

A CHEMOTAXONOMIC STUDY ON *FERULAGO* SPECIES IN TURKEY

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SUMMARY

The genus *Ferulago* W. Koch (Trib. Peucedaneae) consists of c. 49 species which is distributed in the Northern hemisphere (mainly Europe, Northwest and Central Asia, the Caucasus, North and Northwest Africa). The genus *Ferulago* is represented by 32 species of which 17 are endemic in Turkey and this figure is the highest of the world. A considerable number species and proportion of endemic species can be thought that Turkey is a “center of diversity” for *Ferulago* genus.

Ferulago species are known as “çakşırotu” and they are used as aphrodisiac, sedative, carminative, tonic, anthelmintic, food (spice, salad) and fodder in Turkey.

23 *Ferulago* species were investigated with respect to chemotaxonomy of leaf flavonoids. Quercetin, kaempferol, isorhamnetin, luteolin and apigenin flavonoids were used as chemotaxonomical markers. Differences and similarities were determined among the related species.

ÖZET

Ferulago W. Koch (Trib. Peucedaneae) cinsi dünya üzerinde Kuzey Yarıkürede (başlıca Avrupa, Kuzeybatı ve Orta Asya, Kafkaslar, Kuzey ve Kuzeybatı Afrika) yayılış gösteren yaklaşık 49 türe sahiptir. Türkiye’de ise 17’si endemik olmak üzere 32 türle temsil edilir ki bu sayı dünya üzerinde en yüksek miktardır. Dikkate değer tür sayısı ve endemik türlerin oranı ile *Ferulago* cinsi için Türkiye bir “gen merkezi” olarak düşünülebilir.

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Ferulago türleri Türkiye’de “çakşırotu” olarak bilinir ve afrodisyak, sakinleştirici, gaz söktürücü, kuvvet verici, kurt düşürücü, gıda (baharat, salata) ve hayvan yemi olarak kullanılır.

23 *Ferulago* türünün yapraklarında bulunan flavonoidler kemotaksonomik açıdan incelenmiştir. Kersetin, kempferol, isoramnetin, luteolin ve apigenin flavonoidleri kemotaksonomik belirteç olarak kullanılmıştır. Yakın türler arasındaki farklılıklar ve benzerlikler belirlenmiştir.

Key words: *Ferulago*, chemotaxonomy, leaf flavonoids, Turkey

INTRODUCTION

Ferulago W. Koch is a medium sized genus of *Umbelliferae* comprising about 49 species distributed across part of Europe (except North), Southwest and Middle Asia, the Caucasus, North and Northwest Africa. The genus *Ferulago* belongs to the Trib. *Peucedaneae* (27, 30).

Ferulago as a genus was described by W.D. J. Koch (Wilhelm Daniel Joseph Koch, 1771-1848, was a German physician and botanist) on the basis multifloral involucre of the umbella (presence-*Ferulago*, absent-*Ferula*) and fruit characteristics. The type species of *Ferulago* was never indicated to 1979. Pimenov and Tomkovich choose *Ferulago thyrsoiflora* (*Ferula thyrsoiflora*) as lectotype of this genus (28).

The *Ferulago* species usually are located on high altitude, rocky serpentine slopes and stony places. This genus is closely related *Ferula*, *Peucedanum* and *Prangos* genera.

The highest concentration of the genus is to be found in south and west regions of Turkey in some mountains where is also observed maximal diversity of sections. The second area of concentration of species and sections is North Iranian Mountains. And the third to the Iberian Peninsula (30). The species of the genus *Ferulago* are distributed mainly in the Mediterranean Countries (31).

In the main Flora of Turkey account for *Ferulago*, Peşmen (1972) recognized 28 species in Turkey, 14 of which are endemic (26). He recognized the taxonomic problems in the genus and called for a monographic revision. Bernardi provided this revision in 1979, distinguishing a total of 39

species, 26 of which were from Turkey (7). Since the time of the account of first Flora of Turkey, several new taxa have been added such as *F. idaea*, *F. trojana* and *F. glareosa*.



Figure 1: *Ferulago trojana*

The species of *F. autumnalis* that is indicated with red flowers in Flora of Turkey, changed to *Peucedanum* genus (7).

