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Original article

Assessment of chemical composition of essential oil of *Ferula assa-foetida* oleo-gum-resin from two different sites of Yazd province in center of Iran

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Abstract

In this experiment, the chemical composition of the essential oils obtained from *Ferula assa-foetida* oleo-gum resin collected from two different sites of Yazd province (Tabas and Yazd) in the center of Iran, were identified. The gas chromatography mass-spectroscopy (GC/MS) data showed that the qualitative composition of the components appeared to be constant in two different regions. Moreover, no remarkable variations were found in the amounts of the essential oil major constituents. A total thirty-nine components, comprising 91.52% and 95.61% of the total oil, were characterized in Tabas and Yazd samples, respectively. The hydrodistilled oils contained E-1-propenyl *sec*-butyl disulfide (40.15 and 44.36% in Tabas and Yazd samples, respectively), Z-1-propenyl *sec*-butyl disulfide (23.93 and 27.98%), Guaiol (5.50 and 3.14%) and Carotol (5.14 and 1.63%) as major constituents.

Keywords: essential oil, *Ferula assa-foetida,* GC/MS, oleo-gum resin

Introduction

The genus *Ferula* (Apiaceae) is represented by about 140 species in the Mediterranean area and Central Asia [1]. *Ferula assa-foetida* (known by its Persian name "Anghozeh") is a species of *Ferula* which grows in Iran, Afghanistan and Kashmir. It is an herbaceous and perennial plant that grows up to 2 m high [2].

The principal fractions of the Iranian *F. assa-foetida* are gum (glucose, galactose, L-arabinose, rhamnose and glucuronic acid, etc.), resins (ferulic acid esters, free ferulic acid, coumarin derivatives) and volatile oils (sulphur-containing compounds and various monoterpenes) [3].

The oleo-gum resin is obtained from the exudates of rhizomes of *F. assa-foetida* which is used for commercial purposes. *F. assa-foetida* has been used as a folk phytomedicine for the treatment of different diseases such as asthma, epilepsy, flatulence, intestinal parasites, weak digestion and influenza [4-6].

The aim of the present study was to investigate the essential oil profile of *F. assa-foetida* oleo-gum resins from two different sites of Yazd province for the first time and to compare the chemical compositions of the both samples with the results reported in similar studies.

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Experimental

Plant material and oil isolation

The oleo-gum resins were prepared from rhizomes of cultivated plants in two different sites of the central part of Iran: Yazd and Tabas in July 2008. These two regions are located in the Yazd province and about 369 kms from each other (figure 1). Air-dried oleo-gum resins of the two samples (100 g) were dissolved in 1 L of distilled water and the oils were isolated by hydrodistillation using a Clevenger-type apparatus for 3 h. The distilled oils were dried over anhydrous sodium sulfate and stored at 4 °C until analyzed.

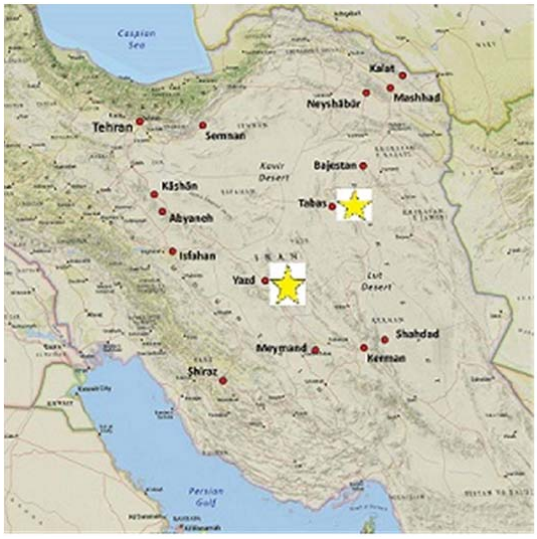

Figure 1. Locations of the plant material collection (Tabas and Yazd)

Gas chromatography

FID-GC was carried out using a Varian CP- 3800 with VF-5 capillary column (fused silica column, 30 m × 0.25 mm i.d., film thickness 0.25 μm). Helium was used as the carrier gas at the constant flow of 1.1 mL/min; split ratio, 1/50. The oven temperature was held at 60 °C for 1 min, then programmed to 250 °C at a rate of 3 °C/min, and held for 10 min. The injector and detector (FID) temperatures were kept at 250 and 280 °C, respectively.

Gas chromatography-mass spectroscopy

GC-MS was performed using a Varian 4000 with an ion trap detector, on a VF-5 column, operating at 70 eV ionization energy, using the same temperature programmed and carrier gas as above. Mass range was from m/z 35-400 amu. Retention indices were calculated by using retention times of *n*-alkanes (C_6-C_{24}) that were injected after the oil at the same chromatographic condition.

