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The Composition of Essential Oils From Two Varieties of *Sideritis erythrantha* var. *erythrantha* and var. *cedretorum**

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Water distilled essential oils from two varieties of *Sideritis erythrantha*: var. *erythrantha* and var. *cedretorum*, both endemic in Turkey, were analysed by GC/MS. The main components were characterized as α-pinene (16.3-19.5%) and sabinene (6.1- 10.4%) for var. *erythrantha*; myrcene (21.9-24.3%) and α-pinene (11.4- 12.4%) for var. *cedretorum*.

Introduction

Sideritis (Labiatae) is represented by 46 species and 53 taxa in Turkey, 39 taxa being endemic (1-3). *Sideritis* species are widely used as herbal tea in Turkey. They are known by different local names and traditional uses in various regions of Turkey. Infusions of *Sideritis* species are used as stomachic, antispasmodic, carminative and taken for cough (4-9). Antispasmodic and antiinflammatory effects of some *Sideritis* species (10-12) have been reported. The aqueous extracts of five *Sideritis* species of Turkey have been found to have antidepressant and antistress activities in mice (13). Essential oil of *S. congesta* exhibited no significant analgesic action (14).

Sideritis erythrantha Boiss. & Heldr. apud Bentham var. *erythrantha* is locally known as "Boz ot" in Isparta while, *Sideritis erythrantha* Boiss. & Heldr. apud Bentham var. *cedretorum* P.H. Davis is locally known as "Yayla çayı" and is used as herbal tea in Antalya: Alanya. In the present work, the essential oils of the varieties of *Sideritis erythrantha* were investigated for the first time.

Experimental

Materials

Aerial parts of the plants were collected from the following localities. Voucher specimens are kept the Herbarium of Faculty of Pharmacy Anadolu University in Eskişehir, Turkey (Acronym: ESSE)

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Sideritis erythrantha var. *erythrantha*

A: Isparta: Sütçüler, Çandır-Söğüt high plate, 1700-1800 m, in August 1993 (ESSE 10979)

B: Isparta: Sütçüler, Çandır-Akçal (fire tower road) 1675 m, in July 1995 (ESSE 114887)

Sideritis erythrantha var. *cedretorum*

C: Antalya: Alanya, Çökele-Gökbel road, 1350 m, in August 1994 (ESSE 10701)

D: Antalya: Alanya, Çökele-Gökbel road, 32 km from Alanya, 1275 m, in July 1995 (ESSE 11489)

Distillation

Air-dried aerial parts were subjected to water distillation for 3 h using a Clevenger apparatus. The percentage yields of the oils based on moisture free basis are shown in Table 1.

GC/MS

The essential oils were analysed by GC/MS using a Hewlett-Packard GC/MSD system. Innowax FSC column (60 m × 0.25 mm øwith 0.25 μm film thickness) was used with helium as carrier gas. GC oven temperature was kept at 60°C for 10 min and programmed to 220°C at a rate of 4°C /min and then kept constant at 220°C for 10 min to 240°C at rate of 1°C /min. Alkanes were used as reference points in the calculation of relative retention indices (RRI). Split ratio was adjusted at 50 mL/min. The injector and detector temperatures were at 250°C . MS were taken at 70 eV. Mass range was from m/z 35 to 425. Library search was carried out using Wiley GC/MS Library and TBAM Library of Essential Oil Constituents. Relative percentage amounts of the separated compounds were calculated from Total Ion Chromatogrammes by the computerized integrator.

Results and Discussion

Essential oils were obtained from dried herbal plants by water distillation. The physicochemical characteristics of the oils and yields are given in Table 1. The results from GC/MS analyses are presented in Table 2. In the oils of *Sideritis erythrantha* var. *erythrantha* 67 and 68 compounds representing 87.8% and 92.5% of the total oils were characterized with α-pinene (16.3 and 19.5%) and sabinene (6.1 and 10.4%) as main constituents, respectively. In the oils of *Sideritis erythrantha* var. *cedretorum* 60 and 76 compounds were characterized making up 90 and 87.2 % of the oils with myrcene (24.3 and 21.9%) and α-pinene (12.4 and 11.4%) as main constituents, respectively. Six components making up 12.3-15.4% of the oils of var. *erythrantha* and three components making up 7.3-8.3% of the oils of var. *cedretorum* were not identified. Their MS values are given in Table 2.