Today the genus *Ferulago* is represented by 34 species in Turkey of which 20 are endemic and this figure is the highest of the World (1, 2, 22, 25). The genus is second containing most species in Turkey. Turkish *Ferulago* species are grouped in 2 subgenera and 7 sections.

Ferulago and related genera such as *Ferula*, *Glaucosciadium* and *Prangos* are known by the vernacular names; ‘Çakşır’ or ‘Çağşır’ and they are mainly used as aphrodisiacs and preferred as fodder to increase animal productivity. 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 (2).

F. trachycarpa named as “İlkıçağşır or Çağşır” in Karaman and its roots are used as aphrodisiac. “Kuzu kişnişi, Kurtkulağı, Kuzubaşı, Kuzukemirdi, Kuzukulağı” other names of *F. trachycarpa* 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. 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 (6).

As an important medicinal and food genus *Ferulago* have previously been investigated for their chemical composition coumarins, flavonoid, essential oil, organic acid.

F. aucheri (Figure 2), *F. asparagifolia*, *F. confusa*, *F. humilis*, *F. sylvatica* are surveyed for flavonoids (12, 13, 14, 15, 21).

Bulgarian *F. sylvatica* samples and *F. trojana* (*F. sylvatica* in Flora of Turkey) samples flavonoids constituent are not similar (21).

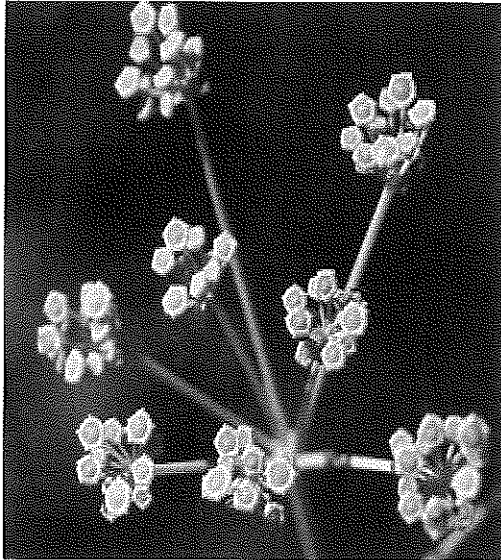


Figure 2: *Ferulago aucheri*

For coumains *F. aucheri*, *F. asparagifolia*, *F. confusa*, *F. humilis*, *F. thirkeana*, *F. isaurica*, *F. syriaca* species have been researched (12, 13, 14, 15, 16, 21, 24)

For essential oils, *F. trachycarpa*, *F. asparagifolia*, *F. aucheri*, *F. confusa*, *galbanifera*, *F. humilis*, *F. idaea*, *F. macrosciadia*, *F. mughlae*, *F. sandrasica*, *F. silaifolia*, *F. sylvatica*, *F. trachycarpa*, *F. thirkeana*, *F. angulata*, *F. isaurica*, *F. syriaca*, *F. antiochia* *F. pachyloba*, *F. platycarpa*, *F. isaurica*

and *F. longistylis* species have been studied (4, 5, 8, 24).

F. trachycarpa's organic acids (16) and *F. asparagifolia*'s caffeoyl derivatives and monoterpenoid glycoside (3) were surveyed.

Essential oil composition of *F. asparagifolia*, *F. galbanifera*, *F. humilis*, *F. trachycarpa*, *F. bernardii*, *F. longistylis* have been investigated for their antimicrobial (18, 23, 29) and antifungal (29) activities.

Also antiulcerogenic activity of *F. isaurica*, *F. syriaca* have been surveyed (17).

A chemotaxonomic study with flavonoids are made by us on the 22 Turkish *Ferulago* species. In this study chemical evidences are seen very important for the classification on this genus (9, 19, 20).

