Chemistry of Natural Compounds, Vol. 44, No. 1, 2008

STUDY OF THE ESSENTIAL OIL VARIATION OF *Ferula gummosa* SAMPLES FROM IRAN

E. Talebi Kouyakhi,[1] M. R. Naghavi,[2] and M. Alayhs[3]

UDC 547.913

In a previous study, Ghasemi et all [1] identified 73 components from *Ferula gummosa* fruits collected from one region (Isfahan, Iran) in wich the major components were β-pinene (43.78%), α-pinene (27.27%), and myrcene (3.37%). So far, however, there has been no published information on the essential oil variation of *Ferula gummosa* samples from Iran. The objective of this investigation was to study the variations in essential oil content and composition of *Ferula gummosa* samples collected from different parts of Iran.

The essential oils isolated by hydrodistillation from plants collected in different locations were white liquids, and the highest (3.85%, w/w) oil yield was from Natanz, while four locations (Feridonshahr, Kashan, Semirom, and Roshehvamasly-Firouzkouh) showed the lowest (1.66%, w/w) oil yield based on fruit dry weights (Table 1).

In the 16 oil samples of *F. gummosa* 120 components with varying degrees of concentration in each sample were detected. Sixty-seven of these components, as the main compounds, are presented in Table 2. Comparison of the oil compositions showed that except for β-pinene and α-pinene, the other compounds were present in particular samples and there was a significant variation in the composition of the oils due to the geographical sites. The four most remarkable compounds found in the oils were: β-pinene, α-pinene, δ-3-carene, and limonene. The content of β-pinene varied from 26.85–69.15%, having the highest concentration in F13 (Roshehvamasly-Firouzkouh). The content of α-pinene ranged from 1.42–33.91%, and the highest concentration was found in F9 (Ham). Both β-pinene and α-pinene were found to have significant antibiotic activity [2]. Ghasemi et all [1] showed that the bacteriostatic and fungistatic properties of the *F. gummosa* oil were associated with the high β-pinene and α-pinene content. The concentrations of essential oil components for δ-3-carene and limonene ranged from 0.59–11.80% and 1.06–9.15%, respectively, and for both of these components the lowest was obtained from F15 (Sarake-Firouzkouh), while the highest was from F11 (Semnan).

Our results showed that samples from tropical regions showed better percentage and type of flavoring combinations than samples from cold regions. The variation of phytochemicals was not only found among samples of different regions but also among samples of one region with different altitude, reflecting the effect of environment on essential oil components. In contrast, samples from different regions but the same altitude showed different compositions, reflecting the genetic variability among samples.

Franz [3] stated that compositional variation within a species can be affected by (1) individual genetic variability; (2) variation among different plant parts and different developmental stages; and (3) modifications due to the environment. The results obtained under this study indicate that the composition of *F. gummosa* essential oil may depend on genetic variability and environment modifications. Understanding these factors can make the difference between a good yield of high-quality oil and a poor yield of undesirable oil. We recommend using molecular markers to determine the genetic makeup of the studied samples.

1) Agronomy and Plant Breeding Department, Faculty of Agriculture, Science and Research Campus, Azad Islamiz University, P.O. Box: 14515/775, Tehran, Iran, soroush3000@yahoo.com; 2) Agronomy and Plant Breeding Department, Faculty of Agriculture, University of Tehran, Karaj, Iran; 3) Research Institute of Forests and Rangelands, Tehran, Iran. Published in Khimiya Prirodnykh Soedinenii, No. 1, pp. 96-97, January-February, 2008. Original article submitted November 23, 2006.

 0009-3130/08/4401-0124

TABLE 1. Place of Collection and Essential Oil Yields of the Studied *Ferula gummosa* Samples

Sample code	Place of collection	Oil yield, %	Sample code	Place of collection	Oil yield, %
F1	Feridonshahr	1.66	F9	Ilam	2.00
F2	Kashan	1.66	F10	Nemadkovsar 2-Lar	2.08
F3	Semirom	1.66	F11	Semnan	1.78
F4	Plour	2.17	F12	Mashhad	2.08
F5	Emampahnak-Lar	2.00	F13	Roshehvamasly-Firouzkouh	1.66
F6	Nemadkovsar 1-Lar	1.92	F14	Reef-Firouzkouh	2.63
F7	Garmsar	1.85	F15	Sarake-Firouzkouh	2.38
F8	Tehran	2.94	F16	Natanz	3.85

