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Essential Oil Composition and Traditional Use of *Prangos ferulacea* (L.) Lindl. (Apiaceae) Fruit and Leaves

Şükrü Hayta[1]*, Emel Akbaba[2]

[1]Bitlis Eren Üniversitesi, Mühendislik ve Mimarlık Fakültesi, Çevre Mühenlisliği Bölümü, Bitlis, Türkiye
[2]Fırat Üniversitesi, Fen Fakültesi, Biyoloji Bölümü, Elazığ, Türkiye

Abstract *Prangos ferulaceae* which is quite common in the Nemrut Caldera, declared as the Ramsar area in Bitlis Province, Turkey was collected from the natural habitats. Using the hydrodistylation method, the yield of essential oil was determined as 0.5% (v/w) in the fruits, and 0.6% (v/w) in the leaves. Essential oil analyzes of the fruits and leaves of this species were made by GC/GC-MS. In total, 47 and 29 components were determined as 94.4% and 93.4% of the oil, respectively. In fruit essential oil, β-elemene 26.9%, β-phellandrene 18.9%, α-terpinolene 14.2%, and α-phellandrene 9.7%, while in leave essential oil β-elemene 48.9%, α-terpinolene 14.6%, and ethylbenzene 9.7% were found as the major compounds. In addition, quantitative and qualitative differences were found in the essential oil composition in different parts of this species. Furthermore, this plant is widely used in livestock in Van and Bitlis provinces, while it is also consumed as vegetable. In addition to cooking, the brine is also made. Local people call this plant as "Heliz". The brine is cooked with egg and a dish with a local name as "cag" is made.

Keyword: *Prangos ferulacea*, Apiaceae, Essential oil, β-elemene.

Introduction

Prangos Lindl. (Umbelliferae) is represented with about 30 species around the world and distributed in different centers of Iran-Turan phytogeographic region. Among these species, *P. ferulacea* Lindl., *P. pabularia* Lindl., *P. trifida* (Mill.) Herrnst. & Heyn have wide range of distribution. All of the remaining species; are clustered around 2 centres: Western region consisting most of species (from Turkey to Western Iran, including Syria) and eastern region (eastern Iran, from Afghanistan to Central Asia) [1-2]. *Prangos ferulacea* is highly consumed as food, especially in Eastern Anatolia and Erzurum. The leaves are stored as brine and consumed as vegetables [3]. In addition, before flowering time, aerial parts of the plant, are putin cheese and other dairy products to give a nice smell [4]. The herbs which are known by the local names as sirmo (*Allium* sp.), Mendi (*Chaerophyllum macropodum* Boiss.), Helis (*Prangos ferulacea*) and siyabo (*Ferula rigidula* DC.) are put in the cheese, known as "otlu peynir". It is stated that these herbs are effective in the ripening of cheese as well as giving different taste, smell and aroma to cheese [5]. According to the results of a study,*P. ferulacea* is a good source of food for animals with containinghigh energy [6].

Chart 1. The list of *Prangos* Lindl. taxons distributed in Turkey [1,7-12].

	Endemics		Non-endemics
1	*Prangos denticulata* Fisch. & Mey.	12	*Prangos acaulis* (DC.) Bornm
2	*Prangos heyniae* H. Duman & M.F. Watson	13	*Prangos corymbosa* Boiss.
3	*Prangos meliocarpoides* Boiss. var.	14	*Prangos meliocarpoides* Boiss. var. *arcis*

	meliocarpoides		*romanae (*Boiss. & Huet) Herrnstadt &Heyn
4	*Prangos platychloena* Boiss. subsp. *platychloena*	15	*Prangos ferulacea* Lindl.
5	*Prangos platychloena* Boiss. subsp. *engizekensis* H. Duman & M.F. Watson	16	*Prangos peucedanifolia* Fenzl
6	*Prangos scabrifolia* Post & Beauverd	17	*Prangos uloptera DC.*
7	*Prangos uechtritzii* Boiss. & Hausskn. (?)	18	*Prangos pabularia* Lindl.
8	*Prangos turcica* A. Duran, M. Sağıroğlu & H. Duman	19	*Prangos papillaris* (Boiss) Menemen
9	*Prangos ilanae* Pimenov, Akalın & Kljuykov		
10	*Prangos hulusii* S.G. Şenol, H. Yıldırım & Ö. Seçmen		
11	*Prangos scabra* Nabelek (suspicious species, not-known well)		

The Umbellifera is rich in furanocumarins and isoprene-bearing compounds which are secondary metabolites[13-14]. Various coumarins, alkaloids, flavonoids and terpenic compounds were has been isolated from *Prangos* species [15]. The first chemical study on this genus was carried out in 1939. In this study, the essential oils obtained from fresh parts of *P. pabularia* were analyzed and their compounds were determined [16]. In the following studies, different compounds were isolated from *Prangos* species. Although the studies began with obtaining essential oil, the second study was carried out in 1970, and most studies focused on coumarin compounds, the other important group consisted in *Prangos*. In addition, in the 1960s, some flavonoids [17] as well as fatty acids in the fixed oil derived from the seeds were analyzed [18].

