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Composition of Essential Oils of *Artemisia sieberi* and *Artemisia khorasanica* from Iran

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Abstract: To compare the essential oil composition of the two Artemisia species from Iran, the aerial parts of *A. sieberi* and *A. khorasanica* were collected at flowering stage. The essential oils were obtained by means of hydro-distillation and their chemical components were identified by GC-MS. The main constituents of their essential oils were as follows: *A. sieberi*; β-thujone (19.79%), α-thujone (19.55%), camphor (19.55%) and verbenol (9.69%), *A. khorasanica*; davanone (36.4%), *p*-cymene (16.55%), (*Z*)-citral (8%) and *β*-ascaridol (5.95%).

Key words: *Artemisia sieberi* · *Artemisia khorasanica* · Davanone · Essential oil · α-thujone · β-thujone

INTRODUCTION

The genus *Artemisia* (*Asteraceae*) is the largest and most widely distributed one of the approximately 60 genera belonging to the tribe Anthemideae. This genus comprises a variable number of species, ranging from 200 to over 400, which are predominantly distributed in the northern temperate region of the world in the 0-50 cm precipitation area [1]. Thirty-four genera of them are reported in Iran and some are endemic [2]. *Artemisia khorassanica* Podl. is a common perennial herb growing wild in northeastern parts of Iran and *Artemisia sieberi* is widely distributed in desert area of Iran [2-4]. As reported, some substances from the genus have shown antifungal [5, 6, 7] antimalarial, antiviral, antitumor, antipyretic, antihemorrhagic, anticoagulant, antianginal, antioxidant, antihepatitis, antiulcerogenic, antispasmodic, anticomplementary and interferon-inducing activity [1, 8, 9]. In Iranian folk medicine, some *Artemisia* species are used for their various medicinal properties. Local people used aerial parts of *Artemisia* species for their antiviral and spasmolytic effects [3, 10].

Numerous reports on essential oils composition of different *Artemisia* species, especially on those used in flavor industry and in medication have been published [11, 12]. Essential oil of *Artemisia sieberi* from Semnan province of Iran have been studied previously and the main components were found to be camphor (49.3%), 1, 8-cineole (11.1%) and bornyl acetate (5.8%) (6). Camphor (44%), 1,8-cineole (19%) and camphene (5%) were the main components of the oils of *Artemisia sieberi* from the north of Tehran [13]. According to the previous study essential oils of *Artemisia khorasanica* from Khorasan province of Iran were identified as thirty-one compounds, representing 79.6% of the total oils. The major constituents were 1, 8-cineol (17.7%), camphor (13.9%), davanone (12.2%) and isogeraniol (5.7%) [3]. The aim of this investigation was to study the composition of essential oils of *Artemisia sieberi* and *Artemisia khorasanica* from south of Khorasan province of Iran.

MATERIALS AND METHODS

Plant Material: Aerial parts of *Artemisia sieberi* and *Artemisia khorasanica* were collected on 30 October 2005 at full flowering stage from south of Khorasan province of Iran, Bajestan at an altitude of 1300 m. Plant materials were dried at ambient temperature and shade condition. Voucher specimen has been deposited in herbarium of

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the Faculty of Horticulture and Plant Protection, University of Tehran, Karaj, Iran (Voucher specimen No. for *A. khorasanica* , 1120 and for *A. sieberi* , 1109).

Oil Isolation Procedure: The essential oil of air-dried samples (100 g) of each species was isolated by hydrodistillation for 3 h, using a Clevenger- type apparatus. The distillated oils were dried over anhydrous sodium sulfate and stored in tightly closed dark vials at 4°C until the analysis and tests.

GC Analysis: GC analysis was performed by using a Thermoquest gas chromatograph with a Flame Ionization Detector (FID). The analysis was carried out using fused silica capillary DB-1 column (60 m × 0.25 mm i.d.; film thickness 0.25 ìm). The operating conditions were as follows: Injector and detector temperatures were 250 and 300°C, respectively. Nitrogen was used as carrier gas at a follow rate of 1 ml min^{-1}; split ratio 1:56; oven temperature programmed 60-250°C at the rate of 5°C min^{-1} and finally held isothermally for 10 min.

GC-MS Analysis: GC-MS analysis was performed by using Thermoquest- Finnigan gas chromatograph equipped with above mentioned column and coupled to a TRACE mass quadruple detector. Helium was used as carrier gas with ionization voltage of 70 ev. Ion source and interface temperatures were 200 and 250°C, respectively. Mass range was from m z^{-1} 43- 456. Gas chromatographic conditions were as given for GC.

Identification of Compounds: The constituents of the essential oils were identified by calculation of their retention indices under temperature- programmed conditions for *n- alkanes* (C_6-C_{24}) and the oil on a DB-1 column under the same chromatographic conditions. Identification of individual compounds was made by comparison of their mass spectra with those of the internal reference mass spectra library or with authentic compounds and confirmed by comparison of their retention indices with authentic compounds or with those of reported in the literature [14]. For quantification purpose, relative area percentages obtained by FID were used without the use of correction factors.

