

COMPOSITION OF ESSENTIAL OILS FROM TWO ENDEMIC *Sideritis* SPECIES OF TURKEY

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The genus Sideritis is represented in Turkey by 46 species and altogether 53 taxa of these being endemic in Turkey (74%) [1-3].

Sideritis species are widely used as herbal tea in Turkey. They are known by different local names and traditionally used in various regions of Turkey. Infusions of *Sideritis* species are used as stomachics, antispasmodics, carminatives, and taken for cough [4-9]. The aqueous extracts of five *Sideritis* species of Turkey have been found to have antidepressant and antistress activities in mice [10]. The essential oil of *S. congesta* exhibited no significant analgesic action [11].

Here, we report on the essential oil compositions of *Sideritis brevidens* P.H. Davis and *S. rubriflora* Hub.-Mor., which are endemic species of Turkey. *S. brevidens* is locally known as "Adacayi" and "Ozel Cay," while *S. rubriflora* Hub.-Mor. is locally known as "Dag cayi" in Icel. Both *Sideritis* species are used as herbal tea in the areas where they grow.

In the present work, the essential oils these *Sideritis* species were investigated for the first time.

Essential oils were obtained from dried aerial parts by water distillation. Results of GC/MS analyses of the essential oils are given in Tables 1 and 2. In the oil of *S. brevidens* and *S. rubriflora* 75 and 98 compounds were characterized representing 91 and 87% of the oils with β -pinene (14 and 13%) and epicubebol (13 and 8%) as major constituents, respectively.

Essential oils of Turkish *Sideritis* species are classified into six groups, namely, "monoterpene hydrocarbon-rich," "oxygenated monoterpene-rich," "sesquiterpene hydrocarbon-rich," "oxygenated sesquiterpene-rich," "diterpene-rich," and "others." Of the *Sideritis* species existing in Turkey, 57% belong to the "monoterpene hydrocarbon-rich" group. *S. brevidens* and *S. rubriflora* were also included in this group.

EXPERIMENTAL

Plant Materials. *S. brevidens* was collected in July 1994 at Icel: Gulnar, step, ESSE 10713, *S. rubriflora* was collected in May 1994 at Icel: Anamur-Aydincik, step, ESSE 10654. Voucher specimens are kept at the Herbarium of the Anadolu University Faculty of Pharmacy in Eskishehir, Turkey (ESSE).

Distillation. Plant materials were hydrodistilled for 3 h using a Clevenger-type apparatus. The percentage yields of the oils calculated on a moisture free basis were as follows: *S. brevidens* 0.7% and *S. rubriflora* 0.18%.

GC/MS. The essential oils were analyzed by GC/MS system. GC/MS analysis was carried out using a Hewlett-Packard GCMSD system. Innowax FSC column (60 m \times 0.25 mm ϕ with 0.25 μ m film thickness) was used with helium as a carrier gas. GC oven temperature was kept at 60°C for 10 min and programmed to 220°C at a rate 4°C/min, then kept constant at 220°C for 10 min and then 240°C at a rate of 1°C/min. The split ratio was adjusted at 50:1.

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Table 1. Composition of the Oil of *Sideritis brevidens*

Compounds	KI	%	Compounds	KI	%
α -pinene	1032	7.88	bicyclogermacrene	1751	5.44
α -thujene	1035	0.12	δ -cadinene	1772	5.82
camphene	1076	0.05	ar-curcumene	1786	0.69
β -pinene	1118	14.06	cadina-1,4-diene	1797	0.87
α -terpinene	1118	0.06	myrtenol	1797	0.30
sabinene	1132	0.14	trans-carveol	1845	<0.01
δ^3 -carene	1156	1.52	calamenene	1849	1.74
α -phellandrene	1176	1.56	m-cymen-8-ol	1856	<0.01
limonene	1203	1.54	p-cymen-8-ol	1864	0.06
1,8-cineole	1213	0.10	epi-cubebol	1900	13.12
β -phellandrene	1218	0.38	2-methyl-butyl-benzoate	1929	0.04
(E)-2-hexenal	1232	<0.01	isoamyl benzoate	1937	0.09
γ -terpinene	1255	0.24	α -calacorene -I	1941	0.04
m-cymene	1278	0.07	palustrol	1953	0.11
p-cymene	1280	0.73	cubebol	1957	5.00
isotrpinolene	1286	<0.01	caryophyllene oxide	2008	0.35
terpinolene	1290	0.22	gleenol	2049	0.45
3-octanol	1393	0.05	germacrene-D-4-ol	2069	0.10
1-octen-3-ol	1452	0.07	cubenol	2080	1.66
α -cubebene	1474	0.90	1-epicubebol	2088	2.97
trans-sabinene hydrate	1474	0.05	viridifloral	2100	0.58
bicycloelemene	1495	0.08	spathulenol	2144	2.53
α -copaene	1497	1.39	(Z)-3-hexen-1-benzoate	2148	0.14
α -bourbonene	1529	0.05	β -bisabolol	2170	0.43
β -bourbonene	1535	1.07	eugenol	2192	0.24
α -gurjunene	1544	0.55	mint-sulfide	2192	0.09
β -cubebene	1547	0.34	thymol	2205	0.15
linalool	1553	1.60	T-muurolol	2209	3.23
pinocarvone	1586	0.14	δ -cadinol	2219	0.36
β -caryophyllene	1612	1.73	trans- α -bergamotol	2241	0.30
trans-pinocarveol	1671	0.33	carvacrol	2246	0.10
epizonarene	1678	0.75	α -cadinol	2255	0.17
α -humulene	1684	0.14	14-hydroxy- β -caryophyllene	2357	0.50
trans-verbenol	1684	0.10	8 α -13-hydroxy-14-en-epilabdane	2396	0.14
α -acoradiene	1690	0.26	monoterpene hydrocarbons		28.57
γ -curcumene	1704	0.31	oxygenated monoterpenes		5.80
α -terpineol	1707	0.53	sesquiterpene hydrocarbons		24.01
ledene	1707	0.11	oxygenated sesquiterpenes		31.86
borneol	1719	0.39	diterpenes		0.14
germacrene D	1726	3.04	others		0.39
α -muurolene	1737	0.34	Total		90.80

