# CHEMICAL COMPOSITION OF THE ESSENTIAL OIL OF *SALVIA LIMBATA* C. A. MEY.

**SEYED EBRAHIM SAJJADI AND ZAHRA SHAHPIRI**

**Department of Pharmacognosy, Faculty of Pharmacy, Isfahan University of Medical Sciences, Isfahan, Iran**

**ABSTRACT**

The essential oil obtained by hydrodistillation of the aerial parts of *Salvia limbata* C.A. Mey. (Lamiaceae) was analyzed by GC/MS. Among the forty-two constituent, forty components were characterized representing 98.6% of the total component which were detected. Bicyclogermacrene (21.1%), α-pinene (15.5%), 1,8-cineole (11.0%), sabinene (10.6%), β-pinene (9.2%), spathulenol (8.2%), β-caryophyllene (5.3%) and δ-elemene (5.1%) were found to be the major constituents.

**Keywords:** *Salvia limbata,*Lamiaceae, essential oil, bicyclogermacrene, α-pinene, 1,8-cineole

## INTRODUCTION

Fifty-eight species of the genus *Salvia* (Lamiaceae) are found in Iran, of which 17 are endemic. The rate of endemism in the genus *Salvia* in Iran is ca.29% (1, 2). The leaves of *Salvia* species have reputation as a medicinal plant. The most common sage in the world is *S. officinalis* L. Sage leaves are used as tonic, carminative, antispasmodic, antiseptic and hypoglycemic herbal drug (3-7). Officinal sage is traditionally used to treat the symptoms of miscellaneous digestive disturbances (8). The sage gargle is also recommended as an antiphlogistic for inflammation of the mouth and throat (6, 7). Sage oil is usually used in soap as a perfumery for its powerful and camphoraceous odor in perfumery industries (9).

*Salvia limbata* C. A. Mey. is a native plant of Iran whose essential oil and other chemical components have not been studied previously. As a part of our research on the aromatic flora of Iran, the analysis of the essential oil of *S. limbata* is described for first time.

## MATERIALS AND METHODS

*Plant material*

Plant material was collected from Charmahal and Bakhtiari Province (south-west of Iran) on June 2000 at an altitude of 2320 m. A voucher specimen has been deposited in the Herbarium of the Faculty of Pharmacy and Pharmaceutical Sciences, Isfahan University of Medical Sciences, Isfahan, Iran (No: 1111).

*Isolation of the oil*

The air- dried aerial parts of *S. limbata* were reduced to a coarse powder and the oil was isolated by hydrodistillation for 3h according to the British Pharmacopoeia (10). The oil was subsequently dried over anhydrous sodium sulfate.

*GC-MS analysis*

GC-MS analysis was carried out on a Hewlett-Packard 6890 gas chromatograph fitted with a fused silica HP-5MS capillary column (30 m × 0.25 mm; film thickness 0.25 μm). The oven temperature was programmed from 60°-280°C at 4°C/min. Helium was used as carrier gas at a flow rate of 2 mL/min. The gas chromatograph was coupled to a Hewlett-Packard 6890 mass selective detector. The MS operating parameters were: ionization voltage, 70 eV; ion source temperature, 200°C.

Identification of components of 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 (11, 12).

## RESULTS AND DISCUSSION

Aerial parts of *S. limbata* yielded 0.3% of a clear yellowish oil. Forty components were characterized representing 98.6% of the total components which were detected. The constituents of the oil of *S. limbata* and their percentage are given in table 1. As it is shown, the main constituents of the oil of *S .limbata* are bicyclogermacrene (21.1%), α-pinene (15.5%), 1,8-cineole (11.0%), sabinene (10.6%), β-pinene (9.2%), spathulenol (8.2%), β-caryophyllene (5.3%) and δ-elemene (5.1%). The oil contains 55.9% monoterpene and 42.8% sesquiterpene.

