JAP&T TPA-Timişoara

Available online at http://journal-of-agroalimentary.ro

Journal of Agroalimentary Processes and Technologies 2019, *25* (4), 216-221

Journal of Agroalimentary Processes and Technologies

The essential oil and yield components of *Coridothymus capitatus* (L.) Reichb. fill., *Salvia albimaculata* Hedge & Hub.-Mor., *Sideritis phlomoides* Boiss. & Ball. used as medicinal tea

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Abstract

The essential oil components of aerial parts from *Coridothymus capitatus* (L.) Reichb. fill., *Salvia albimaculata* Hedge & Hub.-Mor., *Sideritis phlomoides* Boiss. & Ball.were investigated by GC and GC-MS. The oil yields of dried plants (v/dw) obtained by hydrodistillation were 3.85%, 1.31% and 1.0%, respectively. Fifty compounds representing 99.9 % of the *C.capitatus* oil were identified. The main ones were p-cymene (23.5%) and γ-terpinene (16.3%). Twenty-eight components representing 92.7 % of the *S. albimaculata* oil were determined with high contents of limonene (23.8%), α-pinene (17.6%) and geranyl acetate (14.2%). Fourty-nine components were identified accounting for 94.6% of the *S. phlomiodes* oil. Major constituents were octanal (40.0%), hexyle acetate (7.9%) and linalool (7.7%). All oils consist of monoterpenic and sesquiterpenes.

Keywords: *C. capitatus, S. albimaculata, S. phlomiodes*, essential oils, carvacrol, limonene, octanal.

1.Introduction

The genus *Coridothymus* L., *Salvia* L. and *Sideritis* L. belongs to the family Labiatae which includes many species used throughout the ages as culinary herbs, medicinal purposes and for producing flavouring substances [1-5]. *Coridothymus capitatus* (L.) is endemic plant of the Mediterranean region, characterized by a similar "oregano"- like smell. It is used commercially as "oregano" spice [6] (Skoula and Grayer, 2005). *C. capitatus* constitutes a monospecific genus but it is very closely related to *Thymus* spp. [3,6,7]. The genus *Salvia* is a vast one, numbering some 900 species, widespread throughout the world. This genus is represented, in Turkish flora, by 88 species and 93 taxa, 45 of which are endemic [4,8]. Some members of this genus are of economic importance since they have been used as flavouring agents in perfumery and cosmetics [9].

Despite the medicinal potential of plants in Turkey being considerable, knowledge of this area and studies on these plants are searce [10]. The genus *Sideritis*, a member of the family Labiatae, comprises of about 100 species distributed mainly throughout the Mediterranean region [5]. *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 [11]. Sideritis species are a group of plants known as "mountain tea" in Anatolia. Some species are used as tea, flavouring agents and for medicinal purposes in several regions. Local names are "dağçayı" or "yayla çayı" in Turkish [12-15]. Infusion of *Sideritis* species are used as stomachies, antispasmodics, carminatives, and taken for cough [11, 12,16,17].

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These species have been investigated mainly to learn the composition of their essential oils, but very little is known about the composition of the essential oil of *C.capitatus*, S. albimaculata and S. phlomiodes [6,18-22].

In this report, we present an analysis of essential oils in the *C. capitatus*, S. albimaculata and S. phlomiodes growing wild in Turkey. The differences in essential oil content and composition are compared with results of literature.

2.Materials and methods

2.1.Material

Plant materials were collected from Taurus mountains in Turkey. *Coridothymus capitatus* (L.) Reichb. Fill. was collected from Antalya, *Salvia albimaculata* Hedge &Hub.-Mor. was collected from Ermenek-Karaman and *Sideritis phlomoides* Boiss. & Ball. was collected from Niğde provinces. Herbarium speciments [*Coridothymus capitatus* (L.) Reichb. fill. Bağcı 3264 ; *Salvia albimaculata* Hedge & Hub.-Mor. - Bağcı 3466; *Sideritis phlomoides* Boiss. & Ball.- Bağcı - 3389] were deposited at the Department of Biology, Faculty of Science, Selçuk University, Turkey.

