Turk J Biol
30 (2006) 231-233

Chemical Composition of the Essential Oil of *Salvia aethiopis* L.

Medine GÜLLÜCE[1,*], Hakan ÖZER[2], Özlem BARIŞ[1], Dimitri DAFERERA[3], Fikrettin ŞAHİN[4], Moschos POLISSIOU[3]

[1]Department of Biology, Faculty of Arts and Science, Atatürk University, 25240 Erzurum - TURKEY

[2]Department of Field Crops, Faculty of Agriculture, Atatürk University, 25240 Erzurum - TURKEY

[3]Laboratory of General Chemistry, Agricultural University of Athens, Iera Odos 75, Athens 118 55, GREECE

[4]Department of Genetic and Bioengineering, Faculty of Engineering and Architecture, Yeditepe University, 34755 Kayışdağı, İstanbul - TURKEY

Received: 05.01.2006

Abstract: The chemical composition of the essential oil obtained by hydrodistillation from the aerial parts of *Salvia aethiopis* was analyzed by employing GC-MS. Thirty-two components (98.0% of the total oil) were identified in the essential oil of *S. aethiopis.* The main components of this oil were germacrene D (29.0%), α-copaene (19.8%), β-cubebene + β-elemene (9.9%), bicyclogermacrene (9.3%), δ cadinene (8.7%), and β-caryophyllene (7.3%).

Key Words: Lamiaceae, *Salvia aethiopis*, essential oil, GC-MS, germacrene D, α-copaene

Salvia aethiopis L. Uçucu Yağlarının Kimyasal Kompozisyonu

Özet: *Salvia aethiopis*'in toprak üstü kısımlarından hidrodistilasyonla elde edilen uçucu yağ asidi kompozisyonları GC-MS uygulamasıyla analiz edildi. *S. aethiopis*'in uçucu yağlarından 32 tane bileşen (total yağ içeriğinin %98,0'i) tanılandı. Bu yağların temel bileşenleri, germacrene D (%29), α-copaene (%19,8), β-cubebene + β-elemene (%9,9), bicyclogermacrene (%9,3), δ cadinene (%8,7), β-caryophyllene (%7,3) oldu.

Anahtar Sözcükler: Lamiaceae, Salvia aethiopis, Uçucu yağ, GC-MS, germacrene D, _-copaene

Introduction

The genus *Salvia* (Lamiaceae) consists of about 1000 species (1) and is well known in folk medicine. This genus is represented in the Turkish flora by 89 species and 94 taxa, of which 50 are endemic (2). Some members of this genus are used as herbal tea and for food flavoring, as well as in cosmetics, perfumery, and pharmaceuticals (3). *Salvia aethiopis* is a biennial or perennial herb with an erect stem and white corolla, and is 25-60 cm high. This species grows on steppes, igneous and limestone slopes, fallow fields, and roadside banks. Its leaves are simple, mostly basal, and ovate-elliptic to oblong (4). The essential oil composition of *S. aethiopis* from Serbia, Spain, and Iran was reported previously (5-9). However, we found no reference concerning the essential oil of *S. aethiopis* growing wildly in Turkey.

We report the percentage chemical composition of the essential oil isolated from *S. aethiopis* in eastern Anatolian by means of GC-MS in combination with retention indices.

Materials and Methods

Plant material

S. aethiopis was collected at the flowering stage from Erzurum, eastern Anatolia, Turkey. The taxonomic identification of plant materials was confirmed by a senior plant taxonomist, Meryem Şengül, in the Department of Biology, Atatürk University, Erzurum, Turkey. Collected plant materials were dried in the shade, and the leaves were separated from the stem, and ground in a grinder with a 2 mm diameter mesh. The voucher specimen has been deposited at the Herbarium of the Department of Biology, Atatürk University (ATA HERB 9786).

Preparation of the extract

Isolation of the essential oils

The air-dried and ground aerial parts of plants collected were submitted for 3 h to water-distillation using a Clevenger-type apparatus (yield 0.27% v/w). The obtained essential oil was dried over anhydrous sodium sulfate and, after filtration, stored at +4 ºC until tested and analyzed.

GC-MS analysis conditions

The analysis of the essential oil was performed using a Hewlett Packard 5890 II GC, equipped with a HP-5 MS capillary column (30 m x 0.25 mm i.d., 0.25 µm) and a HP 5972 mass selective detector. For GC-MS detection an electron ionization system with ionization energy of 70 eV was used. Helium was the carrier gas, at a flow rate of 1 ml/min. Injector and MS transfer line temperatures were set at 220 and 290 °C, respectively. Column temperature was initially kept at 50 °C for 3 min, then gradually increased to 150 °C at a 3 °C/min rate, held for 10 min, and finally raised to 250 °C at 10 °C/min. Diluted samples (1/100 in acetone, v/v) of 1.0 µl were injected manually and in the splitless mode. The components were identified based on the comparison of their relative retention times and mass spectra with those of standards, NBS75K library data of the GC-MS system, and literature data (10). The identification of components was based on a comparison to their relative retention indices on non-polar phases reported in the literature (10).

Results and Discussion

GC/MS analysis of the crude oil isolated from dried aerial parts of *S. aethiopis* resulted in the identification of 33 compounds representing 98.3% of the essential oil. The compounds identified with their percentages are given in the Table. The compounds are listed in order of their elution from the DB-5 column. The main components of this oil were germacrene D (29.0%), α-copaene (19.8%), β-cubebene+β-elemene (9.9%), bicyclogermacrene (9.3%), δ cadinene (8.7%), and β-caryophyllene (7.3%) (Table). Our literature survey showed that this was the first report on *S. aethiopis* from Turkey.

Table. Chemical composition of the essential oil of Salvia aethiopis.

