

STUDIES ON THE ESSENTIAL OILS OF THE PAKISTANI SPECIES OF THE FAMILY UMBELLIFERAE

Part XIX. *Ferula ovina* Boiss (Kamyan) Oils Distilled from the Mature and the Immature Seeds and the Roots of the Plant

AMNA KARIM and MUHAMMAD KHURSHID BHATTY

PCSIR Laboratories, Lahore 16

(Received January 1, 1978)

The essential oil of the mature and the immature seeds and the roots of *Ferula ovina*, which grows wild in Pakistan has been studied for the first time with respect to its physicochemical constants and chemical composition. The mature seed from two separate places namely Zargoan and Hazarganji in Baluchistan contain 1.0% and 1.2% essential oil respectively. The immature seed at two different stages of maturation and the roots of Hazarganji contain 2.5, 1.3 and 0.8% of essential oil respectively. The essential oils of the mature seeds of Zargoan and Hazarganji, the immature seeds at two different stages and the roots of Hazarganji respectively contain α -pinene (70.6, 62.2, 53.7, 57.1, 13.8%), camphene (7.9, 12.0, 16.7, 14.2, 9.5%), β -pinene (0.8, 2.1, 3.5, 3.0, 2.8%), myrcene (5.8, 6.6, 11.4, 9.8, 10.0%), limonene (3.5, 5.1, 7.6, 6.8, 14.2%), γ -terpinene (0.1, 0.2, 2.0, 1.1, 1.4%) *p*-cymene (traces, traces, 0.0, 0.9%), bornyl acetate (1.2, 0.35, 0.6, 0.6, 0.4, 1.2%), terpinyl acetate (0.8, 0.7, 0, 0.2, 0.8%), geranyl acetate (0.3, 0, 0, 0, 0%), fenchyl acetate (0, 0, 0, 0, 0.5%), camphor (0.3, 0.2, 0.2, 0.8, 7.8%), fenchone (0.2, 0, 0, 0, 4.1%), fenchyl alcohol (0, 0, 0, 0, 8.6%), α -terpineol (2.1, 3.6, 1.0, 1.6, 2.4%), geraniol (2.3, 0, 0, 0, 0%), borneol (1.9, 5.3, 2.5, 3.6, 19.0%) and a mixture of coumarins (1.9, 1.8, 0.7, 1.4, 3.0%). The oils obtained from the seeds of two distinct localities and at two stages of its maturation in the same locality and from the roots of the mature plant were studied. The presence of sulphur compounds was not detected in any one of these oils.

INTRODUCTION

Ferula ovina Boiss, synonym *Peucedanum ovinum* [1] having pine tree-like aroma grows wild in the Pistachio tracts consisting of Hazarganji, Zargoan, Koch and Urak at the altitude above 2400 meters in Baluchistan. Because the species is native to Pakistan, is a member of the genus *Ferula* which enjoy a medicinal and commercial, importance and is the one on which no work has so far been reported in literature. The present studies have, therefore, been undertaken for obtaining basic information for use in developing new plant of essential oils in Pakistan.

A novel feature of the oils is that it is devoid of any sulphur compounds, which fact is in sharp contrast to the *Ferula assafoetida* species whose essential oil both its seed and gum, contains sulphur compounds.

EXPERIMENTAL

Materials and Methods. Fresh and mature seed of *Ferula ovina* from Zargoan and Hazarganji, two lots of immature seed and the roots of mature plant from Hazarganji were collected for these studies. The essential oils from the seeds and the roots were recovered according to the standard method [2]. The general methods used for the determination of the physicochemical values have been discussed in our earlier papers [2, 3].

As usual, the oil was column chromatographed [2] using activated alumina (Brockmann, activity II and

III, E. Merck). The hydrocarbon fraction of the oil was further resolved into terpenes by GLC using 3 mm \times 3 m copper column packed with polyethylene glycol succinate (20%) on Celite (60-80 mesh), nitrogen as carrier gas and flame ionization detector. The column temperature was maintained at 110°. The oxygenated components of the oil were identified by IR comparison and conversion into known derivatives.

RESULTS

The percentage yield, physicochemical values and the chemical composition of the essential oils from the seeds and the roots of *Ferula ovina* are recorded in Tables 1 and 2.

DISCUSSION

The mature and immature seeds essential oils of *Ferula ovina* have turpentine oil-like odour while the roots oil has camphoraceous aroma. The chemical values (Table 1) of the roots oil are much higher than those of the seeds essential oils, thus indicating the presence of considerable amounts of oxygenated compounds in the former.

The hydrocarbon fractions of the oils are mainly composed of monoterpenes. The largest peak amongst these terpenes by GLC was that of α -pinene.

