

CHEMICAL COMPOSITION OF THE VOLATILE OIL FROM *SILENE AVROMANA* BOISS. & HAUSSKN.

Boshra AZADI^{1*}, Farhad AHMADI²

Abstract: The compositions of essential oil which obtained by hydrodistillation from flowering aerial parts of Iranian endemic *Silene avromana* Boiss. & Hausskn. (Caryophyllaceae) were analyzed by gas chromatography–flame ionization detector (GC–FID) and gas chromatography–mass spectrometry (GC–MS) for the first time. Thirty eight components comprising 89.7% of the total oil were identified. The main compounds were (*E*)- β -Ocimene (11.3%), (*Z*)-3-Hexenol (6.5%) and Linalool (6.4%). The volatile oil of *Silene avromana* Boiss. & Hausskn. flowering aerial parts was dominated by high quantities of terpenoids (53.6%).

Key words: *Silene avromana* Boiss. & Hausskn., Caryophyllaceae, Essential oil, Chemical composition, (*E*)- β -Ocimene

Introduction

The genus *Silene* L. is the largest genus of Caryophyllaceae family with more than 700 species which mainly dispersed in the Mediterranean region, Iran, Turkey, Iraq, Central Asia, Italy, Russia, England and Spain (Mabberley, 2008; Melzheimer, 1988).

Nearly 100 species of *Silene* L. genus grow in Iran which among them about 36 species are endemic and *Silene avromana* Boiss. & Hausskn. is one of them (Mozaffarian, 2003).

Silene species contain several natural product classes, comprising volatile oils, triterpens, saponins, ecdysteroids and phytoecdysteroids (Karamian and Ghasemlou, 2013).

Essential oil compositions that have been most frequently informed from this genus species include terpenoids, fatty acid derivatives, benzenoids, phenyl propanoids and nitrogen-containing compounds (Jurgens et al., 2002; Jurgens, 2004; Dotterl et al., 2005; Bajpai et al., 2008; Jhumur et al., 2008).

As far as we know, there is no report on volatile constituents of *Silene avromana* and this article is the first research on this endemic species.

Materials and methods

Flowering aerial parts of *Silene avromana* were collected in June 2012 from Hawraman region (Paveh County, Kermanshah Province, Iran). A voucher specimen has been deposited at the Herbarium of College of Natural Resources, University of Kurdistan, Sanandaj, Iran.

¹ Pharmacognosy Department, Faculty of Pharmacy, Pharmaceutical Sciences Branch, Islamic Azad University, Yakhchal Ave., Dr. Shariati St., Tehran, Iran; Azadi.B@iaups.ac.ir; boshraazadi@yahoo.com (corresponding author*)

² Department of Medicinal Chemistry, Faculty of Pharmacy, Kermanshah University of Medical Sciences, Kermanshah, Iran; e-mail: fahmadi@kums.ac.ir

The air-dried crushed flowering aerial parts of *Silene avromana* were subjected to hydrodistillation using a Clevenger-type apparatus for 4 hrs. The obtained essential oil was dried over anhydrous sodium sulphate and stored at 4-6°C.

Silene avromana oil was analyzed using GC-MS by a Hewlett-Packard 6890 gas chromatograph with DB-5 capillary column (30 m x 0.25 mm; film thickness 0.25 µm). The carrier gas was helium with a flow rate of 1 ml/min. The column temperature was changed from 60°C to 220°C at 6°C/min. The gas chromatograph was coupled to a Hewlett-Packard 5973 mass selective detector. The MS was operated at 70 eV ionization energy. The retention indices were computed using retention times of *n*-alkanes that were injected after the essential oil at the same conditions. The compounds were detected by comparison of retention indices with those informed in the literatures and also by comparison of their mass spectra with the published mass spectra or Wiley library (Adams, 2001; Massada, 1976).

GC analysis was performed by Hewlett-Packard model 6890 equipped with a flame ionization detector (FID). A DB-5 capillary column (30 m x 0.25 mm; film thickness 0.25 µm) was used. The oven temperature set from 60°C to 220°C at 6°C/min. Helium was used as the carrier gas, at flow rate of 1 ml/min. The injector and detector temperatures were 220 and 250°C, respectively. The relative percentage of the identified components was calculated from the GC peak area without applying correction factors.

Results and discussions

The dried flowering aerial parts of *Silene avromana* yielded 0.12% V/W of a pale yellow volatile oil.