KI = Kovats index on Innowax.

Table 2. Composition of the Oil of *Sideritis rubriflora*

Compounds	KI	%	Compounds	KI	%
α -pinene	1032	9.91	trans-carveol	1845	0.07
α -thujene	1035	0.25	calamenene	1849	0.99
camphene	1076	0.08	m-cymen-8-ol	1856	0.02
β -pinene	1118	13.22	p-cymen-8-ol	1864	0.06
α -terpinene	1118	<0.01	epi-cubebol	1900	7.80
sabinene	1132	0.48	α -calacorene-I	1941	0.04
δ 3-carene	1159	0.79	palustrol	1953	0.02
myrcene	1174	0.60	cubebol	1957	2.46
limonene	1203	1.01	α -calacorene-II	1984	0.06
1,8-cineole	1213	0.10	isocaryophyllene oxide	2000	0.88
β -phellandrene	1218	0.35	caryophyllene oxide	2008	4.65
γ -terpinene	1255	0.03	perilla alcohol	2025	0.08
m-cymene	1278	0.06	salvial-4(14)-en-1-one	2037	0.28
p-cymene	1280	0.72	norbourbonone	2045	0.09
hexanol	1360	0.03	gleenol	2049	0.30
octenyl acetate	1386	0.03	(E)-nerolidol	2053	0.05
nonanal	1400	0.09	germacrene-D-1,10-epoxide	2053	0.02
α -p-dimethyl styrene	1452	<0.01	ledol	2057	0.10
1-octen-3-ol	1452	0.12	α -copaene-11-ol	2065	0.10
α -cubebene	1474	0.70	humulene epoxide-II	2069	0.10
trans-sabinene hydrate	1474	0.03	caryophylla-2(12),6(13)-dien-5-one	2073	0.14
α -copaene	1497	0.97	cubanol	2080	1.71
α -bourbonene	1529	0.13	1-epicubebol	2088	1.75
β -bourbonene	1535	2.05	globulol	2096	0.05
α -gurjunene	1544	0.20	hexahydrofarnesyl acetone	2131	0.10
β -cubebene	1547	0.42	spathulenol	2144	0.67
linalool	1553	1.02	nor-copaanone	2179	0.08
octanol	1562	0.04	thymol	2205	0.07
inocarvone	1586	0.45	T-muurolol	2209	0.62
bornyl acetate	1591	0.05	δ -cadinol	2219	0.33
β -elemene	1600	0.24	carvacrol	2246	4.53
β -caryophyllene	1612	6.15	α -cadinol	2255	0.40
hexyl tiglate	1631	0.05	oxo- α -ylangene	2287	0.10
myrtenal	1648	0.60	caryophylla-2(12),6(13)-dien-5 α -ol	2316	0.69
alloaromadendrene	1661	0.20	caryophylla-2(12),6-dien-5 α -ol	2353	0.06
cis-verbenol	1668	0.06	14-hydroxy- β -pcaryophyllene	2357	1.30
trans-pinocarveol	1671	0.47	caryophylla-2(12),6-dien-5 β -ol	2392	0.86
γ -gurjunene	1674	0.06	8 α -13-hydroxy-14-en-epilabdane	2396	0.10
epizonarene	1678	0.13	kaur-16-ene	2426	0.08
α -humulene	1684	0.26	dodecanoic acid	2503	0.14
trans-verbenol	1684	0.51	14-hydroxy- α -humulene	2568	0.07
γ -muurolene	1704	0.09	14-hydroxy-6-cadinene	2607	0.06
α -terpineol	1707	0.34	phytol	2622	0.04
borneol	1719	0.06	heptacosane	2700	0.05
germacrene D	1726	6.35	hexadecanoic acid	2931	0.34
α -cadinene	1740	0.40	monoterpene hydrocarbons		27.56
bicyclgermacrene	1751	0.30	oxygenated monoterpenes		10.08
carvone	1755	0.10	sesquiterpene hydrocarbons		22.01
naphthalene	1765	0.06	oxygenated sesquiterpenes		25.65
δ -cadinene	1772	2.99	diterpenes		0.22
γ -cadinene	1766	0.08	others		1.13
cadina-1,4-diene	1797	0.19	Total		86.65
myrtenol	1797	0.52			

KI = Kovats index on Innowax.

The injector and detector temperatures were at 250°C. MS were taken at 70eV. Mass range was from m/z 35 to 425. Library search was carried out using the Wiley GC/MS Library and the TBAM Library of Essential Oil Constituents. Relative percentage amounts of the separated compounds were calculated from total Ion Chromatogrammes by the computerized integrator.

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