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Essential Oil Composition of Aerial Parts of Two *Salvia* L. (*S. russellii* Bentham and *S. bracteata* Banks & Sol.) Species

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In this study, essential oil composition of the aerial parts of two *Salvia* L. (*Salvia russellii* Bentham and *Salvia bracteata* Banks & Sol.) from East Anatolian region of Turkey were analyzed by GC and GC-MS system. The essential oils of the aerial parts of two *Salvia* L. (*S. russellii* and *S. bracteata*) collected from the Turkey were obtained by hydrodistillation, in 0.8 % (v/w) and 0.7 (v/w) oil yields, respectively. Thirty two and fifty five components were identified representing 98.5 and 91 % of the oils, respectively. The major constituents of *S. russellii* were thymol (31.9 %) α-terpinol (13.1 %), γ-terpinene (12.5 %), whereas those *S. bracteata* were caryophyllene oxide (17.8 %), β-caryophyllene (16.7 %) and β-pinene (10.5 %).

Keywords: *Salvia*, Lamiaceae, GC-MS, Essential oil, Chemotaxonomy.

INTRODUCTION

Salvia is the largest and the most important genus of the family Lamiaceae. It includes nearly 900 species spread throughout the world[1]. This genus is represented in Turkey by 89 species and altogether 94 taxa, 45 of which are endemic in Turkey[2,3]. Since the last revision of the genus, four new species have been described from Turkey *i.e.*, *Salvia nydeggeri* Hub.-Mor.[4], *Salvia aytachii* Vural & Adigüzel[5], *Salvia hedgeana* Donmez[6] and *Salvia anatolica* Hamzaoglu & A. Duran[7]. Plants belonging to this genus are known for their many biological activities, such as antibacterial, antioxidant, antitumor, antidiabetic, antimicrobial, anxiolytic, sedative and antiinflammatory activities[8-10] which could partly explain reasons why this plant is so beneficial in the treatment of many human diseases.

Many *Salvia* species and/or their essential oils are commonly used in the food, drug, cosmetic and perfumery industries. They are well known among people and widely used as flavourings or fragrance and for medicinal purposes in the several regions of the world[11-13]. *S. syriaca* is used as animal food[14,15]. They are used for alimentary, pharmacological and cosmetic purposes[16,17]. *Salvia* species have been used in folk medicine for wound healing and in alleviating stomach, liver and rheumatism pains and for treating the common cold in the form of infusion and decoction in various parts of the world[18,19].

Two species are represented in different groups within *Salvia* genus in Flora of Turkey. *S. russellii* is represented in Group F and *S. bracteata* is in group B, respectively[2]. *Salvia bracteata* is characterized by the large coloured floral leaves, numerous bracts and pink to purple corollas. *S. bracteata* is a permanent herb which belongs to Lamiaceae family and grows widely in the west of Iran[20]. A relatively constant species in most of Anatolia, but variable in the south east where it intergrades with *S. trichoclada*. *Salvia bracteata* forms fertile hybrids with the clearly distinct *S. suffruticosa*[2], *Salvia russellii* is perennial herb, stems 20-60 cm, verticillasters 20-30 flowered, clearly distant, coralla violet-blue, 10 mm, tube straight with an inverted V-shaped annulus; upper lip straight, compressed, narrowed at base. Both are Ir.- Turan Element[2].

At the plant products and biotechnology research laboratoary, extensive research has been carried out into studying the chemical composition of essential oils of the aromatic plants of Turkey. So far, some plant essential oils of belonging to different family have been investigated. In some genera of the Lamiaceae; *Ziziphora*[21], *Cyclotrichium*[22], *Thymus*[23], *Salvia*[24,25], *Teucrium*[26], *Satureja*[27], *Origanum*[28].

There are a number of reports on analyses of essential oils from plants of this genus and morphological and genetic varations are also observed according to their geographical origin[20,29-31].

EXPERIMENTAL

The plant samples were collected from Baskil in Elazig in 2006, Gözeli in Elazig in 2007, respectively. Voucher specimens are kept at the Firat University Herbarium (FUH), Flazig, Turkey.

Isolation of the essential oils: Air-dried aerial parts of the plant material (100 g) were subjected to hydrodistillation using a Clevenger-type apparatus for 3 h to yield.

