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VOLATILE CONSTITUENTS OF FLOWERS AND LEAVES OF *Anthemis hyalina*

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The chemical composition of the essential oils of the flowers and leaves of Anthemis hyalina *were analyzed by GC and GC-MS for the first time. The oils were found to contain seventy-two components.* cis-*Chrysanthenyl acetate (14.9% and 17.8%), camphor (11.6% and 1.7%), terpinen-4-ol (8.3% and 1.2%), germacrene-D (5.1% and 2.1%),* β-*caryophyllene (4.1% and 5.4%), myrcene (3.6% and 16.9%), bicyclogermacrene (3.5% and 0.9%),* α-*pinene (2.3% and 4.1%),* cis-β-*ocimene (2.1% and 4.3%) and isospathulenol (0.4% and 4.3%) were found to be the major constituents of the oils of flowers and leaves respectively.*

Key words: *Anthemis hyalina*, essential oil, GC/MS analysis, *cis*-chrysanthenyl acetate, camphor.

The genus *Anthemis* comprises more than 200 species and is considered one of the largest genera of the Compositae family [1]. The genus is represented in the flora of Iran by 39 species, including 15 endemics [2]. Several *Anthemis* species are used in Iranian folk medicine as medicinal plants [3]. The essential oil of *A. nobilis* possesses interesting anti-inflammatory and sedative properties in rat [4]. There are also reports on antimicrobial and larvicidal activities of the essential oils of *A. xylopoda* and *A. melampodina* respectively [5, 6]. The phytochemical studies of several *Anthemis* species have led to the isolation of sesquiterpene lactones, flavonoids, coumarins, acetylenic compounds, and essential oils [7–10].

Anthemis hyalina DC. is an Iranian native species known as "Babooneh Shafaf"' in Persian [2]. According to the literature, *A. hyalina* has not been the subject of phytochemical research up to now. As part of a program of chemical investigation on the essential oil of Iranian aromatic plants, the chemical constituents of the essential oils from flowers and leaves of *A. hyalina* are reported for the first time.

The yield of essential oils obtained from flowers and leaves of the plant were 0.3% and 0.5% (v/w) respectively. Table 1 shows the composition of the essential oils obtained from flowers and leaves of *A. hyalina*. Compounds are listed in order of their elution from an HP-5 column. Seventy compounds of flower oil and sixty-four components of leave oil were identified. As can be seen, no great qualitative variations were observed in the composition of the flower and leaf essential oils; however, there are considerable quantitative variations in the percentages of some components of the oils. The major components of the oils of the flowers and leaves were *cis*-chrysanthenyl acetate (14.9% and 17.8%), camphor (11.6% and 1.7%), terpinen-4-ol (8.3% and 1.2%), germacrene-D (5.1% and 2.1%), *β*-caryophyllene (4.1% and 5.4%), myrcene (3.6% and 16.9%), bicyclogermacrene (3.5% and 0.9%), *α*-pinene (2.3% and 4.1%), *cis*-*β*-ocimene (2.1% and 4.3%), and isospathulenol (0.4% and 4.3%) respectively.

In spite of the large size of the genus *Anthemis*, the composition of volatile compounds is known in only a small number of species. The main constituents of the flower and leaf oils of *A. xylopoda*, *A. altissima*, and *A. altissima* (L.) var. *altissima* are reported as borneol (31.9% and 30.1%), *β*-caryophyllene (25.3% and 17.2%), and *β*-thujone (19.7% and 33.7%) respectively [5, 11–12]. Santolinatriene (27.3%), 1,8-cineole (7.9%), camphor (19.4%), and *α*-thujone (40.2%) are reported as the major components of the essential oil of *A. melampodina*, *A. tinctoria*, *A. cretia*, and *A. carpatica* respectively [6, 13–15]. Chrysanthenyl acetate, the major component of the oils of *A. hyalina*, was also identified as the major fraction (11.3%) of the oil of *A. montana* [16].

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TABLE 1. Percentage Composition of the Essential Oils of *Anthemis hyalina* DC.

