

## Comparison of the Seed Oils of *Ferulago trachycarpa* Boiss. Different Localities with Respect to Fatty Acids

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**Abstract:** The fatty acid composition of the seed oil of *Ferulago trachycarpa* Boiss., collected from two different localities (Balıkesir-Edremit and Konya-Seydişehir), was analyzed for derived methyl esters of their fatty acids by capillary gas chromatography-mass spectrometry (GC-MS). Seventeen components representing 98.7 % of Balıkesir sample and 98.6 % of Konya sample of *F. trachycarpa* seed oils were identified. GC-MS data showed that the main fatty acids were 9-octadeceneoic acid (68.1 and 73.6 %), 9,12-octadecadienoic acid (23.0 and 18.0 %), 9-hexadeceneoic acid (4.1 and 3.5 %) and 11-octadeceneoic acid (2.0 and 1.8 %) in both oils, respectively. Unsaturated fatty acids were found as high as 97.7 and 97.4 %, while the percentage of the saturated fatty acids was found as low as 1.0 and 1.2 % in both seed oils, respectively.

**Keywords:** *Ferulago trachycarpa*; Apiaceae; GC-MS; seed oil; fatty acid

### 1. Introduction

The genus *Ferulago* W. Koch. (Umbelliferae), distributed in Europe, Asia, and Africa [1], represented by thirty-two species in the Flora of Turkey, seventeen of which are endemic [2-6]. *Ferulago trachycarpa* Boiss. is a perennial setulose herb with 65-150 cm long; leaves 5-6 pinnate; inflorescence paniced thyrses, central umbel with short pedicel or sessile; bract and bracteole ovate; mericarps elliptic, dorsal ribs short winged, resin canals less and chromosome bigger than the other *Ferulago* species. Distribution of *F. trachycarpa* is West, Southwest and South Anatolia in Turkey. In the world, it is distributed in the East Aegean Islands, Syria and Lebanon. *F. trachycarpa* is an element of East Mediterranean Phytogeographic Area [7].

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Since ancient times, *Ferulago* species have been used in folk medicine as sedative, tonic, digestive, carminative, aphrodisiac as well as in the treatment of intestinal worms and hemorrhoids [7,8]. *F. trachycarpa* is named indigenously as “Kuzu kişnişi, Kurtkulağı, Kuzubaşı, Kuzukemirdi, Kuzukulağı” and the fresh base leaves of the plant are picked from nature in spring and purchased from the bazaar in Konya, Bozkır region. These parts are commonly consumed as a salad [9]. In addition, *F. trachycarpa* is known as “Kimyon otu” in the vicinity of Balıkesir, Edremit and, after dried and grinded, the mature seeds of the plant use as spice [7].

To date, there have been some studies on chemical compositions of various *Ferulago* species. Essential oils [10-15] and coumarins [16-18] were reported as the main chemical constituents of the *Ferulago* plants. In the studies with respect to essential oils of *Ferulago* genus, monoterpenes and sesquiterpenes were characterized as the main compounds [10-15]. In the previous two studies, essential oil composition of the fruits of *F. tyrachycarpa* collected from two localities in Turkey, Konya and Balıkesir, was investigated by GC/MS and, (*Z*)- $\beta$ -ocimene and  $\gamma$ -terpinene were detected as major components in both investigated samples [11,12]. In addition, some flavonoids, sesquiterpenes and phytosterols were reported in *Ferulago* species [19-21]. To the best of our knowledge, there are no studies on the fatty acid composition of seeds of the *Ferulago* genus.