Gas chromatographic (GC) analysis: The essential oil was analyzed using HP 6890 GC equipped with and FID detector and an HP-5 MS column (30 m × 0.25 mm i.d., film tickness 0.25 µm) capillary column was used. The column and analysis conditions were the same as in GC-MS. The percentage composition of the essential oils was computed from GC - FID peak areas without correction factors.

Gas chromatography/mass spectrometry (GC-MS) analysis: The oils were analyzed by GC-MS, using a Hewlett Packard system.HP- Agilent 5973 N GC-MS system with 6890 GC in Plant Products and Biotechnology Res. Lab. (BUBAL) in Firat University. HP-5 MS column (30 m × 0.25 mm i.d., film tickness 0.25 µm) was used with Helium as the carrier gas. Injector temperature was 250 °C, split flow was 1 mL/min. The GC oven temperature was kept at 70 °C for 2 min and programmed to 150 °C at a rate of 10 °C/min and then kept constant at 150 °C for 15 min to 240 °C at a rate of 5 °C/min. Alkanes were used as reference points in the calculation of relative retention indices (RRI). MS were taken at 70 eV and a mass range of 35-425. Component identification was carried out using spectrometric electronic libraries (WILEY, NIST). The identified constituents of the essential oils are listed in Table-1.

RESULTS AND DISCUSSION

The essential oils of the aerial parts of two *Salvia* species (*S. russellii* and *Salvia bracteata*) collected from the Turkey were obtained by hydrodistillation, in 0.8 % (v/w) and 0.7 (v/w) oil yields, respectively. Thirty two and fifty five components were identified representing 98.5 and 91 % of the oils, respectively. The major constituents of *S. russellii* were thymol (31.9 %), α-terpinol (13.1 %), γ-terpinene (12.5 %), whereas those *S. bracteata* were caryophyllene oxide (17.8 %), β-caryophyllene (16.7 %), β-pinene (10.5 %) (Table-1).

Monoterpenes and sesquiterpenes were the main class of essential oil of *S. russellii* and *S. bracteata*. The high percantage of monoterpenes was largely due to the thymol (31.9 %), α-terpineol (13.1 %), γ-terpinene (12.5 %), carvacrol (8 %) carvacrol-methyl-ether (6.1 %), benzene (4.7 %) and *p*-cymene (4 %) in *S. russellii* and β-pinene (10.5 %), α-pinene (9.4 %), camphor (4.2 %) in *S. bracteata* (Table-1). In the composition of the essential oils aerial parts of *Salvia bracreata* in different growth stages from Iran, monoterpene compounds, with α-pinene, limonene, myrcene and β-pinene have determined as major components[20]. According to Cardile *et al.*[32], caryophyllene oxide (16.6 %), β-caryophyllene (4.1 %), pulegone (3.9 %), terpinen-4-ol (3.8 %), α-copaene (3.4 %), carvacrol (3.1 %) were among the main components of *Salvia bracteata* from Lebanon.

The high percantage of sesquiterpenes was largely due to the β-caryophyllene (4.8 %) in *S. russellii* and β-caryophyllene (16.7 %), caryophyllene oxide (17.8 %) in *S. bracteata*. Oxygenated derivatives were comprised a little of the esssential oil composition.

TABLE-1
CONSTITUENTS OF THE ESSENTIAL OILS FROM *Salvia russellii* AND *Salvia bracteata* (RRI: Relative retention indices)

