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GC/MS Analysis of the Essential Oils from Aerial parts of *Prangos Latiloba Korov.* Collected in Northeast Iran

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Abstract

Hydrodistilled volatile oils from crushed dry aerial parts of *Prangos latiloba Korov*. (Umbelliferae) growing wild in Sabzevar (Iran), were analyzed by GC and GC/MS. Twenty one compounds constituting 84.9% of the oil from the aerial parts have been identified. The main components of aerial parts oil were geranial (26.8%), methyl chavicol (22.8%) and neral (22.6%).

Keywords: *Prangos latiloba Korov*., Essential oils; GC/MS; Geranial

Introduction

The genus *Prangos* consists of about 30 species [1]. In Iran, fifteen species of this Umbelliferae family plant exist, of which five are endemic: *P. gaubae, P. calligonoides, P. cheilanthifolia, P. tuberculata and P. crossoptera* [2]. Other species of this genus are found in Central Asia, Anatolia and Caucasia, as well as in Iran [2]. In Persian, the *Prangos* genus is called *Jashir*, with *Jashir gachdost* being the common name for *Prangos latiloba Korov*. The essential oil composition of various *Prangos* species has been the subject of several investigations during the past decade [3-21]. Some *Prangos* species have been reported to have medicinal properties, including use as an emollient, as well as having carminative [22], antifungal and antioxidant [23], antibacterial and cytokine release inhibiting [24] and anti-HIV activities [25].

Experimental

Plant material

The plant material was collected at flowering stage in May 2012 near Sabzevar in Khorasan Province, Iran, at an altitude of 1650 m. A voucher specimen (No. 217) was identified in Research Institute of Forests and Rangelands (RIFR), Tehran and it has been deposited in the herbarium of Research Center of Natural Resources, Sabzevar, Iran.

Geographical coordinates and climates of Sabzevar

Sabzevar (latitude: 36°15'N, longitude: 57°40'E) is bounded in the north and south elevations of Alborz mountain. East and north areas of the city are mountainous with temperate climate and south areas of the city are lowland parts with warm weather. Average minimum and maximum temperature in May is 15 and 30°C.

Essential oil isolation

Air-dried aerial parts of *Prangos latiloba Korov* (100 g) were subjected to hydrodistillation in a Clevenger-type apparatus for 3 h to produce oils. The oils were dried over anhydrous sodium sulfate and stored in sealed vials at 4°C before analysis.

GC analysis

GC analysis was performed using a Shimadzu GC-9A gas chromatograph, equipped with a HP-5MS fused silica column (30 m×0.25 mm i.d., film thickness 0.25 μm). The oven temperature was held at 50°C for 5 min and then programmed to 250°C at a rate of 3°C / min. The injector and detector (FID) temperatures were 290°C. Helium was used as carrier gas with a linear velocity of 32 cm/s.

GC/MS analysis

GC/MS analysis was carried out on a Hewlett-packard 6890 gas chromatograph fitted with a fused silica HP-5MS capillary column (30 m×0.25 mm; film thickness 0.32 μm). The oven temperature was programmed from 60 to 220°C at 6°C /min. Helium was used as carrier gas at a flow rate of 1 ml/min. The chromatograph was coupled to a Hewlett-Packard 5973 mass selective detector with an ionization voltage of 70 eV.

Qualitative and quantitative analyses

Constituents of the volatile oils were identified by comparison of their retention indices relative to C9-C21 n-alkanes and of their mass spectral fragmentation pattern with those reported in the literature [26], and stored in a MS library (Wiley 275). The quantification of the components was performed on the basis of their GC peak area data from the HP-5MS column separation.

