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ESSENTIAL OIL COMPOSITION OF TWO *SCUTELLARIA* FROM TOKAT PROVINCE OF TURKEY

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Abstract: The genus *Scutellaria* L. (Lamiaceae) is represented in Turkey by 16 species, 1 natural hybrid, 38 taxa, 16 being endemic in Turkey (1,2). Hydrodistilled essential oils of the aerial parts of *Scutellaria altissima* L. and *Scutellaria orientalis* L. subsp. *pinnatifida* Edmondson were analyzed by GC and GC-MS systems in a simultaneous manner. The oil of *S. altissima* contained β-caryophyllene (34.7 %), caryophyll-5-en-12-al (14.4%), linalool (14.3%) and hexadecanoic acid (7.1%) as main constituents. The oil of *S. orientalis* L. subsp. *pinnatifida* was characterized by the occurrence of germacrene D (56.9%), β-caryophyllene (10.5%) and bicyclogermacrene (10.1%) as major components. To the best of our knowledge, this is the first report on the GC and GC/MS determination of the essential oil composition of the *S. altissima* and *S. orientalis* subsp. *pinnatifida* species studied.

Keywords: *Scutellaria altissima* L., *Scutellaria orientalis* L. subsp. *pinnatifida,* GC, GC/MS

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INTRODUCTION

The genus *Scutellaria* L. (Lamiaceae) is represented by 16 species, 1 natural hybrid, 38 taxa, 16 being endemic in Turkey. This genus spreads in tropical space such as Europe, North America and Eastern Asia (1-3). Infusion of the leaves of these species is used as tranquilizers, hemostatic and wound healing agents in folk medicine and also utilized as a tonic in Eastern Anatolia (4,5). Phytochemical studies belonging to *Scutellaria* species are available in the literature. These species include alkaloids, phytosterols and polysaccharides of phenolic and terpenic constituents (6,7).
Aim of this study is to analyze the essential oil of *Scutellaria altissima* L. and *Scutellaria orientalis* L. subsp. *pinnatifida* Edmondson species.

MATERIAL AND METHODS

Plant material

Scutellaria altissima and *S. orientalis* subsp. *pinnatifida* were collected in May, 2016 in Tokat, Turkey. Collected plant samples were identified and prepared voucher specimens are kept at the Herbarium of Faculty of Pharmacy of Anadolu University, Turkey (ESSE No: 15476, ESSE No: 15475, resp.).

Isolation of the essential oil

Aerial parts of the plants were hydrodistilled for 3 h using a Clevenger-type apparatus. The essential oils were stored at 4 °C in the dark until analyzed. Yields of essential oil obtained from *S. altissima* and S. *orientalis* subsp. *pinnatifida* were found to be 0.01% and % 0.15, respectively.

GC and GC-MS conditions

The oils were analyzed by Gas Chromatography (GC) and Gas Chromatography-Mass Spectrometry (GC-MS) using an Agilent GC-MSD system (Mass Selective Dedector-MSD).

GC-MS analysis

The GC-MS analysis was carried out with an Agilent 5975 GC-MSD system (Agilent, USA; SEM Ltd., Istanbul, Turkey). Innowax FSC column (60 m x 0.25 mm, 0.25 μm film thickness) was used with helium as a carrier gas (0.8 mL/min). GC oven temperature was kept at 60 °C for 10 min and programmed to 220 °C at a rate of 4 °C/min, and kept constant at 220 °C for 10 min and then programmed to 240 °C at a rate of 1 °C/min. Split ratio was adjusted to 40:1. The injector temperature was at 250 °C. The interphase temperature was at 280 °C. MS were taken at 70 eV. Mass range was from m/z 35 to 450.

GC analysis

GC analyses were performed using an Agilent 6890N GC system. FID temperature was set to 300 °C and the same operational conditions were applied to a triplicate of the same column used in GC–MS analyses. Simultaneous auto injection was done to obtain equivalent retention times. Relative percentages of the separated compounds were calculated from integration of the peak areas in the GC-FID chromatograms.