Fractionation of the essential oils through column chromatography gave a mixture of esters which were further separated by preparative TLC and identified by their hydrolysis into known hydroxy

Table 1. Yield and physicochemical constants of the essential oil from different parts of *Ferula ovina*.

Constant	Zargoan mature seed	Hazarganji			
		Mature seed	Immature seed collected on 9.5.74	Immature seed collected on 23.5.74	Roots
Distillation (hr)	12	10	15	15	16
Yield (%)	1.0	1.2	2.5	1.3	0.8
Specific gravity *	0.8280 ⁽³²⁾	0.8464 ⁽¹⁶⁾	0.8223 ⁽³²⁾	0.8372 ⁽³²⁾	0.8137 ⁽³²⁾
Refractive index *	1.4730 ⁽³²⁾	1.4710 ⁽¹⁶⁾	1.4660 ⁽³²⁾	1.4700 ⁽³²⁾	1.4700 ⁽³²⁾
Optical rotation *	+10° 4' ⁽³²⁾	+18° 15' ⁽¹⁶⁾	+7° 6' ⁽³²⁾	+2° 12' ⁽³²⁾	+5° 12' ⁽³²⁾
Acid value	1.70	0.39	1.20	2.20	2.37
Ester value	5.90	0.47	7.22	5.03	18.59
Ester value after acetylation	28.70	—	34.99	58.30	96.56

* The temperature at which these parameters were determined are given in parenthesis.

Table 2. Chemical composition of the essential oil from different parts of *Ferula ovina*.

Eluent	Constituents %	Zargoan mature seed	Hazarganji			
			Mature seed	Immature seed collected on 9.5.74	Immature seed collected on 23.5.74	Roots
n-Hexanae	Hydrocarbons*	89.0	88.0	95.0	92.0	52.0
	α-Pinene	70.6	70.6	53.7	57.1	13.8
	Camphene	7.9	12.0	16.7	14.2	9.5
	β-Pinene	0.8	2.1	3.5	3.0	2.8
	Myrcene	5.8	6.6	11.4	9.8	10.0
	Limonene	3.8	5.1	7.6	6.8	14.2
	γ-Terpinene	0.1	0.2	2.0	1.1	1.4
	p-Cymene	t	t	—	..	0.9
	1% Diethyl ether in n-hexane	Bornyl acetate	1.2	0.35	0.6	0.4	1.28
Terpinyl acetate		0.8	0.7	—	0.2	0.8
Geranyl acetate		0.3	..	..	..	..
Fenchyl acetate		..	..	..	..	..
5% Diethyl ether in n-hexane	Camphor	0.3	0.2	0.2	0.8	7.8
	Fenchone	0.2	..	..	..	4.1
20% Diethyl ether in n-hexane	Fenchyl alcohol	..	..	..	..	8.6
40% Diethyl ether in n-hexane	α-Terpineol	2.1	3.6	1.0	1.6	2.4
	Borneol	1.9	5.3	2.5	3.6	19.0
	Geraniol	2.3	..	..	..	..
100% Diethyl ether	Coumarins	1.9	1.8	0.7	1.4	3.0

* Resolved and estimated by GLC.

compounds and acetic acid. The Zargoan seed essential oil contained bornyl acetate, geranyl acetate and terpinyl acetate while the Hazarganji essential oil contained bornyl acetate and terpinyl acetate only. Besides bornyl acetate and terpinyl acetate, the roots essential oil also contained fenchyl acetate.

Camphor, which was identified by IR, m.p. 176-177° (lit. [4] 178.7-178.8°) and by making its 2,4-dinitrophenyl hydrazone, m.p. 166-168° (lit [5] 166°),

had been found in all the five oils while fenchone was present in mature seeds of Zargoan and the essential oil of roots only.

The alcoholic fraction of the Hazarganji seed essential oil was mainly composed of α-terpineol, both being identified by IR analysis. The Zargoan seed essential oil also contained geraniol while the roots oil of Hazarganji contained fenchyl alcohol which was not detected in any other oil.

The last fractions of the oil contained a mixture of coumarins (4-5 in number) whose existence in the essential oil of the *Umbelliferae* species has been observed to be a common feature[6].

From the above studies it can be concluded that *Ferula ovina* essential oil is rather rich in hydrocarbons particularly α -pinene. In spite of our best efforts we have not found any sulphur compound in this species as we have already observed that *Ferula assafoetida* is well known for containing these compound in its essential oil.

Acknowledgments. We are grateful to the United States Department of Agriculture for financing this research under a PL-480 Scheme and Mr. Abdul Waheed Sabir, our botanist, for the identification

and procurement of authentic sample for this work.

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