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THE ESSENTIAL OIL COMPOSITION OF *SCUTELLARIA PINNATIFIDA* A. HAMILT. SUBSP. *MUCIDA* (STAPF) RECH. F. AND COMPARISON WITH TWO OTHER SUBSPECIES IN IRAN

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ABSTRACT: The essential oil obtained from the aerial parts of *Scutellaria pinnatifida* A. Hamilt. subsp. *mucida* (Stapf) Rech. f. was analyzed by using GC and GC-MS. Fifty one compounds representing 82.96% of the oil were identified. The main ones were Germacrene D (9.56%), α-pinene (5.37%), yl CinnamateBorn (4.09%), t-Muurolol (2.74%), Aromadendrene (2.54%), L Linallol (2.51%), Cinnamyl Cinnamate (2.32%), Cyclosativene (3.28 %), Germacrene B (2.19%), and (+) -Valeranoneand (1.92%).
Key words: *Scutellaria pinnatifida*, Lamiaceae, Volatile oils, Chemical composition.

INTRODUCTION

Scutellaria (Lamiaceae) is a cosmopolitan genus of over 300 species, belonging to Scutellaroideae tribe, Lamiaceae family [1,2,3,4]. This genus comprises about 20 species in Iran which eight of them are endemic species [5]. This plant is named Skullcap, helmet-flower and hood-wort in English [6]. Some species of *Scutellaria* are utilized in folk medicine, e.g., *S. radix* has been used in Chinese medicine and as a medicinal plant in oriental countries for various purposes. It has been reported that *S. baicalenis* has diverse pharmacological effects [7,8,9]. There are many studies in medicinal plants of Lamiaceae but a few reports on the analysis of oils of Lamiaceae genus *Scutellaria* species have been published [10,11,12,13]. Masoudi *et. al*. studied the volatile constituents of *Scutellaria pinnatifida* A. Hamilt. subsp. *pinnatifida* in 2009. A diterpenoid with antifeedant activity from *Scutellaria rubicund*a was obtained by Bruno *et. al*. in 1999. The essential oil of *Scutellaria pinnatifida* A. Hamilt. ssp. *alpina* (Bornm.) Rech. was analyzed by GC and GC/MS [14]. Skaltsa *et al*. investigated the essential oil composition and antimicrobial activity of *S. sieberi* Benth. and *S. rupestris* Boiss. et Helder. ssp. *adenotricha* (Boiss. et Helder.) Greuter et Burdet in 2003. The aim of this study was to determine the essential oil composition of *Scutellaria pinnatifida* A. Hamilt. subsp. *mucida* (Stapf) Rech. f. for the first time and comparing it with the composition of volatile oil from two other subspecies namely, *S. pinnatifida* subsp. *pinnatifida* and *Scutellaria pinnatifida* A. Hamilt. ssp. *alpina* (Bornm.) Rech.[15].

MATERIAL AND METHODS

Plant material:

The aerial part of *Scutellaria pinnatifida* subsp. *mucida* was collected from Tabiz to Zanjan road, 20 km passed from Tabriz, in 18 June 2009. The plant was identified by following Flora Iranica [3] and the voucher specimen (IRAN-45972) is preserved in the herbarium of the Ministry of Jihad-e-Agriculture ("IRAN") at the Iranian Research Institute of Plant Protection (Tehran, Iran).

Isolation of the volatile oils:

The air-dried aerial parts of the plant were subjected to hydrodistillation for four hour using a Clevenger-type apparatus. The oil was kept at 4°C in the sealed brown vials until required.

Gas chromatography-Mass spectroscopy:

Analytical gas chromatography was carried out using a Thermoquest 2000 GC with capillary column DB-5 (30 m. 0.25 mm i.d., 0.25 m film Thickness); carrier gas, He; split ratio, 1:25; and using a flame ionization detector. The column temperature was programmed at 50°C for 1 min. and then heated to 265°C at a rate of 2.5°C/min. and then kept constant at 265°C for 20 min. GC-MS was performed on a Thermoquest 2000 with a quadruple detector, on capillary column DB-5 (GC); carrier gas, He; flow rate, 1.5 ml/min. the column was held at 50°C for 1 min. and programmed up to 265°C at rate of 2.5°C/min, then kept constant at 256°C for 20 min. The MS operated at 70 eV ionization energy.

