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Chemical composition and antimicrobial activity of essential oil of *Prangos ferulaceae* (L.)Lindl from Iran

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ABSTRACT

The hydrodistilled essential oils of fruits and umbels of *Prangos ferulaceae* (L.)Lindl growing in Iran were analysed by GC/MS. Six compounds, comprising 93.7 and 94.7% of the total fruits and umbels oils were identified, respectively. α-Pinene and cis- ocimene are the major components of the oils. The essential oils show high antibacterial effect against *Bacillus cereus*.

KEYWORDS

Prangos ferulaceae;
Essential oil;
α-Pinene;
Cis-ocimene;
Bacillus cereus.

INTRODUCTION

Prangos Lindl is a perennial genus of the Apiaceae distinguished by the presence of winged fruits[5]. The genus is represented by 30 species in the world. 15 species exist in Iran of which 4 are endemic[14].

Prangos species are widely used in folk medicine as tonic, anti flatulent, anti hemorrhoids and for treatment of intestinal worms[6] and treatment of leukoplakia[16].

Prangos ferulaceae (l.) Lindl is the most widespread species of the genus in Iran where named as Djashir.

Essential oil composition of aerial parts[15] and fruits[2-4,8,12,15] have previously been investigated. In previous reports, we described chemical composition of the essential oils of the umbels and fruits of *P. uloptera* [9,10] and *P.scabra*[9,10]. As a part of our ongoing research on the *prangos* genus, in the present work, we report on *P.ferulaceae* fruits and umbels oil. This is the first time that essential oil composition of umbels and antimicrobial activities of the plant have been studied.

EXPERIMENTAL

Plant material

Prangos ferulaceae flowering tops and fruits were collected from Miyaneh (Nashag village) in East Azerbaijan Province in May and July 2005 at an altitude 1726 m.; 37ˀ,40', 57" ; 47ˀ,40', 54" . The voucher specimen has been deposited in the herbarium of the Faculty of sciences, university of Mohaghegh- Ardabili, Ardabil, Iran.

Isolation of the essential oil

Air dried fruits and flowers were crushed and subjected to water distillation for 3 h using a Clevenger apparatus and the resulting oils were subsequently dried over anhydrous sodium sulfate and stored at 4^0C in dark.

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GC-MS Analysis

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 thicknesses). Helium was used as carrier gas at a flow rate of 0.7 mL/min. The oven temperature was kept at 60^{0}C for 5 min and programmed to 280^{0}C at a rate of 3^{0}C/min and then kept constant for 5 min. The injector temperature was 280^{0}C and split ratio was adjusted at 1:67. The MS were taken at following condition: ionization potential ,70 eV; ion source temperature, 280^{0}C; quadrapole 100^{0}C; solvent delay, 3 min; mass range, 25.200 amu; Em voltage; 3000 volts. Identification of compounds was based on direct comparision of the retention times and mass spectral data with those for standard compounds, and computer matching whith the NIST NBS54K Library, as well as by comparision of the fragmentation Patterns of the mass spectra with those reported in the literature[1].

Antimicrobial bioassay

The antibacterial and antifungal activities of the essential oils were determined against *Escherichia coli* (PTCC 1047), *Staphylococcus epidermis* (PTCC 1114), *Bacillus cereus* (ATCC 10876), *Pseudomonas aeroginosa* (ATCC 27853) and *Candidia kefyr* (ATCC 38296) by the disc diffusion method[7]. Muller-Hinton agar (MHA) (oxid) and sabouraud dextrose agar (SDA) was used to bacterial and fungal strains respectively. The filter paper discs (6mm in diameter) were individually impregnated with 10 μl of the oils and then placed onto the agar plates which had previously been inoculated with the tested microorganisms. The plates were inoculated with bacteria incubated at 37°C for 24 h and at 30°C for 48h for fungal strains. The diameters of inhibition zones were measured in millimeters. All the tests were performed in duplicate. Gentamaicin (30μg) served as positive control.

RESULTS AND DISCUSSION

The air-dried fruits and umbels of *Prangos ferulaceae* yielded 0.8% and 0.5% pale green oil, respectively. TABLE 1 summarizes the identified compounds, their retention times, percentage composition and kowats indices.

TABLE 1: Composition of the essential oils of *Prangos ferulaceae* (L.) Lindl

No.	Compound	KI	Amounts,%		Rt(min)	
			Fruits	Umbels	Fruits	Umbels
1	α- Pinene	939	63.1	42.2	17.4	17.5
2	Sabinene	975	1.2	0.5	19.5	19.5
3	β- Pinene	979	8.3	2.3	19.8	19.8
4	Myrecene	991	4.8	5.0	20.3	20.3
5	α- Phellanderen	1003	0.3	2.0	21.2	21.2
6	Para- Cymene	1025	1.1	0.5	22.3	22.3
7	Limonene	1029	1.5	-	22.5	-
8	β- Phellandrene	1030	-	3.3	-	22.7
9	Cis- Ocimene	1037	9.7	36.3	22.8	22.9
10	γ- Terpinene	1060	0.6	0.4	24.2	24.2
11	Terpinolene	1089	0.4	0.6	25.9	25.9
12	Cis- Verbenol	1141	0.5	-	29.0	-
13	β-Caryophyllene	1419	0.2	0.6	43.3	43.3
14	α- Humulene	1455	1.1	-	44.8	-
15	Germacrene D	1485	0.9	-	46.0	-
16	Zingiberene	1495	-	1.0	-	45.6
	Total identified		93.7	94.7		