No	Compounds	RRI	*S. russellii*	*S. bracteata*
1	α-Thujone	1015	0.4	0.3
2	β-Pinene	1021	0.2	9.4
3	Camphene	1034	0.1	1.9
4	Sabinene	1051	0.6	1.3
5	β-Pinene	1056	0.8	10.5
6	3-Octanone	1060	0.9	-
7	β-Myrcene	1063	0.9	0.6
8	α-Terpinene	1085	1.0	-
9	*p*-Cymene	1090	4.0	2.7
10	Limonene	1094	0.3	1.0
11	Eucalyptol	1096	0.2	1.0
12	1,8-Cineole	1097	0.7	1.0
13	1,3,6-Octatriene	1099	1.8	0.5
14	*cis*-Ocimene	1107	0.3	3.5
15	γ-Terpinene	1118	12.5	0.6
16	β-Terpineol	1125	0.4	-
17	*trans*-Pinocarveol	1136	-	0.2
18	Linalool-L	1147	0.5	0.3
19	2-Cyclohexen-1-ol	1164	-	0.4
20	Camphor	1181	-	4.2
21	Pinocarvone	1191	-	0.1
22	Borneol-L	1198	0.1	0.2
23	3-Cyclohexen-1-ol	1204	0.2	0.4
24	Bicyclo (3.1.1) hept-2-ene	1214	-	0.4
25	α-Terpineol	1217	13.1	-
26	*trans*-Carveol	1223	-	0.6
27	Carvacrol-methyl-ether	1237	6.1	-
28	Benzene	1244	4.7	-
29	2H-1-Benzopyran	1289	-	0.1
30	Thymol	1292	31.9	-
31	Carvacrol	1298	8.0	-
32	α-Muurolene	1353	-	0.2
33	α-Copaene	1358	0.3	0.2
34	β-Cubebene	1368	0.1	-
35	Cycloprop(e)azulene	1382	-	0.1
36	β-Caryophyllene	1393	4.8	16.7
37	γ-Elemene	1397	-	0.1
38	H-Cyclopropanaphthalene	1399	-	0.5
39	1,6,10-Dodecatriene	1413	-	0.7
40	α-Humulene	1417	0.5	1.0
41	Naphthalene	1419	-	1.0
42	Epi-bicyclosesquiphellandrene	1420	-	0.2
43	Germacrene D	1434	1.7	-
44	β-Selinene	1438	-	0.1
45	Bicyclogermacrene	1443	0.8	0.2
46	α-Farnesene	1447	-	0.1
47	β-Bisabolene	1450	-	0.3
48	α-Amorphene	1454	-	1.0
49	δ-Cadinene	1455	-	0.1
50	*cis*-Calamenene	1457	-	0.5
51	Dehidroaromadendrene	1458	-	1.4
52	β-Sesquiphellandrene	1460	-	0.2
53	Alloaromadendrene	1470	0.3	-
54	Germacrene B	1482	-	1.1
55	Spathulenol	1490	-	0.3
56	Caryophyllene oxide	1496	0.3	17.8
57	Veridifloral	1503	-	0.5
58	Ledol	1509	-	0.9
59	γ-Muurolene	1512	-	1.4
60	Oplopenone	1515	-	0.3
61	α-Cadinol	1529	-	0.6
62	t-Muurolol	1537	-	0.7
63	α-Ylangene	1545	-	0.6
64	Valeranone	1547	-	0.6
65	γ-Curcumene	1552	-	0.3
66	2-Pentadecanone	1629	-	0.1
	Total		98.5	91

The essential oil composition of the *Salvia trichoclada* and *S. multicaulis* belongs to the same group B in genus *Salvia* from Turkey; 1,8-cineole (17 %), camphor (13.2 %), α-pinene (9.3 %), valeranone (8.5 %) and α-eudesmol (5.7 %) were determined to be present at a high compounds of the *S. multicaulis* oil and β-pinene (13.7 %), camphor (11.3 %), caryophyllene oxide (7 %), 1,8-cineole (5.9 %) and *trans*-caryophyllene (5.5 %) were in *S. trichoclada* essential oil[25].

The essential oil composition of the *Salvia verbenaca* and *Salvia verticillata* belongs to the same group F in genus *Salvia* from Turkey; β-phellandrene (30.3 %), followed by (E)-caryophyllene (16.1 %), methyl ester of 6-octadeconoic acid (15 %), fenchone (9.4 %), isopropyl ester of lauric acid (7.8 %), camphor (7 %) and (Z)-β-ocimene (6.6 %) were determined to be present at a high compounds of the *Salvia* verbenaca oil. *Salvia verticillata* oil was dominated by monoterpenes (64.5 %). Among these, monoterpenes hydrocarbons such as β-pinene (30.7 %), *p*-cymene (23 %) and α-pinene (7.6 %) were detected in high quantities[33]. In another study, the β-caryophyllene (13.3 %), γ-muurolene (10.3 %) and *trans*-chrysanthenol (6.1 %) were the major compounds of essential oil of *Salvia verticillata* from Yugoslavia[34].