Retention indices were calculated by using retention times of *n*-alkanes that were injected after the oil at the same chromatographic conditions. Quantitative data were obtained from the electronic integration of the FID peak areas. The components of the oils were identified by comparison of their mass spectra and retention indicates with Wiley library and those published in the literature [16].

RESULTS AND DISCUSSION

The hydrodistillation of the aerial parts of *Scutellaria pinnatifida* subsp. *mucida* gave yellow oil with a distinct sharp odor in the yield of 0.36% (w/w), basis on dry weight. Table 1 shows constituents of the oil. Fifty one components were detected in the oil of *S. pinnatifida* subsp. *pinnatifida* representing 82.96 % of the total oil. The major constituents were Germacrene D (9.56 %), α-pinene (5.37 %), Bornyl Cinnamate (4.09%), t-Muurolol (2.74%), Aromadendrene (2.54 %), L Linallol (2.51 %), Cinnamyl Cinnamate (2.32%), Cyclosativene (3.28 %), Germacrene B (2.19 %), and (+) -Valeranoneand (1.92%). Figure-1 shows the chromatogram of *S. pinnatifida* subsp. *pinnatifida*.

The oil of of *Scutellaria pinnatifida* subsp. *pinnatifida* contained 14 oxygenated sesquiterpenes (29.22 %), 11 sesquiterpene hydrocarbons (22.46 %), nine non Terpene (15.61%), eight monoterpene hydrocarbones (8.59 %), and eight oxygenated monoterpenes (6.36 %). In addition, the total amount of the monoterpene fraction in the oil of *S. pinnatifida* subsp. *pinnatifida* (14.95 %) was much less than sesquiterpene fraction (51.68 %). According to table 3, one of the common component in three subspecies of *Scutellaria pinnatifida* is Germacrene-D which has been reported in some other taxa of Lamiaceae family such as *Micromeria* Benth., *Nepeta* L., *Eremostachys* Bge., *Ajuga* L. and *Phlomis* L. [17,18,19,20,21]. The other common components in these subspecies are (+)-Spathulenol and dl-limonene (Table-2). According to previous studies on *Scutellaria pinnatifida* subspecies oils, sesquiterpene (91.9%) was the main component in *S. pinnatifida* subsp. *alpina* and the oil of *S. pinnatifida* subsp. *pinnatifia* was rich in phenyl propanoid (84.7 %), whereas in *S. pinnatifida* subsp. *mucida*, monoterpenes (48.6 5%) were the main one. In addition, the earlier reports of the essential oil of *S. pinnatifida* supsp. *mucida* was showed (+)Spathulenol (15.1%) as the main components, but only 0.4% Spathulenol was detected in *S. pinnatifida* subsp. *pinnatifida* and no Spathulenol component was detected in *S. pinnatifida* subsp. *alpina*. The main component of *S. pinnatifida* subsp. *alpina* was Germacrene D (39.7%), but in this research Germacrene D (9.56 %) was the second major component.

Table 1- Chemical composition (%) of the essential oil of *Scutellaria pinnatifida* subsp. *mucida*

Rt	KI	%	Component
9.41	935	0.18	α-Thujene
9.67	939	5.37	α-Pinene
10.10	954	0.48	Camphene
10.32	966	0.40	Verbenene
11.13	978	0.46	Sabinene
11.27	982	1.07	2-βPinene
11.76	994	3.91	3-Octanol
13.52	1034	0.33	1,8-Cineol
13.68	1036	0.40	dl-Limonene
15.08	1063	0.23	γ-Terpinine
16.80	1101	0.22	Nonanal
17.03	1106	2.51	L Linalool
17.55	1111	0.53	6-Camphenol
18.5	1160	0.45	*trans*-Pinocarveol
18.67	1164	0.31	Citronellal
18.88	1169	1.67	Pinocarvone
20.47	1195	0.34	Myrtenal
28.49	1352	0.64	α-Longipinene
29.30	1370	3.28	Cyclosativene
29.55	1375	0.29	α-Copaene
29.86	1386	1.53	β-Bourbonene
30.71	1430	2.54	Aromadendrene
33.48	1484	0.80	β-Ionone
33.72	1487	9.56	Germacrene D

Table-1 cont….