Identification of Compounds

The components of essential oils were identified by comparison of their mass spectra with those in the Baser Library of Essential Oil Constituents, Adams Library (8), MassFinder Library (9), Wiley GC/MS Library (10) and confirmed by comparison of their retention indices. These identifications were accomplished by comparison of retention times with authentic samples or by comparison of their relative retention index (RRI) to a series of n-alkanes. Alkanes were used as reference points in the calculation of relative retention indices (RRI) (11). Relative percentage amounts of the separated compounds were calculated from FID chromatograms. The results of analysis are shown in Table 1.

RESULTS AND DISCUSSION

Thirty-eight compounds constituting about 95.3 % of the essential oil of *S. altissima* and sixty-two compounds constituting 100.0 % of the oil of *S. orientalis* subsp. *pinnatifida* were characterized.

Sesquiterpene hydrocarbons (41.3 %) were the main group of constituents of the oil of *S. altissima*, followed by oxygenated sesquiterpenes (20.5 %), oxygenated monoterpenes (20.3 %). The oil of *S. altissima* contained β-caryophyllene (34.7 %), caryophyll-5-en-12-al (14.4%), linalool (14.3 %) and hexadecanoic acid (7.1 %) as main constituents.

Sesquiterpene hydrocarbons (87.0 %) were the main group of compounds of the oil of S. *orientalis* subsp. *pinnatifida.* The oil of *S. orientalis* L. subsp. *pinnatifida* was characterized by the occurrence of germacrene D (56.9%), β-caryophyllene (10.5 %) and bicyclogermacrene (10.1 %) as major components.

In literature, there are works on essential oil of *Scutellaria* ssp. In a previous work, *S. orientalis* subsp. *alpina* was identified with 71 components in all accounting for 95.7% of the oil. Hexahydrofarnesylacetone (11.7 %) caryophyllene (7.4 %) and caryophyllene oxide (6.8 %) was found as the main components (12).

In a study by İcen et al., 33 components were recognized from the essential oil of *S. orientalis* subsp. *virens* representing 89.29 % of the total oil. β-Caryophyllene (22.1 %), γ-cadinene (19.9 %), camphene (6.0 %) and calarene (5.9 %) were established as the main constituents of the essential oil (13) while, terpinolene (15.6 %), germacren D (16.5 %) and β-caryophyllene (13.4 %) were found as major components by another study (14).

Table 1. Essential oil composition of *S.altissima* (A) and *S. orientalis* subsp. *pinnatifida* (B)

RRI	Compounds	A%	B%	IM
1032	α-Pinene	-	2.4	tR, MS
1035	α-Thujene	-	tr	MS
1076	Camphene	-	0.1	tR, MS
1118	β-Pinene	-	0.5	tR, MS
1132	Sabinene	-	0.5	tR, MS
1174	Myrcene	-	0.4	tR, MS
1188	α-Terpinene	-	tr	tR, MS
1203	Limonene	tr	0.4	tR, MS
1213	1,8-Cineole	tr	-	tR, MS
1213	β-Phellandrene	-	0.1	tR, MS
1246	(Z)-β-Ocimene	tr	-	tR, MS