Some species of *Salvia* from Turkey were rich in germacrene D (27 %), bicyclogermacrene (11.3 %), spathulenol (10 %) in *S. ceratophylla*; germacrene D (26.3 %), bicyclogermacrene (24.1 %), α-copaene (21.1 %), β-cubenene (8.1 %) and δ-cadinene (5 %) are reported in *S. aethiopis*[24]. β-caryophyllene (18 %), germacrene D (16.5 %), linalool L (9.2 %), caryophyllene oxide (7.3 %), sclaraeol (6.6 %), linalyl acetate (6 %) and α-copaene (4.3 %) include *S. palaestina*; α-pinene (33.7 %), germacrene D (7.5 %), β-pinene (6.8 %), α-humulene (6 %), viridiflorol (3.8 %) and limonene (3.1 %) were determined in *S. tomentosa* essential oil[25].

When we compared the results of two *Salvia* essential oil major compounds with the other *Salvia* species, we can say that α/β-pinene characteristic group in *S. syriaca* (12.6-7.3 %)[15], *S. caespitosa* (6.8-22 %)[13], *S. blepharochlaena* (10.1-4 %)[13], *S. pilifera* (11.2-1 %)[13], *S. hypoleuca* (5.9-7.2 %)[35], *S. officinalis* (3.1-9.8 %)[36], *S. tomentosa* (33.7-6.8 %)[25], *S. verticillata* (30.7-7.6 %)[33] and *S. bracteata* (9.4-10.5 %) (Table-1); β-caryophyllene; *S. triloba* (11.8 %)[37], *S. longipedicellata* (16.1 %)[13], *S. hypoleuca* (14.6 %)[35], *S. palaestina* (18 %)[25], *S. verticillata* (13.3 %)[33], *S. russellii* and *S. bracteata* (4.8-16.7 %) (Table-1); caryophyllene oxide; *S. hypergeia* (10.7 %)[13], *S. longipedicellata* (23.3 %)[13], *S. palaestina* (7.3 %)[25], *S. trichoclada* (7 %)[25]; camphor; *Salvia multicaulis* (13.2 %)[25], *S. tricochlada* (11.3 %)[25], S. verbenaca (7 %)[33] and *S. bracteata* (17.8 %) (Table-1).

The results obtained from this study have given some clues on the chemotaxonomy of this plants. In conclusion, this study demonstrates the occurrence of thymol/α-terpineol chemotype of *S. russellii* and caryophyllene oxide/β-caryophyllene chemotype of *S. bracteata* in eastern Anatolian region of Turkey.

