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Distribution Profile of Volatile Constituents in Different Parts of *Astrodaucus orientalis* (L.) Drude

Hossein Nazemiyeh[1], Seyed M. Razavi[2], Abbas Delazar[1], Solmaz Asnaashari[1], Nazanin S. Khoi[1], Samira Daniali[1], Lutfun Nahar[3] and Satyajit D. Sarker[4*]

[1]*Research Center for Pharmaceutical Nanotechnology, Faculty of Pharmacy, Tabriz University of Medical Sciences, Tabriz, Iran*

[2]*Department of Biology, Faculty of Science, University of Mohaghegh Ardabili, Ardabil, Iran*

[3]*Drug Discovery and Design Research Division, Department of Pharmacy, School of Applied Sciences, University of Wolverhampton, MA Building, Wulfruna Street, Wolverhampton WV1 1LY, England, UK*

[4]*Department of Pharmacy, School of Applied Sciences, University of Wolverhampton, MM Building, Molineux Street, Wolverhampton WV1 1SB, England, UK*

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Abstract: The volatile oils of stem, umbels, fruits and roots of *Astrodaucus orientalis* (L.) Drude (Apiaceae) growing wild in Iran were obtained by hydro-distillation and analyzed by GC-MS. The main components of the oils from the stem were sabinene (23.1%), α-pinene (16.4%) and fenchyl-acetate (7.5%). Sabinene (25.6%), β-pinene (22.3%) and α-copaene (16.1%) were the main constituents of the volatile oils of the fruits. While α-copanene (26.1%), β–pinene (15.3%) and sabinene (13.7%) were the major components of the volatile oils of the umbels (flowers), that of the roots were mainly composed of anisole (37.9%), bornyl acetate (36.9%) and geranyl tiglate (11.4%).

Keywords: *Astrodaucus orientalis*; Apiaceae; volatile oils; GC-MS.

* Corresponding author: E-Mail: s.sarker@wlv.ac.uk Phone: +44 1902 322578

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1. Introduction

The genus Astrodaucus Drude (family: Apiaceae) is native to Iran, Iraq, Syria and Turkey from temperate Asia, and Ukraine from Eastern Europe [1]. Astrodaucus orientalis (L.) Drude and A. persicus (Boiss) Drude represent this genus in Iran [2-4]. Astrodaucus orientalis, an herbaceous, erect and glabrous perennial with pleasant odour, known as 'Havij-e- kohi' meaning 'mountain carrot', is found widely in different parts of Iran, especially in the fields, slopes and road sides from 350 to 2700 m altitude [5]. This aromatic plant is traditionally used as a salad, vegetable and a food additive in some parts of Iran and Turkey [5, 6]. A survey of the literature revealed that the composition of the aerial parts and seed oils of A. orientalis from two localities of Iran have been reported previously [2, 5], where fenchyl acetate and α-pinene were identified as the main components of the leaf oils, and myrcene and β-pinene in the seed oils. As part of our on-going studies on medicinal plants from the Iranian flora [7-17], we now report on the composition of the volatile oils of the roots and the umbels A. orientalis for the first time, together with the composition of the volatile oils from the fruits and the stems.

2. Materials and Methods

2.1. Plant Material

Plant parts (stems, roots, umbels and fruits) of *Astrodaucus orientalis* (L.) Drude were collected from the campus of Tabriz University during the flowering and fruiting period (June and July 2005) and a voucher specimen (Tbz-FPh.170) was deposited at the herbarium of the Faculty of Pharmacy, Tabriz University of Medical Sciences. The harvested materials were air-dried for one week at room temperature.

2.2 Distillation

The air-dried flowers, fruits, stems and roots (each 100 g) of the plant were subjected to hydro-distillation, separately, for 3 h in a Clevenger-type apparatus to produce the volatile oils, which were dried over anhydrous sodium sulphate and kept in the fridge. The air-dried flowers, fruits, stems and roots of the plant yielded 0.46, 1.12, 0.34 and 0.11 mL of volatile oils, respectively

2.3 GC-MS analysis of the essential oils

The essential oils were analyzed using a Shimadzu GCMS-Qp5050A gas chromatograph-mass spectrometer fitted with a fused methyl silicon DB-5 column (60 m × 0.25 mm i.d., 0.25 μm film thickness). Helium was used as carrier gas at a flow rate of 1 mL/min. The oven temperature was kept at 50 °C for 3 min and programmed to 240 °C at a rate of 3 °C/min and kept constant for 5 min. The injector temperature was 220 °C and split ratio was adjusted at 1:45. The MS were taken at following condition: ionization potential, 70 ev, ion source temperature 200 °C; quadrupole 100 °C; solvent delay 8 min; mass range, em voltage 3000 volts. Identification of compounds was based on direct comparison of the retention times and mass spectral data with those for standard compounds, and computer matching with the NIST NBS54K library, as well as by comparison of the fragmentation patterns of the mass spectra with those reported in the literature [18].

