comparing our results on *S. dichroantha* essential oil with those previously reported, we can see that they notably same.

According to literature survey, there is only one study on the essential oil from aerial parts of *S. dichroantha* collected from Bilecik in 2011 reported by Kunduhoğlu et al. The essential

oil obtained by hydrodistillation using Clevenger type apparatus and caryophyllene oxide (22%) was found as majör compounds [19]. According to our results, Konya samples were found to be richer in caryophyllene oxide (38.6%-Taşkent and 65.8%-Cihanbeyli), than the Bilecik sample.

Table 1. The compositions of the essential oils of *S. dichroantha.*

RRI	*Compounds*	Taşkent	Cihanbeyli
1612	β-Caryophyllene	-	1.9
1882	*1-Isobutyl 4-isopropyl-2,2-dimethyl succinate*	1.2	-
2008	Caryophyllene oxide	38.6	65.8
2050	(*E*)-Nerolidol	-	0.5
2071	Humulene epoxide-II	1.9	2.7
2131	Hexahydrofarnesyl acetone	-	1.3
2144	Spathulenol	8.7	3.4
2205	Clovenol	2.6	-
2324	Caryophylladienol II	11.1	3.6
	(=*caryophylla-2(12),6(13)-dien-5α-ol*)		
2353	Caryophyllenol I	16.7	4.8
	(=*Caryophylla-2(12),6-dien-5α-ol*)		
2392	Caryophyllenol II	15.6	14.3
	(=*Caryophylla-2(12),6-dien-5*β*--ol*)		
	Sesquiterpene hydrocarbones	-	1.9
	Oxygenated sesquiterpenes Diterpenes	92.6	95.1
		3.6	1.3
	Total	96.2	98.3

RRI; Relative retention indices calculated against n-alkanes C8-C30. %; calculated from the FID chromatograms tr; Trace (<0.1 %)

Various factors, both endogenous and exogenous, can affect the composition of the essential oil of *S. dichroantha*. We believe that the time of flowering, altitude, geographical and climatic factors may be very important. Several papers have reported on the variation in the essential oil composition induced by environmental, physiological and edaphic factors which can induce changes in biosynthesis accumulation or metabolism of given compounds of the essential oil [24].

4. CONCLUSION

Water-distilled essential oil of *S. dichroantha* was analyzed. The analysis was performed by using GC-FID and GC-MS systems, simultaneously. Eight compounds were identified from the oil of Taşkent representing 96.2 % of the total oil and nine compounds were identified from the oil of Cihanbeyli representing 98.3% of the total oil. The major components were found as caryophyllene oxide (38.6%), caryophyllenol I (16.7%), caryophyllenol II (15.6%) and caryophylladienol II (11.1%) for Taşkent; caryophyllene oxide (65.8%), caryophyllenol II (14.3 %) for the oil of Cihanbeyli.

Conflict of Interests

Authors declare that there is no conflict of interests.

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