2.2. Recovery of the essential oils

Dried aerial parts of the plants (200 g) were ground and submitted to hydrodistillation for 4 h using a Clevenger-type apparatus and the oils obtained were dried over anhydrous sodium sulfate. The essential oils were light yellow with yield of 3.85%, 1.3 % and 1.0 %, v/w, on dry basis, respectively.

2.3. Idendification of components

For identification of components, analytical HP 5890 gas chromatograph equipped with FID (GC) was performed a DELSI 121 C apparatus fitted with a flame ionization detector and a CP WAX 51 fused silica column (25 m x 0.3 mm; 0.25 μm film thickness). Temperature was programmed from 50°C for 5 min and to reach 220°C at the rate of 3°C per min. ACP WAX 51 fused silica WCOT column (60 m x 0.3 mm) for GC/ MS was used with helium as carrier gas (flow rate 1 ml/min) and coupled to a HP mass spectrometer: ionization energy 70 eV. Temperature programming was from 50-240°C at the rate 3°C/min. The samples were injected at injector temperature 240°C. The components were identified by comparing linear Kovats indices (KI), their retention times (RT) and mass spectra with those obtained from the authentic samples and/or the MS library. Qualitative analysis was based on a comparison of retention times and mass spectra with corresponding data in the literature [23].

3.Results and Discussion

The percentage of the essential oils of the dried aerial parts from *C. capitatus*, *S. albimaculata* and *S. phlomiodes* were light yellow with yields 3.85%, 1.3% and 1.0%, v/w on dry basis, respectively. The essential oil yield in *C.capitatus* was 2.7-4.6% (v/w) [6]. The oil yields of *Sideritis cilicica, S. perfoliato, S. germanicopolitana* subsp *germanicopolitana* and *S. germanicopolitana* subsp *viridie*, *S. dichotoma* and *S. germanicopolitana* ranged between 0.045% to 0.33% [11,14]. The oil yields of *S.bilgerana*, *S.tmolea* and *S. congesta* were established as 0.26%, 0.33% and 0.83%, respectively [24].

The identified compounds of the volatile oil distilled from the aerial parts of *C.capitatus*, their retention indices and percentage compositions are shown in Table 1. A total of 28 constituents were identified from the essential oil studied on *C. capitatus*. The main monoterpene hydrocarbons have been identified as α-pinene (1.2%), myrcene (2.7%), α-terpinene (2.9%), p-cymene (23.5%) and γ-terpinene (16.4%). The monoterpene fraction was the predominant terpenoid group of the essential oil. The oil was characterized by large amunts of carvacrol (32.1%), p-cymene (23.5%), γ-terpinene (16.3%), thymol (12.9), α-terpinene 2.9%) and myrcene (2.7%). The oil from *C.capitatus* contained 7.4-13.7% γ-terpinene, 13.5-19.6% p-cymene and 5.1-62.6% carcacrol collected from Therisso and Asfendou in Grete [6].

Table 2 shows the detailed composition of the essential oil *Salvia albimaculata*. The major constituents of the essential oil of S. albimaculata were β-pinene 82.3%), borneol (2.4%), 1,8-cineol (3.0%), linalool (3.4%), trans-verbenol (6.3%), geranyl acetate (14.2%), α-pinene (17.6%) and limonene (23.8%). 1,8-cineole (38.9-21.2%), camphor (18.3-24.5%), camphene (7.9-4.3%) and β-pinene (4.3-3.3%) were found to be the major components in both the oils for S. aucheri and S. tomentosa [24]. *S. lavandula efolia* has a high content of 1,8-cineole and camphor [25], while β-thujone and 1,8-cineole are the major constituents of the essential oil of S.officinalis and *S. triloba* [26,27]. As a result, the essential fraction of the *S.albimaculata* differs from many *Salvia* species growing.

The essential oil of *Sideritis phlomiodes* was characterised by large amounts of octanal (40.2%), hexyle acetate (7.9%), linalool (7.7%), heptyle acetate (5.1%) and pentyle isobutirate (2.6%). Adzet et al. [28] determined 20% α-pinene, 18% fenchol, 9% fenchone, 8% fenchyl acetate, 5% 1,8-cineole and 5% limonene as main components in Sideritis granatensis (Pau). It was previously reported that the oil of Sideritis pauli contained 48.0% α-pinene [29].

