



A morphological study of *Smyrniium* (Apiaceae) from Turkey

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Abstract

In this study, six taxa of the genus *Smyrniium* L. (Apiaceae) *Smyrniium olusatrum* L., *S. perfoliatum* L. subsp. *perfoliatum*, *S. perfoliatum* Mill. subsp. *rotundifolium*, *S. cordifolium* Boiss., *S. connatum* Boiss & Kotschy and *S. creticum* Mill. were investigated. Specimens were collected from the field and general morphology of every taxa was drawn. Especially micromorphological surface characteristics of mericarps were investigated by using scanning electron microscopy (SEM) and mericarp characters of each taxa were examined by using light microscopy and quantitative analysis was done because of the mericarp characters importance in systematic. Based on these data, the mericarp's features were added to the identification key in addition to the characters used in differentiating the species in the Flora of Turkey.

Key words: mericarp, morphology, scanning electron microscope, *Smyrniium*, Turkey

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Türkiye'nin *Smyrniium* (Apiaceae) cinsi üzerine morfolojik bir çalışma

Özet

Bu çalışmada, Türkiye'de doğal olarak yetişen *Smyrniium* L. (yabani kereviz) cinsinin 6 taksonu; *S. olusatrum* L. (delikereviz), *S. perfoliatum* L. subsp. *perfoliatum* (sarıkörek), *S. perfoliatum* Mill. subsp. *rotundifolium* (çakalbaldıran), *S. cordifolium* Boiss. (kokarbaldıran), *S. connatum* Boiss & Kotschy (yabani kereviz), *S. creticum* Mill. (belesanotu) incelenmiştir. Araziden toplanan örneklerden her taksona ait genel görünüşler aydınlatılarak üzerine çizilmiştir. Özellikle merikarp karakterlerinin sistematikteki öneminden dolayı, merikarpların mikromorfolojik yüzey özellikleri taramalı elektron mikroskopunda (SEM) incelenmiş, ayrıca her taksona ait örneklerin merikarp karakterleri stereo ışık mikroskobu ile incelenerek sayısal analizleri yapılmıştır. Bu veriler ışığında Türkiye Florası'nda yer alan türlerin ayırımında kullanılan karakterlere ilave olarak, tohum özellikleri de eklenerek teşhis ayırım anahtarı tekrar yapılmıştır.

Anahtar kelimeler: merikarp, morfoloji, *Smyrniium*, taramalı elektron mikroskobu, Türkiye

1. Introduction

Smyrniium which has 38 species in world distribution is represented by 6 taxa in Turkey (Stevens, 1972; Davis, 1988). *Smyrniium galaticum* Czeccott is referred as a species, the presence of which is unknown in the Flora of Turkey. However, Sağiroğlu (2012) indicated that *S. galaticum* is an endemic species in Turkey.

Smyrniium taxa are generally considered as plants with diuretic, depurative and aperient properties, particularly through their roots. However, their most outstanding quality is perhaps as an antiscorbutic because of their high vitamin C content. The fruit has carminative and stomachic properties (Bermejo and Leon, 1994). Some *Smyrniium* taxa were cultivated as an edible vegetable in ancient times (Jafri and El-Gadi, 2001). Their commonest use has been as a fresh vegetable, with a preference being shown for their leaves, young shoots and leaf stalks, which impart a flavour similar to celery (Bermejo and Leon, 1994). In recent years many studies have been done on this valuable genus and most of these consisted of phytochemical research. When these studies are investigated, it can be seen that Bohlmann (1973) and Gonzalez et al. (1975) studied *S. olusatrum*, Ulubelen et al. (1982) investigated *S. perfoliatum*, *S. creticum* and *S.*

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rotundifolium, Gören et al. (1984) focused on *S. rotundifolium* fruits, Tanker et al. (1984) *S. cordifolium* fruits, Poli et al. (1995) examined *S. perfoliatum*, El-Gamal (2001) investigated *S. olusatrum*, Amiri (2006) studied *S. cordifolium*, Mölleken et al. (1998) made studies related to essential oils contained in species *S. olusatrum* and *S. perfoliatum*, and Bertoli et al. (2004) performed phytochemical studies on *S. olusatrum*.

