

FATTY ACID COMPOSITION OF *Sideritis* SPECIES*

A. Ertan,^{1,2} N. Azcan,^{2,3}
B. Demirci,^{1,2} and K. H. C. Baser^{1,2}

UDC 547.915:665.33

Seed oils of 15 Sideritis species collected from different regions in Turkey (S. athoa, S. brevidens, S. caesarea, S. condensata, S. congesta, S. dichotoma, S. erythrantha var. cedretorum, S. germanicopolitana ssp. germanicopolitana, S. hololeuca, S. lanata, S. libanotica ssp. violascens, S. lycia, S. niveotomentosa, S. perfoliata, S. phrygia, S. pisidica) were obtained by a Soxhlet apparatus using hexane. The oil yields were found to be between 5.6–36.3%. Fatty acids in the oils were converted to methyl esters and their compositions were determined by GC/MS. The main fatty acid components of the oils from all the species are linoleic (45.4–64.0%), oleic (12.3–26.5%), 6-octadecynoic (4.5–26.8%), palmitic (0.3–9.4%), and linolenic (0.8–2.0%) acids.

Key words: *Lamiaceae, Sideritis athoa, S. brevidens, S. caesarea, S. condensata, S. congesta, S. dichotoma, S. erythrantha var. cedretorum, S. germanicopolitana ssp. germanicopolitana, S. lanata, S. libanotica ssp. violascens, S. lycia, S. niveotomentosa, S. perfoliata, S. phrygia, S. pisidica*, seed oil, fatty acid, linoleic acid, oleic acid, linolenic acid.

The genus *Sideritis* (*Lamiaceae*-subfamily *Lamioideae*) is represented by 46 species and 53 taxa in Turkey, 39 taxa being endemic (78.2%). *Sideritis* species are widely used as herbal tea and folk medicine in Turkey. These species are known to have antiinflammatory, antispasmodic, carminative, analgesic nervous system stimulant, sedative, antitussive, stomachic, anticonvulsant, and antifeedant activities [1–4].

Most of the studies on *Sideritis* species comprise their essential oils and flavonoids. There is no work on the seed oils of *Sideritis*.

Here, we report on the seed oil compositions of 15 *Sideritis* species (*S. athoa* papanikolaou and Kokkini., *S. brevidens* P.H. Davis, *S. caesarea* Duman, Aytac and Baser, *S. condensata* Boiss. and Heldr. Apud Bentham, *S. congesta* P.H. Davis Hub.-Mor., *S. dichotoma* Huter., *S. erythrantha* Boiss. var. *cedretorum*, *S. germanicopolitana* Boiss ssp. *germanicopolitana*, *S. lanata* L., *S. libanotica* Labill. ssp. *violascens*, *S. lycia* Boiss. and Heldr., *S. niveotomentosa* Hub.-Mor., *S. perfoliata* L., *S. phrygia* Bornm., *S. pisidica* Boiss. and Helder.).

Seeds were collected from *Sideritis* species growing in different localities in Turkey, and the oil yields of the seeds were found to be between 5.6–36.3% in 15 *Sideritis* species investigated (Table 1). The fatty acid compositions of the oils are summarized in Table 2.

The dominant fatty acid in all the species was linoleic acid. Its content ranged from 45.4 to 64.0%. Oleic acid was less abundant (12.3–26.5%) (Table 2). While oleic acid was found to be the second major fatty acid component of most species, 6-octadecynoic acid (26.8%), an unusual fatty acid, was present as the second main component in the oil of *S. pisidica* and in significant quantity in the oil of *S. caesarea* (12.9%). The U/S (Unsaturated/saturated; 4.4–18.3) index, also presented in Table 2, which was considered as a taxonomic marker, does not appear to have much significance in the taxonomy of the family *Lamiaceae* [5, 6].

*Presented at the 4th International Symposium on the Chemistry of Natural Compound (SCNC), 6-8 June 2001, Isparta, Turkey.

1) Faculty of Pharmacy, Department of Pharmacognosy, Anadolu University; 2) Medicinal and Aromatic Plant and Drug Research Centre (TBAM), Anadolu University; 3) Engineering and Architecture Faculty, Department of Chemical Engineering, Anadolu University, 26470, Eskisehir, Turkey. Published in *Khimiya Prirodnykh Soedinenii*, No. 4, pp. 259-261, May-June, 2001. Original article submitted June 19, 2001.