*Correspondence:* S. Ebrahim Sajjadi, Department of Pharmacognosy, Faculty of Pharmacy and Pharmaceutical Sciences, Isfahan University of Medical Sciences, Isfahan, Iran, E-mail: sajjadi@pharm.mui.ac.ir

**Table 1.** Composition of the essential oil of *Salvia limbata*

| No. | Compound | % | RI | No. | Compound | % | RI |
|---|---|---|---|---|---|---|---|
| 1 | α-thujene | 0.3 | 929 | 22 | α-terpineol | 0.6 | 1190 |
| 2 | α-pinene | 15.5 | 937 | 23 | myrtenol | 0.3 | 1195 |
| 3 | camphene | 1.3 | 951 | 24 | *trans*-carveol | T | 1218 |
| 4 | sabinene | 10.6 | 977 | 25 | linalyl acetate | 0.3 | 1256 |
| 5 | β-pinene | 9.2 | 981 | 26 | bornyl acetate | 0.3 | 1285 |
| 6 | myrcene | 0.5 | 992 | 27 | unknown[a] | 0.4 | 1325 |
| 7 | α-phellandrene | 0.1 | 1006 | 28 | δ –elemene | 5.1 | 1338 |
| 8 | δ-3-carene | t | 1010 | 29 | α-cubebene | 0.2 | 1350 |
| 9 | α-terpinene | 0.2 | 1017 | 30 | α-copaene | T | 1375 |
| 10 | p-cymene | 0.1 | 1025 | 31 | β-elemene | 0.1 | 1390 |
| 11 | 1,8-cineole | 11.0 | 1032 | 32 | (*Z*)-jasmone | T | 1396 |
| 12 | γ-terpinene | 0.6 | 1061 | 33 | β-caryophyllene | 5.3 | 1420 |
| 13 | *cis*-sabinene hydrate | 0.4 | 1067 | 34 | aromadendrene | 0.3 | 1437 |
| 14 | terpinolene | 1.4 | 1090 | 35 | α-humulene | 0.2 | 1452 |
| 15 | linalool | 0.2 | 1100 | 36 | allo aromadendrene | 0.3 | 1459 |
| 16 | α-campholene aldehyde | 0.1 | 1125 | 37 | germacrene-D | 1.7 | 1478 |
| 17 | *trans*-sabinol | 0.2 | 1139 | 38 | bicyclogermacrene | 21.1 | 1492 |
| 18 | *trans*-verbenol | 0.3 | 1145 | 39 | γ-cadinene | 0.1 | 1515 |
| 19 | pinocarvone | T | 1161 | 40 | spathulenol | 8.2 | 1578 |
| 20 | borneol | 1.9 | 1166 | 41 | isospathulenol | 0.2 | 1628 |
| 21 | terpinen-4-ol | 0.5 | 1177 | 42 | unknown[b] | 0.2 | 1658 |

Retention indices on HP-5 capillary column , t= trace (≤ 0.05%)

[a] MS, 70 eV, 200°C, m/z (rel. int.): 207[M]$^+$(2), 161(16), 136(14), 121(100), 107(51), 93(76), 79(53), 67(39), 53(31), 41(40)

[b] MS, 70 eV, 200°C, m/z (rel. int.): 220[M]$^+$(11), 159(31), 145(30), 119(44), 107(71), 91(100), 77(65), 67(34), 55(50), 41(46)

**Table 2.** Major components and their relative percentages of essential oils of different *Salvia* species

| Plant Name | Plant Part | Main Component | Percentage | Ref. No. |
|---|---|---|---|---|
| *S. nemorosa* | Aerial Parts | β-caryophyllene | 41.6 | 13 |
| *S. virgata* | Aerial Parts | β-caryophyllene | 46.6 | 14 |
| *S. aethiopis* | Aerial Parts | β-caryophyllene | 27.5 | 15 |
| *S. verticillata* | Aerial Parts | β-caryophyllene | 24.7 | 16 |
| *S. hypoleuca* | Aerial Parts | β-caryophyllene | 22.0 | 17 |
| *S. atropatana* | Aerial Parts | β-caryophyllene | 16.3 | 18 |
| *S. candidissima* | Aerial Parts | β-pinene | 34.4 | 19 |
| *S. tomentosa* | Aerial Parts | β-pinene | 19.2 | 19 |
| *S. lereifolia* | Aerial Parts | β-pinene | 23.7 | 20 |
| *S. santolinifolia* | Aerial Parts | α-pinene | 59.4 | 16 |
| *S. multicaulis* | Aerial Parts | α-pinene | 26.0 | 17 |
| *S. officinalis* | Leaves | camphor | 30.8 | 21 |
| *S. clevelandii* | Leaves | camphor | 31.7 | 22 |
| *S. aytachi* | Aerial Parts | camphor | 30.8 | 23 |
| *S. fruticosa* | Aerial Parts | 1,8-cineole | 55.5 | 19 |
| *S. aramiensis* | Aerial Parts | 1,8-cineole | 46.0 | 24 |
| *S. moorcraftiana* | Aerial Parts | linalool | 26.9 | 25 |
| *S. schimperii* | Leaves | linalool | 26.6 | 26 |
| *S. hydrangea* | Aerial Parts | spathulenol | 23.1 | 27 |
| *S. syriaca* | Aerial Parts | germacrene-B | 34.8 | 14 |
| *S. sclarea* | Aerial Parts | linalyl acetate | 34.9 | 28 |
| *S. cryptantha* | Aerial Parts | borneol | 24.8 | 19 |
| *S. reuterana* | Aerial Parts | (*E*)-β-ocimene | 32.3 | 13 |
| *S. euphratica* | Aerial Parts | *trans*-pinocarvyl acetate | 16.8 | 29 |