Limonene, β-phellandrene, γ-terpinene, p-cymene, hexanol, nonanal, 1-octen-3-ol, α-copaene, linalool, octanol, 1-terpinen-4-ol, caryophyllene, borneol, carvone, hexenyl benzoate, thymol, carvacrol were established in the essential oil of *Sideritis cretica* [30,31].

These results show that Sideritis spp. Are remarkably variable species. Actually, the high quantities of octanal maket hem a most interesting species. In the present study, while *C. capitatus* contain a high percentage (32.1%), S. albimaculata and *S. phlomiodes* contained limonene (23.8%) and octanal (40.2%), respectively. When the results were compared with the literature, the oils showed similarities and differences. The observed differences may be probably due to environmental, soil, locations and nutritional status of the plants as well as other factors that can influence the oil composition.

4. Conclusions

- All plants were very rich in essential oils, yielding 1.0% - 3.85% v/dry weight.
- These results show that these plants are remarkably variable species.
- The high quantities of octanal, p-cymene and carvacrol.
- Especially, *S.albimaculata* and *C.capitatus* contained monoterpene hydrocarbons constituents

Table 1. Chemical composition of *Coridothymus capitata* oil

RT	RI	Constituents	%
6.27	924	tricyclene	0.6
6.48	930	α-pinene	1.2
6.98	946	Camphene	0.2
7.98	974	β-pinene	0.3
8.41	981	Oct-1-en-3-ol	1.2
8.69	988	Myrcene	2.7
8.96	997	Octan-3-ol	0.3
9.02	1004	Alpha-phellandrene	0.4
9.21	1005	Delta-3-carene	0.2
9.50	1014	Alpha-terpinene	2.9
9.93	1026	p-cymene	23.5
9.96	1028/9	Limonene	0.8
10.03	1031	1,8-cineole	0.1
10.67	1045	(E)-β-ocimene	0.1
11.07	1059	γ-terpinene	16.3
11.89	1083	terpinolene	0.2
11.96	1087	p-cymenene	0.1
14.34	1170	borneol	0.1
14.70	1178	Terpinene-4-ol	1.1
15.35	1195	Methyl chvicol+alpha terpineol	0.1
17.06	1249	carvone	0.1
18.01	1283	Trans-anethol	0.1
18.31	1291	thymol	12.9
18.70	1303	carvacrol	32.1
21.22	1417	Beta-caryophyllene	1.9
21.67	1435	aromadendrene	0.2
22.03	1452	Alpha-humulene	0.1
23.05	1448	Alpha-muurolene	0.1
Total			**99.9**

Table 2. Chemical composition of *Salvia albimaculata* oil

RT	KI	Constituents	%
6.59	931	α-pinene	17.6
7.00	947	Camphene	1.2
7.22	950	Thuja-2,4 (10)-diene	0.3
7.95	970	Sabinene	0.6
8.02	974	β-pinene	2.3
8.59	984	Octane-3-one	0.1
8.66	988	Myrcene	0.8
8.95	997	Octan-3-ol	0.2
10.04	1029	Limonene	23.8
10.08	1032	1,8-cineole	3.0
10.66	1046	(E)-β-ocimene	0.4
11.46	1070	Cis -oxyde de linalool	0.3
11.98	1085	Trans- oxyde de linalool	0.4
12.47	1099	Linalool	3.4
12.82	1115	Trans-thujanol	0.2
13.02	1121	Mentha-2,8-dien-1-ol	0.2
13.12	1125	Alpha-campholenal	0.5
13.47	1136	nopinone	0.1
13.56	1139	Cis-verbenol	0.8
13.71	1146	Trans-verbenol	6.3
13.79	1147	Camphore	1.7
13.87	1149	Mentha-1,5-dien-8-ol	0.3
14.22	1159	pinocarvone	0.2
14.40	1169	Borneol	2.4
14.71	1178	Terpinene-4-ol	0.4
15.03	1185	p-cymene-8-ol	0.4
15.15	1191	myrtenal	0.7
15.23	1193	α-terpineol	0.4
15.31	1194	myrtenol	0.3
15.43	1197	Cis-piperitol	0.1
15.67	1205	Verbenone	0.7
16.00	1217	Trans-carveol	0.9
16.13	1225	Trans sabinene hydrate	0.2
16.33	1230	Cis-carveol	0.3
16.66	1242	Carvone	1.0
17.03	1248	Geraniol	0.5
18.03	1285	Trans-sabinyl acetate	1.1
19.12	1331	Terpinyl-4-acetate	0.2
19.93	1354	Neryl acetate	0.1
20.56	1377	Geranyle acetate	14.2
20.96	1403	Alpha gurjunene	0.2
21.19	1416	Beta-caryophyllene	0.2
21.50	1428	Beta-gurjunene	0.3
23.51	1510	Gamma-cadinene	0.4
23.68	1516	Trans-calamenene	0.1
25.11	1580	Caryophyllene oxide	0.3
26.18	1625	isospathulenol	0.4
26.42	1640	Epi-alpha-cadinol	0.4
26.76	1653	Alpha-cadinol	1.8
Total			**92.7**