All the *Sideritis* species of Turkey have been collected by our group and their oils have been analysed. They can be classified into six groups, namely "monoterpene hydrocarbon-rich", "oxygenated monoterpene-rich", "sesquiterpene hydrocarbon -rich", "oxygenated sesquiterpene-rich", "diterpene-rich" and "others". 57% of the *Sideritis* species existing in Turkey belong to the "monoterpene hydrocarbon-rich" group as shown in Table 3. (15-31). Two varieties of *Sideritis erythrantha* are also included in this group.

Table 4. illustrates the status of *Sideritis* species growing outside Turkey according to main components in their oils. Ambiguous conclusions have been indicated. The results show a clear correlation with those of the Turkish species in that 60% of the oils have been classified as "monoterpene hydrocarbon-rich".

Table 1. Physical characteristics of the essential oils of *Sideritis erythrantha* varieties

Plant material	**Yield** %	**Physicochemical properties**		
		d^{20}	$[\alpha]^{20}$	$[n]^{20}$
A	0.39	0.9500	-8.42	1.4820
B	0.49	0.9000	-7.70	1.4800
C	0.70	0.9591	-12.51	1.4840
D	0.56	0.9444	-14.82	1.4842

Table 2. Percentage composition of components identified in the oils of *Sideritis erythrantha* var. *erythrantha* and var. *cedretorum*

Compound	**RRI**	**A**	**B**	**C**	**D**
α-pinene	1032	16.3	19.5	12.4	11.4
α-thujene	1035	0.7	1.3	-	0.1
1,3,5 cycloheptatriene	1056	1.0	-	-	-
camphene	1076	-	0.1	-	<0.1
β-pinene	1118	3.2	4.0	3.7	3.9
sabinene	1132	6.1	10.4	0.2	0.2
myrcene	1174	0.7	0.3	24.4	21.9
α-phellandrene	1176	0.6	0.3	-	-
α-terpinene	1188	0.2	0.3	-	0.2
limonene	1203	1.8	1.8	0.8	0.8
1,8-cineole	1213	2.1	2.0	-	<0.1
β-phellandrene	1218	10.0	6.5	0.1	0.1
(E) -2-hexenal	1232	0.1	0.1	0.2	<0.1
(Z) -β-ocimene	1246	-	-	<0.1	0.1
γ-terpinene	1255	0.5	0.6	-	0.1
(E) -β-ocimene	1266	-	<0.1	0.1	0.3
p-cymene	1280	0.4	0.1	-	<0.1
terpinolene	1290	0.1	0.1	0.2	0.3
1-hexanol	1360	-	<0.1	0.1	0.1
3-octanol	1393	0.1	0.1	0.2	0.1
nonanal	1400	-	<0.1	-	-
perillen	1429	-	-	<0.1	<0.1
1-octen-3-ol	1452	0.3	0.1	0.4	0.2
α-cubebene	1474	-	-	0.4	0.6
trans-sabinene hydrate	1474	0.6	0.6	-	-
α-copaene	1497	0.1	0.1	0.9	0.9
β-bourbonene	1535	0.5	0.3	0.2	0.1
benzaldehyde	1541	0.1	<0.1	0.1	<0.1
α-gurjunene	1544	-	-	0.2	0.2
β-cubebene	1547	-	-	0.2	0.2
linalool	1553	2.7	1.8	1.2	1.3
cis-sabinene hydrate	1556	0.2	0.2	-	-
octanol	1562	0.1	0.1	-	0.1
trans-*p*-menth-2-en-1-ol	1571	0.1	0.1	-	-
methyl citronellate	1571	-	0.1		-
bornyl acetate	1591	0.1	0.1	<0.1	0.1
trans-β-bergamotene	1594	-	-	-	<0.1
β-elemene	1600	-	0.2	-	-
terpinen-4-ol	1607	1.6	2.8	0.1	-