Some taxonomical studies have been done on *Smyrniium* (Hartvig, 1986; Randall, 2003). In recent years, in the studies of flora new records have been obtained for the Flora of Turkey. Kaya and Başaran (2006) added *S. perfoliatum* in their study named ‘Contributions to the flora of Bartın. Randall (2003) carried out a study on the biological characteristic species of *S. olusatrum*. Hinkova and Koeva (1966) carried out a microbiological study on *S. perfoliatum*, Ragozzino (1973) studied *S. olusatrum*. Payne (1977) conducted a study to determine the insects attracted by *S. olusatrum*. Weber (1994) carried out a study on the embryology of *S. perfoliatum*’s stigma, stylus and pollen tube. Bourarach (1999) carried out an ecotoxicological study on *S. olusatrum*. In Turkey there was no adequate study on the taxa of *Smyrniium*, especially of micromorphological characters. The purpose of this study is to examine general morphological and micro-morphological aspects of *Smyrniium* grown in Turkey. Besides, contributing to the flora and expanding the distribution areas with the field work is intended. The systematical condition of species was revised by specified characters.

2. Materials and methods

The specimens collected were dried according to standard procedures and transformed into herbarium specimens. The specimens were collected in March-June because of considering the importance mericarps play in the diagnosis of taxa. Some samples of taxa were fixed into 70% alcohol to be used in morphological studies. Mericarps extracted from the plant specimens containing mature fruits were deposited into envelopes in the field to be used in examinations. Distribution of the species in the investigation area is based on the specimens we have collected (Table 1). The general view of the specimens was drawn by hand due to their significance in the identification of the taxa (Figure 1). The diagnosis of collected samples was done according to Stevens (1972).

In particular, the micromorphological surface characteristics of mericarps were investigated by using scanning electron microscopy (SEM) and the mericarp characters of 30 specimens belonging to each taxa were examined by using light microscopy and quantitative analyses were done because of the mericarp characters’ importance in systematic. These measurements were performed using a millimeter ruler under stereo light microscope. Size of mericarp, surface-type and surface ornamentation were determined. For SEM, mericarp samples were mounted on stubs using double-sided adhesive tape and were then coated with gold using a Polaron SC7620 sputter. These coated mericarps were examined and photographed with a LEO 440 scanning electron microscope at Dokuz Eylül University’s Engineering Faculty. The following morphological characteristics of mericarps were studied according to Stearn (1996). Mericarp characteristic properties of every taxa added to study in table form (Table 2; Figure 2).

Table 1. The location and habitats and some morphological characters in *Smyrniium* (Figures 1-3)

Taxa	Specimen location and habitat	Plant length (cm)	Stem leaves
<i>Smyrniium olusatrum</i>	Izmir: Central exit of Izmir-Cesme highway, inside fence area, 50 m, 12.03.2010, KY0229	30-150	ternate, serrate
<i>S. perfoliatum</i> subsp. <i>perfoliatum</i>	Bolu: Bolu towards Abant Lake, Akcaalan village, 1000 m, 22.04.2010, KY0243	90-140	half perfoliate, crenate serrate
<i>S. perfoliatum</i> subsp. <i>rotundifolium</i>	Izmir: Kemalpaşa, Bağyurdu town, 190 m, 11.03.2010, KY0226	70-110	usually perfoliate, slightly serrate
<i>S. cordifolium</i>	Ankara: Northeast of Hasanoğlan district, Hasanoğlan stream, 1350 m, 15.06.2010,	50-175	opposite, ovate with cordate
<i>S. connatum</i>	Denizli: Honaz district towards Honaz Mountain, 1000 m, 09.04.2010, KY0240	70-150	opposite, serrulate
<i>S. creticum</i>	Manisa: Between Muradiye and Emiralem (Menemen), 70 m, 21.05.2010, KY0247-2	50-130	opposite, serrate-