Results and Discussion

Table 1 summarizes the results of earlier studies on species of *Prangos* and includes the plant name, the method of isolation of volatiles, the main constituents of the oils of each species studied and the part of the plant studied. Because of the variable results obtained in these studies, and as a part of on-going work on the chemical analysis of oils obtained from the wild plants of Iran, we decided to re-investigate the oils of one of these species, *Prangos latiloba Korov* (Umbelliferae) from Sabzevar (Iran),. In this work, hydrodistilled volatile oils from the crushed dry aerial parts of *P. latiloba* were studied by GC and GC/MS. The air-dried aerial parts of the plant yielded 0.27% (w/w) oil. The oil was clear and yellowish. Twenty one components were identified in the aerial parts oil that contains 84.9% of the compounds. Table 2 lists percentages and retention indices of identified compounds in the oils. As can be seen, the main components found are geranial (26.8%), methyl chavicol (22.8%) and neral (22.6%). However, according to the results of our previous study [13] on volatile oils of stems, leaves and roots, γ-cadinene (30.39%), spathulenol (29.5%), germacrene D (27.79%) and α-pinene (25.47%) are the major components of different parts of *Prangos latiloba Korov*.

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Ref.	Country	Plant Parts	Main components (%)	Plant name
[3]	Turkey	fruits	**HDCH method**[a]: α-humulene (11.0%), germacrene D (10.6%), naphthalene (8.5%), terpinolene (7.9%) and bornyl acetate (6.9%), γ -elemene (5.1%), 1,6-germacradien-5β-ol (4.7%), α-pinene (4.3%), p-cymene (4.2%) **MSD-SPME method**[b]: germacrene D (9.2%), naphthalene (8.7%), bornyl acetate (8.2%), α-humulene (7.1%), γ -elemene (6.7%), terpinolene (5.0%), p-cymen-8-ol (4.8%), p-cymene (4.5%), spathulenol (4.2%) **MD method** [c]: p-cymene (12.7%), terpinolene (11.2%), α-pinene (9.9%), naphthalene (7.9%), γ -terpinene (7.3%), α-humulene (7.9%), germacrene D (6.2%)	*P. turcica*
[4]	Iran	aerial parts	**HDCH method**: β-elemene (22%), spathulenol (12.5%) [d] **HDCH method**: β-elemene (40.7%) and kessane (10.7%)[e]	*P. coryombosa*
[5]	Iran	Leaves Stems flowers	**HDCH method**: linalool (36.7%), caryophyllene oxide (16.3%) and α-pinene (12.1%) **HDCH method**: 1,8-cineole (19.0%) and alpha-pinene (10.3%) **HDCH method**: linalool (19.0%), lavandulyl acetate (16.0%), 1,8-cineole (14.5%), α-pinene (12.4%) and geranyl isobutyrate (12.2%)	*P. ferulacea*
[6]	Iran	aerial parts	**HDCH method**: α-pinene (13.6%), limonene (12.9%) and myrcene (8.1%), β-pinene(5.4%), δ-3-carene(25.5%), α-terpinolene(14.8%), caryophylene (3.0%) and γ-curcumene (2.6%)	*P. acaulis*
[7]	Turkey	fruits roots	**HDCH method**: sabinene (26.1%) and p-cymene (19.7%) **HDCH method**: δ-3-carene (49.3%), (Z)-3,5-nonadiyne-7-ene (20.4%)	*P. denticulata*
