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Original Article

Chemical Composition of the Essential Oils of *Peucedanum ruthenicum* M. Bieb. Leaves, Flowers and Fruits

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Abstract

The essential oils of *Peucedanum ruthenicum* M. Bieb. (Umbelliferae) leaves, flowers and fruits were prepared by hydrodistillation and analyzed by GC and GC-MS and the composition of the three essential oils were compared. Thirty-three, thirty-seven and thirty-one compounds were identified in leaves, flowers and fruits essential oils representing 89.13%, 88.66% and 76.45% of total oils respectively. The major components were thymol (18.29%), ß-bisabulene (13.29%) for leaves oil, ß-myrcene (10.68 %) and germacrene-B (10.06%) for flowers oil and caryophyllene oxide (13.65%), 8, 9-dehydroisolongifolene (11.33%) and 1, 8-cineol (11.15%) for fruits oil. The amounts of monoterpens and sesquiterpenes were found nearly to be equal in oils of the three parts of plant.

Keywords: *Peucedanum ruthenicum*; Umbelliferae; essential oil; GC- MS.

Introduction

In Iran, the genus *Peucedanum* (Umbelliferae) is represented by 4 species: *P. glaucopruinosum*, *P. knappii*, *P. translucens* (1) and *P. ruthenicum*, which grows wild in different regions of Iran (2). *P. ruthenicum* is a native Bulgarian Umbellifer (3) and is a glabrous perennial plant with abundant fibers; stem cylindric, striate, solid; leaves 3(-4)-ternate, lobes 20-90 mm; rays 7-28; bracts 1-3, subulate; bracteoles several, filiform; petals pale yellow; fruit 6-7.5 mm in dry places (4). The plant was collected for the first time from Arak (Markazi province) centre of Iran (2). Some species of this genus have been used traditionally in treatment of cold (5), cough due to pathogenic wind-heat, accumulation of phlegm and heat in the lung (6). They have also been used as anti-tussive, anti-asthma and a remedy for angina (7).

Previous studies on these species have shown the presence of furanocoumarins and glycoside derivatives, linear-type furanocoumarin glucosides and simple coumarin glucosides (8, 9). Several new coumarins such as qianhucoumarin I have been reported from *P. praeruptorum* Dunn. (10).

A phytochemical examination of *P. ruthenicum* has shown the presence of peucedanin (furanocoumarin) and peuruthenicin (a new coumarin) in the roots and rutin (flavonol glycoside) in the flowers (3). There were some reports related to the chemical analysis of volatile oil of this genus in the literature. The major components of herb and rhizome essential oil of *P. ostruthium*

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were sabinene (35.2%), 4-terpineol (26.6%), β-caryophyllene (16.1%) and α-humulene (15.8%) (11). The major constituents of *P. verticillare* leaf and branch oil were sabinene and trans-anethole and β-caryophyllene, α-Phellandrene, cis-β-farnesene and β-bisabolene were components of *P. verticillare* dried fruit oil and sabinene was the constituent of *P. verticillare* fresh fruit oil (12). The oils constituents from rhizomes, leaves and fruits of *P. petiolare* (DC.) Boiss. have been studied, the major constituents of rhizome oil were found to be β-bisabolene (31.3%), (E)-sesquilavandulol (20.5%), geranyl acetate (5.7%), citronellyl acetate (5.2%) and sabinene (5.2%); the main components of leaf oil were sabinene (42.3%), α-pinene (42.6%) and limonene (2.6%) and in the fruits, α-pinene (47.3%) and sabinene (45.9%) were the predominant constituents (13). In another study, essential oil of the aerial parts of *P. petiolare* (DC) Boiss. has been analyzed and among the ten components (97.6%) which identified in this oil, sabinene (57.8%) and δ-3-carene (36.2%) were found to be the major constituents(14). The mian components of water distilled essential oil of *P. scoparium* were α-Pinene (39.6%), β-pinene (23.9%) and β-phellandrene (9.5%) (15). The component of *P. ruthenicum* essential oil was not reported previously. In this paper comparison of the essential oils composition of *P. ruthenicum* leaves, flowers and fruits is reported.

