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ESSENTIAL OIL COMPOSITION OF FOUR TURKISH SPECIES OF *SIDERITIS*

NURTEN EZER, ROSER VILA,*† SALVADOR CAÑIGUERAL† and TOMAS ADZET†

Department of Pharmacognosy, Faculty of Pharmacy, Hacettepe University, TR-06100 Ankara, Turkey; †Unitat de Farmacologia i Farmacognòsia, Facultat de Farmàcia, Universitat de Barcelona, Avenue Diagonal 643, E-08028 Barcelona, Spain

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Key Word Index—*Sideritis congesta*; *S. condensata*; *S. argyrea*; *S. perfoliata*; Lamiaceae; essential oil; GC-MS.

Abstract—The composition of the essential oils of four species of *Sideritis*, three of them endemic to Turkey, was investigated by GC and GC-mass spectrometry. They were characterized by the presence of a high percentage of monoterpene hydrocarbons. α- and β-pinene were the main constituents of *S. congesta* and *S. argyrea*, while limonene was the major one of the oil of *S. perfoliata*. *S. condensata* provided an essential oil with high proportions of β-caryophyllene and α-pinene.

INTRODUCTION

The genus *Sideritis* is constituted by aromatic plants widely used in folk medicine for their anti-inflammatory, antirheumatic, digestive and antimicrobial activities [1]. *Sideritis* species are often used in Turkey as herbal teas [2]. Previous results on the pharmacological activities of Turkish *Sideritis* revealed their diuretic [3], anti-inflammatory [4], antispasmodic [5] and antibacterial [6] activities.

Continuing our investigation on the composition of the essential oils of *Sideritis* species [7–10], we now report on the qualitative and quantitative analysis of the volatile oils of four species growing in Turkey, *viz.* *S. congesta*, *S. condensata*, *S. argyrea* and *S. perfoliata*, for which only very few data have been reported previously [11, 12].

RESULTS AND DISCUSSION

The yield (v/w) of essential oil of the air-dried aerial parts of the four species investigated were 0.1% (*S. condensata*), 0.3% (*S. perfoliata*), 0.5% (*S. congesta*) and 0.8% (*S. argyrea*). Qualitative and quantitative analytical results are shown in Table 1. More than 90% of the volatile oil was identified in each sample, 79 different compounds in total being identified. Monoterpene hydrocarbons were shown to be the main group of constituents in all samples. In the oils of *S. congesta* and *S. argyrea*, α- and β-pinene were the major components, the latter being the main constituent, reaching percentages of 28.8% and 23.9%, respectively.

The essential oil of *S. argyrea* was also characterized by the presence of 18.1% of limonene, which was the major compound (22.4%) of the oil of *S. perfoliata*, followed by *cis*-ocimene (12.3%) and α-pinene (12.1%). β-Caryophyllene showed the highest percentage (15.9%) in the essential oil of *S. condensata*, whch was also characterized by the presence of β-pinene (12.1%), β-caryophyllene oxyde (6.2%), germacrene D (5.4%) and spathulenol (4.1%).

Monoterpene hydrocarbons have previously been rereorted as the main constituents of the essential oils of several speices of the genus *Sideritis*. Thus, β-pinene, which is the major component of the volatile oil of *S. congesta* and *S. argyrea*, also showed high contents in the oils of *S. granatensis* [7] and *S. lycia* [10]. To our knowledge, limonene, which was found to be the major component of the essential oil of *S. perfoliata*, has not been hithertwo reported as the main constituent in any species of *Sideritis*. More rarely, some species of this genus are charaterized by their contents of sesquiterpene hydrocarbons, mainly β-caryophyllene, as was found in *S. hyssopifolia* var. *pyrenaica* [9], *S. chamaedryfolia* [13] and *S. arborescens* [14] and, in the present work, in *S. condensata*.

EXPERIMENTAL

Plant material. Aerial parts of *S. congesta* P. H. Davis et Hub.-Mor., *S. condensata* Boiss. et Heldr., *S. argyrea*

*Author to whom correspondence should be addressed.