33.84	1491	0.30	ocaryophyelleneIs
34.29	1537	2.19	rmacrene BGe
34.92	1548	0.36	γ-Cadinene
35.11	1551	1.34	*trans*-Calamenene
35.36	1563	0.43	δ-Cadinene
35.57	1567	0.20	Longipinanol
35.72	1574	0.72	β-Bisabolene
35.94	1579	1.76	1,6-Germacradiene-5-ol
36.12	1582	1.50	*cis*β-Elemenone
37.32	1591	15.1	(+)-Spathulenol
38.07	1641	0.60	Selin-11-en-4-ol
39.15	1656	0.57	Valerianol
39.29	1661	0.48	10-*epi*-γ-Eudesmol
39.46	1675	0.36	5-*neo*-Cedranol
39.91	1681	1.54	β-Eudesmol
40.18	1687	2.74	t-Muurolol
40.52	1672	1.92	(+)-Valeranone
40.70	1685	1.11	8-Cedren-13-ol
42.45	1693	0.54	Himachalenol
42.62	1701	1.77	Heptadecane
47.23	1777	1.61	Pentadecanol
51.39	1875	0.23	Hexadecanoic acid
55.65	2109	0.16	Heneicosane
66.73	2511	0.40	Pentacosane
69.63	2611	4.09	Bornyl Cinnamate
69.83	2678	2.32	Cinnamyl Cinnamate
70.04	2712	1.12	Hydrocinamic acide
		82.96	**Total**
Rt = Retention time; KI= Kovats Index			

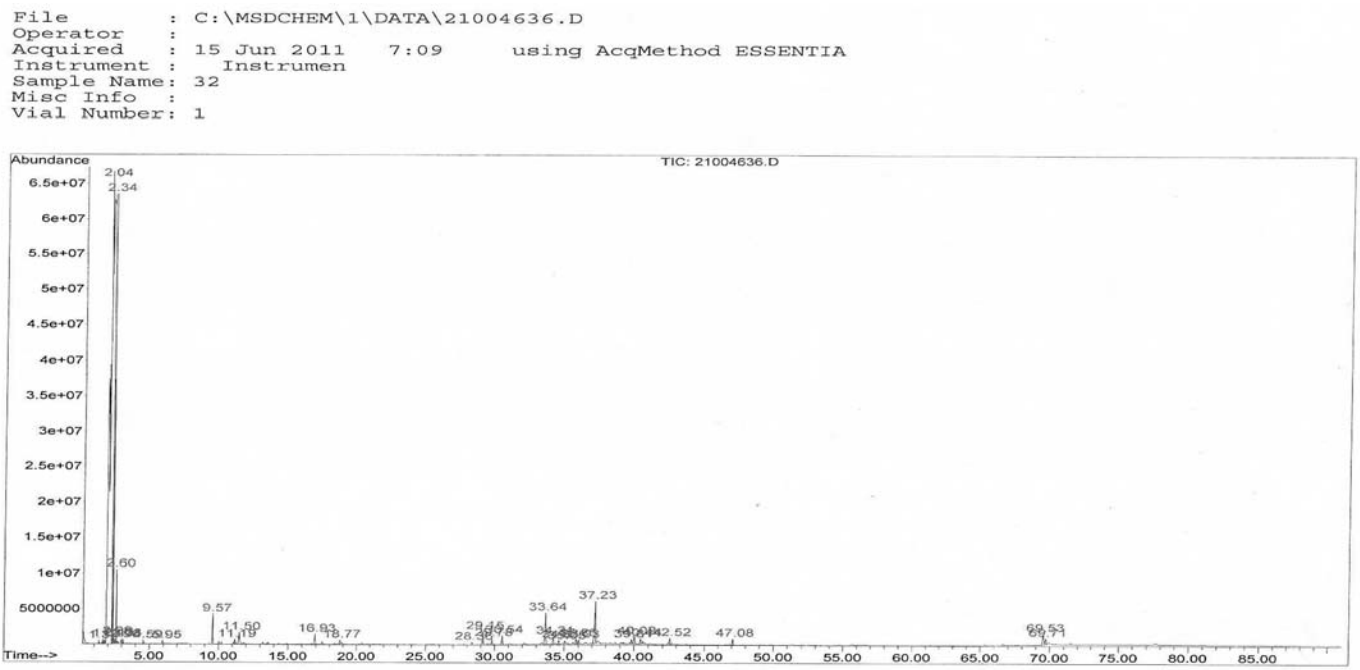

Figure-1- Chromatogram of *Scutellaria pinnatifida* subsp. *mucida*

Table 2- Comparing the essential oil composition (%) from three subspecies of *Scutellaria pinnatifida*