RI	Compound	Flower	Leaf	RI	Compound	Flower	Leaf
856	*trans*-2-Hexenal	0.1	0.2	1230	*cis*-Carveol	0.1	-
882	2-Methyl butyl acetate	0.1	1.9	1265	***cis*-Chrysanthenyl acetate**	**14.9**	**17.8**
927	Tricyclene	0.1	0.3	1279	*trans*-Carvone oxide	0.1	2.1
932	α-Thujene	0.2	Tr.	1288	Bornyl acetate	2.5	0.3
940	**α-Pinene***	**2.3**	**4.1**	1294	*trans*-Sabinyl acetate	0.6	0.5
955	Camphene	1.9	0.3	1317	*trans, trans*-2,4-Decadienal	0.1	-
977	Sabinene	1.3	0.5	1328	*iso*-Dihydrocarveol acetate	1.7	1.4
981	β-Pinene	1.1	1.0	1338	Bicycloelemene	1.6	0.3
993	**Myrcene***	**3.6**	**16.9**	1373	α-Copaene	0.1	0.1
1003	δ-2-Carene	0.1	1.9	1381	β-Bourbonene	0.2	Tr.
1007	α-Phellandrene	1.1	0.9	1388	β-Elemene	0.4	0.2
1013	δ-3-Carene	-	0.6	1396	*n*-Tetradecane	0.2	-
1020	α-Terpinene	1.2	0.2	1416	**β-Caryophyllene***	**4.1**	**5.4**
1028	*p*-Cymene	0.7	0.8	1429	β-Gurjunene	0.1	Tr.
1033	Limonene	0.1	0.2	1451	α-Humulene	1.1	1.6
1035	1,8-Cineole	3.1	0.3	1456	*trans*-β-Farnesene	1.9	0.3
1042	***cis*-β-Ocimene**	**2.1**	**4.3**	1460	β-Santalene	-	0.2
1046	Benzene acetaldehyde	0.1	-	1471	γ-Gurjunene	0.2	0.3
1053	*trans*-β-Ocimene	0.8	1.6	**1478**	**Germacrene D**	**5.1**	**2.1**
1065	γ-Terpinene	2.3	0.6	1487	*cis*-β-Guaiene	0.2	0.2
1071	*cis*-Sabinenehydrate	1.1	0.3	**1491**	**Bicyclogermacrene**	**3.5**	**0.9**
1091	Terpinolene	0.6	0.1	1506	(*E*,*E*)-α-Farnesene	0.5	0.1
1100	*trans*-Sabinenehydrate	0.2	0.8	1521	δ-Cadinene	0.2	0.1
1105	Nonanal	0.7	0.2	1562	*trans*-Nerolidol	0.3	0.8
1117	*trans*-Thujone	0.2	0.3	1574	Spathulenol	1.8	1.2
1128	α-Campholenal	0.3	0.1	1579	Caryophyllene oxide	0.9	2.5
1132	*allo*-Ocimene	0.2	0.3	1597	Guaiol	1.5	3.0
1146	**Camphor***	**11.6**	**1.7**	1602	*n*-Hexadecane	0.4	0.9
1165	Pinocarvone	0.1	0.2	1619	*trans*-Isolongifolanone	0.1	-
1168	Borneol	2.1	0.2	**1633**	**Isospathulenol**	**0.4**	**4.3**
1176	*cis*-Pinocamphone	0.2	0.3	1649	β-Eudesmol	0.5	0.1
1180	**Terpinen-4-ol**	**8.3**	**1.2**	1651	α-Cadinol	0.6	3.3
1193	α-Terpineol	0.4	0.1	1686	*epi*-α-Bisabolol	0.3	1.7
1198	Myrtenol	0.6	Tr.	1701	*n*-Heptadecane	0.6	-
1207	*n*-Decanal	0.1	Tr.	1722	Chamazulene	0.9	0.8
1209	*trans*-Piperitol	0.1	-	1797	*n*-Octadecane	0.1	-

RI: retention indices on HP-5 capillary column.
Tr.: trace (< 0.05%).
*Co-injection with authentic compounds.

EXPERIMENTAL

Plant Material. The flowers and leaves of *A. hyalina* were collected from Ghazvin province (northwest Iran) in May 2004 at an altitude of 1900 m. The plant was identified at the Botany Department of Isfahan University, and a voucher specimen (No. 1148) was deposited at the Herbarium of the Faculty of Pharmacy and Pharmaceutical Sciences, Isfahan University of Medical Sciences, Isfahan, Iran.

Isolation of Essential Oil. Plant material was hydrodistilled in a Clevenger-type apparatus for 3 h according to the method recommended in the British Pharmacopoeia [17]. The essential oil was dried over anhydrous sodium sulfate and stored in sealed vials at 4°C until analysis. The yield of oil was calculated based on dried weight of plant material.

Gas Chromatography. The oil was analyzed on a Perkin-Elmer gas chromatograph Model 8500, equipped with a FID detector and a BP-1 capillary column (30 m × 0.25 mm; film thickness 0.25 μm). The oven temperature was programmed from 60°–280°C at 4°C/min. The carrier gas was nitrogen with a flow rate of 2mL/min. Injector and detector temperatures were 280°C.

GC-MS. Gas chromatography combined with mass spectrometry was used for identification of the components detected. The analysis was performed on a Hewlett-Packard 5972A mass selective detector coupled with a Hewlett-Packard 6890 gas chromatograph, equipped with a HP-5MS capillary column (30 m × 0.25 mm; film thickness 0.25 μm) and operating under the same conditions as described above. The MS operating parameters were: ionization voltage, 70 eV; ion source temperature, 200°C.

Identification of the Components. Identification of components of the oils was based on GC retention indices relative to *n*-alkanes and computer matching with the Wiley 275.L library, as well as by comparison of the fragmentation patterns of the mass spectra with those reported in the literature [18, 19]. Whenever possible, the constituents were matched by co-injection with authentic compounds.

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