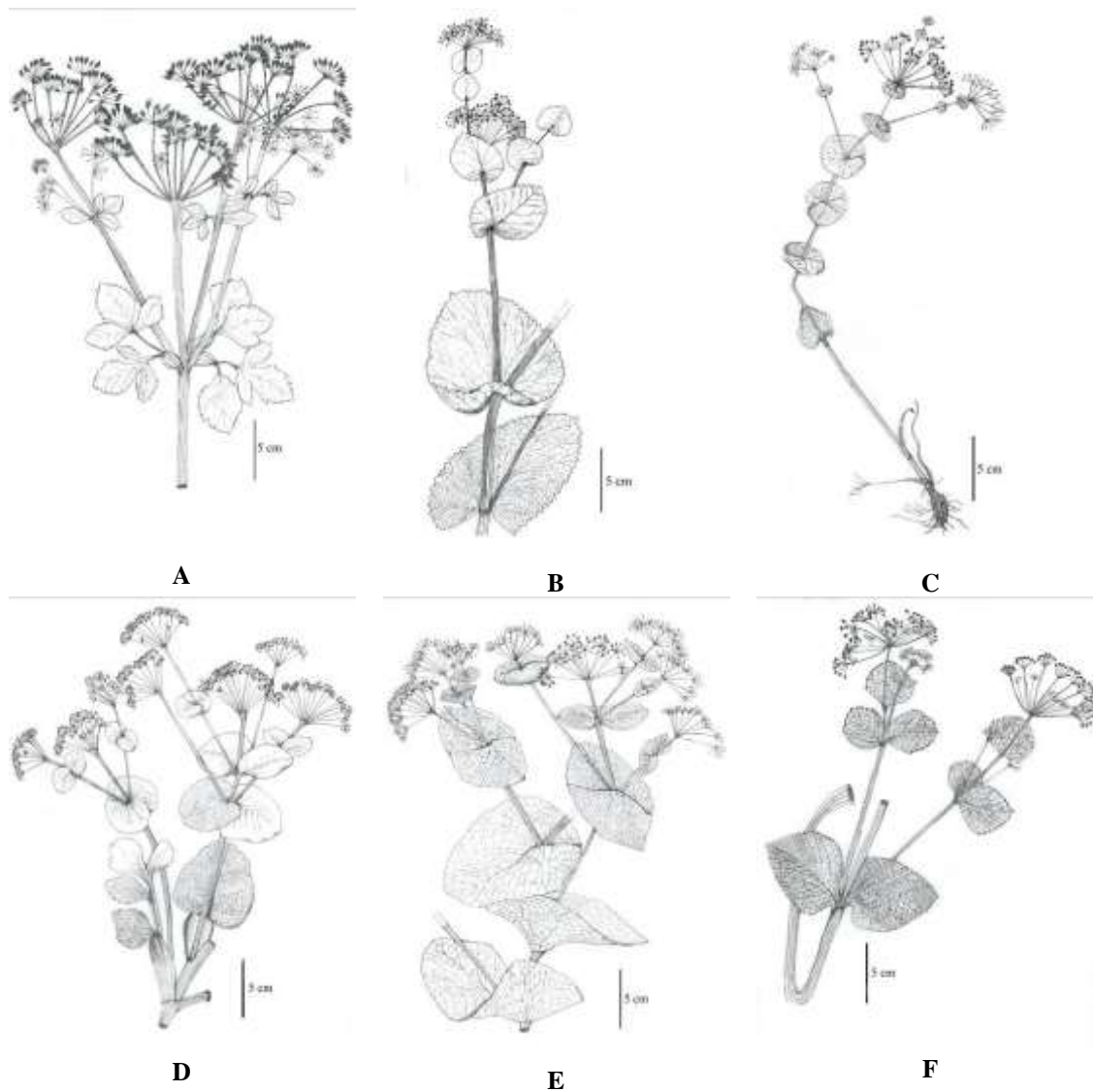


Figure 1. a. *Smyrniium olusatrum*, b. *S. perfoliatum* subsp. *perfoliatum*, c. *S. perfoliatum* subsp. *rotundifolium*, d. *S. cordifolium*, e. *S. connatum*, f. *S. creticum*.

Table 2. Mericarp morphological characters of the *Smyrniium* taxa.

Mericarp Taxa	Size Length (L) X Weight (W) (mm)	L/W (Min- Max)	Surface type	Colour	Surface ornamentation	Mericarp type
<i>Smyrniium olusatrum</i>	5-7x2-4	1.75-2.5	flat- concave	dark brown to black	foveolate-rugose	Reniform
<i>S. perfoliatum</i> subsp. <i>Perfoliatum</i>	4x3	1.33	flat- concave	dark brown to black	Ruminate	Reniform
<i>S. perfoliatum</i> subsp. <i>Rotundifolium</i>	3-4 x 2-3	1.33-1.5	flat- concave	dark brown to black	Rugulose	Reniform
<i>S. cordifolium</i>	5-7x 2-2.5	2.5-2.8	flat- convex	dark brown to black	Reticulate-rugose	Reniform
<i>S. connatum</i>	2,8 x 2.3	1.21	flat- convex	dark brown to black	Reticulate-rugose	Reniform
<i>S. creticum</i>	3.7 x 3	1.23	flat- convex	dark brown to black	Reticulate-rugose	Reniform