[8]	Iran	aerial parts	**HDCH method**: α-pinene (13.6%), limonene (12.94%), myrcene (8.1%), β-pinene (5.4%), δ-3-carene (25.54%), α-terpinolene (14.76%), caryophylene (2.98%) and γ-curcumene (2.65%)	*P. asperula*
[9]	Turkey	fruits	**HDCH method**: α-Humulene (16.6%), bicyclogermacrene (16.1%), spathulenol (10.6%), germacrene D (5.7%) and α-pinene (4.2%) **MD method**: α-Humulene (15.5%), bicyclogermacrene (7.9%), spathulenol (5.7%), germacrene D (2.9%), α-pinene (23.9%)	*P. pabularia*
[10]	Iran	umbels fruits	**HDCH method**: α-pinene (31.8%), β-bourbonene (15.9%), α-curcumene (10.7%), spathulenol (9.00%) and m-cymene (5.51%) **HDCH method**: α-pinene (15.0%), β-bourbonene (7.81%), α-humulene (7.74%), germacrene B (7.23%) and n-tetracosane (6.65%)	*P. uloptera*
[11]	Iran	aerial parts	**HDCH method**: cis-sesquisabinene hydrate (25.6%), α-pinene (12.5%)	*P. acaulis*
[12]	Turkey	aerial parts	**HDCH method**: δ-3-Carene (3.39%), p-cymene (3.38%)	*P. platychlaena*
[12]	Turkey	aerial parts	**HDCH method**: α-pinene (40.8%), nonene (17.0%), β-phellandrene (11.1%), δ-3-carene (7.39%), p-cymene (4.90%)	*P. uechtritzii*
[13]	Iran	stems leaves roots	**HDCH method**: γ-cadinene (30.4%), α-pinene (25.5%), sabinene (12.6%) **HDCH method**: germacrene D (27.8%), α-pinene (17.8%), β-caryophyllene (12.8%) and β-pinene (11.2%) **HDCH method**: spathulenol (29.5%), 1,8-cineol (19.4%), p-cymene (17.0%) and α-bisabolol (15.3%)	*P.latiloba*
[14]	Iraq	flowers leaves	**HDCH method:** α-pinene (35.58%), β-pinene (22.13%), and α-phellandrene (12.54%) **HDCH method:** m-cresol (50.38%)	*P. peucedanifolia*
[15]	Iran	aerial parts	**HDCH method:** δ-3-carene (32.1%), α-pinene (16.8%), camphene (4.1%) **MA-HS-SDME** [f]**:** δ-3-carene (26.3%), α-pinene (15.4%), camphene (2.7%)	*P. uloptera*
[16]	Iran	aerial parts	**HDCH method:** β-phellandrene (20.4 %), α-terpinolene (15.3 %), α-pinene (11.6%), δ-3-carene (11.1 %), α-phellandrene (9.1 %), trans-β-ocimene (9.7 %)	*P. ferulacea*
[17]	Iran	leaves flowers	**HDCH method:** β-Pinene (29.6 %), α-pinene (19.8 %), δ-3-carene (11.4 %), β-phellandrene (11.1 %) **HDCH method:** β-pinene (20.6 %), α-pinene (8.8 %), δ-3-carene (10.4 %), β-phellandrene (8.1 %)	*P. ferulacea*
[18]	Iran	aerial parts	**HDCH method**: α- pinene (57.0%)[d] **HDCH method**: (E)-anethol (95.5%)[e]	*P. ferulacea*
[19]	Iran	leaves fruits umbels	**HDCH method**: spathulenol (16.1%), α-bisabolol (14.30%) **HDCH method**: α-pinene (33.9%) **HDCH method**: α-pinene (21.5%)	*P. pabularia*
[20]	Iran	aerial parts	**HDCH method**: β-carryophyllene (26.4 %), δ-3-carene (6.1 %), linalool (5.7 %), α-phellandrene (5.3 %), p-cymene (5.2 %), camphene (5.1 %), α-pinene (3.7 %)	*P. serpentinica*
[21]	Iran	root	**HDCH method**: δ-3-carene (22.5%), β-phellandrene (11.8%), α-pinene (8.6%), terpinolene (7.2%), p-cymene (6.3%), α-phellandrene (6.2%), myrcene (4.5%)	*P. ferulacea*