REFERENCES

1. D.J. Mabberley, The Plant Book, Cambridge University Press: Cambridge, edn. 2 (1997).
2. P.H. Davis, Flora of Turkey and The East Aegean Island, Edinburgh University Press, Vol. 7 (1982).
3. A. Güner, N. Özhatay, T. Ekim and K.H.C. Baser, Flora of Turkey and The East Aegean Islands, Edinburgh University Press, Vol. 11 (2000).
4. P.H. Davis, R.R. Mill and K. Tan, Flora of Turkey and The East Aegean Island, Edinburgh University Press, Vol. 10 (1988).
5. M. Vural and N. Adigüzel, *Turk. J. Bot*., **20**, 531 (1996).
6. A.A. Dönmez, *Bot. J. Linn. Soc*., **137**, 413 (2001).
7. E. Hamzaoglu, A. Duran and N.M. Pinar, *Ann. Bot. Fenn*., **42**, 215 (2005).
8. S.Y. Ryu, C.O. Lee and S.U. Choi, *Planta Med*., **63**, 339 (1997).
9. A.P. Longaray Delamare, I.T. Moschen-Pistorello, L. Artico, L. Atti-Serafini and S. Echeverrigaray, *Food Chem*., **100**, 603 (2006).
10. M. Kelen and B. Tepe, *Bioresour. Technol*., **99**, 4096 (2008).
11. J.C. Chalchat, A. Michet and B. Pasquier, *Flav. Fragr. J*., **13**, 68 (1998).
12. M. Ozcan, O. Tzakou and M. Couladis, *Flav. Fragr. J*., **18**, 325 (2003).
13. B. Demirci, K.H.C. Baser, B. Yildiz and Z. Bahcecioglu, *Flav. Fragr. J*., **18**, 116 (2003).
14. F. Ertug, *Econ. Bot*., **54**, 155 (2000).
15. G. Flamini, P.L. Cioni, I. Morelli and A. Bader, *Food Chem*., **100**, 732 (2007).
16. J. Lawless, The Encyclopedia of Essential Oils, Thorsons, London (2002).
17. N. Perry, C. Bollen, E.K. Perry and C. Ballard, *Pharmacol. Biochem. Behav*., **75**, 651 (2003).
18. A. Bayrak and A. Akgül, *Phytochemistry*, **26**, 846 (1987).
19. E. Sezik and E. Yesilada, in eds. N. Krimer & A. Mat, Essential Oils; In Honour of Prof. Dr. K.H.C. Baser on his 50th birthday (pp. 98), Eskisehir, Turkey (1999).
20. H. Amiri, *Daru J. Fac. Pharm*., **15**, 79 (2007).
21. E. Bagci and S. Hayta, Composition of Essential Oils of *Ziziphora clinopodiodies* Lam. (Lamiaceae) from Turkey, 6th Conference on Medicinal and Aromatic Plants of Southeast European Countries (6 CMAPSEEC), Antalya (2010).
22. E. Bagci and G. Dogan, Essential Oil Composition of Endemic *Cyclotrichium niveum* (Boiss.) Manden. & Scheng from Turkey, A Chemotaxonomic Approach 20, Ulusal Biyoloji Kongresi, Denizli (2010).
23. E. Bagci and K.H.B. Baser, *Flav. Fragr. J*., **20**, 199 (2005).
24. E. Bagci and A. Koçak, *Firat Üniv. Fen ve Müh. Bil. Dergisi*, **19**, 435 (2007).
25. E. Bagci and A. Koçak, *Firat Üniv. Fen ve Müh. Bil. Dergisi*, **20**, 35 (2008).
26. M. Dogan, E. Yüce, G. Dogan and E. Bagci, *Firat Üniv. Fen ve Müh. Bil. Dergisi*, **20**, 389 (2008).
27. E. Bagci, N. Gür, A. Koçak, S. Hayta, H. Evren and M.T. Babaç, Chemical Composition of the Essential oil of *Satureja hortensis* L. (Lamiaceae) Growing in Turkey, 6th Conference on Medicinal and Aromatic Plants of Southeast European Countries (6 CMAPSEEC), Antalya (2010).
28. E. Bagci and Ö. Kiliç, *Firat Üniv. Fen ve Müh. Bil. Dergisi*, **20**, 83 (2008).
29. C. Formisano, F. Senatore, N.A. Arnold, F. Piozzi and S. Rosselli, *Nat. Prod. Commun*., **2**, 181 (2007).
30. A. Raal, A. Orav and E. Arak, *Nat. Prod. Res*., **21**, 406 (2007).
31. F. Sefidkon, F. Hooshidary and Z. Jamzad, *J. Essent. Oil-Bearing Plants*, **10**, 265 (2007).
32. V. Cardile, A. Russo, C. Formisano, D. Rigano, F. Senatore, N.A. Arnold and F. Piozzi, *J. Ethnopharmacol*., **126**, 265 (2009).
33. D. Pitarokili, O. Tzakou and A. Loukis, *Flav. Fragr. J*., **21**, 670 (2006).
34. J.C. Chalchat, M.S. Gorunovic, S.D. Petrovic and Z.A. Maksimovic, *J. Essent. Oil Res*., **13**, 416 (2001).
35. B. Nickavar, F. Mojab and J. Asgarpanah, *Int. J. Aromatherapy*, **15**, 51 (2005).
36. E.T. Tsankova, A.N. Konaktchiev and E.M. Genova, *J. Essent. Oil Res*., **6**, 375 (1994).
37. A.P. Longaray Delamare, I.T. Moschen-Pistorello, L. Artico, L. Atti-Serafini and S. Echeverrigaray, *Food Chem*., **100**, 603 (2007).