TABLE 1. Collection Sites and Seed Oil Yields of *Sideritis* Species

Species	Collected Area	Oil Yield, %
<i>S. athoa</i>	Balikesir, Edremit, Mehmetalan Village to Kazdagi 9-10 km	25.0
<i>S. niveotomentosa</i>	Icel-Mut-Culnar Road	28.0
<i>S. perfoliata</i>	Alanya	25.6
<i>S. phrygia</i>	Afyon-Cay-Sultan Mountain	5.6
<i>S. pisidica</i>	Antalya-Termesos	9.0
<i>S. congesta</i>	Isparta-Egirdir-Akpınar Village	29.6
<i>S. germanicopolitana</i> ssp. <i>germanicopolitana</i>	Kirsehir-Karaman-Savcili, Kostepe	27.0
<i>S. brevidens</i>	Icel-Mut-Gulnar	24.0
<i>S. caesarea</i>	Kayseri-Sariz	35.4
<i>S. libanotica</i> ssp. <i>violascens</i>	Antalya	36.3
<i>S. lycia</i>	Antalya-Kemer	18.0
<i>S. erythrantha</i> var. <i>cedretorum</i>	Antalya-Alanya	20.0
<i>S. lanata</i>	Aydin-Narliova	25.0
<i>S. dichotoma</i>	Balikesir-Edremit-Kazdagi-Ortaoba	20.0
<i>S. condensata</i>	Antalya-Manavgat-Yukari Isiklar Village	19.5

TABLE 2. Fatty Acid Compositions of *Sideritis* Species, %

Fatty Acids	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
8:0	-	Tr.	Tr.	Tr.	-	Tr.	-	-	Tr.	Tr.	Tr.	0.1	Tr.	Tr.	Tr.
9:0	-	-	-	Tr.	-	-	Tr.	-	Tr.	Tr.	0.2	-	Tr.	0.1	Tr.
12:0	Tr.	Tr.	Tr.	Tr.	Tr.	Tr.	Tr.	Tr.	Tr.	Tr.	2.6	Tr.	Tr.	0.1	0.1
14:0	Tr.	0.1	0.1	0.1	0.2	0.1	0.1	Tr.	0.1	0.1	0.7	0.1	0.1	0.2	Tr.
15:0	Tr.	Tr.	Tr.	Tr.	0.2	Tr.	Tr.	Tr.	0.1	Tr.	0.1	0.1	Tr.	0.1	0.1
16:0	6.0	6.9	7.0	5.7	8.9	7.0	5.1	0.3	6.6	8.0	9.4	8.7	8.2	7.1	6.9
16:1(7Z)	0.1	0.1	0.1	0.1	Tr.	0.1	-	-	0.2	0.1	0.2	0.1	0.1	0.3	0.2
16:1(9Z)	0.1	0.1	0.1	0.1	Tr.	0.1	Tr.	0.1	0.1	0.1	0.3	Tr.	0.1	0.1	0.1
16:2(9,12)	-	Tr.	-	-	-	-	-	-	-	-	Tr.	-	-	-	-
17:0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
18:0	2.8	3.3	4.0	3.0	2.4	3.1	2.3	4.1	2.4	2.5	4.9	3.6	3.2	2.5	3.8
18:1(9Z)	25.4	24.8	24.5	25.0	12.3	25.9	19.4	26.5	18.5	21.3	20.3	21.6	22.9	22.4	19.6
18:1(9E)	1.2	1.1	1.2	0.9	0.8	1.1	0.9	1.1	0.9	1.3	1.0	0.8	0.8	0.8	0.8
18:2	54.6	52.6	56.1	52.9	45.4	53.8	64.0	52.3	55.0	53.6	48.9	54.2	49.7	57.0	56.2
18:1(6 yn)*	4.5	7.6	5.3	7.0	26.8	6.1	5.9	4.9	12.9	9.1	8.4	8.6	11.5	7.3	8.1
18:3	1.3	1.2	0.9	1.3	2.0	1.3	0.8	1.2	1.6	1.6	1.0	1.4	1.3	1.4	1.1
20:0	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.2	Tr.	0.1
20:1	0.5	0.6	0.3	0.6	Tr.	0.5	0.5	Tr.	0.5	0.7	0.3	Tr.	0.2	Tr.	0.4
22:0	-	-	Tr.	0.2	-	Tr.	-	-	-	0.1	0.1	-	0.1	-	-
24:0	-	0.1	Tr.	0.2	-	Tr.	-	-	Tr.	Tr.	Tr.	-	Tr.	-	Tr.
Total	95.3	98.7	99.8	96.5	99.2	99.3	99.2	90.8	99.1	98.7	98.7	99.5	98.5	99.5	97.6
Σ _{Saturated}	9.1	12.3	11.3	9.3	11.9	10.4	7.6	4.7	9.4	10.9	18.3	12.8	11.9	10.2	11.1
Σ _{Unsaturated}	86.2	86.4	88.5	87.2	87.3	88.9	91.6	86.1	89.7	87.8	80.4	86.7	86.6	89.3	86.5
U/S	9.5	7.0	7.8	9.4	7.3	8.5	12.1	18.3	9.5	8.1	4.4	6.8	7.3	8.8	7.8
18:3/18:2	0.02	0.02	0.02	0.03	0.04	0.02	0.01	0.02	0.03	0.03	0.02	0.03	0.03	0.03	0.02