TABLE 2. Percentage Composition of the Essential Oils of the 16 Locations of *Ferula gummosa*

Compounds	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16
α-Thujene	5.61	-	-	-	4.93	2.87	-	-	4.46	2.73	4.02	-	-	-	-	2.24
α-Pinene	27.97	1.42	31.40	19.13	19.69	17.54	31.04	33	33.91	16.65	2.74	9.78	4.83	5.01	4.26	6.67
β-Pinene	30.68	28.44	34.76	26.85	51.55	50.12	32.59	31.63	36.30	49.79	40.99	37.91	69.15	59.21	67.19	34.54
β-Myrcene	1.63	1.35	0.95	1.74	1.17	1.88	0.51	-	-	-	-	-	-	-	-	-
δ-3-Carene	1.29	8.86	1.05	7.29	7.57	6.23	-	1.72	1.36	6.07	11.80	9.10	1.64	-	0.59	4.46
Limonene	6.78	5.09	5.89	2.08	1.87	4.84	3.32	2.83	5.37	5.24	9.15	-	-	-	1.06	4.09
Sabinyl acetate	0.69	-	-	-	0.88	-	-	-	0.86	-	-	-	-	-	-	-
(*E*,*E*)-1,3,5-Undecatriene	0.29	0.33	-	0.41	-	-	-	-	-	-	-	-	-	-	-	0.45
Fenchyl acetate	6.70	-	5.73	-	-	-	-	3.67	4.99	-	-	-	-	-	-	-
δ-Elemene	0.79	-	1.29	-	-	-	-	-	0.56	-	2.56	-	-	0.86	-	-
β-Cubebene	1.64	-	1.29	-	-	-	-	-	-	-	-	-	-	-	-	-
δ-Cadinene	0.43	0.76	-	1.35	0.38	-	0.91	1.41	-	-	-	2.59	0.78	-	-	-
Guaiol	1.44	-	0.70	-	-	-	-	1.64	-	-	-	-	-	4.33	-	-
β-Patchoulene	1.66	-	-	-	-	-	-	-	-	-	1.11	-	-	-	-	-
α-Bisabolene	0.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
α-Phellandrene	-	10.3	4.23	7.89	-	-	-	6.81	-	-	-	-	-	-	-	-
cis-Ocimene	-	0.92	-	0.56	-	-	-	-	0.48	-	-	-	0.47	-	-	-
Pinocarvone	-	0.46	-	-	1.13	-	-	0.88	0.76	-	-	-	-	-	-	0.34
(3*E*,5*Z*)-1,3,5-Undecatriene	-	0.67	-	-	-	-	-	-	-	-	0.92	-	-	-	0.63	-
α-Cubebene	-	1.56	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Germacrene-D	-	4.45	-	4.39	1.35	-	-	1.10	1.18	-	1.07	1.61	1.01	-	-	1.45
β-Bisabolene	-	0.52	-	1.54	-	1.36	-	-	-	-	-	-	-	-	-	-
Germacrene-B	1.46	2.07	-	1.86	1.67	-	-	1.94	5.92	-	7.17	1.45	-	-	-	1.17
Camphene	-	5.04	-	-	-	-	-	0.88	-	-	-	-	-	-	1.26	14.09
α-Cadinene		0.68	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Calarene	-	2.35	-	-	-	1.19	-	-	1.10	1.46	1.25	6.33	-	1.99	5.05	6.71
α-Patchoulene	-	2.41	-	-	-	-	-	-	-	-	-	5.00	-	-	-	7.82
Sabinene	-	-	2.3	-	-	-	-	-	-	-	-	-	1.60	-	-	-
β-Eudesmol	-	-	2.32	-	-	-	-	2.45	-	-	-	-	-	-	-	-
trans-Caryophyllene	-	-	-	0.43	-	-	-	-	-	-	-	-	2.52	-	-	-
γ-Muurolene	-	-	-	1.09	-	-	-	-	-	-	-	-	-	-	-	-
(±)-Gymnomitrene	-	-	-	0.95	-	-	-	-	-	-	-	-	-	-	-	-
α-Humulene	-	-	-	0.81	-	-	-	-	-	-	-	-	-	-	-	-
Piperonylamine	-	-	-	1.35	-	-	-	-	-	-	-	-	-	-	-	-
Allocimene	-	-	-	0.43	-	-	-	-	-	-	-	-	-	-	-	-
Methylthiobenzamide	-	-	-	5.50	-	-	-	-	-	-	-	-	-	-	-	-
α-Copaene	-	-	-	1.38	-	-	-	-	-	-	-	-	0.354	-	-	-
Unknown	-	-	-	6.75	-	-	-	-	-	1.29	-	2.41	-	-	-	-

