

Chemical composition of essential oil of *Prangos ferulacea* (L.) Lindl. roots

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Water-distilled essential oil from *Prangos ferulacea* (Umbelliferae) roots was analysed by GC–MS for the first time. Fifty-three components comprising 96.3% of the total oil were identified, of which δ -3-carene (22.5%), β -phellandrene (11.8%), α -pinene (8.6%), terpinolene (7.2%), p-cymene (6.3%), α -phellandrene (6.2%) and myrcene (4.5%) were found to be the major components. The oil of *P. ferulacea* roots consisted of 16 monoterpene hydrocarbons (78.4%), 17 oxygenated monoterpenes (9.4%), 12 sesquiterpene hydrocarbons (5.3%) and three oxygenated sesquiterpenes (1.0%). Five nonterpenic compounds also comprised 2.2% of the oil. Thus, the oil of *P. ferulacea* roots was characterized by a high content of monoterpenes (87.8%), whereas sesquiterpenes comprised only 6.3% of the essential oil.

Key words: *Prangos ferulacea*, Umbelliferae, essential oil composition, δ -3-carene, β -phellandrene

INTRODUCTION

The genus *Prangos* (Jashir in Persian), which belongs to the Umbelliferae family, consists of about 30 species [1]. Fifteen species of the genus *Prangos* are found in Iran, of which five are endemic [2]. Some of *Prangos* species are used in traditional medicine as emollient, carminative [3], tonic, anti-flatulent, anthelmintic, antifungal and antibacterial agents [4, 5].

Components of the genus *Prangos* include various coumarins, alkaloids, flavonoids, terpenoids and γ -pyrone

derivatives [6–9]. Some of the isolated coumarins showed anti-HIV activity [10].

Prangos ferulacea (L.) Lindl. is a plant found in the Mediterranean and Middle-East regions. Regarded as high-energy forage, aerial parts of *P. ferulacea* are usually used as animal fodder in Iran and some other countries [11]. There are some reports on the antioxidant and antibacterial activities of *P. ferulacea* [12, 13].

The composition of essential oil of the aerial parts and fruits of *P. ferulacea* has been investigated earlier [13–15]; however, the available information indicates that the essential oil of *P. ferulacea* roots has not been the subject of any study, and this paper is the first report of this kind.

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EXPERIMENTAL

Plant material

P. ferulacea roots were collected from Yasouj in the Kohgiluyeh-Boirahmad province in June 2010 at an altitude of ca. 1800 m above sea level. The plant was identified at the Botany Department of Yasouj University, and a voucher specimen (No. 2408) was deposited at the Herbarium of the School of Pharmacy and Pharmaceutical Sciences, Isfahan University of Medical Sciences, Isfahan, Iran.

Isolation of the oil

Crushed dry roots of *P. ferulacea* were subjected to hydrodistillation for 3 h, using a Clevenger-type apparatus, according to the method recommended in the British Pharmacopoeia [16], and the resulting oil was subsequently dried over anhydrous sodium sulfate.

GC/MS analysis

Gas chromatography combined with mass spectrometry was used for the identification of the components. 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). The oven temperature was programmed from 60 to 280 °C at 4 °C/min. Helium was used as the carrier gas at a flow rate of 2 mL/min. The injector and detector temperature was 280 °C. The MS operating parameters: ionization voltage 70 eV, ion source temperature 200 °C.

Identification of the oil components was based on GC retention indices relative to *n*-alkanes and computer matching with NIST and Wiley275 libraries, as well as by comparison of the fragmentation patterns of the mass spectra with those reported in the literature [17, 18].

RESULTS AND DISCUSSION

The air-dried roots of *P. ferulacea* yielded 0.2% of essential oil. Fifty-three components, comprising 96.3% of the total oil, were identified in *P. ferulacea* roots. The list of the compounds identified in the oil sample is presented in Table. The main components were δ -3-carene (22.5%), β -phellandrene (11.8%), α -pinene (8.6%), terpinolene (7.2%), p-cymene (6.3%), α -phellandrene (6.2%) and myrcene (4.5%).

The essential oil composition of some *Prangos* species fruits has been reported earlier [19–24]; however, there are few reports on their root oil composition. δ -3-Carene, the main oil constituent of *P. ferulacea* roots (22.5%), has been reported as the major component of *P. denticulate* root oil [25]. According to the results of our study, spathulenol, the major component of *P. latiloba* roots (29.5%), was not detected in the root oil of *P. ferulacea* [26].