1 - *S. athoa*, 2 - *S. niveotomentosa*, 3 - *S. perfoliata*, 4 - *S. phrygia*, 5 - *S. pisidica*, 6 - *S. congesta*, 7 - *S. germanicopolitana* ssp. *germanicopolitana*, 8 - *S. brevidens*, 9 - *S. caesarea*, 10 - *S. libanotica* ssp. *violascens*, 11 - *S. lycia*, 12 - *S. erythrantha* var. *cedretorum*, 13 - *S. lanata*, 14 - *S. dichotoma*, 15 - *S. condensata*.

Tr: Trace, lower than 0.1. U/S: Unsaturated/Saturated. *Tentative identification by GC/MS.

TABLE 3. GC/MS Analysis Conditions

System	Hewlett Packard GCD
Column	Innowax (60 m × 0.25 φ, 0.25 μm film thickness) fused silica capillary column
Carrier gas and flow rate	Helium, 1 ml/min
Injection temperature	250°C
Column temperature	60°C for 10 min, 220°C at a rate of 4°C/min and kept constant at 220°C for 10 min, 240°C at a rate of 1°C/min
Split ratio	50:1
Electron energy	70 eV
Mass range	35-425 <i>m/z</i>

According to Maffei et al. fatty acids were mainly composed of 18:3 in leaves and flowers of *Lamiaceae* [6]. Its findings reflect, in part, previous reports on fatty acid composition of seed lipids in the family *Lamiaceae*. In the seed oils of the genus *Sideritis* 18:2 was found to be the main component. The main fatty acid components vary between the two subfamilies of *Lamiaceae*, namely *Lamioideae* and *Nepetoideae* [7]. In the subfamily *Lamioideae*, the ratio of 18:3 fatty acid is less than 30%, and in most species it is even less than 5%. Since *Sideritis* belongs to this subfamily, our results agree with these findings in that it is 0.01–0.04. Likewise, the ratio of 18:3/18:2 ranged between 0.01–0.04, in agreement with the characteristics of the subfamily *Lamioideae*.

EXPERIMENTAL

Fifteen *Sideritis* species were collected from different regions of Turkey (Table 1). Seeds were separated from plant material. The amount of seeds from each species varied between 0.03 and 2.5 g. Seed oil was obtained using a 25 ml capacity Soxhlet apparatus with n-hexane, and fatty acids were later converted to methyl esters with 14% BF₃ in methanol [8]. The fatty acid compositions of the seed oils were determined by GC/MS and its conditions are given in Table 3.

We would like to thank Prof. Dr. Mecit Vural for supplying the seeds of *S. germanicopolitana* ssp., *germanicopolitana*, *S. brevidens*, and the Seed Bank of the Aegean Agricultural Institute, Menemen–Izmir, for seeds of *S. athoa*.

REFERENCES

1. P. H. Davis, *Flora of Turkey and East Aegean Islands*, **10**, University Press, Edinburgh, 1988, 203.
2. N. Kirimer, N. Tabanca, G. Tumen, H. Duman, and K.H.C. Baser, *Flav. Frag. J.*, **14**, 421 (1999).
3. A. Godoy, B. Heras, J. M. Vivas, and A. Villar, *Biol. Pharm. Bull.*, **23**, 1193 (2000).
4. M. L. Bondi, M. Bruno, F. Piozzi, K. H. C. Baser, and M. S. J. Simmond, *Bio. Chem. Syst. Ecol.*, **28**, 299 (2000).
5. P. D. Marin, V. Sajdl, S. Kapor, B. Tatic, and B. Petkovic, *Phytochemistry*, **30**, 2979 (1991).
6. M. Maffei, and S. Scannerini, *Bio. Chem. Syst. Ecol.*, **21**, 475 (1993).
7. P. D. Cantino, and R.W. Sander, *Syst. Bot.*, **11**, 163 (1986).
8. S. Williams, *Official Methods of Analysis of the Association of Official Analytical Chemists*, Virginia, USA, 1984, 503.