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Short Communication

Chemical composition of essential oil of *Ferulago macrocarpa* (Fenzl) Boiss. fruits

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Abstract

Water-distilled essential oil of *Ferulago macrocarpa* (Umbelliferae) fruits was analyzed using GC-MS for the first time. Forty-two components comprising 99.5% of the total oil were identified, of which bornyl acetate (40.8%), 2,3,6-trimethyl benzaldehyde (7.2%), δ-selinene (5.5%), 1,10-di-epi-cubenol (5.1%), germacrene D (3.5%), β-phellandrene (3.5%) and α-pinene (3.4%) were found to be the major components. The oil of *F. macrocarpa* fruits consisted of 15 monoterpene hydrocarbons (21.4%), 6 oxygenated monoterpenes (42.2%), 17 sesquiterpene hydrocarbons (22.4%) and one oxygenated sesquiterpene (5.1%). Three benzenoid derivatives also comprised 8.4% of the oil. Monoterpenes and sesquiterpenes comprised 63.6% and 27.5% of the *F. macrocarpa* fruits essential oil respectively; however, bornyl acetate (40.8%) was identified as the most abundant component of the oil.

Keywords: *Ferulago macrocarpa;* essential oil composition; GC/MS; bornyl acetate; 2,3,6-trimethyl benzaldehyde

INTRODUCTION

Apiaceae (Umbelliferae) family comprises 300 genera and 2500-3000 species distributed in most parts of the world (1). The genus *Ferulago* (Chavil in Persian) consists of about 40 species which are centered in south-west of Asia (2). Seven *Ferulago* species are also found in the flora of Iran, most of which are endemic (3).

Previous phytochemical studies of *Ferulago* have led to isolation of various coumarins (4-6) and volatile oils (7-9). Some of the isolated coumarins have shown antimicrobial, antioxidant (10), cytotoxic (11) and acetylcholinesterase inhibitor (12) activities. In addition, the essential oils of many other *Ferulago* species have exhibited antimicrobial activities (13-16).

Ferulago macrocarpa (Fenzl) Boiss. is a perennial herb which grows in the west of Iran. The plant popularly referred to as Chavil-e-Roshanball in Farsi. A literature survey has revealed that the essential oil of the aerial parts of the plant has shown larvicidal activity (17); however, the available information indicates that the essential oil of *F. macrocarpa* fruits has not been the subject of any study, and this paper is the first report in this regard.

MATERIALS AND METHODS

Plant material and isolation of the oil

F. macrocarpa fruits collected from Salehabad in Ilam province in the west of Iran in May 2010 at an altitude of *ca.* 800 m above sea level and the plant identity was confirmed by the Ilam Agricultural and Natural Resource Research Center. Crushed dry fruits of *F. macrocarpa* were subjected to hydro distillation for 3 h, using a Clevenger-type apparatus, according to the method recommended in the British Pharmacopoeia (18), and the resulting oil was subsequently dried over anhydrous sodium sulfate.

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GC/MS analysis

Gas chromatography combined with mass spectrometry was used for the identification of the components. The analysis was performed on an Agilent 5975C mass selective detector coupled with a Hewlett-Packard 6890 gas chromatograph equipped with a HP-5MS capillary column (30 m × 0.25 mm; film thickness 0.25 μm). The oven temperature was programmed from 60 to 280°C at 4°C/min. Helium was used as the carrier gas at a flow rate of 2 ml/min. The injector and detector