***S. pinnatifida* subsp. *alpina* (%)**	***S. pinnatifida* subsp. *pinnatifida* (%)**	***S. pinnatifida* subsp. *mucida* (%)**	**Component**
	0.6	0.18	α-Thujene
		5.37	α-Pinene
		0.48	Camphene
		0.40	Verbenene
		0.46	Sabinene
		1.07	2-βPinene
		3.91	3-Octanol
0.1		0.33	1,8-Cineol
0.2	1.9	0.40	dl-Limonene
0.5		0.23	γ-Terpinine
		0.22	Nonanal
1.1		2.51	L Linalool
		0.53	6-Camphenol
		0.45	*trans*-inocarveolP
		0.31	Citronellal
		1.67	Pinocarvone
		0.34	Myrtenal
0.8		0.64	α-Longipinene
		3.28	Cyclosativene
5.0		0.29	α-Copaene
0.9		1.53	β-Bourbonene
0.9		2.54	Aromadendrene
		0.80	β-Ionone
39.7	1.3	9.56	Germacrene D
		0.30	Isocaryophyllene
0.9		2.19	Germacrene B
		0.36	γ-Cadinene
		1.34	*trans*-Calamenene
5.3		0.43	δ-Cadinene
		0.20	Longipinanol
0.2		0.72	β-Bisabolene
		1.76	-5-ol 1,6-Germacradiene
		1.50	*cis*β-Elemenone
2.0	0.4	15.1	(+)-Spathulenol
		0.60	Selin-11-en-4-ol
		0.57	Valerianol
		0.48	10-i*ep*-γ-Eudesmol
		0.36	5-*neo*-Cedranol
		1.54	β-Eudesmol
		2.74	t-Muurolol
		1.92	(+)-Valeranone
		1.11	8-Cedren-13-ol
		0.54	Himachalenol
		1.77	Heptadecane
		1.61	Pentadecanol
		0.23	Hexadecanoic acid
		0.16	Heneicosane
		0.40	Pentacosane
		4.09	Bornyl Cinnamate
		2.32	Cinnamyl Cinnamate

Table-2 cont….

		1.12	Hydrocinamic acide
	5.2		(Z)-β-Ocimene
	4.1		(E)-β-Ocimene
	81.9		Methyl chavicol
	0.2		Bornyl acetate
	2.8		Methyl eugenol
15.0	0.5		β-Caryophyllene
4.8	1.1		Bicyclogermacrene
0.4			β-Cubebene
0.3			α-Gurjunene
0.7			*trans*-α-Bergamotene
0.7			α-Humulene
2.0			*trans*-β-Farnesene
0.3			Alloaromadendrene
1.9			β-Himachalene
0.5			*Cis*-γ-Bisabolene
0.6			α-Cadinene
0.4			α-Calacorene
2.5			Caryophyllene oxide
0.8			Viridiflorol
1.3			α-Muurolol
2.2			α-Cadinol
93.8	**100**	**82.96**	**Total**