The chemical constituents of *P. ferulacea* fruit essential oil have been reported elsewhere [13]. Chrysanthenyl acetate

Table. Essential oil composition of *Prangos ferulacea* roots

No	Compound	RT	KI	Percentage
1	Hexanal	2.08	802	0.4
2	<i>n</i> -Hexanol	2.77	867	t
3	Tricyclene	3.61	926	t
4	Thujene	3.69	930	0.7
5	α-Pinene	3.85	940	8.6
6	Camphene	4.10	953	2.6
7	Sabinene	4.57	977	3.6
8	β -Pinene	4.64	980	1.0
9	Myrcene	4.93	993	4.5
10	α-Phellandrene	5.33	1007	6.2
11	δ-3-Carene	5.48	1014	22.5
12	α -Terpinene	5.56	1021	t
13	p-Cymene	5.75	1030	6.3
14	β-Phellandrene	5.90	1034	11.8
15	<i>cis</i> - β -Ocimene	6.02	1041	0.2
16	<i>trans</i> - β -Ocimene	6.26	1051	0.2
17	γ -Terpinene	6.56	1062	3.0
18	Terpinolene	7.37	1090	7.2
19	Fenchol	8.00	1115	0.1
20	p-Mentha-2-en-1-ol	8.23	1121	0.2
21	<i>cis</i> -p-Mentha 2,8 diene-1-ol	8.62	1136	0.2
22	Terpinene-1-ol	8.74	1139	0.3
23	Camphor	8.93	1146	0.2
24	4-Vinylanisol	9.11	1152	0.2
25	Isoborneol	9.25	1158	0.2
26	p-Mentha 1,5 diene-8-ol	9.37	1166	0.6
27	Menthol	9.53	1169	0.4
28	Terpinene-4-ol	9.88	1176	1.3
29	m-Cymen-8-ol	10.05	1181	0.8
30	p-Cymen-8-ol	10.14	1183	0.7
31	Pulegone	11.78	1238	0.3
32	Carvacrol methyl ether	11.91	1244	t
33	Piperitone	12.22	1252	0.4
34	<i>cis</i> -Chrysanthenyl acetate	12.46	1261	0.3
35	Bornyl acetate	13.28	1285	3.2
36	β -Elemene	16.56	1388	0.4
37	<i>cis</i> - α -Bergamotene	17.25	1411	0.2
38	β -Cedrene	17.51	1420	0.9
39	<i>trans</i> - α -Bergamotene	17.85	1433	0.2
40	Aromadendrene	18.17	1442	0.3
41	<i>trans</i> - β -Farnesene	18.52	1455	0.7
42	<i>cis</i> -Muurola-4(14),5-diene	18.87	1465	0.5
43	ar-Curcumene	19.27	1481	0.2
44	Zingiberene	19.66	1491	0.4
45	β -Bisabolene	20.05	1503	0.9
46	β -Sesquiphellandrene	20.47	1519	0.5
47	<i>trans</i> - γ -Bisabolene	20.70	1527	0.1
48	Carotol	22.52	1591	0.9
49	Himacholol	24.08	1648	t
50	α -Bisabolol	25.02	1680	0.1
51	Cyclopentadecanolide	26.11	1720	0.7
52	Oxacycloheptadecan-2-one	31.19	1928	0.6
53	Osthol	35.99	2135	0.5
	Total			96.3

t = trace (<0.05%). RI = retention indices on HP-5MS capillary column. Percentages calculated from TIC data.

(26.5%), limonene (19.6%), α -pinene (19.5%), δ -3-carene (6.6%), mesitaldehyde (6.1%) and germacrene B (3.6%) were the main components of the fruit oil. As one can see in Table, δ -3-carene (22.5%) and α -pinene (8.6%) are also the major components of *P. ferulacea* root oil. However, chrysanthenyl acetate, which is the most abundant component of the oil of fruits, was found only in trace amounts (0.3%) in *P. ferulacea* roots.

CONCLUSIONS

The oil of *P. ferulacea* roots contained 16 monoterpene hydrocarbons (78.4%), 17 oxygenated monoterpenes (9.4%), 12 sesquiterpene hydrocarbons (5.3%) and three oxygenated sesquiterpenes (1.0%). Five nonterpenic compounds were also present (2.2%) in the oil. Thus, the oil of *P. ferulacea* root was characterized by a high content of monoterpenes (87.8%), whereas sesquiterpenes comprised only 6.3% of the essential oil.

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PRANGOS FERULACEA (L.) LINDL. ŠAKNŲ ETERINIŲ ALIEJŲ CHEMINĖ SUDĖTIS

S a n t r a u k a

Prangos ferulacea šaknų eteriniai aliejai buvo distiliuoti vandens garais ir pirmą kartą tirti dujų chromatografijos–masių spektrometrijos metodu. Identifikuoti 53 komponentai, bendrai sudarantys 96,3 % aliejaus. Tarp jų vyrauja δ -3-karenas (22,5 %), β -felandrenas (11,8 %), α -pinenas (8,6 %), terpinolenas (7,2 %), p-cimenas (6,3 %), α -felandrenas (6,2 %) ir mircenas (4,5 %).