Table. Composition of the essential oil of the fruits of *Ferulago macrocarpa*

No	Compound	RT	KI	Percentage
1	α-thujene	3.66	929	t
2	**α-pinene**	**3.80**	**937**	**3.4**
3	camphene	4.07	952	0.9
4	sabinene	4.54	975	2.6
5	β-pinene	4.61	978	0.1
6	myrcene	4.88	991	2.0
7	mesitylene	4.95	994	0.3
8	α-phellandrene	5.19	1004	2.3
9	δ-3-carene	5.32	1011	0.8
10	α-terpinene	5.46	1017	t
11	p-cymene	5.65	1025	1.8
12	**β-phellandrene**	**5.76**	**1030**	**3.5**
13	*cis*-β-ocimene	5.96	1038	0.1
14	*trans*- β-ocimene	6.22	1049	t
15	γ-terpinene	6.50	1060	0.4
16	α-terpinolene	7.29	1087	2.9
17	borneol	9.50	1167	0.6
18	terpinene-4-ol	9.86	1176	t
19	p-cymene-8-ol	10.10	1183	t
20	carvacrol methyl ether	11.93	1243	t
21	*cis*-chrysanthenyl acetate	12.48	1262	1.4
22	**bornyl acetate**	**13.35**	**1286**	**40.8**
23	2,3,4-trimethyl benzaldehyde	14.15	1312	0.9
24	δ-elemene	14.83	1335	0.6
25	**2,3,6-trimethyl benzaldehyde**	**15.39**	**1352**	**7.2**
26	α-ylangene	16.00	1371	t
27	β-elemene	16.52	1387	1.5
28	β-caryophyllene	17.31	1415	1.6
29	α-guaiene	17.91	1436	t
30	α-humulene	18.34	1450	2.1
31	β-acoradiene	18.75	1466	t
32	**germacrene D**	**19.18**	**1481**	**3.5**
33	β-selinene	19.31	1485	1.3
34	**δ-selinene**	**19.51**	**1489**	**5.5**
35	bicyclogermacrene	19.65	1496	1.9
36	germacrene A	19.89	1505	0.8
37	γ-cadinene	20.16	1511	1.5
38	δ-cadinene	20.53	1521	0.5
39	α-cadinene	20.85	1535	t
40	germacrene B	21.36	1556	0.4
41	selin-4,7(11)-diene	21.77	1571	1.2
42	**1,10-di-epi-cubenol**	**23.06**	**1612**	**5.1**
	Total			**99.5**
	monoterpene hydrocarbons			**21.4**
	oxygenated monoterpenes			**42.2**
	sesquiterpene hydrocarbons			**22.4**
	oxygenated sesquiterpenes			**5.1**
	benzenoid derivatives			**8.4**

RI = Retention indices on HP-5MS capillary column, calculated by using retention times of *n*-alkanes (C_8-C_{24}).
Percentages calculated from TIC data.
t = trace (<0.05%).

temperature was 280°C. The MS operating parameters were: ionization voltage 70 eV, ion source temperature 200°C.

Identification of the oil components was based on the retention indices relative to *n*-alkanes (C_8-C_{24}) and computer matching with NIST and Wiley 275 libraries, as well as by the comparison of fragmentation patterns of the mass spectra with those reported in the literature (19,20).

RESULTS

The air-dried fruits of *F. macrocarpa* yielded 0.8% of a yellowish essential oil. Forty-two components, comprising 99.5% of the total oil, were identified in the *F. macrocarpa* fruits essential oil. The compounds identified in the oil sample are presented in Table. As it is evident, bornyl acetate (40.8%), 2,3,6-trimethyl benzaldehyde (7.2%), δ-selinene (5.5%), 1,10-di-epi-cubenol (5.1%), germacrene D (3.5%), β-phellandrene (3.5%) and α-pinene (3.4%) were found to be the major components.

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DISCUSSION

Essential oil compositions of the aerial parts of some *Ferulago* species have been reported earlier (8,9,14,15, 21-23). There have also been reports on their fruit oil composition. The main constituents of the fruit oils of *F.angulata*, *F. campestris* and *F. confusa* are reported as *cis*-ocimene (64.8%), myrcene (33.4%) and *cis*-chrysanthenyl acetate (37.7%), respectively (24-26).

Chemical constituents of the essential oil of the aerial parts of *F. macrocarpa* have been previously reported. Bornyl acetate (45.7%), borneol (17.2%) and β-gurjunene (9.2%) are the main components of the aerial parts oil (17) which is in accordance with our findings. According to the results of our study, bornyl acetate (40.8%) was found to be the major components of the essential oil of the fruits of *F. macrocarpa*. 2,3,6-Trimethylbenaldehyde comprising 7.2% of the *F. macrocarpa* fruits essential oil is not present in the aerial parts essential oil of this herb. 2,3,6-Trimethyl benzaldehyde, the other main volatile oil constituent of the fruits of *F. macrocarpa,* has been also identified as the major component of the *F. asparagifolia* (38.9%) and *F. longistylis* (29.0%) fruit oils (27,28).

CONCLUSION

In summary, the present study, for the first time, showed that the essential oil of *F. macrocarpa* fruits is mainly composed of terpenoids and benzenoid derivatives were also detected.

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