There are many reports on the essential oils of different *Salvia* species. Table 2 presents the major component of the essential oils of twenty four *Salvia* species. As it can be seen, β-caryophyllene is the major component of the oil of aerial parts of *S. nemorosa*, *S. virgata, S. aethiopis, S. verticillata*, *S. hypoleuca and S. atropatana* (13-18). In the essential oil of *S. candidissima*, *S. tomentosa* and *S. lereifolia*, β-pinene; (19-20) and in the oils of *S. santolinifolia* and *S. multicaulis*, α-pinene are recorded as the major constituent (16-17). Camphor was detected as the dominant fraction in the oils of *S. officinalis*, *S. clevelandii* and *S. aytachi* (21-23). About fifty percent of the volatile oils of *S. fruticosa* and *S. aramiensis* are consisted of 1,8-cineole (19, 24). Linalool, spathulenol, germacrene-B, linalyl acetate, borneol, (*E*)-β-ocimene and *trans*-pinocarvyl acetate are also reported as major components of the oils of other *Salvia* species (25-34).

Many identified compounds in the oil of *S. limbata* such as β-caryophyllene, 1,8-cineole, α-pinene, β-pinene and spathulenol are very common components in the essential oil of *Salvia* species. Although bicyclogermacrene, as the main component of the oil of *S. limbata*, was previously reported in the volatile oil of some *salvia* species such as *S. euphratica* (29), *S. aethiopis*, *S. hypoleuca* (17), *S. verticillata* (16) and *S. sclare* (28), however, it is present in high amount only in the oil of *S. hypoleuca* (15.1%) (17).

**ACKNOWLEDGMENT**

The authors would like to acknowledge the financial support by the Research Council of Isfahan University of Medical Sciences for this work. We are also grateful to Mr. I. Mehregan for identification of plant material.

**REFERENCES**

1. Rechinger KH. Flora Iranica. No. 150, Graz: Akademische Druck-u. Verlagsanstalt; 1982. p. 462.
2. Mozaffarian V. A dictionary of Iranian plant names. Tehran: Farhang Moaser; 1996. p. 477.
3. Chiej R. The Macdonald encyclopedia of medicinal plants. London: Macdonald and Co (Publishers) Ltd.; 1988. p. 272.
4. Wichtl M. Herbal drugs and phytopharmaceuticas. Stuttgart: Medpharm Scientific Publishers; 1994. p. 441.
5. Ebadi M. Pharmacodynamic basis of herbal medicine. Boca Raton: CRC Press; 2002. p. 45.
6. Schulz V, Hansel R, Tyler VE. Rational phytotherapy. Berlin: Springer Verlag; 1998. p. 27.
7. Duke JA. CRC Handbook of medicinal herbs. Boca Raton: CRC Press Inc.; 1989. p. 420.
8. Bruneton J. Pharmacognosy, phytochemistry and medicinal plants. Paris: Lavoisier Publishing; 1995. p. 439.
9. Poucher WA. Poucher's perfumes, cosmetics and soaps. Vol. 1, 9th Ed. London: Chapman & Hall; 1991. p. 301.
10. British pharmacopoeia. Vol. 2, London: HMSO; 1988. p. A137-A138.
11. Adams RP. Identification of essential oil components by gas chromatography /mass spectroscopy. Illinois: Allured Publ. Corp.; 1995. p. 69-351.
12. Swigar AA, Silverstein RM. Monoterpenes. Infrared, mass, $^{1}$H-NMR, $^{13}$C-NMR spectra and kovats indices. Wisconsin: Aldrich Chemical Company Inc.; 1981. p. 1-121.
13. Mirza M, Sefidkon F. Essential oil composition of two *Salvia* species from Iran, *Salvia nemorosa* L. and *Salvia reuterana* Boiss. Flav Fragr J 1999; 14: 230-232.
14. Sefidkon F, Mirza M. Chemical composition of the essential oils of two *Salvia* species from Iran, *Salvia virgata* Jacq. and *Salvia syriaca* L. Flav Fragr J 1999; 14: 45-46.
15. Chalchat JC, Gorunovic MS, Petrovic SD, Maksimovic Z.A. Chemical composition of two wild species of the genus *Salvia* L. from Yugoslavia: *Salvia aethiopis* and *Salvia verticillata*. J Essent Oil Res 2001; 13: 416-418.
16. Sefidkon F, Khajavi MS. Chemical composition of the essential oils of two *Salvia* species from Iran: *Salvia verticillata* L. and *Salvia santolinifolia* Boiss. Flav Fragr J 1999; 14: 77-78.
17. Rustaiyan A, Masoudi SH, Monfared A, Komeilizadeh H. Volatile constituents of three *Salvia* species grown wild in Iran. Flav Fragr J 1999; 14: 276-278.
18. Mirza M, Ahmadi L. Composition of the essential oil of *Salvia atropatana* Bunge. J Essent Oil Res 2000; 12: 575-576.
19. Bayrak A, Akgul A. Composition of essential oils from Turkish *Salvia* species. Phytochemistry 1987; 26: 846-847.

