Iranian Journal of Pharmaceutical Sciences
2004:1(1): 33-37

Original Article

Composition of the Volatile Oils of Three Different Species of *Artemisia*

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Abstract

The essential oils of the aerial parts of three different *Artemisia* species (*A. scoparia, A. diffusa, A. turanica*) growing wildly in the northeast of Iran were analyzed by GC-MS. Twenty-two, twenty-six, and thirteen components were identified in the essential oils of these plants, respectively. The major constituents of the oil of *A. scoparia* were β-pinene (16.10%), carvacrol (13.81%), limonene (8.82%), *cis*-ocimene (8.38%), methyl eugenol (7.62%), and *trans*-ocimene (7.17%). Camphor (25.5%), 1,8-cineol (25.0%), β-thujone (22.%), and α-thujone (6.0%) were the major components identified in the volatile oil of *A. diffusa*. The main identified compounds in the volatile oil of *A. turanica* were 1,8-cineol (40.94%), *cis*-verbenyl acetate (19.03%) and camphor (11.03%). The identified components and their percentages in the essential oil of three different *Artimisia* species in this study were quite different. Since the chemical composition of the oil depends on various environmental conditions, therefore, these differences can be expected.

Keywords: Artemisia scoparia; Artemisia diffusa; Artemisia turanica; GC-MS; Essential oil.
Received: August 2004; *Accepted:* October 2004

1. Introduction

The large genus *Artemisia* (Compositae) comprising about 300 species is widely distributed in various parts of the world, south west America, South Africa, Europe and mainly Asia [1, 2]. Thirty-four species of these plants are growing wildly in various parts of Iran, including north of Khorasan province, northeast of Iran [3].

The common name of the genus *Artemisia* in Iran is "Dermaneh", but these plants locally called "Terekh" in Khorasan province [3-5]. Most of the *Artemisia* species are medicinal herbs, which have had several uses in the folk medicine all over the world. There are several reports on the pharmacological effects of this herb, i.e. carminative, antipyretic, antiparasitic, anthelmintic, antiseptic, antispasmodic, antimicrobial, anti-inflammatory, appetite-

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stimulating, digestive, funguicidal, emmenagogue, stomachic, vermifuge, vulnerary, and hypnotic [1, 4-6].

The chemical composition of the essential oils and plant extracts of several *Artemisia* species has been the subject of many investigations [7-9]. However, there is no report on the chemical composition of the oils of these plants growing in Khorasan province, northeastern Iran. Since the chemical composition of the volatile oils depends on various environmental conditions and varies from one species to another [10, 11], it was, therefore, of great interest to investigate the chemical constituents of the oils of three different *Artemisia* species, *A. scoparia* Waldst. and Kit, *A. diffusa* Krasch. ex Poljak and *A. turanica* Krasch, growing in this area.

2. Materials and methods

2.1. Plant material

Artemisia scoparia Waldst. and Kit was collected from the campus of Ferdowsi university of Mashhad, Khorasan province, Iran, in August 2003. *Artemisia diffusa* Krasch. ex Poljak and *Artemisia turanica* Krasch were collected from the Marzdaran region (northern Khorasan province, Iran), in November 2002. Professor Ghoraishi Al-Hossainy, Botany Department, Faculty of Sciences, Ferdowsi University, Mashhad, identified the plants. Voucher specimens are deposited in the Herbarium of Ferdowsi University.

2.2. Isolation of the volatile components

The aerial parts of each of the three different *Artemisia* species, (*A. scoparia, A. diffusa and A. turanica*) were collected, air-dried, and powdered. The oils were isolated from powdered plant materials by wet steam distillation for 4 h [26]. The essential oils were separated from the aqueous layer, dried over anhydrous sodium sulfate and were stored in the refrigerator until analyzed.

2.3. Gas chromatography-mass spectrometric analysis

The GC-MS analysis of the essential oils of three different *Artemisia* species *(scoparia, diffusa, turanica)* were carried out on a Varian Saturn 3 GC-MS spectrometer and the oils were analyzed under the following operating conditions: column DB-5, 0.32 mm × 30 m (J & W Scientific); carrier gas, He; flow rate 2 ml/min; oven temperature: 60-240 ºC with rate of 3 ºC/min; injector mode: split injection; ionization mode: electron impact (EI) at 70 eV; interface temperature: 270 ºC; scan range 40-300 u.

The identification of the essential oil components was performed by comparison of their relative retention time (RRT) and their mass spectra with those of authentic samples, literature data [13], and computerized MS-data bank (Saturn, version 4). The peak area method was followed for quantitative determination of different constituents; the percentage was calculated relatively [13].

3. Results

The wet steam distillation of the aerial parts of *Artemisia scoparia, A. diffusa* and *A. turanica*, gave clear yellow oils with a strong characteristic odor. On a dry weight basis, they yielded 0.32% (v/w), 0.28% (v/w), and 0.30% (v/w) of volatile oils, respectively. GC-MS analysis was used for the identification of components of the volatile oils. Twenty-two compounds (Table 1) were identified in the oil of *A. scoparia* (91.7% of the total composition) and twenty-six compounds (Table 2) were identified in the oil of *A. diffusa* (94.43% of the total composition of the oil). In the oil of *A. turanica*, only 13 compounds were identified making up 86.43% of the total composition (Table 3).

