

CHEMICAL COMPOSITION OF THE ESSENTIAL OIL OF *Stachys inflata* Benth. FROM IRAN

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The chemical composition of a hydrodistilled oil of Stachys inflata Benth. growing wild in Iran was examined by GC/MS. Thirty-nine constituents were identified. The major components of the oil were germacrene-D (16.9%), bicyclogermacrene (16.6%), α -pinene (11.3%), β -phellandrene (9.8%), bicycloelemene (6.6%), β -pinene (5.6%), and spathulenol (3.2%).

Key words: *Stachys inflata*, essential oil, GC/MS analysis.

The genus *Stachys* is one of the largest genera of the Labiatae with a worldwide distribution. About three hundred *Stachys* species are reported [1] of which 34 ones are found in the flora of Iran [2]. Some of the *Stachys* species are used as medicinal plants around the world [3–5]. *Stachys inflata* Benth. is one of the most distributed species in the country [6] which have been used in Iranian folk medicine in rheumatic and other inflammatory disorders. The last study on the hydroalcoholic extract of aerial parts of *S. inflata* showed significant anti-inflammatory activities on rats [7]. The Persian name of the plant is "Sonboleiyeh Badkonaki" [2]. There are some reports on the phytochemical analysis of *Stachys* species, but only a very small number of these species have been studied for their essential oils [8–17].

Literature survey has shown that *S. inflata* has not been previously investigated for its essential oil. As part of our research on the aromatic medicinal plants of Iran, we decided to investigate the volatile oil of aerial parts of *S. inflata*.

Aerial parts of *S. inflata* yielded 0.1% (v/w) of a yellowish oil with an aromatic odor. Thirty-nine components were detected in the volatile oil of *S. inflata*. The list of compounds identified in the oil sample is presented in Table 1 with their percentage compositions. As can be seen in Table 1, the major components of the oil are germacrene-D (16.9%), bicyclogermacrene (16.6%), α -pinene (11.3%), β -phellandrene (9.8%), bicycloelemene (6.6%), β -pinene (5.6%), and spathulenol (3.2%).

Previous studies on the volatile oil of members of *Stachys* genus showed various compositions. However, the oil of *S. inflata* consisted mainly of sixteen monoterpene hydrocarbons (42.2%), six oxygenated monoterpenes (6.9%), eleven sesquiterpene hydrocarbons (44.5%), five oxygenated sesquiterpenes (4.9%), and one aliphatic aldehyde (0.1%). Germacrene-D, the dominant compound of the essential oil of *S. inflata*, was reported as the major components of the volatile oils of *S. laxa* Boiss. [16] and *S. obliqua* L. [13]. According to this study, oct-1-en-3-ol, the major components of *S. recta* and *S. atherocalyx* C. Koch., was not detected in *S. inflata* oil [9, 11].

EXPERIMENTAL

Stachys inflata Benth. was collected from Sofe mountain in Isfahan Province (center of Iran) in May 2001 at an altitude of 1570 m. A voucher specimen has been deposited in the Herbarium of the Faculty of Pharmacy and Pharmaceutical Sciences, Isfahan University of Medical Sciences, Isfahan, Iran.

The volatile oil of the aerial parts of *S. inflata* was obtained by hydrodistillation using a Clevenger-type apparatus for 3 h. The oil was subsequently dried over anhydrous sodium sulfate.

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TABLE 1. Composition of the Essential Oil of *Stachys inflata*

RI	Compound	%	RI	Compound	%
926	α -Thujene	0.9	1175	Terpinen-4-ol	0.7
934	α -Pinene	11.3	1188	α -Terpineol	2.0
971	Sabinene	2.8	1283	Bornyl acetate	Tr.
975	β -Pinene	5.6	1333	Bicycloelemene	6.6
987	Myrcene	2.2	1347	α -Cubebene	0.1
1003	α -Phellandrene	1.3	1372	α -Copaene	1.1
1009	δ -3-Carene	2.9	1386	β -Cubebene	0.1
1015	α -Terpinene	0.4	1388	β -Elemene	1.1
1019	<i>o</i> -Cymene	Tr.	1427	β -Gurjunene	0.5
1023	<i>p</i> -Cymene	0.7	1458	<i>allo</i> -Aromadendrene	0.1
1027	β -Phellandrene	9.8	1479	Germacrene-D	16.9
1030	1,8-Cineole	2.1	1494	Bicyclogermacrene	16.6
1036	(<i>Z</i>)- β -Ocimene	1.8	1511	γ -Cadinene	Tr.
1045	(<i>E</i>)- β -Ocimene	0.3	1522	δ -Cadinene	1.4
1058	γ -Terpinene	1.2	1575	Spathulenol	3.2
1064	<i>cis</i> -Sabinene hydrate	Tr.	1580	Caryophyllene oxide	0.5
1085	Terpinolene	1.0	1632	Isospathulenol	1.0
1097	Linalool	2.1	1646	β -Eudesmol	0.1
1101	Nonanal	0.1	1650	α -Cadinol	0.1
1126	<i>allo</i> -Ocimene	Tr.			

RI: Retention indices on HP-5 capillary column.

%: Calculated from TIC data.

Tr.: Trace ($\leq 0.05\%$).

GC/MS analyses was performed with a Hewlett-Packard 6890 gas chromatograph equipped with a HP-5MS capillary column (30 m \times 0.25 mm; coating thickness 0.25 mm) and a Hewlett-Packard 6890 mass selective detector. The oven temperature was programmed from 60–280°C at 4°C/min. Carrier gas, helium, was adjusted to a flow of 2 mL/min. The MS operating parameters were: ionization voltage, 70 eV; ion source temperature, 200°C.

Identification of components was based on comparison of their mass spectra with those found in the literature [18–19], retention indices relative to *n*-alkanes, and computer matching with the WILEY275.L library.

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