Table 3. Chemical composition of *Sideritis phlomiodes* oil

RT	RI	Constituents	%
6.48	930	α-pinene	0.8
8.66	988	Myrcene	0.7
8.95	997	Octan-3-ol	0.6
9.13	1003	Octanal	40.2
9.56	1012	Hexyl acetate	7.9
11.06	1058	Pentyl isobutyrate	2.6
11.55	1071	Octan-1-ol	26.8
11.99	1085	Trans-linalool oxide	0.5
12.41	1099	linalool	7.7
12.52	1103	nonanal	1.7
12.85	1110	Heptyl acetate	5.1
Total			**94.6**

Compliance with Ethics Requirements. Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human / or animal subjects (if exist) respect the specific regulation and standards.

Acknowledgement: This study was supported by Selcuk University Scientific Research Project (S.Ü.-BAP, Konya-Turkey). The authors wish to thank BAP Staffs.

References

1. Arikat,N.A., Jawad, F.M., Karam, S.K., Shibli, R.A., Micropropagation and accumulation of essential oils in wild sage (*Salvia fruticosa* Mill.). *Scientia Horticulturae,* **2004**, *100*, 193-202.
2. Pala-Paul, J., Jose Perez-Alonso, M., Velasco-Negueruela, A., Teresa Ballesteros, M., Sanz, J., Essential oil composition of Sideritis hirsuta L. From Guadalajara province, Spain. *Flavour and Fragrance Journal*, **2006**, *21*, 410-415.
3. Davis P.H., *Flora of Turkey and The East Aegean Islands*, Edinburgh Univ. Press., **1982a**, Vol. 7, p.382. Edinburg.
4. Davis P.H., *Flora of Turkey and The East Aegean Islands*, Edinburgh Univ. Press., **1982b**,Vol. 7, p.423. Edinburg.
5. Davis P.H., *Flora of Turkey and The East Aegean Islands*, Edinburgh Univ. Press., **1982c**, Vol. 7, page:184-185.Edinburg.
6. Skoula, M., Grayer, R.J., Volatile oils of Coridothymus capitatus, Saturaje thymbra, Satureja spinosa and Thymbra calostachya (Lamiaceae) from Crete. *Flavour and Fragrance Journal* **2005**, *20*, 573-576.
7. Morales-Valverde, R., EL genero *Thymbra* L. (Labiatae) . Anales del *Jardín* Botánico de Madrid **1987**, *44*, 349-380.
8. Güner, A., Özhatay, N., Ekim, T., Başer, K.H.C., Flora of Turkey and the East Aegean Islands, **2000**, Vol.II, Edinburgh: Edinburgh University Pres (Supplement-II).
9. Arslan, I., Çelik, A., Chemical composition and antistaphylococcal activity of an endemic *Salvia chrysophylla* Sataph. Naturally distributed Denizli province (TURKEY) and its vicinity. *Pakistan Journal of Botany* **2008**, *40*, 1799-1804.
10. Dığrak, M., Alma, M.H., Ilçim, A., Antibacterial and antifungal activities of Turkish medicinal plants. *Pharmaceutical Biology*, **2001**, *39*(5), 346-350.
11. Kırımer, N., Tabanca, N., Özek, T., Başer, K.H.C., Tümen, G., Composition of essential oils from two endemic *Sideritis* species of Turkey. *Chemistry of Natural Compounds*, **1999**, *35*, 61-63.
12. Yeşilada, E., Ezer, N., The antiimflammatory activity of some *Sideritis* species growing in Turkey. *International Journal of Crude Drug Research.*, **1989**, *27*, 38-40.
13. Ezer, N., Sezik, E., Erol, K., Özdemir, M., The antispasmodic activity of some *Sideritis* species. Proceedings of the 9th Symposium on Plant Drugs, **1991**, Eskişehir, Turkey.
