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ESSENTIAL OIL COMPOSITION OF *Santolina etrusca* FROM ITALY

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The essential oil composition of aerial parts of Santolina etrusca *Marchi & D´Amato from Italy was analyzed by GC and GC/MS. Twenty-nine compounds of oil were identified representing 97.1% of the oil. The most abundant compounds were viridiflorol (17.9%), terpinen-4-ol (14.4%), myrcene (11.8%),* β*-pinene (9.9%), and* cis*-muurola-4(14),5-diene (9.9%). To the best of our knowledge, this is the first report on the GC/MS determination of the essential oil composition of* S. etrusca.

Key words: *Santolina etrusca* (Lacaita), *Asteraceae*, essential oil composition, GC and GC-MS, viridiflorol, terpinen-4-ol.

Santolina etrusca (Lacaita) Marchi & D'Amato. is an endemic herb belonging to the *Asteraceae* family. The distribution area is limited to Northern Latium, Tuscany, and Umbria [1]. Studies on the folk traditions of plants report that the flavoring aerial part placed in wardrobes and cupboards ward off parasites; the plant, placed in large wooden cases where linen was stored or in dog and cat litters, kept away fleas and other parasites [2]. Methanol and aqueous extracts of *S. etrusca* had an antimycotic activity against *Saprolegnia ferax* [3]. A few studies report about the composition of the essential oil in the genus *Santolina*, but none is referring to *S. etrusca* species. The aim of this paper was to determine the composition of the essential oil of wild-growing plants.

Table 1 shows the composition of the essential oil obtained from the aerial parts of *S. etrusca*. Compounds are listed in order of their elution from a HP-5 column. Twenty-nine compounds of oil were identified representing 97.1% of the oil.

The *S. etrusca* oil was characterized by five main constituents: viridiflorol (17.9%), terpinen-4-ol (14.4%), myrcene (11.8%), β-pinene (9.9%), and *cis*-muurola-4(14),5-diene (9.9%). Oxygenated monoterpenes represented 38% of the total oil, terpinen-4-ol (14.4%) being the most abundant compound. The monoterpene hydrocarbons represented 24.4% of the total oil, myrcene (11.8%) and β-pinene (9.9%) being the most abundant constituents of this fraction. Significant amounts of oxygenated sesquiterpenoid (19.4%) and sesquiterpene hydrocarbons (15.3%) were also observed.

Compared with previous reports, the composition of the oil that we analyzed greatly differed from the oils of the other studied species. The oil of *S. chamaecyparissus* L. was characterized by artemisia ketone [3–16] while the oils of *S. canescens* [17], *S. rosmarinifolia* [18], and *S. oblongifolia* [19] were characterized by santolindiacetylene, acetylenic, and dihydrofuran sesquiterpenes respectively. Some interesting similarities exist between the oils of *S. etrusca* and *S. ligustica*, the latter oil being characterized by myrcene, 1,8-cineole, and terpinen-4-ol [20]. There are fewer similarities to the oil of *S. neapolitana*; this oil was characterized by γ-muurolene and α-pinene [21], and in the oil of *S. etrusca* an important contribution is also made by muurolene derivatives.

The observed differences in the composition of the examined essential oils of *S. etrusca* and the other *Santolina* species are in accord with the difference between their morphological.characters, with the exception of *S. ligustica* where there was a substantial morphological character difference but a quite similar oil composition. Further investigations of the essential oil composition for a larger number of different populations of the same species, along with more data on the different species of the genus *Santolina*, can be helpful in chemiotaxonomy.

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TABLE 1. Chemical Composition of *S. etrusca* Essential Oil

Compound	RRI	%	Compound	RRI	%
α-Pinene	939	0.3	β-Cedrene	1417	0.3
β-Pinene	978	9.9	Aromadendrene	1447	1.4
Myrcene	997	11.8	*cis*-Muurola-3,5-diene	1453	0.2
α-Terpinene	1021	0.5	*cis*-Muurola-4(14),5-diene	1470	9.9
p-Cymene	1029	1.1	γ-Gurjunene	1476	0.3
1,8-Cineole	1031	4.6	γ-Muurolene	1480	0.1
γ-Terpinene	1062	0.8	Germacrene D	1485	0.9
trans-Sabinene hydrate	1101	1.4	*trans*-Muurola-4(14),5-diene	1492	0.2
trans-Pinocarveol	1140	8	γ-Cadinene	1515	0.8
Pinocarvone	1164	2.7	Viridiflorol	1581	17.9
Terpinen-4-ol	1177	14.4	β-Oplopenone	1599	0.3
Thuj-3-en-10-al	1192	3.2	Eremoligenol	1632	0.5
Myrtenol	1195	3.7	*epi*-α-Cadinol	1640	0.1
α-Ylangene	1367	0.1	*epi*-α-Muurolol	1647	0.6
β-Ylangene	1406	1.1			

RRI: relative retention indices calculated against *n*-alkane series on an HP-5 column.

EXPERIMENTAL

The aerial parts of *S. etrusca* growing near Corbara lake (Umbria) were collected during flowering. Voucher specimens were deposited in the Herbarium Botany Institute, University of Perugia, with the numbers SA6/05.
Fresh plant material was subjected to hydrodistillation using a Clevenger-type apparatus for 3 h, yielding 0.7% of a yellowish oil. The oil was dried over anhydrous sodium sulfate and stored in sealed vials under refrigeration prior to analysis.

Gas Chromatography. The GC analyses were carried out using a Varian 3300 instrument equipped with an HP-5 capillary column (30 m $\times$ 0.25 mm, 0.25 μm film thickness), working with the following temperature program: 3 min at 60°C, and subsequently at 4°C/min up to 210°C (for 15 min); injector and detector temperatures, 250°C; carrier gas, helium (1 mL/min); split ratio, 1:10.

GC-MS analyses were carried out using a Hewlett Packard 5890-5972 GC-MS system operating in the EI mode at 70 eV, using two different columns, an HP InnoWax (30 m $\times$ 0.25 mm, film thickness 0.17 μm) capillary column and an HP-5 (30 m $\times$ 0.25 mm, film thickness 0.25 μm) capillary column. The temperature program for the HP InnoWax was 60–260°C at a rate of 4°C/min, and for the HP-5 it was 60–300°C at a rate of 4°C/min. Injector and transfer line temperatures were 220°C and 280°C, respectively. Helium was used as the carrier gas, flow rate 1 mL/min. Split ratio, 1:10.

Identification of the Components. The identification of the components was made for both columns by comparison of their retention time with respect to the *n*-alkane series (C6-C22) internal standards. The mass spectra and relative retention indices (RRI) were compared with those of commercial (NIST 98 and WILEY) and home-made library mass spectra built up from pure compounds and MS literature data [4–9].

Area percentages were obtained electronically from the GC-FID response without the use of an internal standard or correction factors.

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