Essential fatty acids (EFAs) are of vital significance for human beings. The role of EFAs in the diet such as  $\alpha$ -linolenic (18:3 $\omega$ 3), linoleic (18:2 $\omega$ 6) and  $\gamma$ -linolenic (18:3 $\omega$ 6) acids, especially obtained from plant ingredients, is crucial. It has been suggested that consumption of a diet enriched in EFAs posses beneficial health effects such as in the prevention and treatment of cardiovascular, inflammatory (rheumatoid arthritis and ulcerative colitis), autoimmune (atopic dermatitis and psoriasis) and malignant diseases [22]. This work attempts to contribute to the knowledge of seed oil composition of *F. trachycarpa*, in Turkey, which has not been documented up to date. The present study is conducted to examine the fatty acid composition of the seed oil from *F. trachycarpa* wild populations collected from two different regions of Turkey.

## 2. Materials and Methods

### 2.1. Plant Material

The seeds of mature *Ferulago trachycarpa* Boiss. were collected from two different localities of Turkey in the natural habitats of the plants. The plants were identified by our of us, E. Akalın, Ph.D. Voucher specimens were deposited in the Herbarium of the Faculty of Pharmacy at Istanbul University in Istanbul (ISTE), Turkey. The collection sites and herbarium number for both plant material are; Balıkesir, Edremit, Kazdağı in 2002 (ISTE 74661) and Konya, Seydişehir in 2002 (ISTE 81223).

### 2.2 Oil Extraction and Transesterification

The seeds of *Ferulago trachycarpa* were separated from plant materials and dried under shade. The weighed seeds (2.5 g) were ground with anhydrous sodium sulfate and extracted with petroleum ether (bp 40-60 °C, Merck Co., USA) for 6 h in a Soxhlet apparatus. The lipophylic extracts were evaporated under vacuum at 40 °C to dryness and the obtained seed oils were weighed accurately and percentage yields (w/w) were calculated. Then, the seed oils were saponified with 0.5 N methanolic NaOH solution by heating on a steam bath, and then boiled for 2 minutes. Subsequently, 2 mL of boron trifluoride-methanol complex (20 %, Merck Co., USA) was added and the solutions heated for 2 minutes in a boiling water bath. After cooling, each solution was completed with saturated NaCl solution in 10 mL measuring flasks. The mixtures were left for 30 min for gathering the oily part on the surface of the solution and the converted methyl esters of fatty acids were extracted with petroleum

ether, and then the organic layer was separated using Pasteur pipettes [23]. The methyl esters of the fatty acids were dissolved in  $\text{CH}_2\text{Cl}_2$  and injected into a GC-MS apparatus.

### 2.3 Gas Chromatography Mass Spectrometry

The fatty acid methyl esters were analyzed using Trace 2000 GC series gas chromatography and Thermo mass spectrometer. SGE BPx70 column (60 m x 0.25mm, 0.25  $\mu\text{m}$  film thickness) was used. The carrier gas was helium at a rate of 1mL/min. GC oven temperature was kept at 100 °C for 5 min and programmed to 240 °C at a rate of 4 °C/min and kept constant at 240 °C for 5 min. The injection temperature and source temperature were 250 °C and 220 °C, respectively. MS interface temperature was 240 °C. The injection volume was 0.5  $\mu\text{L}$  with a split ratio of 1:30. EI/MS were taken at 70 eV ionization energy. Mass range was used from  $m/z$  50 to 650 amu. Scan time 0.5 sec. with 0.1 interscan delay. The library search carried out using NIST and Wiley GC-MS library and TÜBİTAK-UME library. Supelco™ 37 components FAME mixture (Catalog no:47885-U) were used for the comparison of the GC chromatograms. The relative percentage of separated compounds were calculated from Total Ion Chromatography by the computerized integrator [24].

## 3. Results and Discussion

We investigated the constituents of the seed oil of *F. trachycarpa* collected from two localities in Turkey, Balıkesir-Edremit and Konya-Seydişehir, by means of GC-MS. In this study, the seed oils were obtained yields of 7.3 % in Balıkesir sample and 9.1 % in Konya sample. The composition of the fatty acids of the seed oils and their relative percentages are given in Table 1. Seventeen components representing 98.7 % of Balıkesir sample and 98.6 % of Konya sample of *F. trachycarpa* seed oils were identified. Almost all of the oil contents, 97.7 % in Balıkesir sample and 97.4 % in Konya sample, were unsaturated fatty acids.