RRI	Compounds	A%	B%	IM
1255	γ-Terpinene	tr	tr	tR, MS
1266	(E)-β-Ocimene	0.1	-	tR, MS
1280	p-Cymene	-	tr	tR, MS
1290	Terpinolene	0.1	0.1	tR, MS
1306	1-octen-3-one	tr	-	MS
1393	3-Octanol	1.7	-	MS
1400	Nonanal	0.5	tr	MS
1444	Dimethyl tetradecane	0.1	-	MS
1452	1-Octen-3-ol	1.1	0.1	tR, MS
1483	α-amorphene	-	0.1	MS
1484	Bicycloelemene	-	tr	MS
1492	α-Ylangene	-	tr	MS
1497	α-Copaene	-	1.9	MS
1529	α-Bourbonene	-	tr	MS
1532	Camphor	0.2	-	tR, MS
1535	β-Bourbonene	0.1	1.3	tR, MS
1541	Benzaldehyde	tr	-	MS
1548	(E)-2-Nonenal	0.2	-	MS
1550	β-Cubebene	-	0.3	MS
1553	Linalool	14.3	0.2	tR, MS
1568	trans-α-Bergamotene	-	tr	MS
1577	β-Ylangene	-	0.2	MS
1600	β-Elemene	-	tr	MS
1602	β-Copaene	-	0.3	MS
1612	β-Caryophyllene	34.7	10.5	tR, MS
1661	Alloaromadendrene	-	0.5	MS
1668	(Z)-β-Farnesene	-	1.9	MS
1684	γ-Gurjunene	-	tr	MS
1687	α-Humulene	4.3	1.0	tR, MS
1700	Heptadecane	0.1	-	tR, MS
1706	α-Terpineol	2.1	-	tR, MS
1726	Germacrene D	0.5	56.9	MS
1744	Eremophilene	-	0.7	MS
1747	Piperitone	-	tr	tR, MS
1751	Bicyclogermacrene	-	10.1	MS
1758	(E,E)-α-Farnesene	1.7	-	MS
1772	δ-Cadinene	-	1.1	tR, MS
1776	γ-Cadinene	-	0.2	MS
1808	Nerol	0.9	-	tR, MS
1856	Geraniol	2.8	-	tR, MS
1882	1-Isobutyl-4-isopropyl-2,2-dimethyl succinate	-	tr	MS
1900	Epicubebol	-	0.1	MS
1933	Cubebol	-	0.4	MS
1984	(E)-12-Norcaryophyll-5-en-2-one	0.9	-	MS
2001	Isocaryophyllene oxide	0.3	tr	MS
2008	Caryophyllene oxide	2.1	0.7	tR, MS
2041	(E)-Nerolidol	1.0	-	tR, MS
2045	Norbourbonone	-	tr	MS
2057	Ledol	-	tr	MS
2067	(2R, 5E)-Caryophyll-5-en-12-al*	1.9	-	MS
2069	Germacrene D-4-ol	-	0.7	MS
2080	Cubenol	-	tr	MS
2081	Junenol	-	tr	MS
2096	Globulol	-	0.1	MS
2100	Heneicosane	tr	-	tR
2103	(2S, 5E)-Caryophyll-5-en-12-al*	14.4	-	MS
2104	Viridiflorol	-	0.2	MS
2122	Rosifoliol	-	tr	MS
2131	Hexahydrofarnesyl acetone	tr	0.1	tR, MS
2144	Spathulenol	-	0.6	tR, MS
2179	3,4-Dimethyl-5-pentylidene-2(5H)-furanone	tr	tr	MS
2191	T-Cadinol	-	0.2	MS

RRI	Compounds	A%	B%	IM
2192	Copaborneol	-	0.2	MS
2209	T-Muurolol	-	0.4	MS
2219	δ-Cadinol	-	tr	MS
2241	trans-α-Bergamotol	-	tr	MS
2255	α-Cadinol	-	1.1	tR, MS
2300	Tricosane	1.3	-	tR, MS
2316	Caryophylladienol I	tr	-	MS
2324	Caryophylladienol II	0.8	-	MS
2500	Pentacosane	-	tr	MS
2696	Tetradecanoic acid	tr	tr	tR, MS
2931	Hexadecanoic acid	7.1	3.4	MS

RRI: (Relative retention indices) calculated against n-alkanes, %: calculated from FID (Flame ionization detection) data; tr : Trace(< 0.1 %); IM, identification method: t_R, identification based on the retention times (t_R) of genuine compounds on the HP Innowax column; MS, identified on the basis of computer matching of the mass spectra with those of the Wiley and MassFinder libraries and comparison with literature data; *R, S not identified (2*R*, 5*E* and 2*S*, 5*E*).

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