Acta Pharm. 55 (2005) 321–326 Short communication

Essential oil of the Persian sage, *Salvia rhytidea* Benth.

SEYED-EBRAHIM SAJJADI[1,2]
ALIREZA GHANNADI[2]*

[1] *Isfahan Pharmaceutical Sciences Research Isfahan University of Medical Sciences Isfahan 81746-73461, Iran*

[2] *Department of Pharmacognosy, School of Pharmacy and Pharmaceutical Sciences Isfahan University of Medical Sciences Isfahan 81746-73461, Iran*

Received September 27, 2004
Accepted May 24, 2005

Chemical composition of volatile compounds from *Salvia rhytidea* Benth. was analyzed, for the first time, by gas chromatography/mass spectrometry. The volatiles were isolated from dried aerial parts of the plant by hydrodistillation. A total yield of 2.0 mg of essential oil per g of plant dry mass was obtained and sixty compounds were identified, representing 98.2% of total volatiles. The essential oil was characterized by a high content of hydrocarbon and oxygenated monoterpenes. The main constituents were *p*-cymene-8-ol (11.9%), spathulenol (7.3%), pulegone (6.4%), sabinene (5.8%), terpinen-4-ol (5.5%) and α-copaene (5.3%).

Keywords: *Salvia rhytidea* (*Lamiaceae*), essential oil, *p*-cymene-8-ol, spathulenol, pulegone

Salvia genus belongs to the subfamily *Nepetoideae* of *Mentheae* tribe in *Lamiaceae* family (1). Numerous species of the genus *Salvia* have been used since ancient times in folk medicine and have been subjected to extensive pharmacognostic research intended to identify biologically active compounds (2, 3). These species have been found to possess significant biological activities, including antibacterial, antiviral, adstringent, antitumor, spasmolytic, antioxidant, anti-inflammatory, antihydrotic activity and have been also used in the treatment of mental, nervous and gastrointestinal conditions. Sage species are used traditionally in foods and cosmetics preparation as well (2–5). There are several reports in the literature on the phytochemical analysis of species belonging to *Salvia*. These scientific studies on *Salvia* species show the presence of many compounds belonging mainly to the groups of phenolic acids, phenolic glycosides, flavonoids, anthocyanins, coumarins, polysaccharides, sterols, terpenoids and essential oils (2, 6, 7). *S. rhytidea* (syn: *S. lalesarica* RECH. f.) is spread wildly in western regions of Iran as well as in Afghanistan. It is used in local folk medical practices. It generally grows in or near disturbed habitats and is less commonly found in natural habitats. *S. rhytidea* has an altitudinal range from 2000–3800 m (8).

Although the chemical composition of essential oils from several *Salvia* species is well studied (3–7, 9–19), to our best knowledge no research has been conducted on this Persian sage so far. Therefore, the present paper gives a detailed analysis of its oil by GC/MS.

* Correspondence, e-mail: ghannadi@pharm.mui.ac.ir

EXPERIMENTAL

Plant material

The aerial parts of *S. rhytidea (Laminaceae)* were collected during the flowering period from wild-growing plants around Taftan Mountain in Sistan va Balouchestan province, Eastern Iran, at an altitude of ca. 2500 m (spring 2000). The species was authenticated in Herbarium Department of Iranian Research Institute of Forests and Rangelands, Tehran, Iran.

Isolation of the essential oil

The air-dried, powdered aerial parts (flowers and leaves) of the plant were subjected to hydro-distillation in a Clevenger-type apparatus for 4 h (7). The volatile oil was dried over anhydrous sodium sulfate and stored at 4 °C in the dark before analysis.

Volatile oil analysis

The oil was analyzed by GC/MS using a Hewlett Packard 6890 mass selective detector coupled with a Hewlett Packard 6890 gas chromatograph (Hewlett Packard, USA), equipped with a cross-linked 5% PH ME siloxane HP-5MS capillary column (30 m × 0.25 mm, film thickness 0.25 μm). Operating conditions were as follows: carrier gas, helium, flow rate 2 mL min^{-1}, column temperature 60–275 °C (4 °C min^{-1}), injector temperature 280 °C, volume injected 0.1 μL, split ratio 1:50. The MS operating parameters were as follows: ionization potential 70 eV, ion source temperature 200 °C, resolution 1000.