Table 1. Chemical composition of volatile oils obtained from the stems, roots, umbels (flowers) and fruits of *Astrodaucus orientalis*

Peak no.	RI	Compound	Stems	Umbels	Fruits	Roots
1	930	α-Thujene	4. 6	1.1	1.5	-
2	939	α-Pinene	16:4	1.1	1.1	-
3	960	2,4(10)- Thujodien	0.3	-	-	-
4	954	Camphene	0.5	-	-	-
5	968	Verbenene	0.1	-	-	-
6	975	Sabinene	23.1	13.8	25.6	-
7	979	β-Pinene	2.9	15:4	22.3	-
8	991	Myrecene	1.1	1.7	3.3	-
9	1002	δ-2-Carene	1.9	-	0.3	-
10	1017	α-Cymene	-	0.6	-	-
11	1025	*para*-Cymene	3.6	1.1	0.6	-
12	1029	Limonene	1.0	0.5	1.0	-
13	1031	δ–3-Carene	-	0.2	-	-
14	1037	(*Z*)–β-Ocimene	0.7	-	0.2	-
15	1058	Acetophenone	-	-	-	7.2
16	1060	γ-Terpinene	4.1	1.5	0.9	-
17	1070	*cis*-Sabinene hydrate	0.2	0.3	0.7	-
18	1089	Terpinolene	1.0	0.4	-	-
19	1097	Linalool	-	0.4	0.8	-
20	1101	Nonanal	0.2	-	0.3	-
21	1114	β-Thujone	0.3	-	-	-
22	1126	α-Compholenal	0.7	-	-	-
23	1139	*trans*-Ppinocarveol	0.7	0.9	0.2	-
24	1143	*cis*-Sabinol	-	0.4	-	-
25	1177	Terpinen-4-ol	4.8	3.5	1.8	-
26	1184	α-Thujenal	0.4	-	-	-
27	1189	α-Terpineol	0.2	0.7	0.5	-
28	1196	Myrtenol	0.4	0.2	1.2	-
29	1196	Myrtenal	0.6	2.9	-	-
30	1202	*n*-Decanal	0.1	-	-	-
31	1220	endo-Fenchyl acetate	7.5	4.4	3.7	6.6
32	1235	Anisole	0.3	-	-	37.9
33	1242	Cuminal	0.3	-	-	-
34	1289	Bornylacetate	1.0	0.6	0.3	36.9
35	1327	(2*E*,4*E*)-2,4-Decadiene	0.2	0.2	-	-
36	1351	α-Cubebene	-	0.5	0.4	-
37	1371	α -Copaene	0.9	28.1	16.1	-
38	1388	β -Bourbonene	0.2	-	0.2	-
39	1419	β -Caryophynene	0.3	1.6	1.7	-
40	1435	α -Bergamotene	0.6	-	-	-
41	1455	α -Humulene	0.2	-	0.6	-
42	1485	α -Amorphene	0.2	-	-	-
43	1485	Germacrene-D	1.1	2.0	3.7	-
44	1490	β -Selinene	0.2	-	-	-
45	1514	γ -Cadinene	0.12	-	-	-
46	1523	δ-cadinene	-	5.9	1.9	-

Table 1 continued

47	1578	Spathulenol	0.5	-	0.3	-
48	1583	Caryophyllene oxide	0.6	1.0	0.3	-
49	1647	Cubenol	-	1.4	-	-
50	1651	β -Eudesmol	2.1	-	-	-
51	1654	α - Eudesmol	1.2	-	-	-
52	1694	Geranyl tiglate	-	-	-	11.4
		Monoterpenes	62.8	37.5	57.7	0
		Oxygenated Monoterpenes	17.6	14.5	9.9	43.5
		Sesquiterpens	3.6	38.1	24.5	0
		Oxygenated Sesquiterpenes	4.5	3.4	0.6	11.4
		Phenol	0.3	-	-	45.2
		Total identified	88.0	93.6	92.7	100

3. Results and Discussion

Table 1 presents the comparative list of compounds identified in the oils from different parts of *A. orientalis* by the GC-MS analyses. The major components present in the stem volatile oils were sabinene (23.1%), α -pinene (16.34%) and fenchyl acetate (7.5%) and that of the volatile oils of umbels (flowers) were α -copaene (26.1%), α -pinene (15.3%) and sabinene (13.7%). In the fruits oil, the main components were sabinene (25.6%), α -pinene (22.3%) and α-copaene (16.1%). Anisole (37.0%), bornyl acetate (36.9%) and geranyl tiglate (11.4%) were identified as the principal components of the volatile oils of the roots. Monoterpene hydrocarbons were predominantly present in the essential oils of stems (62.7%), umbels (37.5%) and fruits (57.6%), while in the root oils, phenolic compounds were dominant and no monoterpenes were detected.

Fenchyl acetate and bornyl acetate, which are the oxygenated monoterpenes, were found in the all parts of the plant. It was interesting to note that the distribution profile of the components of the essential oils of the stems, the fruits and the umbels of *A. oriantalis* was quite similar, especially with respect to the occurrence and quantity of sabinene, α -pinene, β-pinene, myrecene, *para*-cymene, terpineol-4, fenchyl acetate and germacerene D (Table 1). On the other hand, there were considerable variations in the chemical profiles of the volatile oils of the aerial parts and roots. Phenolic compounds like anisole and acetophenone were not present in the volatile oils of the aerial parts, but they were found in the volatile oils of the roots.

Comparison of the results of the present study with those reported from other localities in Iran [2,6] revealed considerable differences in the quantity of major constituents of the essential oils. While sabinene (23.1%), α-pinene (16.4%) and exo-fenchyl acetate (7.5%) were the main compounds in the samples collected from the northwest of Iran, the plant materials harvested in the north and central parts of Iran yielded oils having the main constituents α-pinene (32.7% and 21.6%) and fenchyl acetate (14.5% and 21.6%). It is not unusual to have such variations in the composition of the essential oils of plants resulting from geographical differences, growing conditions and variations in climate.

Previous studies on the another Iranian species, *A. persicus*, revealed the presence of α-pinene (56.4%) and fenchyl acetate (25.1%) as the main components [4]. On the basis of the present findings as well as the findings from previous studies, it is reasonable to state that α-pinene and fenchyl acetate could be used as chemotaxonomic markers within the species of the genus *Astrodaucus*, at least two Iranian species, *A. persicus* and *A. orientalis.*

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