

Identification of the chemical components of (*Salvia spinosa* L.) in Isfahan climatic conditions

Saied Salehi¹, Ahmad Reza Golparvar^{2*}, Amin Hadipanah³

¹Department of Agronomy, College of Agriculture, Sanandaj Branch, Islamic Azad University, Sanandaj, Iran;

²Department of Agronomy and plant Breeding, Isfahan (Khorasgan) Branch, Islamic Azad University, Isfahan, Iran;

*Email: dragolparvar@gmail.com

³Department of Horticulture, Tehran Science and Research Branch, Islamic Azad University, Tehran, Iran;

ARTICLE INFO

Type: Original Research

Topic: Medicinal Plants

Received April 4th 2014

Accepted June 5th 2014

Key words:

- ✓ (*Salvia spinosa* L.)
- ✓ chemical compositions
- ✓ GC-MS

ABSTRACT

Background & Aim: (*Salvia spinosa* L.) is perennial shrub and aromatic plant belongs to Lamiaceae family. *S.spinosa* growing wild in Iran. The aim of this study was to identify of the chemical components of *S.spinosa* in Isfahan climatic conditions.

Experimental: The aerial parts of the plants were collected from Isfahan province in 2014. The essential oil was extracted by a Clevenger approach and analyzed using GC/MS.

Results: In total, 21 compounds were identified in the essential oil from the aerial parts *S.spinosa*. The results obtained in our study indicated that the major components in the oil were α -terpinolene (32.731%), β -ocimene (30.915%), β -patchoulene (12.779%), β -bourbonene (4.263%) and 1,8-cineol (2.883%).

Recommended applications/industries: there is only little report on the essential oil composition of *S.spinosa* from Iran, *S.spinosa* can use in traditional medicines for activity antimicrobial.

1. Introduction

The genus *Salvia* the largest genus (Lamiaceae: subfamily Nepetoideae, tribe Menthae) represents a cosmopolitan assemblage of nearly 1000 species worldwide, there are 58 *salvia* species growing naturally in Iran, 17 species endemic (Walker et al. 2004; Mozaffarian, 1996). The genus *Salvia* in three regions of the world: Central and South America (500 spp.), western Asia (200 spp.) and eastern Asia (100 spp.). The gametic chromosome number for this

species $n=10$ is the first to be reported. The somatic count was found to be $2n=20$ (Walker and Sytsma, 2007).

Latin word "salvare" is the source of the word *Salvia*, which means to restore to health or to secure health. Ancient authors called it *elelispakon* (Rivera et al., 1994). *Salvia spinosa* is a polymorphic taxon with high morphological variability (Kharazian 2012). Kharazian (2012) also showed that *S. spinosa* was closely related morphologically but differs in diagnostic characters such as the form of the leaves and calyx.

Salvia species are used in traditional medicines all around the world, possessing antioxidant, antibacterial, antidiabetic, anti-tumor, antiplasmodial and anti-inflammatory activities (Kamatou *et al.*, 2008). Study Amin *et al.*, (2006) showed the major components (*Salvia spinosa* L.) a potent antimicrobial activity against *Pseudomonas aeruginosa* (2.06 μ L/disc).

Baher Nik and Mirza (2005) reported the major components oil (*Salvia spinosa* L.) collected from Dizin (Tehran) province were β -ocimene (12.3%), β -caryophyllene (10.2%), isopentyl isovalerate (9.5%), α -gurjunene (7.2%) and isoarnyl, 2-methyl butyrate (7%).

According to Amin *et al.*, (2006) the major components (*Salvia spinosa* L.) collected from Baraghan (Tehran) province were 1,8-cineole (32.87%), β -ocimene (20.03%), germacrene-D (10.66%), 2-butyl thiophene (9.83%), trans caryophyllene (5.01%) and 3-butyl thiophene (3.49%).

Golparvar and Hadipanah (2013) reported the major components (*Salvia officinalis* L.) cultivated in Isfahan climatic conditions were; camphor (17.75%), thujone (13.25%), 1,8-cineole (13.03%), α -pinene (6%), β -thujone (5.85%), α -humulene (5.48%), β -caryophyllene (5.07%) and borneol (3.72%). There are many reports in the literature showing the variation in the yield and chemical composition of the essential oil with respect to geographical regions (Vanvuuren *et al.*, 2007). The aim of this study was to identify of the chemical components of *Salvia spinosa* L. in Isfahan climatic conditions.

2. Materials and Methods

2.1. Plants materials

The aerial parts of the plant samples of *Salvia spinosa* L. were collected from (Bakhtiardasht mountain) Shahin Shahr county (26 km North of Isfahan), Isfahan province, in center Iran (32° 87' N and 51° 57' E, 1595 m above sea level), during spring 2014. Climate in this province varies from semi-dry.

