

Chemical composition of the essential oils of two *Salvia* species from Iran: *Salvia verticillata* L. and *Salvia santolinifolia* Boiss.

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Received 23 May 1997

Accepted 22 August 1997

ABSTRACT: The chemical composition of the essential oils of *Salvia verticillata* L. and *Salvia santolinifolia* Boiss. growing wild in Iran were examined by GC and GC–MS. Twenty-seven components were characterized for *S. verticillata* with β -caryophyllene (24.7%), γ -muurolene (22.8%), limonene (8.9%) and α -humulene (7.8%) as the major constituents, whereas for *S. santolinifolia*, 17 components were identified with α -pinene (59.4%), β -pinene (12.4%) and limonene (3.8%) as the major constituents. Copyright © 1999 John Wiley & Sons, Ltd.

KEY WORDS: *Salvia verticillata* L.; *Salvia santolinifolia* Boiss.; Lamiaceae; essential oil; β -caryophyllene; γ -muurolene; α -pinene; β -pinene

Introduction

The sage plant, *Salvia*, belongs to the family Lamiaceae, which also includes the mints, many species and varieties of which grow wild or are cultivated in many parts of the world.¹ The herbs and/or their essential oils are used commonly in the food, drug and perfumery industries.² Many species of the genus *Salvia* (Lamiaceae) are to be found in Iran. Due to the various usage of this genus, we intend to investigate the oils of all *Salvia* species which grow wild or are cultivated in Iran. In this paper, we describe the analysis of the essential oils of two *Salvia* species, *S. verticillata* L. and *S. santolinifolia* Boiss., which grow wild in many regions of Iran. To the best of our knowledge the oils of *S. verticillata* and *S. santolinifolia* have not been studied previously.

Experimental

Plant Material

Aerial parts of *S. verticillata* L. and *S. santolinifolia* Boiss. were collected during their flowering periods (May–June 1996) near Tehran (Fasham-Garmabedar) and the south-eastern area of Iran (Zabol), respectively. Voucher specimens have been deposited in the herbarium of Research Institute of Forests and Rangelands (TARI).

Isolation Procedure

The essential oils were isolated by steam distillation for 30–45 min for *S. verticillata* and 50–60 min for *S. santolinifolia*.

Gas Chromatography

GC analyses were performed using a Shimadzu GC-9A gas chromatograph equipped with a DB-5 fused silica column (30 m \times 0.25 mm i.d., film thickness 0.25 μ m). Oven temperature was held at 40°C for 5 min and then programmed to 220°C at a rate of 4°C/min; injector and detector (FID) temperatures were 250°C; split ratio, 1/60; carrier gas, helium with a linear velocity of 30 cm/s.

Gas Chromatography–Mass Spectrometry

GS–MS analyses were carried out on a Varian 3400 GC–MS system equipped with a DB-5 fused silica column (30 m \times 0.25 mm i.d.); oven temperature was as above; transfer line temperature, 240°C; carrier gas, helium with a linear velocity of 30 cm/s; split ratio 1/60; ionization energy, 70 eV; scan time 1 s; mass range, 40–300 amu.

Identification of Components

The components of both oils were identified by comparison of their mass spectra with those of a computer

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Table 1. The percentage composition of the oils from *Salvia verticillata* L. and *Salvia santolinifolia* Boiss

Compound	<i>S. verticillata</i> (%)	<i>S. santolinifolia</i> (%)	RI	Methods of identification
α -Thujene	0.3	0.8	923	RI, MS
α -Pinene	2.6	59.4	932	RI, MS, Co-I
Camphene	0.2	2.9	947	RI, MS, Co-I
Sabinene	2.7	0.5	970	RI, MS
β -Pinene	5.1	12.4	973	RI, MS, Co-I
Myrcene	1.9	—	986	RI, MS, Co-I
α -Phellandrene	0.8	0.2	1000	RI, MS
δ -3-Carene	0.3	—	1007	RI, MS, Co-I
α -Terpinene	—	0.6	1013	RI, MS, Co-I
<i>o</i> -Cymene	tr	0.5	1020	RI, MS
Limonene	8.9	3.8	1026	RI, MS, Co-I
(<i>Z</i>)- β -Ocimene	1.4	—	1037	RI, MS
(<i>E</i>)- β -Ocimene	1.4	—	1047	RI, MS
γ -Terpinene	0.2	1.7	1057	RI, MS, Co-I
Terpinolene	—	0.4	1087	RI, MS
Borneol	—	1.3	1165	RI, MS, Co-I
4-Terpineol	—	0.5	1177	RI, MS
α -terpineol	—	0.4	1190	RI, MS
Bornyl acetate	tr	—	1284	RI, MS
α -Cubebene	0.3	—	1347	RI, MS
α -Copaene	0.5	0.6	1372	RI, MS
β -Borbonene	0.9	—	1380	RI, MS
β -Cubebene	0.3	—	1386	RI, MS
α -Gurjunene	4.9	—	1406	RI, MS
β -Caryophyllene	24.7	0.9	1418	RI, MS
Aromadendrene	—	0.8	1434	RI, MS
α -Humulene	7.8	—	1452	RI, MS, Co-I
<i>allo</i> -Aromadendrene	0.7	—	1457	RI, MS
β -Cadinene	0.3	—	1471	RI, MS
γ -Muurolene	22.8	—	1474	RI, MS
Germacrene B	6.6	—	1495	RI, MS
δ -Cadinene	0.3	—	1526	RI, MS
Caryophyllene Oxide	0.6	—	1596	RI, MS
Totals	96.5	87.7		

RI = Retention index. MS = mass spectrum. tr = Trace. Co-I = coinjection with an authentic sample.

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.³

Results and Discussion

The essential oils isolated by steam distillation from the aerial parts of *S. verticillata* and *S. santolinifolia* were obtained in yields of 0.26% and 0.18% (w/w), respectively based on dry weights. Twenty-seven components were identified in the oil of *S. verticillata*, representing 96.5% of the total oil, and 17 components were identified in the oil of *S. santolinifolia*, representing 87.7% of the total oil.

The identified components and their percentages are given in Table 1. The components are listed in order of their elution on the DB-5 column. The oil of *S. santolinifolia* is characterized by a high content of α - and β -pinene (71.8%), whereas these two

components represent only 7.7% of the oil of *S. verticillata*. By contrast, the oil of the latter species is dominated by the sesquiterpene β -caryophyllene (24.7%), γ -muurolene (22.8%) and α -humulene (7.8%) being the major components. Limonene, camphene, thujene, sabinene and some other monoterpenoids and sesquiterpenoids are found in both oils but in different percentages. Some components exist in just one of the oils, which can be seen in the table.

Acknowledgements — The authors would like to acknowledge the financial support by the Research Institute of Forests and Rangelands for this work. We are grateful to Dr Mirza for helping us in GC-MS analysis and Miss Jamzad for identification of plant materials.

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