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Chemical Composition of Volatile Oil of *Ferula Assafoetida* L

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Abstract: *Asafoetida is an oleo-gum-resin obtained from the exudates of the roots of the Iranian endemic medicinal plant, F. asafoetida. It is used widely all over the world as a flavoring spice in a variety of foods. was analysed by GC and GC/MS. The constituents were identified by their mass spectra and Kovats' indices. Among those, The main constituents were (E)-1-propenyl sec-butyl disulfide (58.9%), (Z)-β-ocimene (11.9%), (E)-β-ocimene (9.0%), β-pinene (5.0%) and (Z)-1-propenyl sec-butyl disulfide (3.9%).*

Keywords: *Asafoetida , GC/MS*

1. INTRODUCTION

The genus Ferula, the third largest genus of the Apiaceae (alt.Umbelliferae) family,is composed of ca. 180 species (Yaqoob and Nawchoo, 2016), 15 of whichare endemic to Iran (Mozaffarian, 1996),nine species to Turkey, seven to China (Yaqoob and Nawchoo, 2016) and one species to Italy, and the rest are indigenousentities of several other countries.The majority of the Ferula plants have a pungent odor and can beused for different purposes.In the literature, numerous reports have described various biological and medicinal activities for different essential oils and ex-tracts of the Ferula plants. These include anticancer (Paydar et al., 2013;Perveen et al., 2017;Upadhyay et al., 2017), anthelmintic (Upadhyay et al., 2017), anti-epileptic (Sayyah et al., 2001;Kiasalari et al., 2013), aphicidal, antioxidant (Paydar et al., 2013;Amiri, 2014; Yusufoglu et al .2015,c;Zhang et al., 2015;Nguir et al., 2016), antimicrobial (Yang et al.,2007;Kavoosi et al., 2013; Paydar et al., 2013; Bashir et al., 2014b), antihypertensive (Ghanbariet al., 2012), antifungal (Bashiret al., 2014b;Upadhyay et al., 2017), antidepressant (Mohammadhosseini, 2016), phytotoxic (Bashir et al., 2014b), (Paydar et al., 2013), antiproliferative (Poli et al., 2005;Moradzadeh et al., 2017), acetylcholinesterase in-hibitory and muscarinic receptors inhibitory, antiprotozoal activity (Bafghi et al., 2014;Barati et al., 2014), antihemolytic antimycobacterial anti-ulcer (Alqasoumi et al., 2011), antitumor (Zhang et al., 2015;Bagheriet al., 2017), anticoagulant (Fraigui et al., 2002),antifertility, antispasmodic (Fatehi et al., 2004;Upadhyay et al., 2017), anticonvulsant (Sayyah and Mandgary, 2003;Bagheri et al., 2014b), relaxant, antinociceptive (Bagheri et al., 2014a), hypnotic (Abbasnia and Aeinfar, 2016), hypotensive (Upadhyay et al., 2017), muscle relaxant Upadhyay et al., 2017), memory enhancing (Upadhyay et al., 2017) ,enhancing digestive enzyme (Upadhyay et al., 2017), antiviral (Lee et al., 2009;Ghannadi et al., 2014;Upadhyay et al., 2017), anxiolytics (Upadhyay et al., 2017), antihyperlipidemic (Yusufoglu et al., 2015a,b),antigenotoxic (Hu et al., 2009), anti-in-flammatory (Paydar et al., 2013;Bagheri et al,. 2015), cytotoxic antihyperglycemic (Yusufoglu et al., 2015a,b;Yusufoglu et al., 2015c), acaricidal (Fatemikia et al., 2017), antidiabetic (Yarizade et al., 2017), hepatoprotective (Upadhyay et al., 2017) and antibiotic modulation (Paydar et al., 2013) activities. In this paper, chemical com- position of the essential oil, specie Ferula described.

2. MATERIAL

2.1. Plant Material

Samples of Ferula Assafoetida were collected during in May, 2013. The dried aerial parts were submitted to Hydro distillation for 3 h using Clevenger type apparatus, according to the European Pharmacopoeia[5]. The essential oil was collected, dried over anhydrous sodium sulphate and stored at 4°C until used.

2.2. Gas Chromatography

Essential oil samples (0.1 µL) were injected neat into an HP 6890 gas chromatography equipped with a flame ionisation detector (FID) and a 30 m x 0.25 mm HP-5 (cross-linked Phynel-Methyl Siloxane) column with 0.25 µm film thickness (Agilent), was used for the study. Helium was used as carrier gas, the flow through the column was 1, 4 mL min^{-1} and the splitless mode was used. The column was maintained at 40°C for 5 min, increased to 230°C at rate of 10°C min^{-1} and finally raised from 230 to 280 at rate of 30°C min^{-1}.

2.3. Mass Spectrometry Analysis

The oil was analysed by gas chromatography-mass spectrometry (GC-MS) using a Hewlett Packard 6890 mass selective detector coupled with a Hewlett Packard 6890 gas chromatograph. The MS operating parameters were as follows: ionisation potential, 70 eV; ionisation current, 2 A; ion source temperature, 200°C, resolution, 1000. Mass unit were monitored from 30 to 450 m/z. Identification of components in the oil was based on retention indices relatives to n-alkanes and computer matching with the WILLEY275.L library, as well as by comparison of the fragmentation patterns of mass spectra with those reported in the lite rature (Adams, 1995).