2.2. Essential oil extraction

The fresh aerial of *S.spinosa* were dried inside for six days at room temperature (25 \pm 5 °C), and the ground to fine a powder using Moulinex food processor. The essential oil was extracted from 50 g of ground tissue in 1 L of water contained in a 2 L flask and heated by heating jacket at 100 °C for 3 h in a Clevenger-type apparatus, according to producers

outlined British Pharmacopoeia. The collected essential oil was dried over anhydrous sodium sulphate and stored at 4 °C until analyzed.

2.3. GC/MS analysis

GC/MS analysis was carried out with an Agilent 5975 GC-MSD system. HP-5MS column (30 m x 0.25 mm, 0.25 μ m film thickness) was used with helium as carrier gas with flow rate of 1.0 mL/min. The oven temperature was kept 20 °C at 50 °C for 4 min and programmed to 280 °C at a rate of 5 °C /min, and kept 20 °C constant at 280 °C for 5 min, at split mode. The injector temperature was at 20°C at 280 °C. Transfer 20 line temperatures 280 °C. MS were taken at 70 eV. Mass range was from m/z 35 to 450.

3. Results and discussion

Results of GC/MS indicated that 21 compounds were identified in the essential oil from the aerial parts of *S.spinosa*. The results indicated that the major components were α -terpinolene (32.731%), β -ocimene (30.915%), β -patchoulene (12.779%), β -bourbonene (4.263%) and 1,8-cineol (2.883%) (Table 1 & Fig. 1).

Aboee-Mehrzi *et al.*, (2013) reported the major components the essential oils of *Salvia compressa* growing wild in Iran were α -pinen (70.93%), borneol (7.1%), and camphen (5.92%).

The oil obtained from the aerial parts of *S. lanigera* and *S. spinosa* were rich in thymol (54.9% and 68.9%, respectively) (Flamini *et al.*, 2007). In this study, while thymol was not found in *S. spinosa* studied but β -ocimene was detected at the similar percentages with the results Baher Nik and Mirza (2005) and Amin *et al.*, (2006).

The chemical composition of plants is known to be influenced by several external factors including climate, as some compounds may be accumulated at a particular period to respond to environmental changes. Plant material collected at different times of the year may contain different novel compounds with other bioactivities. The effects of seasonal variations on the chemical and biological characteristics of some essential oils of the family Lamiaceae have been reported in the literature (Kofidis *et al.*, 2004). Feo *et al.*, (2009) reported the major components of *S. hierosolymitana* Boiss. and *S. multicaulis* Vahl. var. *simplicifolia* Boiss. collected in Lebanon were carboxylic compounds (17%) characterizes the oil from

S. hierosolymitana, while *S. multicaulis* var. *simplicifolia* oil is rich of monoterpenes (34.5%) and sesquiterpenes (46.9%). Feo *et al.*, (2010) reported the major components the essential oils of *Salvia africana* L., *Salvia elegans* Vahl, *Salvia greggii* A. Gray, *Salvia mellifera* Green and *Salvia munzii* Epling, cultivated in Eboli (Salerno, Southern Italy). In all, 88 compounds were identified, 54 for *S. africana*, accounting for 95.4% of the total oil, 55 for *S. elegans* (92.9%), 50 for *S. greggii* (96.9%), 54 for *S. mellifera* (90.4%) and 47 for *S. munzii* (97.5%), respectively.

Table 1. Chemical composition of the essential oil from *Salvia spinosa* L.

No.	Compounds ^a	RI ^b	%
1	Sabinene	970	0.501
2	p-Cymene	1019	0.189
3	Acetaldehyde	1024	0.273
4	4-Amino butanoic acid	1025	0.259
5	1,8-cineol	1034	2.883
6	β -Cymene	1043	1.134
7	Butanoic acid, 2-methyl-, pentyl ester	1054	0.824
8	β -Ocimene	1062	30.915
9	α -Terpinolene	1071	32.731
10	1,3-Cyclohexadiene, 1,5,5,6-tetram ethyl	1124	2.843
11	Butanoic acid, octyl ester	1175	0.884
12	Camphene	1235	1.085
13	Heptane, 3-methyl-	1285	2.239
14	Butanoic acid, 3-methyl-, hexyl ester	1294	0.298
15	Octane, 3,4-dimethyl	1298	0.720
16	Cyclohexane, 1-ethenyl-1-methyl-2,4-bis(1-methylethenyl)-, (1 α ,2 β ,4 β)	1345	2.298
17	β -Patchoulene	1368	12.779
18	β -Bourbonene	1385	4.263
19	N-Benzoyl-3-methylleucine	1394	1.264
20	4-Amino-furazan-3-yl-phenyl-methanone	1410	0.165
21	β -Gurjunene	1418	1.452

a Compounds listed in order of elution

b RT (Retention Indices)

Rustaiyan *et al.*, (2009) reported the main components found in the oil of *S. compressa* collected at Tange- malavi, was α -pinene (18.4%), while in the oil of the plant collected at Mamolan to Pol-e-dokhtar, was, α -pinene (4.8%).