Thirty eight constituents consisting 89.7% of the total oil were identified. The predominant compounds and their percentage are presented in Table 1.

Table 1. The essential oil composition of *Silene avromana* Boiss. & Hausskn. aerial parts

No.	Compound	RI ^a	Content (%)
1	<i>n</i> -Hexanal	800	2.8
2	(<i>E</i>)-2-Hexenal	853	1.7
3	(<i>Z</i>)-3-Hexenol	857	6.5
4	α -Pinene	938	2.1
5	Benzaldehyde	963	2.2
6	Sabinene	975	0.3
7	β -Pinene	980	5.1
8	<i>n</i> -Octanal	1002	4.6
9	(<i>Z</i>)-3-Hexenyl acetate	1004	3.8
10	α -Phellandrene	1006	Tr. ^b
11	Hexyl acetate	1009	1.9
12	α -Terpinene	1019	0.4
13	Limonene	1029	4.0
14	1,8-Cineole	1031	0.3

15	Phenylacetaldehyde	1044	4.5
16	(<i>E</i>)- β -Ocimene	1049	11.3
17	Methyl benzoate	1094	0.9
18	Linalool	1101	6.4
19	α -Terpineol	1190	0.7
20	Myrtenol	1197	0.1
21	Dodecane	1200	Tr.
22	Decanal	1208	5.4
23	α -Copaene	1377	0.3
24	β -Bourbonene	1386	1.0
25	β -Caryophyllene	1420	3.4
26	(<i>E</i>)- β -Farnesene	1458	2.7
27	γ -Muuroleone	1477	1.2
28	α -Selinene	1494	0.6
29	α -Muuroleone	1500	2.3
30	α -Farnesene	1507	4.9
31	δ -Cadinene	1522	2.7
32	α -Cadinene	1537	0.4
33	(<i>E</i>)-Nerolidol	1561	0.7
34	Caryophyllene oxide	1583	2.6
35	β -Eudesmol	1650	0.1
36	Tetradecanol	1671	Tr.
37	Benzyl benzoate	1772	1.8
38	<i>n</i> -Pentadecanol	1777	Tr.

^a Retention indices; relative to *n*-alkane series on DB-5 capillary column.

^b trace (<0.05%).

Essential oil of *Silene avromana* flowering aerial parts was dominated by high quantities of terpenoids (53.6%). Monoterpene hydrocarbons represented 23.2% of the volatile oil which characterized by (*E*)- β -Ocimene (11.3%), β -Pinene (5.1%) and Limonene (4.0%). The sesquiterpene hydrocarbons included 19.5% of *Silene avromana* oil with α -Farnesene (4.9%) and β -Caryophyllene (3.4%) as the main components. Oxygenated monoterpenes comprised 7.5% of the essential oil and Linalool (6.4%) constituted the major ingredient of this fraction. Oxygenated sesquiterpenes amounted to only 3.4%.

Fatty acid derivatives (26.7%) also had the high contribution of *Silene avromana* flowering aerial parts volatile oil and their principle compounds were (*Z*)-3-Hexenol (6.5%), Decanal (5.4%), *n*-Octanal (4.6%) and (*Z*)-3-Hexenyl acetate (3.8%).

Benzenoids contained 9.4% of the oil and their abundant constituent was Phenylacetaldehyde (4.5%).

Essential oil compositions of several species of *Silene* genus were previously reported. The detected components belong to five classes: terpenoids (e.g. Limonene, α -

Pinene, β -Pinene, Myrcene, Linalool, (*Z*)- β -Ocimene, (*E*)- β -Ocimene and Lilac compounds), fatty acid derivatives (e.g. (*Z*)-3-Hexenol, (*Z*)-3-Hexenyl acetate and *n*-Nonanal) and benzenoids (e.g. Phenylacetaldehyde, Benzyl alcohol, Methyl benzoate, (*Z*)-3-Hexenyl benzoate, Benzyl benzoate, Benzyl acetate, Methyl salicylate and Benzaldehyde). Moreover, phenyl propanoids and nitrogen-containing constituents were found in *Silene* species oil (Jurgens et al., 2002; Jurgens, 2004; Dotterl et al., 2005; Bajpai et al., 2008; Jhumur et al., 2008).

A thorough literature review revealed that there was no research on volatile components of *Silene avromana* and this paper is the first report on this endemic species.

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