Identification of compounds

Compounds were identified by comparison of their mass spectra with those of the internal reference mass spectra library (Wiley 7) or with authentic compounds and confirmed by comparison of their retention indices with authentic compounds or with those reported in the literature [7-11]. For quantification purpose, relative area percentages obtained by FID were used without the use of the correction factors.

Results and Discussion

The essential oil of *F. assa-foetida* oleo-gum resins yielded 2.3 and 2.1% (v/w) in Tabas and Yazd samples, respectively. The colors of the oils were dark green and had strong sulfurous odor. Thirty-nine components, comprising 91.52% and 95.61% of the total oil, were characterized in Tabas and Yazd samples, respectively (table 1). The identified components and their percentage are shown in Table 1, where the components are listed in order of their elution on the VF-5 capillary column. With the results obtained in this research, the essential oils from both samples were characterized by sulphur-containing components (77.71 and 72.36% in Tabas and Yazd samples, respectively), monoterpenes hydrocarbons (2.82 and 3.43%), oxygenated monoterpenes (0.11 and 0.16%), and sesquiterpenes hydrocarbons (4.62 and 7.27%) and oxygenated sesquiterpenes (6.26 and 12.39%).

As it is observed, E-1-propenyl *sec*-butyl disulfide (40.15 and 44.36% in Tabas and Yazd samples, respectively), Z-1-propenyl *sec*-butyl

Table 1. Relative composition of the identified components in the analysis of the essential oils of *Ferula assa-foetida* oleo-gum resins from two different sites of Iran

No.	Compound	KI	Content (%)	
			Tabas	Yazd
1	Methyl sec-butyl disulfide	995	0.33	0.10
2	Para-cymene	1023	0.10	0.32
3	Limonene	1028	0.12	0.11
4	Z- β-ocimene	1049	0.12	0.22
5	E-β-ocimene	1054	0.70	0.61
6	γ- terpinene	1056	0.11	0.11
7	Propyl *n*-butyl disulfide	1152	0.97	0.61
8	Z-1-propenyl *sec*-butyl disulfide	1173	23.93	27.98
9	E-1-propenyl *sec*-butyl disulfide	1181	40.15	44.36
10	bis (1-methyl propyl) disulfide	1214	3.17	1.87
11	α- longipinene	1349	1.86	1.17
12	Neryl acetate	1358	0.16	0.11
13	α- ylangene	1368	0.22	0.14
14	α- copaene	1374	0.19	0.13
15	Methyl 1-(methylthio) ethyl disulfide	1392	0.87	0.64
16	Cedrene	1399	0.24	0.11
17	Longifolene	1408	0.20	0.13
18	β-caryophyllene	1418	0.12	0.08
19	α-gurjunene	1424	2.49	1.16
20	bis [(1-methylthio) propyl] disulfide	1428	1.12	0.94
21	β- humulene	1444	0.47	0.31
22	allo-aromadendrene	1451	0.13	0.07
23	α- humulene	1454	0.28	0.20
24	Methyl 1-(methylthio) propyl disulfide	1469	0.66	0.47
25	Germacerene D	1474	0.07	0.06
26	Valencene	1494	0.36	0.20
27	β- himachalene	1499	0.44	0.32
28	Methyl penthyltetrasulfide	1504	1.16	0.74
29	Cuparene	1509	0.17	0.12
30	γ- cadinene	1512	0.27	0.22
31	δ- cadinene	1517	0.95	0.75
32	E-α- bisabolene	1539	0.18	0.14
33	Germacerene B	1559	0.90	0.75
34	Spathulenol	1576	0.15	0.13
35	Guaiol	1598	5.50	3.14
36	Carotol	1601	5.14	1.63
37	Eudesmol(10-epi-gama)	1622	0.98	0.64
38	Eudesmol(7-epi-alpha)	1653	0.33	0.39
39	Patchouli alcohol	1693	0.29	0.32
	Total		91.52	95.61

disulfide (23.93 and 27.98%), Guaiol (5.50 and 3.14%) and Carotol (5.14 and 1.63%) were identified to be the major constituents of the oils.

The qualitative composition of the components appeared to be constant in the two different regions and no remarkable variation was found in the amounts of the essential oil major constituents. It is considerable that, at least regarding the compositions of the essential oils, the metabolisms of both samples seem to be similar. The chemical composition of the essential oil of *F. assa-foetida* oleo-gum resins has been previously studied and the major constituents were reported to be sulphur-containing materials. Table 2 indicates the diversity of the main constituents of the oils of *F. assa-foetida* oleo-gum which have been investigated before from different zones.