Mirza and Baher Nik (2007) reported the major constituents of the essential oil of (*Salvia lachnocalyx* Hedge) collected from Fars province were bicyclogermacrene (31.3%), α -pinene (13.2%), sabinene (11.7%) and β -pinene (10.3%). Dzumayer *et*

al., (1995) reported the major constituents of the essential oil (*Salvia schimperii* Benth.) were Linalool (22-32%) and Linalool acetate (25–51%).

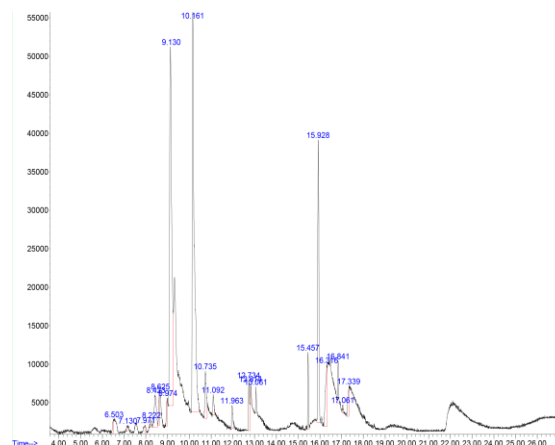


Fig 1. TIC of the essential oil from *Salvia spinosa* L.

Bagci and Kocak (2008) reported the major constituents of the essential oil of *Salvia multicaulis* Vahl. Enum. and *S. tricochlada* Benth from east Anatolian region (Turkey) were 1,8-cineole (17.0%), camphor (13.2%), α -pinene (9.3%), valeranone(8.5%) and α -eudesmol (5.7%) for *S.multicaulis* and β -pinene (13.7%), camphor (11.3%), caryophyllene oxide (7.0%), 1,8-cineole (5.9%) and *trans*-caryophyllene (5.5%) were the major constituents of *S. tricochlada*. Some of the components isolated from the flowering shoots of *S. multicaulis* from Iran were bornyl acetate, β -caryophyllene and α -pinene (Ahmadi and Mirza, 1999).

Ghani *et al.*, (2010) reported the major constituents of the essential oil of (*Salvia sclarea* L.) cultivated in Mashhad climatic conditions were linalool (30.03%), linalyl acetate (23.08%) and α -terpineol (11.13%).

Mirza and Baher Nik (2006) reported the major constituents of the essential oil of *Salvia compressa* Vent. collected from Jahrom in Fars province were tau-cadinol (36%), caryophyllene oxide (15.7%), geraniol (10.5%) and borneol (9.3%). Comparison between these results and the results of the other reports showed differences, probably due to that plant varieties or sites, as well as the time of harvesting. The variations in chemical composition of the essential oils with respect to season might have been due to the influence of phenological status, and environmental conditions can influence the regulation of the biosynthesis of essential oil (Masotti *et al.* 2003).

4. Conclusion

In conclusion, this study demonstrates the occurrence of chemical components of *Salvia spinosa* L. such as α -terpinolene, β -ocimene, β -patchoulene, β -bourbonene and 1,8-cineol in Isfahan climatic conditions. A comparison of our results with different reports, differences in the volatile composition of the plants could be attributed to genetic (genus, species, and ecotype), chemotype, distinct environmental and climatic conditions, seasonal sampling periods, geographic origins, plant populations, vegetative plant phases, and extraction and quantification methods.

5. Acknowledgement

This research project has been supported by Islamic Azad University, Isfahan (Khorasgan) branch, Isfahan, Iran.