4. Discussion

Table 1. Chemical composition of the volatile oil of *Artemisia scoparia.*

Components	Kovats index	Percentage
α-Pinene	938	5.18
Sabinene	978	0.98
β-Pinene	981	16.10
Myrcene	990	5.74
o-Cymene	1018	0.31
Limonene	1028	8.82
cis-Ocimene	1043	8.38
trans-Ocimene	1053	7.17
_-Terpinene	1064	1.88
Terpineol<4>	1173	1.62
α-Terpineol	1187	1.07
Carvacrol	1292	13.81
Eugenol	1360	t
Methyl Eugenol	1395	7.62
β-Caryophyllene	1421	1.02
β-Gurjunene	1478	4.33
Spathulenol	1571	2.79
Globulol	1578	2.09
Viridiflorol	1594	t
_-Eudesmol	1626	1.73
Cadinol (tau)	1642	1.06
α-Bisabolol	1680	t
Total		**91.7**
Grouped compounds		
Monoterpene hydrocarbons		54.56
Oxygen-containing monoterpenes		24.12
Sesquiterpenes hydrocarbons		5.35
Oxygen-containing sesquiterpenes		7.67

t = trace (< 0.1 %)

Table 2. Chemical composition of the volatile oil of *Artemisia diffusa.*

Components	Kovats index	Percentage
Camphene	955	0.28
o-Cymene	1020	0.93
1,8-Cineole	1035	25.00
_-Terpinene	1064	0.22
α-Thujone	1100	6.93
β-Thujone	1110	22.00
trans-Pinocarveol	1135	t
Camphor	1145	25.50
Pinocarvone	1163	0.42
Borneol	1168	2.78
Terpineol<4>	1175	1.10
p-Cymen-8-ol	1181	0.25
α-Terpineol	1186	0.35
Dihydro carveol	1190	0.44
cis-Piperitol	1194	1.05
Estragole	1197	t
Cumin aldehydes	1236	0.38
Carvone	1244	0.35
cis-Verbenyl acetate	1278	0.69
Isobornyl acetate	1281	4.17
Thymol	1287	0.79
trans-Verbenyl acetate	1293	0.25
Carvacrol	1300	0.22
cis-Jasmone	1392	0.85
Spathulenole	1573	0.54
Caryophyllene oxide	1578	0.22
Total		**94.43**
Grouped compounds		
Monoterpene hydrocarbons		1.53
Oxygen-containing monoterpenes		92.59
Sesquiterpene hydrocarbons		-
Oxygen-containing sesquiterpenes		0.76

t = trace (< 0.1 %)

The analysis of the essential oils isolated from aerial parts of *A. scoparia, A. diffusa,* and *A. turanica*, carried out by GC-MS, lead to the identification of different components. The identified compounds and their percentages are listed according to their elution on the DB-5 column given in Tables 1, 2, and 3, respectively. Twenty-two compounds were identified in the oil of *A. scoparia* making up 91.7% of the total composition. Monoterpene hydrocarbons represented the most abundant constituents of the volatile oil of *A. scoparia* (54.56%). The oxygen containing monoterpenoids, identified in the oil of this plant, were 24.12%. The amounts of the sesquiterpenoid hydrocarbons and oxygen containing sesquiterpenoids were both at relatively low levels in the oil of *A. scoparia* (5.35% and 7.67%, respectively). No nonterpenic constituents were detected in the essential oils. The major components in the volatile oil of *A. scoparia* were β-pinene (16.10%), carvacrol (13.81%), limonene (8.82%), *cis*-ocimen (8.38%), methyl eugenol (7.62%) and *trans*-ocimene (7.17%).

Twenty-six compounds were identified in the oil of *A. diffusa,* which represented about 94.43% of the total composition of the oil. In the volatile oil of *A. diffusa,* the oxygen containing monoterpenoids represented

Table 3. Chemical composition of the volatile oil of *Artemisia turanica.*

Components	Kovats index	Percentage
Camphene	956	1.20
p-Cymene	1024	1.84
1,8-Cineole	1036	40.94
Artemisia alcohol	1083	1.36
trans-Pinocarveol	1140	1.10
Camphor	1144	11.03
Terpineol<4>	1180	1.52
cis-Verbenyl acetate	1279	19.03
Isobornyl acetate	1282	0.86
b-Patchoulene	1376	0.75
Methyl Eugenol	1397	0.48
Spathulenole	1579	4.86
Caryophyllene oxide	1584	1.46
Total		**86.43**
Grouped compounds		
Monoterpene hydrocarbons		3.04
Oxygen-containing monoterpenes		76.32
Sesquiterpene hydrocarbons		0.75
Oxygen-containing sesquiterpenes		6.32

the most abundant constituents (92.59%). Monoterpene hydrocarbons, identified in the oil of this plant, were at low level (1.53%). No sesquiterpenoid hydrocarbons were identified in the oil, while oxygenated sesquiterpenoids were at very low level in the oil of *A. diffusa* (0.76%). No nonterpenic constituents were also detected in the essential oil of this plant. However, camphor (25.5%), 1,8-cineol (25.0%), β-thujone (22.0%), and α-thujone (6.93%) were the major components identified in the volatile oil of *A. diffusa*. In the oil of *A. turanica*, only 13 compounds were identified making up 86.43% of the total composition. The major components in the volatile oil of this plant were 1,8-cineol (40.94%), *cis*-verbenyl acetate (19.03%), and camphor (11.03%). The volatile oil of *A. turanica* is very rich in oxygen containing monoterpenoids (76.32%), while it is quite poor in monoterpene hydrocarbons (3.04%). Although there are some oxygenated sesquiterpenoids in the essential oils of this plant (6.32%), there is not a significant amount of sesquiterpenoid hydrocarbons in the oil. No nonterpenic constituents were detected in the essential oils.

The components identified and their percentages from the essential oils of three different *Artimisia* species in this study were quite different. The components identified were also different with previous reports [7, 10]. Since the chemical composition of the essential oils of plants can be influenced by the environmental factors, and it is varied among species, therefore, these differences can be expected.

Acknowledgments

The authors would like to thank the authorities of the Faculty of Pharmacy, Mashhad University of Medical Sciences for its financial support.

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