Identification of components in the oil was based on retention indices relative to *n*-alkanes and computer matching with the WILEY275.L library, as well as by comparison of the fragmentation patterns of the mass spectra with those reported in the literature (20–22). Relative percentage amounts of the separated compounds were calculated from peak areas of the total ion chromatograms.

RESULTS AND DISCUSSION

The yield of essential oil obtained by hydro-distillation from dried plant material was 0.2% (*m/m*). GC/MS analysis indicated the presence of more than sixty compounds, out of which 60 were identified, accounting for 98.2% of total oil. Many of the unidentified compounds were present in trace amounts. In Table I the components are listed in the order of elution. The major constituents of the oil were *p*-cymene-8-ol (11.9%), spathulenol (7.3%), pulegone (6.4%), sabinene (5.8%), terpinen-4-ol (5.5%) and α-copaene (5.3%). Other components were present in amounts less than 5%. The oil was rich in hydrocarbon and oxygenated monoterpenes.

According to our literature surveys, *p*-cymene-8-ol, spathulenol, pulegone, sabinene, terpinen-4-ol and α-copaene were previously detected in other *Salvia* species (5, 7, 9–12, 15–19) or other taxa belonging to the *Mentheae* tribe, like *Micromeria, Mentha* and

Nepeta species (23–25), but their predominance has not been recorded. Spathulenol, which was found as a second major component of our oil, has been reported in the oils of several sage species (7, 10, 15, 18). Pulegone, the third prominent component of the oil, has been found in the essential oils of *Salvia euphratica* as well as *Micromeria* and *Mentha* species from the same tribe (6, 24, 25). Sabinene, terpinen-4-ol and α-copaene were also present and common in the essential oils of several *Salvia* species (5, 10, 17–19).

The results obtained in this study indicated that the chemical pattern of the essential oil of the plant is very similar to some *Salvia* species but different from the others with respect to traces of α-thujene and β-thujone found in this oil. Thujone has been shown to cause brain damage and is responsible for the neurotoxicological properties of some medicinal herbs (27).

Table I. Composition of the essential oil of Salvia rhytidea *Benth. (Persian sage)*

Compound		RI	Content (%)
1	*cis*-3-hexenol	874	0.2
2	α-Thujene	929	0.6
3	α-Pinene	937	3.4
4	Camphene	950	0.2
5	Thuja-2,4(10)-diene	955	0.1
6	Sabinene	976	5.8
7	β-Pinene	980	2.9
8	Myrcene	992	0.6
9	α-Phellandrene	1006	0.3
10	σ-3-Carene	1011	0.4
11	α-Terpinene	1017	0.3
12	*p*-Cymene	1026	2.4
13	Limonene	1031	3.5
14	1,8-Cineole	1033	1.9
15	*trans*-β-Ocimene	1046	0.1
16	γ-Terpinene	1057	0.5
17	*cis*-Sabinene hydrate	1069	1.1
18	Terpinolene	1087	3.9
19	*p*-Cymenene	1090	1.1
20	*trans*-Sabinene hydrate	1102	1.3
21	1,3,8-*p* -Menthatriene	1112	0.1
22	β-Thujone	1118	0.1
23	*p*-Menth-2-en-1-ol	1124	0.6
24	*trans*-Sabinol	1141	1.7
25	*trans*-Verbenol	1147	1.6
26	Terpinen-4-ol	1182	5.5
27	*p*-Methyl-acetophenone	1187	0.8
28	*p*-Cymene-8-ol	1188	11.9
29	α-Terpineol	1194	2.6
30	Myrtenol	1200	0.5
31	Piperitol	1211	0.3
32	*trans*-Carveol	1223	0.7
33	Pulegone	1243	6.4
34	Carvone	1248	0.7

35	Piperitone	1258	0.2
36	Geranial	1273	0.1
37	*p*-Cymen-7-ol	1292	0.4
38	Perilla alcohol	1301	0.2
39	Bicycloelemene	1336	0.2
40	α-Cubebene	1348	0.4
41	α-Copaene	1378	5.3
42	β-Bourbonene	1385	1.3
43	β-Cubebene	1390	0.8
44	β-Elemene	1392	0.4
45	*cis*-Jasmone	1399	0.7
46	Methyl eugenol	1406	0.8
47	Germacrene-D	1481	2.7
48	β-Selinene	1484	0.7
49	Bicyclogermacrene	1494	0.9
50	E,E-α-Farnesene	1507	0.3
51	β-Agarofuran	1516	2.6
52	δ-Cadinene	1521	0.8
53	α-Calacorene	1539	0.1
54	*cis*-Nerolidol	1566	0.5
55	Spathulenol	1578	7.3
56	β-Copaen-4-α-ol	1588	0.3
57	Caryophyllene epoxide	1610	0.6
58	10-epi-γ-Eudesmol	1617	0.2
59	T-Cadinol	1640	1.5
60	β-Eudesmol	1649	4.8
Total			98.2

CONCLUSIONS

The present study has elucidated the chemical composition of the essential oil of *S. rhytidea* aerial parts for its possible use in foods, beverages and toiletry products.