TABLE 2. (continued)

Compounds	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16
β-Ocimene	-	-	-	-	0.49	-	-	-	-	-	-	-	-	-	-	-
Bicyclogermacrene	-	-	-	-	0.39	-	-	-	-	-	-	-	-	-	-	-
Calarene	-	-	-	-	0.46	-	-	-	-	-	-	-	2.73	-	-	-
trans-Ocimene	-	-	-	-	-	0.98	-	-	-	1.04	-	-	-	-	-	-
α-Gurjunene	-	3.01	-	-	-	5.61	-	2.17	-	4.94	-	-	0.76	-	-	15.02
Ledene	-	-	-	-	-	1.82	0.90	-	-	1.70	-	-	-	-	-	-
Cyclofenchene	-	-	-	-	-	-	1.56	-	-	-	-	-	-	-	-	-
Aromadendrene	-	-	-	-	-	-	0.66	0.93	-	-	-	-	-	-	-	-
β-Cubebene	-	-	-	-	-	-	0.74	-	-	-	-	-	-	-	-	-
Myrcene	-	-	-	-	-	-	1.14	0.85	1.46	1.71	2.24	2.36	2.95	1.82	2.26	0.95
γ-Selinene	-	-	-	-	-	-	0.69	-	0.84	-	3.76	-	-	8.40	-	-
Valencene	-	-	-	-	-	-	5.38	-	-	-	-	-	-	4.60	3.42	-
trans-Pinocarveol	-	-	-	-	-	-	-	1.53	-	-	-	-	-	-	-	-
γ-Gurjunene	-	-	-	-	-	-	-	0.93	-	-	-	-	5.14	-	-	-
Terpinolene	-	-	-	-	-	-	-	-	0.78	-	-	-	-	-	-	-
α-Amorphene	-	-	-	-	-	-	-	-	0.58	-	1.53	1.96	0.53	-	-	-
α-Eudesmol	-	-	-	-	-	-	-	-	1.97	-	-	-	-	-	-	-
Nerolidol	-	-	-	-	-	-	-	-	-	2.44	5.80	1.46	-	-	4.24	-
β-Gurgunene	-	-	-	-	-	-	-	-	-	-	1.59	-	-	-	-	-
β-Phellandrene	-	-	-	-	-	-	-	-	-	-	6.52	-	-	-	-	-
β-Guaiene	-	-	-	-	-	-	-	-	-	-	-	-	1.63	-	-	-
α-Terpinene	-	-	-	-	-	-	-	-	-	-	-	-	-	1.01	-	-
trans-β-Ocimene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.16	-
β-Farnesene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.02	-
α-Elemene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.03	-

F1: Isobornyl acetate - 0.35, α-Terpineol - 0.77, α-Ylangene - 0.35, Clovene - 0.45.

ACKNOWLEDGMENT

We are grateful to the Azad Islamiz University for financial support of this work.

REFERENCES

1. Y. Ghasemi, P. Faridi, I. Mehregan, and A. Mohagheghzadeh, *Chem. Nat. Comp.*, **41**, 312 (2005).
2. J. A. Duke and S. M. Beckstrom, *Handbook of Medicinal Mints, Phytochemicals, and Biological Activities,* CRC Press, Florida, 1996, p. 379, p. 383.
3. C. Franz, Genetics, in: *Volatile Oil Crops: Their Biology, Biochemistry and Production,* Hay RKM, Waterman PG Eds., Longman, Harlow, UK, 1993, p. 63.