Experimental

Plant Material and Isolation Procedure

The *P. ruthenicum* was collected during August to October 2003 from Arak (Markazi province) in Iran and voucher specimen was deposited in the private herbarium of Dr. H. Akhani (hb. Akh.15487) Plant Science Department of Tehran University, Iran.

The plant's different parts were dried at ambient temperature in the shade. The leaves (150g), flowers (120g) and fruits (120g) were subjected to hydrodistillation using a Clevenger-type apparatus for 4 h (16) and the oils were dried over anhydrous sodium sulfate and stored at 2-8ºC.

Identification of the Oil Components

The analysis of the essential oils was performed using a Hewlett Packard 6890 GC equipped with a HP-5MS capillary column (30m x 0.22 mm i.d., 0.25 μm film thickness) and a mass spectrometer 5973 from the same company, for GC-Mass detection with an electron ionization system (70 eV) was used.

Helium was the carrier gas, at a flow rate of 1ml/min., injector and detector temperatures were set at 250 and 290ºC respectively, column temperature was initially kept at 60ºC for 5 min. then gradually increased to 220ºC at the rate of 6ºC/min. Retention indices were calculated by using retention times of *n*-alkanes that were injected after the oil at the same chromatographic conditions. The compounds were identified by comparison of retention indices (RRI, DB-5) with those reported in the literature and by comparison of their mass spectra with the Wiley library or with published mass spectra (17, 18, 19).

Results and Discussion

The results of GC and GC-MS analysis of the essential oils of *P. ruthenicum* are presented in Table 1. The color of essential oils of leaves, flowers and fruits were pale green, pale yellow and yellow in the total yields of 0.4%, 1.6%, 1.8% (*v/w*) , respectively. The leaves, flowers and fruits oils of *P. ruthenicum* contained (34.87%), (50.21%), (43.22%) monoterpenes and (43.57%), (38.45%), (39.67%) sesquiterpenes respectively.

A total of 33 components were identified in leaf oil, representing (89.13%), the major constituents were thymol (18.29%) and β-bisabulene (13.29%). In the oil of flowers, 37 components were identified; representing (88.66%); β-myrcene (10.68%) and germacrene-B (10.06%) were the main components. Twenty four compounds were found in fruits oil, representing (76.45%) of the total oil, caryophyllene oxide (13.65%), 8, 9-dehydroisolongifolene (11.33%) and 1,8-cineol (11.15%) were the major compounds. Comparisons of the major components of the three oils showed some differences among them (Table 1). The oil from leaves is characterized by high contents of thymol (18.29%) and β-

Table 1. The percentage composition of the essential oils from *Peucedanum rutenicum* M. Bieb. different parts.

No	Compounds Name	Leaves%	Flower%	Fruits%	[a]RRI
1	α-Thujene	-	0.36	-	934
2	α-Pinene	0.64	5.49	0.46	943
3	Camphene	-	0.19	0.04	957
4	Sabinene	-	8.65	0.05	981
5	β-Pinene	6.05	5.41	0.12	985
6	β-Myrcene	0.83	10.68	-	999
7	α-Phellandrene	-	3.11	-	1008
8	α-Terpinene	0.09	-	0.13	1021
9	o-Cymene	2.07	-	-	1025
10	p-Cymene	-	6.21	0.89	1028
11	β-Phellandrene	0.26	6.69	0.38	1029
12	Limonene	-	-	0.109	1031
13	1,8-Cineole	-	-	11.15	1034
14	trans-β-Ocimene	-	0.13	0.86	1051
15	γ-Terpinene	1.43	0.15	0.25	1064
16	p-Tuleol	2.42	-	-	1072
17	α-Terpinolene	-	0.65	-	1086
18	Linalool	0.25	-	-	1100
19	Octen-3-yl acetate	2.09	-	-	1110
20	Camphor	-	-	5.86	1139
21	4-Terpineol	-	1.32	4.87	1169
22	α-Terpineol	-	0.31	-	1175
23	Ethyl-dimethyl-thiophen	8.69	-	-	1179
24	α-Phellandrene epoxide	-	0.45	-	1182
25	cis-Dihydrocarvone	-	-	0.89	1194
26	trans-Carveol	-	-	3.97	1214
27	cis-Carveol	-	-	6.88	1226
28	Carvone	-	-	5.61	1240
29	3-Methoxy p- cymene	2.1	-	-	1243
30	Carvacrol methyl ether	0.46	-	-	1247
31	Bournyl acetate	-	0.23	-	1286
32	Thymol	18.29	-	-	1292
33	δ-Eelemene	-	1.79	-	1241
34	α-Longipinene	2.32	-	-	1354
35	Cyclosativene	0.88	-	-	1368
36	α-Yelangene	3.92	-	-	1372
37	α-Copaene	0.21	-	-	1375
38	β-Bourbonene	0.84	0.22	-	1386
57	trans-β-Elemene	0.29	1.64	-	1390
39	Tetradecane	-	-	0.71	1402
40	α-Cedrene	0.3	-	-	1418
41	trans-β-Caryophyllene	4.67	4.14	-	1420
42	γ-Elemene	-	4.83	-	1430
43	α-Bergamotene	0.28	-	-	1437
44	α-Guaiene	-	0.24	-	1440
45	3,7-Guaiadiene	-	0.33	-	1443
46	α-Humulene	-	1.41	-	1452
47	trans-β-Farnesene	4.95	0.78	-	1456
48	γ-Gurjunene	-	0.62	-	1470
49	γ-Curcumene	0.67	-	-	1475
50	Germacrene D	-	1	-	1477
51	δ-Selinene	-	0.25	-	1480
52	ar- Curcumene	0.6	-	-	1482
53	β- Selinene	5.47	0.51	-	1484
54	β-Ionone	-	-	0.68	1486