Comparison between the present results and the previous investigations showed that the stages of development and environmental conditions have a significant effect on the relative amounts of sulphur-containing constituents of *assa-foetida* oleo-gum resins.

Table 2. Comparison of major volatile compounds of *Ferula assa-foetida* oleo-gum-resin from different sites

Place of collection	Time of collection	Major compounds (%)	Reference
Iran/Fars	15th June	(*E*)-1-propenyl *sec*-butyl disulfide (23.9%) and 10-*epi*-γ- eudesmol (15.1%)	[7]
Iran/Fars	30th June	(*Z*)-1-propenyl *sec*-butyl disulfide (27.7%) and (*E*)-1-propenyl *sec*-butyl disulfide (20.3%)	[7]
Iran/Fars	15th July	β-pinene (47.1%) and α-pinene (21.3%)	[7]
Iran/Kerman	Summer	(*E*)-1-propenyl *sec*-butyl disulfide (58.9%), (*Z*)-β-ocimene (11.9%) and (*E*)-β-ocimene (9.0%)	[12]
Iran/Isfahan	August	(*Z*)-1-propenyl *sec*-butyl disulfide (35.1), (*E*)-1-propenyl *sec*-butyl disulfide (22.1) and α-pinene (12.2)	[13]
Pakistan	Not found	Phelandrene (6.49%), Propenyl *sec*-butyl disulfide (51.9%) and Undecylsulfonyl acetic acid (18.8%)	[14]

References

[1] Mozaffarian V. *Dictionary of Plant Names.*Tehran: Farhang Moaser Publishers, 1996.

[2] Iranshahy M, Iranshahi M. Traditional uses, phytochemistry and pharmacology of *Ferula assa-foetida* oleo-gum-resin—A review. *J ethnopharmacol*. 2011; 134(1):1-10.

[3] Kajimoto T, Yahiro K, Nohara T. Sesquiterpenoid and disulphide derivatives from *ferula assa-foetida*. *Phytochemistry*. 1989; 28(6):1761-1763.

[4] Al-Ja'fari AH, Vila R, Freixa B, Costa J, Canigueral S. Antifungal compounds from the rhizome and roots of *Ferula hermonis*. *Phytother Res*. 2013; 27(6):911-915.

[5] Ross IA. *Medicinal Plants of the World: Chemical Constituents, Traditional and Modern Medicinal Uses*. Springer, 2005.

[6] Zellagui A, Gherraf N, Rhouati S. Chemical composition and antibacterial activity of the essential oils of *Ferula vesceritensis*Coss et Dur. leaves, endemic in Algeria. *Org med chem lett.* 2012; 2(1):1-4.

[7] Kavoosi G, Rowshan V. Chemical composition, antioxidant and antimicrobial activities of essential oil obtained from *Ferula assa-foetida* oleo-gum-resin: effect of collection time. *Food chem*. 2012; 134(1):1-10.

[8] Khajeh M, Yamini Y, Bahramifar N, Sefidkon F, Reza Pirmoradei M. Comparison of essential oils compositions of *Ferula assa-foetida* obtained by supercritical carbon dioxide extraction and hydro distillation methods. *Food Chem*. 2005; 91(4):639-644.

[9] Mirzaei HH, Hasanloo T. Essential oil composition of root of *Ferula assa-foetida* from two Iranian localities (Gonabad and Tabas). *Asian J chem.* 2009; 21(8):6354-6358.

[10] Mirzaei HH, Hasanloo T. Chemical Compositions of the Essential Oils of *Ferula assa-foetida* Seeds from Two Iranian Ecotypes. *JEOBP*. 2012; 15(1):84-88.

[11] Adams RP. *Identification of essential oil components by gas chromatography/quadrupole mass spectroscopy*. Allured Publishing Corporation, 2001.

[12] Sefidkon F, Askari F, Mirza M. Essential oil composition of *Ferula assa-foetida* L. from Iran. *J Essen Oil Res*. 1998; 10(6):687-689.

[13] Sadraei H, Ghannadi A, Malekshahi K. Composition of the essential oil of asa-foetida and its spasmolytic action. *Saudi Pharmaceut J*. 2003; 11(3):136-140.

[14] Ashraf M, Ahmad R, Mahmood S, Bhatty M. Studies on the essential oils of the Pakistani species of the family Umbelliferae. Part 45. *Ferula assafoetida*, Linn (HerraHing) gum oil. *Pak J Sci Ind Res*. 1980; 23(1-2):68-69.