Table 1. Constituents of essential oils of four *Sideritis* species

Components	Percentage in samples* A	B	C	D
Monoterpene hydrocarbons	63.4	37.8	67.5	81.3
Tricyclene	tr	—	0.1	—
α-Thujene	1.1	0.4	1.8	1.0
α-Pinene	19.5	7.1	16.5	12.1
Camphene	1.0	0.1	0.5	0.3
β-Pinene	28.8	12.1	23.9	8.7
Sabinene	1.6	0.5	0.6	6.6
3-Carene	1.1	0.3	0.1	—
Myrcene	1.5	3.7	1.1	4.5
α-Phellandrene	1.0	0.3	0.2	1.4
α-Terpinene	tr	0.3	0.3	3.3
Limonene	4.0	6.1	18.1	22.4
β-Phellandrene	1.0	1.4	2.7	—
cis-Ocimene	—	1.9	—	12.3
trans-Ocimene	tr	0.5	—	0.2
γ-Terpinene	0.7	0.8	0.5	1.4
p-Cymene	1.5	2.1	0.7	2.1
Terpinolene	0.5	0.2	0.3	4.9
α,*p*-Dimethylstyrene	tr	—	0.1	0.1
Oxygenated monoterpenes	13.2	6.4	10.5	5.3
Fenchyl acetate	—	0.1	—	—
Menthone	—	0.3	—	—
Campholenal	0.3	—	0.2	—
Linaool	4.7	3.9	1.6	1.1
cis-Sabinene hydrate	tr	—	—	0.1
Fenchyl alcohol	0.1	—	0.1	—
Pinocarvone	0.8	0.2	0.9	0.2
Bornyl acetate	0.7	—	0.2	—
Terpinen-4-ol	1.1	tr	1.4	1.9
Myrtenal	1.1	0.1	1.1	0.2
Pulegone	—	0.2	—	—
trans-Pinocarveol	1.3	0.4	1.4	0.3
α-Terpineol	1.6	0.7	1.8	0.8
α-Terpenyl acetate	tr	—	—	—
Borneol	0.3	0.1	0.5	—
Verbenone	0.2	—	0.2	—
Carvone	tr	—	0.2	0.3
Myrtenol	0.8	0.2	0.5	—
trans-Carveol	tr	—	0.2	—
Geraniol	—	0.2	—	—
p-Cymen-8-ol	0.1	—	0.2	0.3
Thymol	—	—	—	0.1
Sesquiterpene hydrocarbons	10.7	29.4	10.7	6.1
α-Cubebene	0.3	—	0.4	—
α-Copaene	0.7	0.9	0.4	—
β-Bourbonene	0.6	0.6	0.2	—
α-Gurjunene	0.2	0.4	0.1	—
β-Elemene	—	tr	—	—
β-Caryophyllene	0.3	15.9	2.1	2.6
β-Farnesene	—	0.5	—	0.5
α-Humulene	0.1	0.6	0.2	0.1
β-Cubebene	0.7	—	0.8	—
Germacrene D	1.2	5.4	0.3	—
Bicyclogermacrene	—	2.0	—	—
E,*E*-α-Farnesene	—	0.7	—	—
δ-Cadinene	5.1	1.8	4.7	—
γ-Cadinene	0.5	0.2	—	0.8
α-Curcumene	—	0.2	—	1.8
α-Cadinene	0.4	—	0.4	—
Cuparene	—	—	—	0.1
Calamenene	0.6	0.2	1.1	0.2
Oxygenated sesquiterpenes	3.8	15.6	5.9	2.1
Isocaryophyllene oxide	—	tr	—	—
δ-Cadinol	—	—	—	0.5
β-Caryophyllene oxide	0.2	6.2	1.8	1.3
Nerolidol	0.2	0.5	—	—
Cubenol	1.3	0.4	1.2	0.3
epi-Cubenol	1.6	0.5	1.6	—
Viridiflorol	0.2	0.4	—	—
Spathulenol	—	4.1	—	—
γ-Eudesmol	—	0.1	—	—
T-Cadinol	—	0.2	—	—
10-Epicadinol	—	2.1	—	—
α-Cadinol	0.2	0.5	0.5	—
2*E*,6*Z*-Farnesol	0.1	0.2	0.8	—
2*E*,6*E*-Farnesol	—	0.4	—	—
Others	1.4	2.3	0.7	0.6
Hexanal	tr	0.1	—	—
cis-2-Hexenal	tr	0.1	0.3	—
6-Methyl-5-hepten-2-one	tr	—	0.1	0.1
3-Octanol	0.1	0.1	0.1	0.1
1-Hexanol	0.2	0.2	0.1	—
Nonanal	tr	0.2	—	0.2
1-Octen-3-ol	1.0	1.6	0.1	0.2
Total identified	92.6	91.6	95.3	95.4

*Sample A: *S. congesta*; sample B: *S. condensata*; sample C: *S. argyrea*; sample D: *S. perfoliata*.
tr: traces (⩽ 0.05%).

P. H. Davis and *S. perfoliata* L. (Lamiaceae) were collected at the flowering stage in July 1991 and 1992 in Antalya Alanya (Turkey). Voucher specimens of each sample are deposited in the Herbarium of the Faculty of Pharmacy of Hacettepe University of Ankara (HUEF) with the numbers 91054, 92105, 91061 and 74003, respectively.

Analysis of oils. Essential oil contents of air-dried plant material was determined according to ref. [15] using 1,2,3,4-tetramethylbenzene as collecting solvent. Analysis of volatile oils obtained by hydrodistillation was carried out by GC and GC-MS using fused silica capillary columns with two different stationary phases (Carbowax 20M and methylsilicone, SE-30). Analytical conditions were the same as those described previously [16]. Identification of components was made on the basis of their retention indices in relation to an homologous series of fatty acid Me esters and their mass spectra, which were compared with those in our library and with lit. data [17, 18].

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