[a] hydrodistillation with conventional heating; [b] micro-steam distillation – solid-phase microextraction; [c] microdistillation; [d] in the vegetative phase; [e] during flowering, [f] microwave-assisted headspace single-drop microextraction

Table 1: Main components of essential oils from different species of *Prangos* genus found in earlier studies

The GC and GC/MS analysis method revealed several monoterpenoid hydrocarbons (MH), oxygenated monoterpenes (OM), sesquiterpenoid hydrocarbons (SH), oxygenated sesquiterpenes (OS) and nonterpenoid hydrocarbons (NH) in the oil from the aerial parts of *Prangos latiloba Korov*. Two monoterpene hydrocarbons (0.5%), four oxygenated monoterpene (49.9%), nine sesquiterpene hydrocarbons (5.9%), one oxygenated sesquiterpene (4.1%) and five nonterpene hydrocarbons (24.5%) were detected in this oil. These data lead to a rank order of constituent groups: OM>NH>SH>OS.NH for the aerial parts oil. The main components in this oil were geranial (26.8%), methyl chavicol (22.8%) and neral (22.6%). A comparison of these results with those from our previous study on volatiles of *Prangos latiloba Korov*., which was done with plants from the same location but different altitude (400 m) showed some differences. In our previous investigation, the hydrodistilled volatile oils from stems, leaves, and roots (but not flowers) of *Prangos latiloba Korov*. were found to contain primarily γ-cadinene (30.4%), α-pinene (25.5%), sabinene (12.6%) in the stems; germacrene D (27.9%), α-pinene (17.8%), β-caryophyllene (12.8%) and β-pinene (11.23%) in the leaves; and spathulenol (29.5%), 1,8-cineol (19.42%), p-cymene (17.03%) and α-bisabolol (15.33%) in the roots [13] .

As can be seen from the above data, there are significant differences in the results of the two studies for the different parts of *P. latiloba*. These discrepancies are not entirely unexpected since hydrodistillation relates to the interactions of the oil constituents with water vapor. Of course, there may also be differences related to environmental conditions such

No	Name	Molecular formula	Class	KI (Lit) [b]	Percentage
1	limonene	$C_{10}H_{16}$	MH [c]	1029	0.2
2	α- thujone	$C_{10}H_{16}$	MH	1102	0.4
3	methyl chavicol	$C_{10}H_{12}O$	NH [d]	1196	22.8
4	neral	$C_{10}H_{16}O$	OM [e]	1238	22.6
5	piperitone	$C_{10}H_{16}O$	OM	1252	0.2
6	geranial	$C_{10}H_{16}O$	OM	1267	26.8
7	α-cubebene	$C_{15}H_{24}$	SH [f]	1348	0.6
8	α-copaene	$C_{15}H_{24}$	SH	1377	0.4
9	β -cubebene	$C_{15}H_{24}$	SH	1388	0.4
10	methyl eugenol	$C_{11}H_{14}O_2$	NH	1403	0.7
11	β-caryophyllene	$C_{15}H_{24}$	SH	1419	2.2
12	α-humulene	$C_{15}H_{24}$	SH	1454	1.6
13	trans-β-farnesene	$C_{15}H_{24}$	SH	1456	0.2
14	trans-β-ionone	$C_{13}H_{20}O$	OM	1488	0.3
15	β-bisabolene	$C_{15}H_{24}$	SH	1505	0.2
16	cis-α-bisabolene	$C_{15}H_{24}$	SH	1507	0.2
17	δ-cadinene	$C_{15}H_{24}$	SH	1522	0.1
18	caryophyllene oxide	$C_{15}H_{24}O$	OS [g]	1583	4.1
19	isobutyl phthalate	$C_{16}H_{22}O_4$	NH	1877	0.6
20	methyl palmitate	$C_{17}H_{34}O_2$	NH	1925	0.2
21	n-hexadecanoic acid	$C_{16}H_{32}O_2$	NH	1964	0.2
	Total percentage				84.9

[a]The compounds have been arranged according to retention indices relative to C9-C21 n-alkanes on an HP-5MS capillary column
[b] Kovatz retention indices given in the literature
[c] Monoterpene hydrocarbons
[d] Nonterpene hydrocarbons
[e] Oxygenated monoterpene
[f] Sesquiterpene hydrocarbons
[g] Oxygenated sesquiterpene

Table 2: Composition of volatiles from the aerial parts of *Prangos latiloba Korov*. obtained by Hydrodistillation[a]

as climate, altitude, collection time and ground composition of the sampling area.

Conclusion

The chemical composition of the essential oil of aerial parts from *Prangos latiloba Korov*. growing in Sabzevar was investigated. This study showed considerable amounts of geranial (26.8%), methyl chavicol (22.8%) and neral (22.6%). These major constituents were different from our previous study on the same species [13]. These results indicate that the chemical composition of the essential oil of the same species can change depending on a variety of conditions. Comparing these results with those of an earlier study, we know that the altitude of plant collection was different, but other factors can be important, including climate, time of collection and the ground composition of the sampling area and also variability in the hydrodistillation method.

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