3. RESULTS

3.1. Chemical Composition of the Essential Oil

Essential oil yield was 1.0%. Freshly isolated essential oil was a yellow liquid with intensive, narcotic odour. The components of essential oil were separated into five classes, which were monoterpene hydrocarbons, oxygenated monoterpenes, sesquiterpene hydrocarbons, oxygenated sesquiterpenes and others (Table I). Based on GC and GC-MS analysis of the essential oil of Ferula Assafoetida 40 components were identified. An analysis of asafoetida shows of constituents were identified by their mass spectra and 40 compounds were identified representing 95 % of total oil composition. The main constituents were (E)-1-propenyl sec-butyl disulfide (58.9%), (Z)-β-ocimene (11.9%), (E)-β-ocimene (9.0%), β-pinene (5.0%) and (Z)-1-propenyl sec-butyl disulfide (3.9%) (Table I).

Table1. Chemical composition of *Ferula Assafoetida L.*

Peak number	Compounda	Retention index	Percentage
1	α-Pinene	1032	0.97
2	α-Thujene	1035	0.07
3	α-Fenchene	1070	0.02
4	Camphene	1076	0.32
5	β-Pinene	1118	5
6	Sabinene	1132	0.72
7	Thuja-2,4(10)-diene	1137	0.8
8	δ-3-Carene	1159	3.83
9	Myrcene	1175	0.09
10	α-Phellandrene	1176	9
11	α-Terpinene	1188	0.47
12	Limonene	1204	0.9
13	β-Phellandrene	1218	0.02
14	(Z)-β-Ocimene	1246	11.9
15	γ-Terpinene	1255	0.95
16	(E)-β-Ocimene	1266	9
17	(E)-1-propenyl sec-butyl disulfide	1280	58.9
18	Isoterpinolene	1236	0.26
19	Terpinolene	1290	0.17
20	γ-Campholene aldehyde	1477	0.06
21	trans-Sabinene hydrate	1451	0.67
22	Longipinene	1482	0.10
23	Fenchyl acetate	1464	0.18
24	Citronellal	1487	0.09
25	Cyclosativene	1485	9.08
26	α-Ylangene	1493	0.18

27	α-Copaene	1497	0.08
28	α-Campholene aldehyde	1500	0.06
29	Decanal	1506	0.07
30	Longicyclene	1497	0.65
31	Cyperene	1528	0.06
32	α-Gurjunene	1545	0.02
33	β-Cubebene	1549	1.79
34	Linalool	1553	0.50
35	cis-Sabinene hydrate	1571	0.72
36	trans-p-Menth-2-en-1-ol	1573	0.08
37	Pinocarvone	1586	0.03
38	1,7-Diepi-β-cedrene	1562	0.07
39	Aristolene	1565	0.06
40	(Z)-1-propenyl sec-butyl disulfide	1592	3.9

4. DISCUSSION

Ferula has many applications in Iranian folk medicine such as preservation of meat and oil and treatment of ulcer, but there are no studies proving their uses. Previous studies on chemical composition of essential oil of other specie of genu Ferula including F. ovina (Ghannadi et al., 2002). Composition of the essential oil of Ferula ovina (Boiss.) , F. cummunis (Chibani et al., 2011). F. gummosa (Sayyah et al., 2001). Antiepileptic potential and composition of the fruit essential oil of Ferula gummosa Boiss similarly indicated that monoterpene fractions were the main constituents of essential oils (76.2, 81.7, and 75.9% of essential oils, respectively). The main component in flower, leaf, and the stem are dl-limonene (25.04%), β-pinene (13.87%), and α-terpinyl isobutyrate (8.69%), respectively, which are different from the main compounds of other Ferula species essential oils like F. ovina, F. cummunis, and F. gummosa. It was found that monoterpene hydrocarbons were the most abundant compounds in the essential oils from flower (81.19%) and leaf (55.09%), while oxygenated monoterpenes were the main constituents of the essential oil from stem (61.69%) (Ozek et al, 2008) Composition and antimicrobial activity of the oils of Ferula szowitsiana DC. From Turkey showed that the essential oil of F. szowitsiana inhibited the growth of both Gram-positive and Gram-negative bacteria and its major constituents were β-eudesmol, α-eudesmol, and α-pinene. Abedi et al. (Abedi, 2008) Composition and antimicrobial activity of oleogumresin of Ferula gumosa Bioss. essential oil using Alamar blue reported that F. gummosa essential oil was contained about 88% monoterpene hydrocarbons and the main constituents were sabinene, β-pinene, and α-pinene. The MIC values of F. gummosa essential oil against some pathogenic bacteria (S. aureus 3.125 µL/mL and P. aeruginosa 50 µL/mL) were comparable with the MICs of F. cupularis essential oils. Previous studies showed that the essential oils from F. badrakema (Asili et al., 2009) Identification of essential oil components of Ferula badrakema fruits by GC-MS and 13C-NMR methods and evaluation of its antimicrobial activity F. latisecta (Iranshahi et al., 2008b) High content of polysulphides in the volatile oil of Ferula latisecta rech. F. et Aell. fruits and antimicrobial activity of the oil and Ferula assafoetida (Kavoosi et al., 2013) Evaluation of antioxidant and antimicrobial activities of essential oils from Carum copticum seed and Ferula assafoetida latex were moderately active against Gram-positive bacteria (S. aureus and Bacillus cereus), but Gram-negative bacteria (E. coli and P. aeruginosa) were not susceptible to the essential oils of these plants. Results of this study showed that the essential oil from stem of F. cupularis inhibited the growth of all t+est bacteria at lower MIC values than essential oils of flower and leaf parts. This may be due to its high content of oxygenated monoterpene hydrocarbons (Kotan et al., 2007).

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