Peak No.	Compounds[a]	RI[b]	Percentage in Oil
1	δ-Elemene	1354	1.3
2	α-Cubebene	1369	0.8
3	α-Copaene	1397	19.8
4	β-Bourbonene	1412	0.6
5	β-Cubebene + β-Elemene	1416-1422	9.9
6	β-Caryophyllene	1448	7.3
7	β-Copaene	1459	0.7
8	β-Gurjunene	1467	0.1
9	Guaia-3,7-diene	1474	0.9
10	trans-Muurola-3,5-diene	1484	0.2
11	α-Humulene	1486	1.9
12	cis-Muurola-4(14),5-diene	1496	0.4
13	Germacrene D	1515	29.0
14	Bicyclogermacrene	1534	9.3
15	γ-Cadinene	1552	0.6
16	δ-Cadinene	1561	8.7
17	trans-Cadina-1(2),4-diene	1572	0.2
18	α-Cadinene	1577	0.1
19	α-Calacorene	1583	0.1
20	β-Calacorene	1604	0.1
21	Spathulenol	1620	1.6
22	Caryophyllene oxide	1625	0.5
23	Salvial-4(14)-en-1-one	1634	0.2
24	Cubenol (1-epi)	1669	0.2
25	Isospathulenol	1680	0.2
26	epi-β-Muurolol	1684	0.3
27	β-Muurolol	1689	0.2
28	β-Cadinol	1696	1.0
29	Eudesma-4(15),7-dien-1-beta-ol	1728	0.2
30	6,10,14-trimethyl-2-Pentadecanone	1868	0.3
31	Sclareoloxide	1906	0.3
32	Diterpene ($C_{20}H_{32}$)	1976	0.8
	Total		98.0

[a] Compounds listed in order of elution from a HP-5 MS column,
[b] Retention Index on DB-5 column in reference to n-alkanes (10).

Several studies have been conducted to examine the essential oil composition of *S. aethiopis* in Serbia, Iran, and Spain. The findings reported by Torres et al. (7) and Rustaiyan et al. (8) demonstrated that in *S. aethiopis* the most abundant components were beta-caryophyllene (24.6%) and bicyclogermacrene (41.5%-29.5%). A study by Velickovic et al. (6) showed that essential oil components varied with different parts of *S. aethiopis*, and that the main component of the oil of the plant was bicyclogermacrene (29%) in flowers, alpha-copaene (22.4%) in leaves, and spathulenol (20.1%) in stems. Chalchat et al. (5) also reported beta-caryophyllene (27.5%) and germacrene-D (6.4%) as the main components of *S. aethiopis*.

Our study and previous studies (5-8) show clear qualitative and quantitative differences. In our sample, β-caryophyllene and bicyclogermacrene were lower than in previous studies. Some components such as β-cubebene+β-elemene and δ cadinene were much greater than in other works. Considering previous studies (5-8) with *S. aethiopis,* the most striking difference was that germacrene-D (29.0%) was the most abundant component in our oil sample. The difference observed in this study seems to be related to climatic variations (11). This result indicates that *S. aethiopis* collected from Turkey is also a germacrene-D chemotype.

Acknowledgments

The authors are indebted to Atatürk University for the financial support of this work and the State Planning Organization of Turkey (DPT) for purchasing a GC-MS instrument (Atatürk University).

Corresponding author:
Medine GÜLLÜCE
Department of Biology,
Faculty of Arts and Science,
Atatürk University,
25240 Erzurum-TURKEY
E-mail: mgulluce@atauni.edu.tr

References

1. Walker JB, Sytsma KJ, Treutlein J et al. *Salvia* (Lamiaceae) is not monophyletic: implications for the systematics, radiation, and ecological specializations of *Salvia* and tribe Mentheae. American Journal of Botany, 91: 1115-1125, 2004.
2. Başer KHC. Aromatic biodiversity among the flowering plant taxa of Turkey. Pure and Applied Chemistry, 74: 527-545, 2002.
3. Philipson JD. In Secondary Products from Plant Tissue Culture, Charlwood, BV & Rhodes, MJ (eds). Oxford: Clarendon Press, 1990: pp. 1-22.
4. Davis, PH. Flora of Turkey and the East Aegean Islands, Vol 5. University Press: Edinburgh, pp. 262, 1982.
5. Chalchat, JC, Gorunovic MS, Petrovic SD et al. Chemical compositions of two wild species of the genus *Salvia* L. from Yugoslavia: *Salvia aethiopis* and *Salvia verticillata*. Journal of Essential Oil Research, 13: 416-418, 2001.
6. Velickovic D, Ristic M, Velickovic A. Chemical composition of the essential oils obtained from the flower, leaf and stem of *Salvia aethiopis* L. and *Salvia glutinosa* L. originating from the southeast region of Serbia. Journal of Essential Oil Research, 15: 346-349, 2003.
7. Torres ME, Negueruella AV, Alanso MJP et al. Volatile constituents of two *Salvia* species grown wild in Spain. Journal of Essential Oil Research 9: 27-33, 1997.
8. Rustaiyan A, Masoudi S, Monfared A et al. Volatile constituents of three *Salvia* species grown wild in Iran. Flavour and Fragrance Journal, 14: 276-278, 1999.
9. Morteza-Semnani K, Goodarzi A, Azadbakht M. The essential oil of *Salvia aethiopis* L. Journal of Essential Oil Research 17: 274-275, 2005.
10. Adams RP. Identification of Essential Oils Components by Gas Chromatography/ Quadruple Mass Spectroscopy, Allured Publishing Corporation. Illinois, USA, 2001.
11. Bernath J, Danos B, Hethelyi E. Variation in essential oil spectrum on *Salvia* species affected by environment. Herba Hungarica. 30: 35-46, 1991.