14. Kırımer, N., Koca, F., Başer, K.H.C, Özek, T., Tanrıverdi, H., Kaya, A., Composition of the essential oils of two subspecies of *Sideritis germanicopolitana* Bornm. *Journal of Essential Oil Research* **1992**, *4*, 533-534.
15. Kırımer, N., Tabanca, N., Tümen, G., Duman, H., Başer, K.H.C., Composition of essential oils of four endemic *Sideritis species* from Turkey. *Flavour and Fragrance Journal* **2000**, *4*(6), 421-425.
16. Baytop, T. *Treatment with plants in Turkey*. İstanbul Univ. Publ. No. 3255, **1984**, İstanbul. (in Turkish)
17. Tabata, M., Honda, G., Sezik, E., Yeşilada, E., Traditional Med,c,ne and Medicinal Plants in Turkey, **1998**, Kyota Universty, Japan.
18. Sendra, J.M., Cunat, P., Volatile phenolic constituents of Spanish origanum (*Coridothymus capitatus*) essential oil. *Phytochemistry* **1980**, *19*, 1513-1517.
19. Fleisher, A., Fleisher,Z., Abu-Rukun, S., Chemovarieties of *Coridothymus capitatus* L. Rchb. Growing in Israel. *Journal of the Science Food and Agriculture* **1984**, *35*(5), 495-499.
20. Kokkini,S., Vokou, D. (1989). Carvacrol-rich plants in Greece. *Flavour Fragr. J.*, **1989**, *4*(1), 1-7.
21. Kustrak, D., Martinis, Z., Kuftinec, J., Blazevic, N., Composition of the essential oils of some *Thymus* and *Thymbra* species. *Flavour and Fragrance Journal* **1990**, *5*(4), 227-231.
22. Fleisher, Z., Flesiher, A., Volatiles of Coridothymus capitatus chemotypes growing in Israel: aromatic plants of the holy land and the sinai. *Journal of Essential Oil Research*, **2002**, *14*, 105-106.
23. Adams, R., *Essential oil comporents by Quadrupole GC/MS.* Allured Publishing Corp., Carol Stream, **2001**, IL, USA.
24. Özcan, M., Chalchat, J.C., Akgül, A., Essential oil composition of Turkish mountain tea (*Sideritis* spp.). *Food Chemistry* **2001**, *75*, 459-463.
25. Lawrence, B.M., Hogg, J.W., Terhune, S.J., Essential oils and their constituents. Some new trace constituents in the essential oil of *Salvia lavandulaefolia* Vahl. *Journal Chromatography* **1970**, *50*, 59-65.
26. Pitaveric, I., Kuftinec, J., Blazevic, N., Kustrak, P., Seasonal variation of essential oil, yiled and composition of Dalmatian sage, *Salvia officinalis*. *Journal of Natural Product* **1984**, *47*, 409-412.

27. Harvala, C., Menounos, P., Argyriadou, N., Essential oil from *Salvia triloba*. *Fitoterapia* **1987**, *58*, 353-356.
28. Adzet, T., Conigueral, S., Ibanez, C., Vila, R., Essential oil of *Sideritis granatensis* (Pau) Rivas-Goday (Lamiaceae). *Flavour and Fragrance Journal* **1989**, *4*(3), 129-132.
29. Burzaco, A., Velasco-Negueruela, A., Perez-Alonso, M.J., Essential oil analysis of *Sideritis pauli* Pau. *Flavour and Fragrance Journal*, **1992**, *7*(1), 47-48.
30. Komaitis, M.E., Falirea, A., Voudouris, C., Constituents of the essential oil of *Sideritis cretica* Boiss. *Journal of the Science and Food Agriculture* **1985**, *36*(10), 970-972.
31. Koedam, A., Volatile oil composition of Grek mountain tea (*Sideritis* spp.). *Journal of the Science and Food Agriculture* **1986**, *37*, 681-684.