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Chemical composition of the essential oils of two *Salvia* species from Iran, *Salvia virgata* Jacq. and *Salvia syriaca* L.

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ABSTRACT: The chemical composition of the essential oils of *Salvia virgata* Jacq. and *Salvia syriaca* L. growing wild in Iran were examined by GC and GC–MS. Fifteen components were characterized for *S. virgata* with β-caryophyllene (46.6%), germacrene B (13.9%), β-caryophyllene epoxide (13.2%), spathulenol (6.4%) and germacrene D (5.7%) as the major constituents. Twenty-two components were identified in the oil of *S. syriaca*, with germacrene-B (34.8%), germacrene-D (29.2%), α-ylangene (3.6%) and spathulenol (3.4%) as the major constituents. Copyright © 1999 John Wiley & Sons, Ltd.

KEY WORDS: *Salvia virgata* Jacq.; *Salvia syriaca* L.; Lamiaceae; essential oil; β-caryophyllene; germacrene-B; germacrene-D

Introduction

Fifty-eight species of the genus *Salvia* (Lamiaceae) are found in Iran, seventeen of which are endemic. Due to the use of this genus or their essential oils in the food, drug and perfumery industries,[1,2] we are investigating the oils of *Salvia* species which grow wild or are cultivated in Iran. Previously we reported the essential oil compositions of *S. verticillata* L. and *S. santolinifolia* Boiss.[3] In this paper, we describe the analysis of the essential oils of two other *Salvia* species, *S. virgata* Jacq. and *S. syriaca* L., that grow wild in many regions of Iran. A literature search did not reveal any reference to previous work on the essential oils of these species, but references could be found to the extraction and identification of diterpene, sesquiterpene and absisic acid derivative.[4–8]

Experimental

Plant Material

Aerial parts of *S. virgata* Jacq. and *S. syriaca* L. were collected during flowering (July–August 1997) near Tabriz (north-western Iran) and Khoramabad (western Iran), respectively. Voucher specimens have been deposited in the herbarium of Research Institute of Forests and Rangelands (TARI).

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Isolation Procedure

The essential oils were isolated by steam distillation of dried aerial parts in all-glass apparatus. The sample oils, which were light yellow in colour, were dried over anhydrous calcium chloride and stored in sealed vials at low temperature before analysis.

Gas Chromatography

GC analyses were performed using a Shimadzu GC-9A gas chromatograph equipped with a DB-1 fused silica column (60 m × 0.25 mm i.d., film thickness 0.25 μm). Oven temperature was held at 60°C for 5 min and then programmed to 220°C at a rate of 2°C/min; injector and detector (FID) temperatures were 250°C; carrier gas, helium with a linear velocity of 32 cm/s.

Gas Chromatography–Mass Spectrometry

GC–MS analyses were carried out on a Varian 3400 GC–MS system equipped with a DB-1 fused silica column (60 m × 0.25 mm i.d.), oven temperature was 50–220°C at a rate of 4°C/min, transfer line temperature 240°C, carrier gas, helium with a linear velocity of 31.5 cm/s, split ratio 1/60, ionization energy 70 eV; scan time 1 s; mass range 40–300 amu.

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Table 1. The percentage composition of the essential oils from *Salvia virgata* Jacq. and *Salvia syriaca* L.

Compound	*S. virgata* (%)	*S. syriaca* (%)	RI[a]	Methods of identification[b]
α-Thujene	0.7	–	931	RI–MS
α-Pinene	tr	0.3	938	RI–MS
Sabinene	3.4	0.3	973	RI–MS, Co-I
β-Pinene	tr	0.5	977	RI–MS, Co-I
(*Z*)-β-Ocimene	tr	0.3	1035	RI–MS
(*E*)-β-Ocimene	–	tr	1047	RI–MS
γ-Terpinene	0.5	–	1057	RI–MS, Co-I
cis-Sabinene hydrate	0.4	–	1064	RI–MS
Terpinolene	–	0.7	1087	RI–MS, Co-I
Linalol	–	tr	1092	RI–MS, Co-I
Borneol	–	tr	1155	RI–MS, Co-I
Linalyl acetate	–	tr	1248	RI–MS
Isobornyl acetate	–	4.1	1279	RI–MS
α-Cubebene	–	tr	1357	RI–MS
cis-Jasmone	–	1.3	1377	RI–MS
α-Ylangene	–	3.6	1387	RI–MS
β-Bourbonene	tr	1.4	1390	RI–MS
Cyperene	–	2.0	1397	RI–MS
β-Caryophyllene	46.6	2.7	1423	RI–MS
Aromadendrene	0.5	–	1440	RI–MS
cis-β-Farnesene	4.1	–	1449	RI–MS
allo-Aromadendrene	–	0.4	1464	RI–MS
Germacrene-D	5.7	29.2	1485	RI–MS, Co-I
Germacrene-B	13.9	34.8	1495	RI–MS, Co-I
δ-Cadinene	–	2.1	1526	RI–MS
Spathulenol	6.4	3.4	1568	RI–MS
β-Caryophyllene epoxide	13.2	0.5	1585	RI–MS

[a] On DB-1 column. [b] RI = retention index; MS = mass spectrum; Co-I = co-injection with an authentic sample.

Identification of Components

The components of both oils were identified by comparison of their mass spectra with those of a computer library or with authentic compounds and confirmed by comparison of their retention indices, either with those of authentic compounds or with data published in the literature.[9]

Results and Discussion

The essential oils isolated by steam distillation from the aerial parts of *S. virgata* and *S. syriaca* were obtained in yields of 0.48% and 0.3% (w/w) respectively. Fifteen components were identified in the oil of *S. virgata*, representing 95.4% of the oil, and twenty-two components were identified in the oil of *S. syriaca*, representing 87.6% of the oil.

The compounds identified, with their percentages, are given in Table 1. The compounds are listed in order of their elution from the DB-1 column.

The oils of both species are dominated by sesquiterpenes; 90% in *S. virgata* and 81% in *S. syriaca*. In particular, the oil of *S. virgata* is characterized by a high content of β-caryophyllene (46.6%) and β-caryophyllene epoxide (13.2%) with germacrene-B (13.9%). In contrast, the oil of *S. syriaca* is rich in germacrene-B (34.8%) and germacrene-D (29.2%) with much smaller amounts of the caryophyllene derivatives. Comparing these results with our earlier work[3], the oil of *S. verticillata* is also dominated by sesquiterpenes (70.7%) with β-caryophyllene as the major component (24.7%), whereas the oil of *S. santolinifolia* contains mainly monoterpenoids (71.8% α- and β-pinene). The second major compound in the oil of *S. verticillata* is γ-muurolene (22.8%), while that of *S. virgata* is germacrene-B. It is noteworthy that the oil of *S. virgata*, with the highest content of β-caryophyllene, was judged as having the most pleasant aroma, while that of *S. verticillata*, with 24.7% β-caryophyllene, was judged second.

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