

## THE ESSENTIAL OILS FROM FLOWERS, STEMS AND LEAVES OF *Ferulago angulata* FROM IRAN

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The genus *Ferulago* consists of 35 species, seven of which are found in Iran, including two endemics: *F. contracta* Boiss. et Hausskn. and *F. phialocarpa* Rech. f. et H. Riedl [1, 2].

Based on literature survey, the chemical composition and biological activity of some species from the genus *Ferulago* have been the subjects of previous studies and chemical investigations have concerned the following: aerial parts of *Ferulago angulata* in which (*Z*)- $\beta$ -ocimene (35.5%), terpinolene (5.7%), and  $\alpha$ -phellandrene (5.4%) have been the main components [3]; fruits and roots of *F. isaurica* Pesmen and *F. syriaca* Boiss. in which major the constituents have been: in the fruit oil,  $\alpha$ -pinene (31.5%), limonene (24.2%), and myrcene (17.0%) for *F. isaurica*; and myrcene (15.3%) and 4,6-guaiadiene (10.7%) for *F. syriaca*; in the root oil, terpinolene (42.1%) and myrcene (27.0%) for *F. isaurica*; and bornyl acetate (69.4%) and terpinolene (12.5%) for *F. syriaca* [4]; hydrodistillation and methanol extraction of aerial parts of *F. carduchrom* Boiss. et hausskn. in which the oil and extract were characterized by high amounts of monoterpene hydrocarbons including (*Z*)- $\beta$ -ocimene (21.2% and 20.0%), terpinolene (13.1% and 6.0%),  $\alpha$ -phellandrene (12.7% and 8.3%), and  $\beta$ -phellandrene (10.9% and 8.8%) [5]; aerial parts of *F. phialocarpa* Rech. f. et H. Riedl in which the main components have been  $\alpha$ -pinene (40.9%),  $\alpha$ -phellandrene (14.2%), and  $\beta$ -phellandrene (9.6%) [6]; aerial parts of *F. angulata* in which the major constituents have been  $\beta$ -phellandrene (32.0%) and  $\alpha$ -phellandrene (13.8%) [7]; isolation and identification of a new monoterpene ester, ferulagon, from the essential oil of *F. thirkeana* [8]; crushed fruits of *F. aspargifolia* in which 2,3,6-trimethylbenzaldehyde (38.9%) and myrcene (18.2%) have been identified as major constituents [9]; steam distillation (SD) and supercritical carbon dioxide extraction (SFE) of the essential oil of *F. nodosa* is the subject of other investigation in which 2,3,4-trimethylbenzaldehyde (42.2%) has been the main compound for the SD method and  $\alpha$ -pinene (55.4%), myrcene (10.1%), *cis*- $\beta$ -ocimene (7.0%),  $\beta$ -phellandrene (5.6%), and sabinene (4.5%) have been the major components for the SFE method [10]. Also the biological activity of essential oils of some *Ferulago* species were reported [8, 11, 12].

In this work hydrodistilled essential oils from crushed dry flowers, stems, and leaves of *Ferulago angulata* (Schlecht.) Boiss. (*Umbelliferae*) from Khorasan province (Iran) were studied by GC and GC/MS. The air-dried flowers, stems, and leaves of the plant yielded 0.66%, 0.54%, and 0.43% (w/w) light yellowish colored oil, respectively. The percentage compositions of flower, stem, and leaf oil from *F. angulata* is given in Table 1. From Table 1 it is evident that the composition of the oils obtained from different parts of *F. angulata* are similar and include monoterpenes.

TABLE 1. Percentage Composition of Essential Oils from Flowers, Stems, and Leaves of *Ferulago angulata*

Compound	Retention indices	Flowers	Stems	Leaves
$\alpha$ -Thujene	931	0.97	-	-
$\alpha$ -Pinene	939	12.24	21.20	16.81
Camphene	953	1.40	1.43	2.36
Sabinene	976	1.32	0.50	2.37
$\beta$ -Pinene	980	0.66	1.01	0.43
Myrcene	991	3.52	4.43	5.10
$\alpha$ -Phellandrene	1005	27.24	18.14	20.68
$\delta$ -3-Carene	1011	7.75	4.13	4.56
<i>p</i> -Cymene	1026	10.32	17.74	14.56
$\beta$ -Phellandrene	1031	16.62	15.79	16.19
( <i>Z</i> )- $\beta$ -Ocimene	1040	6.04	3.12	2.49
( <i>E</i> )- $\beta$ -Ocimene	1050	-	0.17	1.04
$\gamma$ -Terpinene	1062	1.77	-	-
Isoterpinolene	1086	0.63	-	-
Terpinolene	1088	1.18	0.43	0.29
Linalool	1098	1.57	1.14	0.37
<i>cis</i> -Verbenol	1140	-	0.48	-
<i>cis</i> -Pinocarveol	1183	-	0.60	-
Citronellol	1228	1.41	1.38	0.76
Bornyl acetate	1285	2.95	5.32	5.50
Citronellyl acetate	1354	-	1.06	-
Total percentage		97.59	98.07	93.51

The compounds have been sorted according to retention indices on an HP-5MS capillary column.

## REFERENCES

1. K. H. Rechinger, *Ferulago*, In: *Flora Iranica, Umbelliferae*. No. 162. Edits., K. H. Rechinger and I.C. Hedge, p. 430, Akademische Druck and Verlagsanstalt, Graz, Austria (1987).
2. V. Mozaffarian, *A Dictionary of Iranian Plant Names*, Farhang Moaser, Tehran (1996).
3. K. Javidnia, R. Miri, N. Edraki, M. Khoshneviszadeh, and A. Javidnia, *J. Essent. Oil Res.*, **18**, 548 (2006).
4. C. S. Erdurak, M. Coskun, B. Demirci, and K. H. C. Baser, *Flavour Fragrance J.*, **21**, 118 (2006).
5. K. Samiee, M. R. Akhgar, A. Rustaiyan, and S. Masoudi, *J. Essent. Oil Res.*, **18**, 19 (2006).
6. S. Masoudi, A. Rustaiyan, and N. Ameri, *J. Essent. Oil Res.*, **16**, 143 (2004).
7. A. Rustaiyan, S. Sedaghat, K. Larijani, M. Khosravi, and S. Masoudi, *J. Essent. Oil Res.*, **14**, 447 (2002).
8. K. H. C. Baser, B. Demirci, F. Demirci, T. Hashimoto, Y. Asakawa, and Y. Noma, *Planta Med.*, **68**, 564 (2002).
9. K. H. C. Baser, B. Demirci, and H. Duman, *J. Essent. Oil Res.*, **13**, 134 (2001).
10. G. Ruberto, D. Biondi, and A. Renda, *Phytochem. Anal.*, **10**, 241 (1999).
11. F. Demirci, G. Iscan, K. Guven, N. Kirimer, B. Demirci, and K. H. C. Baser, *Z. Naturforsch. C, Biosciences*, **55**, 886 (2000).
12. C. Demetzos, D. Perdetzoglou, M. Gazouli, K. Tan, and C. Economakis, *Planta Med.*, **66**, 560 (2000).