20. Rustaiyan A, Masoudi Sh, Yari M, Rabbani M, Motiefar R, Larijani K. Essential oil of *Salvia lereifolia* Benth. J Essent Oil Res 2000; 12: 601-602.
21. Chalchat JC, Michet A, Pasquier B. Study of clones of *Salvia officinalis* L. yields and chemical composition of essential oil. Flav Fragr J 1998; 13: 68-70.
22. Tucker AO, Maciarello MJ, Clebsch BB. Volatile leaf oil of *Salvia clevelandii* (Gray) Greene Gilman. J Essent Oil Res 1996; 8: 669-670.
23. Baser KHC, Duman H, Vural M, Adiguzel N, Aytac Z. Essential oil of *Salvia aytachii* M. Vural et N. Adiguzel. J Essent Oil Res 1997; 9: 489-490.
24. Demirci B, Baser KHC, Tumen G. Composition of the essential oil of *Salvia aramiensis* Rech. Fil. growing in Turkey. Flav Fragr J 2002; 17: 23-25.
25. Shawl AS, Raina VK, Srivastava SK, Kumar T. Essential oil composition of *Salvia moorcraftiana*. J Essent Oil Res 2001; 13: 238-239.
26. Endeshaw M.M, Gautun OR, Asfaw N, Aasen AJ. Volatile oil constituents of the Ethiopian plant *Salvia schimperi* Benth. Flav Fragr J 2000; 15: 27-30.
27. Rustaiyan A, Masoudi Sh, Jassbi A. Essential oil of *Salvia hydrangea* DC. ex Benth. J Essent Oil Res 1997; 9: 599-600.
28. Carrubba A, La Torre R, Piccaglia R, Marotti M. Characterization of an Italian biotype of clary sage (*Salvia sclarea* L.) grown in semi-arid Mediterranean environment. Flav Fragr J 2002; 17: 191-194.
29. Baser KHC, Kurkcuoglu M, Aytac Z. Composition of the essential oil of *Salvia euphratica* Montbret et Aucher ex Bentham var. *euphratica* from Turkey. Flav Fragr J 1998; 13: 63-64.
30. Ghannadi A, Samsam-Shariat SH, Moattar F. Composition of the leaf oil of *Salvia hydrangea* DC. ex Benth. grown in Iran. J Essent Oil Res 1999; 11: 745-746.
31. Baser KHC, Demircakmak B, Ermin N. Essential oil of *Salvia syriaca* L. J Essent Oil Res 1996; 8: 105-106.
32. Baser KHC, Kurkcuoglu M, Ozek T, Sarikardasoglu S. Essential oil of *Salvia caespitosa* Montbret et Aucher ex Benth. J Essent Oil Res 1995; 7: 229-230.
33. Baser KHC, Bies SH, Ozek T. Composition of the essential oil of *Salvia cryptantha* Montbret et Aucher ex Benth. from Turkey. J Essent Oil Res 1995; 7: 113-114.
34. Rustaiyan A, Komeilizadeh H, Masoudi S, Jassbi AR. Composition of the essential oil of *Salvia sahendica* Boiss.& Buhse. J Essent Oil Res 1997; 9: 713.