TABLE 2: Chemical class distribution of the essential oil components of *Prangos ferulaceae*

Compound class	% Area		Number of compounds	
	Fruits	Umbels	Fruits	Umbels
Monoterpens	93.1	96.4	11	11
Monoterpenoids	0.5	-	1	-
Sesquiterpens	2.2	1.9	3	3

16 components were identified in the oils from fruits and umbels (flowers), respectively. The main components of fruits oil were α-pinene(63.1%), cis-ocimene (9.7%) and β-pinene(8.3%), wherease in umbels, the main components were α-pinene(42.2%), cis-ocimene (36.3%) and myrecene(5%).

Monoterpene hydrocarbons dominated the chemical composition of the investigated oils. The sesquiter pens and monoterpenoides are present in very small quantities. Sesquiterpenoides and phenols are absent in the essential oils (TABLE 2). While β- phellandrene and zingiberene were present in umbels oil, they were not found in fruits oil. Similarly, limonene, verbenol, humulene and germacrene D were only present in the fruits oil, but not in the umbels oil.

Results from the antimicrobial assay are summarized in TABLE 3. The data indicated that Grame-positive *Bacillus cereus* was the most sensitive strain to the fruits and umbels oils of *Prangos ferulaceae* with inhibition zone of 15 mm. The oils also exhibited modest activities against *E.coli, S.epidermidis, P.aeruginosa* and *C.kefyr*, with inhibition zone of 9-12mm.

The GC-MS result obtained with the fruits oil in

TABLE 3: Antimicrobial activity of the essential oil of fruits and umbels of *Prangos ferulaceae*, by the disc diffusion method

Microorganism	Essential oil inhibition zone (mm)		Gentamicin inhibition zone (mm)
	Fruits	Umbels	
Bacillus cereus	15	15	31
Escherichia coli	9	9	21
Staphylococcus epidermidis	10	9	33
Pseudomonas aeruginosa	12	12	19
Candida kefyr	11	12	-

TABLE 4: Majour components of fruits oil of some species of Prangos genus

Species / compound	PU	PP	PF	PC	PUe	PA	PH	PT	PB
α-Pinene	14.9	33.8	63.1	-	6.1	10.5	+	+	+
β-Pinene	1.6	1.8	8.3	.1	3.2	1.5	+	+	+
Limonene	-	1.1	1.5	0.3	-	+	+	-	+
Sabinene	-	-	1.2	-	4.8	-	+	+	-
β-Pinene	-	0.6	9.7	-	4.6	-	-	-	+
β- Elemene	-	-	-	23.3	-	-	-	-	-
Germacrene D	2.7	0.4	0.9	0.4	1.1	5.4	+	+	42
Germacrene B	7.2	-	-	5.1	1.5	0.3	+	+	+
β- Bisabolene	1.2	-	-	-	-	-	+	-	-
γ- Cadinene	-	-	-	9.9	1.7	4.2	-	-	10.9
γ- Terpinene	-	-	0.6	-	0.5	0.5	+	+	+
Terpinolene	-	-	0.4	-	1.1	-	+	+	-
β-Carypphyllene	-	0.5	0.2	9.2	0.7	+	-	-	+
β- Farnesene	-	-	-	16.2	0.3	-	+	+	-
α-Copaene	4.03	-	-	-	0.3	-	-	-	-
Phellanderene	4.8	-	0.3	-	6.3	14.6	-	-	-
α-Humulene	7.7	-	1.1	1.6	0.6	7.8	+	+	-
Spathulenol	4.1	9.3	-	4.9	1.8	+	+	+	+
β- Burbonene	7.8	0.8	-	-	-	+	-	-	-
Para- Cymene	7.7	-	1.1	-	10.9	-	+	+	-
Δ-3-Carene	-	-	-	-	1	16.1	-	-	-
α- Cadinole	-	-	-	-	1.3	1.6	-	-	-
Myrecene	0	-	4.8	-	1.4	-	+	+	+

PU=*P. uloptera*, PP=*P. pabularia*, PF=*P. ferulaceae*, PC=*P. coryombosa*, PUe= *P. uechtritzii*, PA=*P. asperula*, PH=*P. heyniae*, PT=*P. turcica*, PB=*P. bornmeuelleri*

this study was considerable different from other previously published results where the main components of fruits oil were reported to be: β-pinene(33.0%) and α-pinene(10.1%) in a sample from Fasham in Iran[15]; γ-terpinene(30.22%) and *α*-pinene(16.7%) in a sample from Turkey[2-4,12]; β-ocimene(26.8%) and γ-terpinene (27.8%) in a sample from Italy[8]. Thus, it is assumed that *P.ferulaceae* could have different chemotypes. On the other hand, observed differences in the composition of fruit essential oil could be depended on climatic or edaphic factors.

There are many reports on the essential oils of the fruits of different prangos species[2-4,9-12]. TABLE 4 presents the major component of the fruits oil of 9 Prangos species. As it can be seen, α-pinene, β-pinene and germacrene D are the common components of Prangos genus fruits. On the other hand, α-pinene and β-pinene were found in relatively high amount in the fruits oil of Prangos genus, thus can be considered as characteristic compound in the genus.

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