REFERENCES

[1] Paton, A. 1990. A global taxonomic investigation of *Scutellaria* (Labiatae). Kew Bulletin. 45, 399-450.
[2] Evans, W. C. 1998. Trease and Evans' Pharmacognosy, 13th ed. Bailliere Tindall. London, pp. 216-217.
[3] Rechinger, K. H. 1982. Flora Iranica, N0.150. Akademische Druck-u. Verlagsanstalt, Gra. pp. 2, 48- 78.
[4] Zargari, A. 1990. Medicinal plants, vol. 4. Tehran Univ. Pub. Tehran, pp. 148-150.
[5] Mirza, M., Najafpour Navaei, M., and Dini, M. 2005. Essential Oil Composition of *Scutellaria pinnatifida*, Iranian Journal of Medicinal and Aromatic Plants. 20(4), 417-423.
[6] Mozaffarian, V. 2003. A Dictionary of Iranian plant names. Farhang Moaser. Tehran, pp. 497-499.
[7] Kimura, Y., Okuda, H., and Arachi, S. 1985. Studies on *Scutellaria radix* XIII. Effects of various flavonoids on arachidonate metabolism in leukocytes. Planta Med. 52, 132-136.
[8] Bochorakova, H., Paulova, H., Slanina, Musil, P., and Taborskova. 2003. Main flavonoids in the roots of *Scutellaria baicalensis* cultivated in Europe and their comparative antiradical properties. Phytother. Res. 17,640-644.
[9] Wozniak, D., Lamer-Zarawska, E., and Matkowski. 2004. Antimutagenic and antiradical properties of flavones from the roots of *Scutellaria baicalensis* Georgi. Nahrung. 48, 9-12.
[10] Skaltsa, H. D., Lazari, D.M., Mavromati, A. S., and Tiligada, E. A. 2000. Composition and antimicrobial activity of the essential oil of *Scutellaria albida* ssp. *albida* from Greece. Planta Med. 66, 672-674.
[11] Firouznia, A., Rustaiyan, A., Masoudi, S., Rahimzadeh, M., and Bigdeli, M. 2005. Volatile constituents of *Salvia limbata* C. A. Mey, Stachys turcomanica Trautv., *Scutellaria litwinowii* Bornm & Sint ex Bornm. And *Hymnocrater elegans* Bung. Four Lamiaceae herbs growing wild in Iran. J. Essent. Oil Bear. Plants. 12, 482-489.
[12] Golpavar, A. R., Ghaisari, M. M., Hadipanah, A. and Armin, A. 2013. Chemical analysis and identification of the components of Black Seed and Thyme cultivated in Iran. Scientia Agriculturae. 4(2), 55-57.
[13] Sharafzadeh, S. 2014. Comparison of the Main Essential Oil Components of Different Species of Satureja from Iran: A Review. Applied Science Reports. 2(1), 1-3.

[14] Ghannadi, A. and Mehregan, I. 2003. Essential oil of one of the Iranian Skullcaps. Verlag der Zeitschrift für Naturforschung, Türbinger. 58c: 316-318.
[15] Masoudi, Sh., Azad, L., Yari, M., Jamzad, M., Akhlaghi, H., Motevalizadeh, A., and Rustaiyan, A. 2009. Volatile constituents of *Micromeria persica* Boiss., *Hymenocrater platystegius* Rech. f. and *Scutellaria pinnatifida* subsp. *pinnatifida*, three Labiatae herbs growing wild in Iran, J. Essent. Oil Res. 21, 515-518.
[16] Adams, R.P. 1995. Identification of Essential Oil Components by Gas Chromatography/ Mass Spectroscopy. Allured Publishing Co. Carol Stream, Illinois, 94-353.
[17] Amiri, H., Meshkat Al Sadat, M.H. and Lari Yazdi, H. 2007. Chemical composition of the essential oil of *Eremostachys laevigata* bung. DARU. 15, 141-44.
[18] Dabiri, M. and Sefidkon, F. 2003. Chemical composition of *Nepeta crassifolia* Boiss. & Buhse oil from Iran. Flavour Fragr. J. 18, 225-227.
[19] Sajjadi, S.E. and Ghannadi, A. 2004. Volatile oil composition of the aerial part of *Ajuga orientalis* L. from Iran. Verlag der Zeitschrift für Naturforschung, Türbinger. 59, 166-168.
[20] Skaltsa, H. D., Lazari, D.M., Mavromati, A. S., and Tiligada, E. A. 2000. Composition and antimicrobial activity of the essential oil of *Scutellaria albida* ssp. *albida* from Greece. Planta Med. 66, 672-674.
[21] Skaltsa, H.D., Lazari, D.M., Kyriazopoulos, P., and Golegou, S. 2003. Composition and antimicrobial activity of the essential oils of *Scutellaria sieberi* Benth. And *Scutellaria rupestris* Boiss. et Helder. ssp. *adenotricha* (Boiss. Et Helder.) Greuter et Burdet from Greece.