The GC/MS analysis of the seeds, collected from different localities, of *F. trachycarpa* showed that the composition and the relative amount of the fatty acids were found to be considerably similar (Table 1). Oleic acid was found as the main fatty acid of the seed composition by 68.1 and 73.6 % in both samples, respectively. The followed main compounds were also detected as unsaturated fatty acids such as 9,12-octadecadienoic acid (linoleic acid, 23 and 18 %), 9-hexadecenoic acid (palmitoleic acid, 4.1 and 3.5 %) and 11-octadecenoic acid (vaccenic acid, 2 and 1.8 %) in the both seed oils, respectively. In addition, these unsaturated fatty acids, 11-hexadecenoic and 9,12,15-octadecatrienoic (linolenic acid) acids were determined in the seeds. Besides, saturated fatty acids, namely dodecanoic, pentadecanoic, 14-methylhexadecanoic, heptadecanoic, octadecanoic, eicosanoic, 11,13-eicosadienoic, docosanoic, tricosanoic, tetracosanoic and hexacosanoic acids, were found in low amounts, totally 1.0 % in Balıkesir sample and 1.2 % in Konya sample.

The remarkable high content on fatty oleic and linoleic acids must be emphasized in the seed oils of the plant. Oleic acid (18:1 $\omega$ 9) is the principal fatty acid of olive oil. Oleic acid is an effective hypocholesterolemic agent and as one of the key components of the Mediterranean diet, characterized by a moderately low intake of polyunsaturated fatty acids and high intake of monounsaturated fatty acids from olive oil. It has been considered potentially useful in the prevention of cardiovascular

diseases. In addition, linoleic acid (18:2 $\omega$ 6) has also been known for its cholesterol-lowering property for many years [25].

Our data showed that the wild edible spice *F. trachycarpa* seeds which have been used in the vicinity of Balıkesir, exhibited a good nutritional potential with respect to the fatty acids content. Although, further research is needed to evaluate the nutritional profile of this species for the development of new sources of food. To best of our knowledge, the present work is the first report on the fatty acid composition of seed of *F. trachycarpa*.

**Table 1.** Fatty Acid Composition of *Ferulago trachycarpa* Seeds\*

Fatty Acids	<i>F. trachycarpa</i> (Balıkesir- Edremit)	<i>F. trachycarpa</i> (Konya- Seydişehir)
Dodecanoic acid (12:0)	t	t
Pentadecanoic acid (15:0)	t	0.1
14-Methyl hexadecanoic acid (16:0)	t	t
9-Hexadecenoic acid (Z) (16:1)	<b>4.1</b>	<b>3.5</b>
11-Hexadecenoic asit (Z) (16:1)	0.2	0.2
Heptadecanoic acid (17:0)	t	t
Octadecanoic acid (18:0)	t	t
9-Octadecenoic acid (18:1)	<b>68.1</b>	<b>73.6</b>
11-Octadecenoic acid (18:1)	<b>2.0</b>	<b>1.8</b>
9,12-Octadecadienoic acid (18:2)	<b>23.0</b>	<b>18.0</b>
9,12,15-Octadecatrienoic acid (18:3)	0.3	0.3
Eicosanoic acid (20:0)	0.1	0.2
11,13-Eicosadienoic acid (20:2)	0.1	0.1
Docosanoic asit (22:0)	0.2	0.2
Tricosanoic acid (23:0)	0.3	0.3
Tetracosanoic acid (24:0)	0.3	0.3
Hexacosanoic acid (26:0)	t	t
Oil Yield, %	7.3	9.1
$\Sigma$ Saturated fatty acids	1.0	1.2
$\Sigma$ Unsaturated fatty acids	97.7	97.4
U/S	0.01	0.01
Total Fatty Acids	98.7	98.6

\* GC/MS analyses were replicated for three times (Mean RSD value is % 0.1)

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