Table 2. Contunie

β-caryophyllene	1612	2.2	4.2	8.0	5.5
2-methyl-6-methylene-3,7-octadien-2-ol	1628	-	-	0.2	0.1
cis-p-menth-2-en-1-ol	1638	0.1	-	-	-
citronellyl acetate	1668	0.4	0.2	-	0.1
(E)-β-farnesene	1671	0.2	0.3	0.1	-
α-humulene	1684	0.1	0.2	0.4	0.4
δ-terpineol	1684	0.2	0.2	-	-
trans-verbenol	1684	0.5	-	0.1	-
cryptone	1687	-	0.1	-	-
p-mentha-1,8-dien-4-ol	1700	-	-	-	<0.1
α-terpineol	1707	1.7	1.2	0.2	0.1
ledene	1707	-	-	<0.1	0.1
germacrene D	1726	4.0	6.0	3.2	4.2
β-bisabolene	1740	0.2	0.6	0.3	0.3
bicylogermacrene	1751	1.9	1.1	3.4	3.7
α-farnesene	1755	-	-	0.4	0.3
geranyl acetate	1765	0.1	-	-	-
δ-cadinene	1772	-	0.1	1.9	1.4
citronellol	1772	0.5	0.3	0.1	0.2
γ-cadinene	1776	-	<0.1	-	<0.1
β-sesquiphellandrene	1783	-	0.3	0.1	0.2
cadina-1,4-diene	1797	-	-	0.4	0.3
p-methyl acetophenone	1797	0.2	-	-	-
methyl salicylate	1800	0.1	-	-	-
isobutyl benzoate	1808	0.8	0.1	0.1	<0.1
β-damascenone	1838	0.1	-	-	<0.1
calamenene	1849	-	-	0.1	0.1
geraniol	1857	-	<0.1	-	-
butyl benzoate	1882	0.3	-	-	-
epicubebol	1900	-	-	6.3	6.3
isoamyl benzoate	1937	0.3	-	0.1	<0.1
cubebol	1957	-	-	2.1	1.9
isocaryophyllene oxide	2000	-	-	0.1	0.1
caryophyllene oxide	2008	1.6	0.6	0.8	0.4
pentadecanal	2041	0.1	-	-	<0.1
gleenol	2049	-	-	-	0.1
(E)-nerolidol	2053	0.1	0.1	0.1	0.1
germacrene D-4-ol	2069	-	-	-	0.1
humulene epoxide-II	2069	-	0.1	<0.1	-
1-epicubenol	2088	-	-	1.0	0.7
globulol	2096	-	-	-	0.1
hexyl benzoate	2096	0.1	-	-	-
viridiflorol	2100	-	-	0.1	0.1
hexahydrofarnesyl acetone	2131	0.5	0.9	-	-
spathulenol	2144	0.9	0.1	0.1	-
valeranone	2144	-	-	0.1	0.7
(Z)-3-hexen-yl-benzoate	2148	0.3	0.1	0.1	0.1
α-bisabolol oxide B	2157	-	0.1	-	-
eugenol	2162	0.4	0.1	-	0.1
thymol	2205	0.2	-	-	0.1