6. References

- Aboee-Mehrizi, F., Farjam, M.H., Rustaiyan, A., Zare, A. and Salari, A. 2013. Volatile Constituents of *Salvia compressa* and *Logochilus macranthus*, two labiatae herbs growing wild in Iran. *Research Journal of Recent Sciences.*, 2(2): 66-68.
- Ahmadi, L. and Mirza, M. 1999. Essential oil of *Salvia multicaulis* Vahl from Iran. *Journal of Essential Oil Research.*, 11: 289-292.
- Amin, G., Salehi Sourmaghi, M.H., Samadi, N., Hemmati, F. and Sarkhail, P. 2006. Chemical composition and antimicrobial activity of essential oil of (*Salvia spinosa* L.). *Asian Journal of plant sciences.*, 5(4): 654-656.
- Bagci, E. and Kocak, A., 2008. Essential oil composition of the aerial parts of two *Salvia* L. (*S. multicaulis* Vahl. Enum and *S. tricochlada* Bentham) species from east Anatolian region (Turkey). *International Journal of Science & Technology.*, 3(1): 13-18.
- Dzumayer K.H., Tsibulskaya L.A,b., Zenkevick L.G., Tkachenko K.G. and Satzyperova L.F. 1995. Volatile oil constituents of the Ethiopian plant *Salvia schimperi* Benth. *Journal of essential oil Research.*, 28: 700-712.
- Feo, V.D., Martino, L.D., Roscigno, G., Mancini, E. and Falco, E.D. 2010. Chemical composition and antigerminative activity of the essential oils from five *Salvia* species. *Molecules.*, 15: 735-746.
- Flamini, G., Cioni, P. L., Morelli, I. and Bader, A. 2007. Essential oils of the aerial parts of three *Salvia* species from Jordan: *Salvia lanigera*, *S. spinosa* and *S. syriaca*. *Food chemistry.*, 100: 732-735.
- Ghani, A., Ebrahimpour, A., Tehrani-far, A. and Hassanzadeh-Khayyat, M. 2010. Evaluation of growth and development adaptability and medicinal ornamental potential of Clary sage (*Salvia sclarea* L.) cultivated in Mashhad climatic conditions. *Journal of Plant Production.*, 17(1): 77-90.
- Golparvar, A.R. and Hadipanah, A. 2013. Identification of the Components of Sage (*Salvia officinalis*L.) and Thyme (*Thymus vulgaris*L.) Cultivated in Isfahan Climatic Conditions. *Electronic Journal of Biology.*, 9(2): 42-45.
- Kamatou, G.P.P., Viljoen, A.M., Makunga, N.P. and Ramogola, W.P.N. 2008. South African *Salvia* species: a review of biological activities and phytochemistry. *Journal of Ethnopharmacol.*, 119: 667-672.
- Kharazian, N. 2012. Morphometry study of some *Salvia* L. species in Iran. *Scientific Journal of Biological Sciences.*, 1: 126-137.
- Kofidis, G., Bosabalidis, A. and Kokkini, S. 2004. Seasonal variation of essential oils in a linalool-rich chemotype of *Mentha spicata* grown wild in Greece. *Journal of essential oil Res.*, 16: 469-472.
- Mirza, M. and Baher Nik Z. 2005. Volatile constituents of (*Salvia spinosa* L.) from Iran. *Flavor fragr.*, 20: 311-312.
- Mirza, M. and Baher Nik Z. 2006. Extraction and identification of chemical components of the essential oil of *Salvia compressa* Vent. *Iranian Journal of Medicinal and Aromatic Plants.*, 22(4): 431-436.
- Mirza, M. and Baher Nik Z. 2007. Extraction and identification of the essential oil components of *Salvia lachnocalyx* Hedge. *Iranian Journal of Medicinal and Aromatic Plants.*, 23(2): 278-284.
- Masotti, V., Juteau, F., Bessiere, J.M. and Viano, J. 2003. Seasonal and phonological variation of the essential oil from the narrow endemic species *Artemisia molinieri* and its biological activities. *Journal of Agricultural and Food Chemistry.*, 51: 7115-7121.

- Mozaffarian, V. 1996. A Dictionary of Iranian Plant Names. Farhang Moaser, Tehran, Iran. pp. 542.
- Rivera, D., Obon, C. and Cano, F. 1994. The Botany, History and Traditional Uses of threelobed Sage (*Salvia fruticosa* Miller) (Labiatae). *Economic Botany.*, 48: 190–195.
- Rustaiyan, A., Jamzad, M., Larijani, K., Masoudi, S. and Jamzad Z. 2009. Composition of the essential oil of *Salvia compressa* Vent. and *Cyclotrichium leucotrichum* (Stapf. Ex Rech.f.) Leblebici from Iran, *J.Essent.Oil Res.*, 21: 222-224.
- Vanvuuren, S.F., Viljoen, A.M., Ozek, T., Demirici, B. and Baser, K.H.C. 2007. Seasonal and geographical variation of *Heteropyxis natalensis* essential oil and the effect thereof on the antimicrobial activity. *South African Journal of Botany.*, 73(3): 441-448.
- Walker J.B and Sytsma K.J. 2007. Staminal evolution in the genus *Salvia* (Lamiaceae): Molecular phylogenetic evidence for multiple origins of the stamina lever. *Annals Bot.*, 100: 375-391.
- Walker, J.B.; Sytsma, K.J.; Treutlein, J. and Wink, M. 2004. *Salvia* (Lamiaceae) is not monophyletic: implication for the systematics, radiation, and ecological specialization of *salvia* and Tribe Mentheae. *American Journal of Botany.*, 91: 1115-1125.