Materials and Methods

Plant source: The materials (leaves and fruits) belonging to *Prangos ferulacea* were obtained from the specimen collected from Natural Habitats in Bitlis, Turkey. Samples are stored at the Firat University Herbarium (FUH) for ready reference.

Obtain of the essential oils: Air-dried plant materials (100 g/ each) were used in this study. Clevenger-type apparatus was selected to obtain the essential oil. This procedure took 3 hours to yield.

Gas chromatographic (GC) analysis: The GC analysis was carried out by HP 6890, supplied with FID detector and a column type HP-5 MS (30 m × 0.25 mm i.d., film thickness 0.25 μm). Fort he analysis, same column and same conditions were used in GC and GC-MS. The quantitative of each compound was calculated from GC-FID peak areas without correction factors.

Gas chromatography/mass spectrometry (GC-MS) analysis: Hewlett Packard system was used to analyze the essential oils in HP-Agilent 5973 N GC-MS system. The chemical analysis was carried out in Plant Products and Biotechnology Res. Lab. (BUBAL) in Firat University. Helium was used as the carrier gas. The temperature of injector was 250 ºC, the injection was performed in splitless mode. The precedure was as follow: At the beginning, 70 ºC was the temperature of the oven. After staying 2 minutes in this temperature, it was increased to 150 ºC (increasing rate was 10 ºC/min.). Then, it was allowed to be stable at 15 ºC for15 min before increased to 240 ºC (increasing rate was 5 ºC/min.).For the calculation of retention indices (RI) n-alkanes were used as references. Identification of the components was done by comparing their mass spectra with mass spectra in WILEY and NIST libraries.

Results and Discussion

Using the hydrodistillation method, the yield was obtained as 0.5% (v/w) in the essential oil of the fruits, and 0.6% (v/w) in the essential oil of the leaves. Essential oil analyzes of the fruits and leaves of this species were made by GC/GC-MS system. In total, 47 and 29 components were determined as 94.4% and 93.4% of the total oil derived from fruits, and the total oil derived from the leaves, respectively. In the fruit essential oil, β-elemene (26.9%), β-

phellandrene (18.9%), α-terpinolene (14.2%), and α-phellandrene (9.7%), while in the leave esential oil β-elemene (48.9%), α-terpinolene (14.6%) and ethylbenzene (9.7%) were determined as the major components.

The first studies on the essential oils of *Prango*ssamples from Turkey goes back to 1996. In the mentioned study, the essential oils obtained from crushed and non-crushed fruits of *P. ferulacea* by water distillation were analyzed by GC and GC/MS. In total 23 components were found, constituting 93.83% of the essential oil of the crushed fruits and 85.32% of the essential oil of the non-crashed fruits. The essential oils of crushed and not crushed fruits were determined as rich in γ-terpinene (30.22% and 33.27%) and α-pinene (16.71% and 12.83%). After the first distillation, non-crashed fruits were crashed and distilled again. This procedure let the essential oil to be recovered. The major components of essential oil derived from this distillation were found as germacrene B (30.3%) and γ-terpinene (17.17%) [19]. As a result of our analysis, α-pinene was found to be 4.1% while γ-terpinene was found in trace amounts in the fruit essential oil of of *P. ferulacea*. Germacrene B, on the other hand, was not detected in the essential oil of fruits or leaves.

In 1998, the seeds and aerial parts of *P. ferulacea*, which was naturally grown in Iran, were obtained by using the water vapor distillation method and characterized by GC and GC/MS system. While the oil yield was 2.33% in the aerial parts, and 30 compounds were determined in the essential oil of the aerial parts, the seed oil yield was 0.84% and only 20 compounds were determined in the essential oil the seeds. The main compounds in the essential oil of the aerial parts were β-pinene (22.9%) and Δ-3-carene (16%). The main compounds of the essential oil of seeds were determined as β-pinene (33%) and α-pinene (10.1%) [20]. The major compounds obtained in our results are not show similarity to the major compounds obtained in this study. But β-pinene and α-pinene were detected in trace amounts. The compounds found in the essential oil obtained from mature fruits of *P. ferulacea* grown in Italy were investigated in 1987. The essential oil yield of these fruits is 1.4%. In essential oil α-pinene (4.1%), sabinene (2.8%), β-pinene (0.5%), *p*-cymene (6.9%), *cis*-β-o-cymene (26.8%), γ-terpinene (27.8%), terpinolene (0.7%), 4-terpineol (12.2%), trimethylbenzaldehyde (1.2%) and β-humulene were determined [21]. The findings of our study show similarities with this study.