Table 2. Contunie

δ-cadinol	2219	-	-	-	0.1
α-bisabolol	2232	1.1	7.2	5.0	4.8
carvacrol	2246	1.0	1.8	0.3	0.9
diterpene (M^+272)	2251	2.0	4.2	2.6	4.5
α-cadinol	2255	-	0.1	0.7	0.8
dimyrcene-II-b	2269	0.5	-	0.7	0.6
sesquiterpene (M^+262)	2308	2.1	1.5	-	-
diterpene (M^+270)	2312	2.3	1.3	1.5	1.2
caryophylladienol*	2320	-	<0.1	-	-
α,-13 oxy-14-en-epilabdane	2396	0.2	0.1	0.1	0.2
sesquiterpene (M^+262)	2411	6.0	1.8	-	-
kaur-16-ene	2426	-	-	-	0.3
sesquiterpene (M^+220)	2459	0.6	2.2	3.2	2.6
sesquiterpene (M^+220)	2577	2.4	1.3	-	-
heptacosane	2700	0.6	0.1	-	<0.1
hexadecanoic acid	2931	0.5	-	-	-
RRI= Relative retention indices *Tentative identification by GC/MS data alone					
A,B: *Sideritis erythrantha* var. *erythrantha* **C,D:** *Sideritis erythrantha* var. *cedretorum*					

RRI *MS of unidentified components are the following*

2251 *m/z* 272 (M^+, 0.5%), 119 (100%, 69 (81%), 93 (68%), 132 (52%), 41 (41%), 91 (32%)

2308 *m/z* 262 (M^+, 0.3%), 43 (100%), 93 (54%), 91 (39%), 133 (39%), 79 (36%), 105 (30%)

2312 *m/z* 270 (M^+, 0.3%), 119 (100%), 132 (82%), 145 (52%), 69 (34%), 41 (33%), 105 (31%)

2411 *m/z* 262 (M^+, 0.23%), 43 (100%), 93 (54%), 79 (33%), 91 (31%), 119 (27%), 41 (26%)

2459 *m/z* 220 (M^+, 1%), 93 (100%), 91 (79%), 79 (74%), 133 (64%), 41 (62%), 43 (50%), 189 (46%)

2577 *m/z* 220 (M^+, $\leq$ 0.01%), 93 (100%), 79 (63%), 43 (61%), 41 (55%), 133 (48%), 105 (39%), 107 (37%), 189 (30%)

Table 3. Classification of *Sideritis* species according to main components in essential oils (15-31)

Monoterpene Hydrocarbons	*amasiaca, argyrea, armeniaca, athoa, bilgerana, brevidens, congesta, dichotoma, erythrantha* var. *erythrantha, erythrantha* var. *cedretorum, galatica, germanicopolitana* ssp. *germanicopolitana, germanicopolitana* ssp. *viridis, gulendamii, hispida, huber-morathii, libanotica* ssp. *libanotica, libanotica* ssp. *kurdica, lycia, niveotomentosa, phrygia, rubriflora, scardica* ssp. *scardica, serratifolia, sipylea, stricta, syriaca* ssp. *nusairiensis, trojana, vuralii*
Oxygenated Monoterpenes	*arguta, libanotica* ssp. *microchlamys, romana* ssp. *romana*
Sesquiterpene Hydrocarbons	*akmanii, albiflora, brevibracteata, caesarea, cilicica, condensata, curvidens, hololeuca, leptoclada, libanotica* ssp. *linearis, libanotica* ssp. *violascens, montana* ssp. *montana, montana* ssp. *remota, ozturkii, pisidica, tmolea, vulcanica*
Oxygenated Sesquiterpenes	*phlomoides, taurica*
Diterpenes	*perfoliata*
Others	*lanata*

Table 4. Classification of *Sideritis* species according to main components in essential oils growing outside Turkey (32-49)

Monoterpene Hydrocarbons	*angustifolia, clandestina* ssp. *cyllena, foetens, granatensis, hirsuta, javalambrensis, leucantha* ssp. *bourbeana, linearifolia, mugronensis, paulii, pusilla, raeseri* ssp. *raeseri, scardica* ssp. *scardica*
Oxygenated Monoterpenes	*flavovirens, mugronensis, reverchonii, romana, scardica*
Sesquiterpene Hydrocarbons	*arborescens, chamaedryfolia, clandestina* ssp. *clandestina, hyssophila* var. *pyrenaica, scordioides, cavanillesii, scardica*
Oxygenated Sesquiterpenes	*illicifolia*
Others	*raeseri* ssp. *raeseri*
Others	*lanata*

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