This work shows that further investigations on the essential oil and evaluation of the biological activities of *S. rhytidea* should be initiated. As a renewable bioresource, this low-thujone and thujene content essential oil can serve as a good source of safe and natural medicines and cosmetics with a traditional background.

Acknowledgements. – The authors thank Mrs. Mahboobeh Khatamsaz of the Herbarium Department, Iranian Research Institute of Forests and Rangelands, Tehran, Iran, for providing and identifying plant material. Authors are also thankful to Mrs. Armita Jamshidi of our School for her technical help.

REFERENCES

1. J. A. Pederson, Distribution and taxonomic implications of some phenolics in the family *Lamiaceae* determined by ESR spectroscopy, *Biochem. System. Ecol.* **28** (2000) 229–253.
2. Y. Lu and L.Y. Foo, Polyphenolics of *Salvia* – a review, *Phytochemistry* **59** (2002) 114–140.

3. A. Sivropoulou, C. Nikolaou, E. Papanikolaou, S. Kokkini, T. Lanars and M. Arsenakis, Antimicrobial, cytotoxic and antiviral activity of *Salvia fructicosa* essential oil, *J. Agric. Food Chem.* **45** (1997) 3197–3201.
4. C. F. Lima, F. Carvalho, E. Fernandes, M. L. Bastos, P. C. Santos-Gomes, M. Fernandes-Ferreira and C. Pereira-Wilson, Evaluation of toxic/protective effects of the essential oil of *Salvia officinalis* on freshly isolated rat hepatocytes, *Toxicol. In Vitro* **18** (2004) 457–465.
5. B. Tepe, E. Donmez, M. Unlu, F. Candan, D. Daferera, G. Vardar-Unlu, M. Polissiou and A. Sokmen, Antimicrobial and antioxidative activities of the essential oils and methanol extracts of *Salvia cryptantha* and *Salvia multicaulis*, *Food Chem.* **84** (2004) 519–525.
6. K. H. C. Baser, M. Kurkcuoglu and Z. Aytac, Composition of the essential oil of *Salvia euphratica* Montbret et Aucher ex Bentham var. *euphratica* from Turkey, *Flavour Fragr. J.* **13** (1998) 63–64.
7. A. Ghannadi, S. H. Samsam-Shariat and F. Moattar, Volatile constituents of the flower of *Salvia hydrangea* DC. ex Benth., *Daru* **7** (1999) 23–25.
8. K. H. Rechinger, *Flora Iranica*, No. 150, Akademische Druck und Verlagsanstalt, Graz 1982, pp. 403–476.
9. A. Bayrak and A. Akgul, Composition of essential oils from Turkish *Salvia* species, *Phytochemistry* **26** (1987) 846–847.
10. J. C. Chalcat, M. S. Gorunovic, S. D. Petrovic and Z. A. Maksimovic, Chemical compositions of two wild species of the genus *Salvia* L. from Yugoslavia: *Salvia aethiopis* and *Salvia verticillata*, *J. Essent. Oil Res.* **13** (2001) 416–418.
11. J. C. Chalcat, A. Michet and B. Pasquier, Study of clones of *Salvia officinalis* L. yields and chemical composition of essential oil, *Flavour Fragr. J.* **13** (1998) 68–70.
12. B. Demirci, K. H. C. Baser and G. Tumen, Composition of the essential oil of *Salvia aramiensis* Rech. fil. growing in Turkey, *Flavour Fragr. J.* **17** (2002) 23–25.
13. M. W. Endeshaw, O. R. Gautun, N. Asfaw and A. J. Aasen, Volatile oil constituents of the Ethiopian plant *Salvia schimperi* Benth., *Flavour Fragr. J.* **15** (2000) 27–30.
14. M. Mirza and L. Ahmadi, Composition of the essential oil of *Salvia atropatana* Bunge., *J. Essent. Oil Res.* **12** (2000) 575–576.
15. M. Mirza and F. Sefidkon, Essential oil composition of two *Salvia* species from Iran, *Salvia nemorosa* L. and *Salvia reuterana* Boiss., *Flavour Fragr. J.* **14** (1999) 230–232.
16. A. Rustaiyan, S. Masoudi, M. Yari, M. Rabbani, H. R. Motiefar and K. Larijani, Essential oil of *Salvia lereifolia* Benth., *J. Essent. Oil Res.* **12** (2000) 601–602.
17. A. Rustaiyan, S. Masoudi, A. Monfared and H. Komeilizadeh, Volatile constituents of three *Salvia* species grown wild in Iran, *Flavour Fragr. J.* **14** (1999) 276–278.
18. F. Sefidkon and M. Mirza, Chemical composition of the essential oils of two *Salvia* species from Iran, *Salvia virgata* Jacq. and *Salvia syriaca* L., *Flavour Fragr. J.* **14** (1999) 45–46.
19. F. Sefidkon and M.S. Khajavi, Chemical composition of the essential oils of two *Salvia* species from Iran: *Salvia verticillata* L. and *Salvia santolinifolia* Boiss., *Flavour Fragr. J.* **14** (1999) 77–78.
20. R. P. Adams, *Identification of Essential Oil Components by Gas Chromatography/Mass Spectroscopy*, Allured Publishing Co., Carol Stream 1995.
21. F. W. Mclafferty and D. B. Stauffer, *The Important Peak Index of the Registry of Mass Spectral Data*, Wiley, New York 1991, Vol. 1.
22. P. Sandra and C. Bicchi, *Capillary Gas Chromatography in Essential Oil Analysis*, Dr. A. Huethig, Heidelberg 1987, pp. 259–274, 287–328.
23. A. Ghannadi, F. Aghazari, M. Mehrabani, A. Mohagheghzadeh and I. Mehregan, Quantity and composition of the SDE prepared essential oil of *Nepeta macrosiphon* Boiss., *Iranian J. Pharm. Res.* **2** (2003) 103–105.