MATERIAL AND METHODS

The plant materials were collected in Western Anatolia. Voucher specimens were kept at Herbarium of the Faculty of Pharmacy at Istanbul University, Istanbul (ISTE), Turkey. Flavonoids

Extracts were obtained by distillation from crushed leaves 22 species of *Ferulago* using ethanol (some of material from herbarium sheets were used). Extracts were hydrolyzed with 2 M HCl for 30-40 minutes at 100°C. Solutions were extracted with ethyl acetate. Paper chromatography in BAW (butanol-acetic acid-water) were used for separation of flavonoids and thin layer chromatography on silica gel in BAW and chloroform-acetone-formic acid (9:2:1) methods were used for separation of aglycones. Five common substance apigenin, luteolin, kaempferol, quercetin and isorhamnetin were applied for a marker (10, 11).

RESULT AND DISCUSSION

Chemotaxonomy is a combinative discipline between chemistry and taxonomy. Mainly it is concerned with chemical properties of definite groups of plant. Chemotaxonomy tends to act very much as a support of classical taxonomy. Chemical characters of plants can often be used in classification. These 22 species are investigated by chemical survey of leaves flavonoids. The results of chemical studies are shown to as diversities and similarities

among the related species. For example; isorhamnetin has been identified in *F. humilis*, but there is not in *F. macrosciadia*. Kaempferol presents in *F. humilis*, in spite of *F. idaea* have not. This situation is an important evidence for a new species. All results are given in the Table.

22 Species gather into 6 groups (A-F) that these species are related morphologically.

Any substances as used marker are not separated from *F. silaifolia*, but different flavonoids are observed. Apigenin occurs only two species, *F. antiochia* (group A) and *F. mughlae* (group B). All species, except *F. mughlae* and *F. amani*, contain flavonols substance. All of flavonols, kaempferol, quercetin and isorhamnetin are presented only *F. humilis* and *F. sandrasica* that are closely related species. Luteolin and apigenin flavons are not determined in groups C, D, E.

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Table. Flavonoids contents as a marker in 23 *Ferulago* species.

(Q: Quercetin, K: Kaempferol, I: Isorhamnetin, L: Luteolin, A: Apigenin)

Groups		Flavonol			Flavon		ISTE Number
		Q	K	I	L	A	
A	Aglikonlar						
	<i>Ferulago pachyloba</i> (Fenzl) Boiss.	-	-	+	+	-	80766
	<i>Ferulago blancheana</i> Post	-	+	+	-	-	80353
	<i>Ferulago trachycarpa</i> Boiss.	+	-	+	-	-	81351, 81175
	<i>Ferulago antiochia</i> Saya et Miski	-	+	-	+	+	80775
	<i>Ferulago bracteata</i> Boiss.&Hauskn.	+	-	-	-	-	80309
B	<i>Ferulago syriaca</i> Boiss.	+	-	-	-	-	80293
	<i>Ferulago isaurica</i> Pesmen	-	+	-	-	-	81254
	<i>Ferulago pauciradiata</i> Boiss. & Heldr.	+	-	-	+	-	81346, 81272
C	<i>Ferulago mughlae</i> Pesmen	-	-	-	+	+	74254
	<i>Ferulago cyprea</i> H. Wolf	+	+	-	-	-	80226
	<i>Ferulago galbanifera</i> (Miller) W.Koch	+	-	-	-	-	72397
D	<i>Ferulago cassia</i> Boiss.	+	-	-	-	-	80256
	<i>Ferulago asparagifolia</i> Boiss.	+	-	-	-	-	74253
	<i>Ferulago aucheri</i> Boiss.	+	-	+	-	-	68258
E	<i>Ferulago sandrasica</i> Pesmen & Quézel	+	+	+	-	-	72553, 74540
	<i>Ferulago idaeae</i> N.Ozhatay & E.Akalin	+	-	+	-	-	74485
	<i>Ferulago humilis</i> Boiss.	+	+	+	-	-	74248
	<i>Ferulago macrosciadia</i> Boiss.& Bal.	+	+	-	-	-	72018, 72023
F	<i>Ferulago confusa</i> Velen.	+	-	+	-	-	68119
	<i>Ferulago trojana</i> E. Akalin & Pimenov	+	-	-	+	-	72038
	<i>Ferulago thirkeana</i> (Boiss.) Boiss.	+	-	+	-	-	71551
	<i>Ferulago silaifolia</i> (Boiss.) Boiss.	-	-	-	-	-	72530
	<i>Ferulago amani</i> Post	-	-	-	+	-	81377