Table 1. The percentage composition of the essential oils from *Peucedanum rutenicum* M. Bieb. different parts. (Continued)

55	Sinularane	-	1.57	-	1490
56	α- Selinene	-	1.21	-	1495
57	α-Zingiberene	0.38	-	-	1498
58	β-Himachalene	1.32	-	-	1501
59	γ- Selinene	-	0.53	-	1503
60	β-Bisabulene	13.29	-	-	1508
61	δ-Cadinene	1.04	-	-	1520
62	trans-γ-bisabulene	0.7	-	-	1530
63	8,9-Dhydroisolongifolene	-	-	11.35	1545
64	Lepidozene	-	1.58	-	1552
65	Germacrene B	-	10.06	0.45	1560
66	Eremophyllene	-	0.21	-	1571
67	α-Copaene-8-ol	-	2.74	-	1583
68	Caryophyllene oxide	1.42	1.61	13.65	1585
69	Valerenol	-	0.44	-	1655
70	Farnesol (Z-E)	-	-	1.18	1700
71	Caryophylla-4(12),8(13)-dien-5-β-ol	-	-	5.19	1704
	Hydrocarbon monoterpenes	11.37	47.7	2.91	
	Oxygenated monoterpenes	23.5	2.51	40.33	
	Hydrocarbon sesquiterpenes	42.15	32.9	12.48	
	Oxygenated sesquiterpenes	1.42	5.55	20.02	
	Nonterpenes	10.78	-	0.71	
	Unknown	10.87	11.34	23.55	
	Total identified	89.13	88.66	76.45	

[a] RRI: relative retention indices as determined on a HP-5 column using the homologous series of n-alkanes

bisabulene (13.29%), which do not exist in flowers and fruits oil. In addition, caryophyllene oxide is a major component of fruits oil (13.65%) and the minor component of the leaves (1.42%) and the flowers oil (1.61%). *8, 9*-Dehydroisolongifolene (11.33%) and 1, 8-cineol (11.15%) are the major components of fruits oil which do not exist in leaves and flowers oil.

There are some differences between the components of *P. ruthenicum* and *P. verticillare* fruit essential oils; caryophyllene oxide, 8,9-Dehydroisolongifolene and 1,8-cineol were the major components of *P. ruthenicum* but β-caryophyllene, α-phellandrene, cis-β-farnesene and β-bisabolene were the main constituents of the fruit oil of *P. verticillare*.

The major compounds of leaf oil of *P. verticillare* were sabinene, trans-anethole and of *P. petiolare* were sabinene, alpha-pinene and limonene whereas leaf oil of *P. ruthenicum*, thymol and β-bisabulene were the main compounds.

In conclusion it seems that the components of *P. ruthenicum* and other Peucedanum oils are similar but the major compounds of them are different.

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