RESULTS

Table 1: Percentage of essential oils composition of *A. sieberi* and *A. khorasanica* from Iran

Compound	RI	*A. sieberi*	*A. khorasanica*
Tricyclene	927	0.2	-
α-Pinene	936	2.5	1.7
Camphene	950	3.6	-
Sabinene	971	0.4	0.2
β-Pinene	978	0.3	-
Myrcene	985	0.8	-
α-Phellandrene	1001	0.6	0.4
α-Terpinene	1014	0.3	0.2
p-Cymene	1017	1.2	16.5
1,8-Cineol	1027	5.7	2.0
ã-Terpinene	1053	0.7	0.2
trans-Linalool oxide	1076	0.8	0.3
Linalool	1089	0.5	2.5
Hotrienol	1091	0.2	-
α-Thujone	1096	10.6	0.8
β-Thujone	1108	19.8	0.6
cis-*p*-Menth-1-ol	1113	-	0.2
Camphor	1133	19.5	0/9
Verbenol	1139	9.7	-
p-Mentha-1,5-dien-8-ol	1154	6.4	-
p-Cymene-8-ol	1167	0.2	0.5
4-Terpineol	1170	0.9	0.7
α-Terpineol	1180	1.0	-
Myrtenol	1188	0.2	-
Nordavanone	1211	0.4	0.5
Carvone	1224	0.3	-
(*Z*)-Citral	1225	-	8.0
Geraniol	1235	-	0.4
(*E*)-Citral	1248	-	0.7
cis-Chrysanthenyl acetate	1250	0.7	-
Thymol	1273	-	3.7
Carvacrol	1283	-	0.9
β-Ascaridol	1290	-	5.9
α-Terpinenyl acetate	1338	0.5	-
(*E*)-Methyl cinnamate	1359	-	0.2
Geranyl acetate	1362	-	0.5
(*E*)-Jasmone	1365		0.2
(*Z*)-Jasmone	1377	0.2	3.8
Davanaether	1471	-	0.6
Zingiberene	1490	0.3	1.8
β-Sesquiphellandrene	1519	-	0.4
Davanone	1569	5.8	36.4
Caryophyllene oxide	1584	-	0.4
(*E*)-Sesquilavandulol	1617	0.5	-
4-Hydroxy-3,5-dimethyl acethophenone	1646	-	1.4
β-Davanone-2-ol	1730	-	0.9
Monoterpene hydrocarbons		9.9	19
Oxygenated monoterpenes		78.1	29.7
Sesquiterpene hydrocarbons		0.5	6.8
Oxygenated sesquiterpenes		6.3	39.1
Other		-	0.2
Total		94.8	94.5

RI: retention indices relative to C6-C24 n-alkanes on the DB-1 column; t, trace <0.1%

The oil yields of *A. sieberi* and *A. khorasanica* obtained were 1.4% and 0.6% (w/w), respectively. The essential oil of *A. sieberi* had a pale yellow color and thirty one compounds were identified, making a total of 94.8% of the oil. Oxygenated monoterpenes (78.2%) were found to be present in high concentration. β-thujone

(19.8%), camphor (19.5%), α-thujone (10.6%), verbenole (9.7%), *p*-mentha-1, 5-dien-8-ol (6.4%) and 1, 8- cineole (5.7%) were the major identified compounds (Table 1). The essential oil of *A. khorasanica* had thirty three compounds and was identified making a total of 94.5% of the oil. Oxygenated sesquiterpenes (39.2%) were found to be present in high concentration. Davanone (36.5%), *p*-cymene (16.5%), (*Z*)-citral (8%) and *β*-ascaridol (5.9%) were the major identified compounds (Table 1).

DISCUSSION

The essential oils of *A. sieberi* and *A. khorasanica* were subjected to detailed *GC-MS* analysis in order to determine the variation of their volatile constituents. The main constituents of their essential oils were as follows: *A. sieberi* ; β-thujone (19.79%), α-thujone (19.55%), camphor (19.55%) and verbenol (9.69%), *A. khorasanica* ; davanone (36.4%), *p*-cymene (16.55%), (*Z*)-citral (8%) and *β*-ascaridol (5.95%). β-thujone, camphor, verbenol and 1,8-cineol were previously reported as predominant components in the oil of other Artemisia from Iran [15-18]. As indicated above, there are considerable qualitative and quantitative differences between essential oils composition of *A. sieberi* and *A. khorasanica* in this study, collected from desert area of Khorasan province and those of previously reported from different parts of Iran [3, 13, 15, 19, 20]. In conclusion, chemical differentiation of Artemisia essential oils might be correlated with the genetic composition, geographic origin of populations, ecological conditions in which they grow [21, 22] and even existence of different chemotypes within natural populations of *A. sieberi* and *A. khorasanica* in Iran. As many researches which have been carried out to identification of essential oils and allelochemicals [23, 24], a comprehensive study is necessary for identifying of these chemotypes.

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