24. N. Aghel, Y. Yamini, A. Hadjiakhoondi and S. M. Pourmortazavi, Supercritical carbon dioxide extraction of *Mentha pulegium* L. essential oil, *Talanta* **62** (2004) 407–411.
25. S. Vladimir-Knežević, N. Blažević and Z. Kalođera, Seasonal variations in the content and composition of the essential oil of *Micromeria thymifolia* (Scop.) Fritsch., *Acta Pharm.* **51** (2001) 147–151.
26. V. Radulescu, S. Chiliment and E. Opera, Capillary gas chromatography-mass spectrometry of volatile and semi-volatile compounds of *Salvia officinalis*, *J. Chromatogr. A* **1027** (2004) 121–126.
27. J. Patocka and B. Plucar, Pharmacology and toxicology of absinthe, *J. Appl. Biomed.* **1** (2003) 199–205.

S A Ž E T A K

Eterično ulje u perzijskoj kadulji, *Salvia rhytidea* Benth.

SEYED-EBRAHIM SAJJADI i ALIREZA GHANNADI

Po prvi put je ispitivan kemijski sastav hlapljivih komponenata iz biljke *Salvia rhytidea* Benth. plinskom kromatografijom/masenom spektrometrijom. Hlapljivi sastojci su izolirani iz osušenih vršnih dijelova biljke destilacijom vodenom parom. Dobiveno je 2,0 mg eteričnog ulja po gramu suhe biljke, a identificirano je 60 spojeva (98,2% od ukupnih hlapljivih komponenata). Eterično ulje sadrži visoki udio ugljikovodičnih i oksigeniranih monoterpena. Glavni sastojci su *p*-cimen-8-ol (11,9%), spatulenol (7,3%), pulegon (6,4%), sabinen (5,8%), terpinen-4-ol (5,5%) i α-kopaen (5,3%).

Ključne riječi: Salvia rhytidea (*Lamiaceae*), eterično ulje, *p*-cimen-8-ol, spatulenol, pulegon

Isfahan Pharmaceutical Sciences Research and Departement of Pharmacognosy, School of Pharmacy and Pharmaceutical Sciences, Isfahan University of Medical Sciences, Isfahan 81746-73461, Iran