Sajjadi and Mehregan, in 2003, found the major compound of essential oil obtained from *P. uloptera*, *P. latilopa* and *P. ferulaceae* fruits as α-pinene (% 41.9, % 25.1 ve % 16.7) respectively. In the same study the major compound of *P. uechtritzii* fruit essential oil was determined as δ-cimene (10.9%).

We speculate the factors affecting our results as locality difference, climate conditions, and soil structure.

Table 1: Essential oil composition of *Prangos ferulaceae* leaves

No.	Compounds	RI	%
1	Ethylbenzene	970	9.7
2	*p*-Xylene	975	3.4
3	Cumene	1013	0.2
4	α-Pinene	1021	0.1
5	Sabinene	1051	0.1
6	β-Pinene	1055	0.1
7	β-Myrcene	1063	0.1
8	α-Phellandrene	1077	0.2
9	*o*-Cymene	1091	1.7
10	D-limonene	1094	0.3
11	β-Phellandrene	1096	2.3
12	*cis*-Ocimene	1099	0.1
13	*trans*-β-ocimene	1107	0.5
14	α-Terpinolene	1137	14.61
15	Undecane	1147	0.1
16	Crypton	1209	0.1
17	*m*-Cymene	1215	0.1

18	*n*-Decanal	1221	0.1
19	Bornylacetate	1281	0.1
20	Anisyl acetone	1360	5.3
21	β-Elemene	1371	48.91
22	Tetra decanal	1385	0.5
23	1-Undecanol	1429	0.1
24	β-Ionone	1432	0.1
25	α-Cucumene	1434	0.1
26	β-Bisabolene	1451	0.1
27	Dodecanoic acid	1484	0.1
28	1.Isopropyl-5 methylbicyclo(3.2.2)non-3-en-2-one	1498	4.21
29	Tetradecanol	1514	0.1
	Total	**93.4**	

Table 2: Essential oil composion of *Prangos ferulaceae* fruits

No.	Compounds	RI	%
1	Ethyl benzene	970	3.2
2	*p*-xylene	975	1.1
3	Benzene-1,3 dimethyl	991	0.4
4	Nonane	995	0.1
5	Benzene 1-methyl-ethyl	1013	0.1
6	α-Thujene	1015	0.1
7	α-Pinene	1022	4.1
8	Camphene	1034	0.2
9	Sabinene	1051	0.3
10	β-Pinene	1055	0.3
11	β-Myrcene	1064	0.6
12	α-Phellandrene	1078	9.7
13	α-Terpinene	1085	0.1
14	*p*-Cymene	1092	5.1
15	β-Phellandrene	1099	18.9
16	β-Ocimene	1107	0.7
17	γ-Terpinene	1116	0.1
18	α-Terpinolene	1139	14.2
19	Undecane	1147	0.1
20	1.3,8-Para menthatriene	1156	0.1
21	*p*-Menth-2-en-1-ol	1165	0.1
22	4-Terpineol	1205	0.1
23	Crypton	1209	0.2
24	*Trans*-carveol	1230	0.1
25	*p*-Mentha 1.5 dien-7-ol	1272	0.1
26	Phellandral	1276	0.1
27	Carvacreol	1296	0.1
28	*p*-Vinyl guaiacol	1304	0.1
29	Methyl cumate	1357	0.1

30	*cis*-Methyl isoeagenol	1360	3.1
31	β-Elemene	1373	26.91
32	Tetra-decanal	855	0.1
33	Thymohydro gunane dimethyl ether	855	0.1
34	Cedrene	855	0.1
35	*trans*-Caryophyllene	855	0.1
36	Cedr-8-ene	855	0.1
37	α-caryophyllene	855	0.1
38	γ-Curcumene	1431	0.2
39	β-Cubebene	1434	0.3
40	δ-Cadinene	1451	0.1
41	Spathulenol	1494	0.1
42	1-Isopropyl-5 methylbicyclo(3.2.2)non-3-en-2-one	1498	1.8
43	α-Cadinol	1538	0.1
44	Acorenone 13	1556	0.1
45	γ-Cadinene	1559	0.1
46	*n*-Hexadecanoic acid	1691	0.2
47	Osthol	1800	0.3
	Total		**94.4**

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