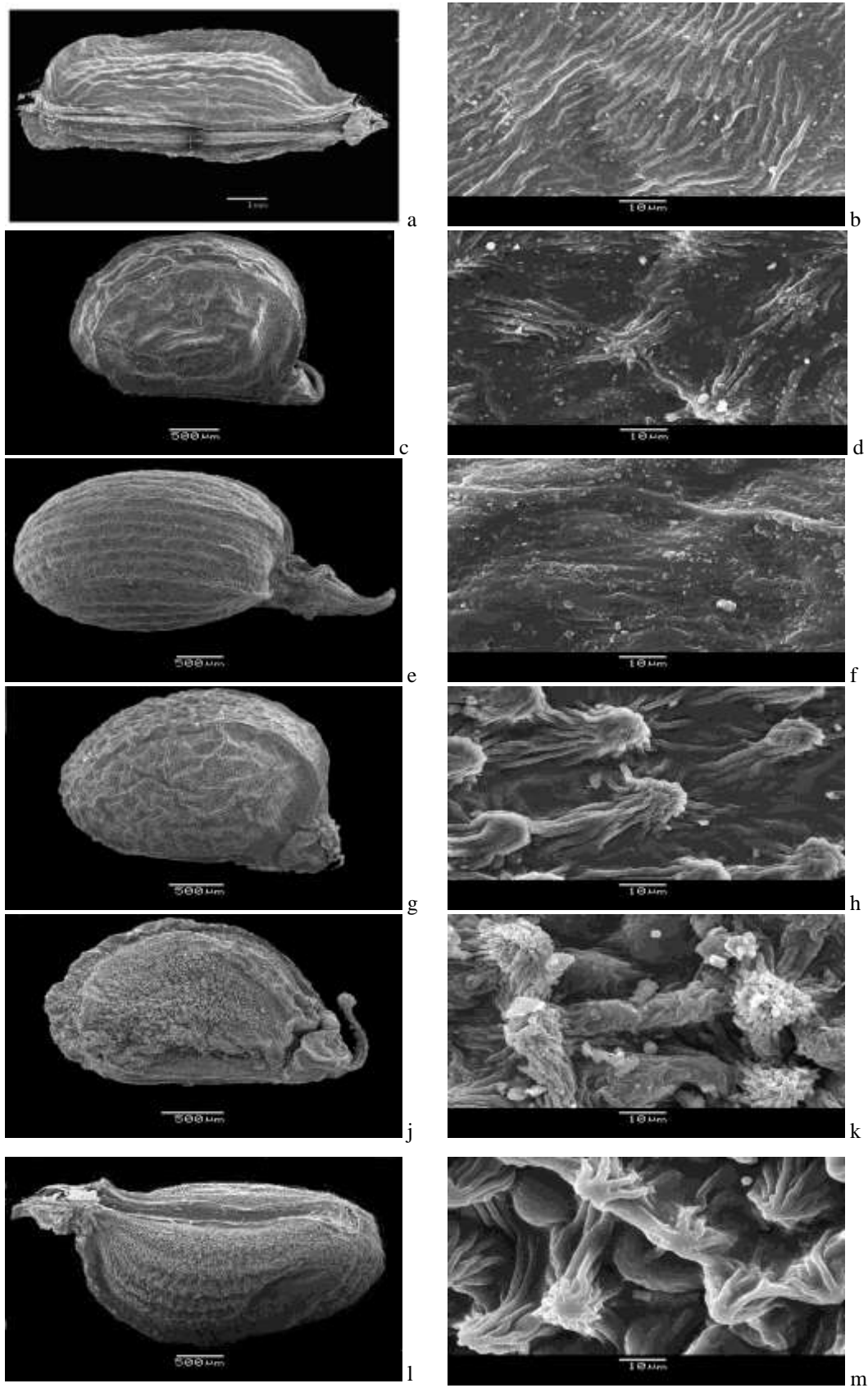


Figure 2. Mericarp (SEM): a,b. *Smyrnium olusatrum*, c,d. *S. perfoliatum* subsp. *perfoliatum*, e,f. *S. perfoliatum* subsp. *rotundifolium*, g,h. *S. cordifolium*, j,k. *S. connatum*, l,m. *S. creticum*

3. Results

In this study, general morphology and micromorphological features of mericarp have been studied in detail. According to our data, the identification key of *Smyrniium* was formed as follows;

1. Upper stem leaves ternate; dorsal ridges of fruit prominent, mericarp surface foveolate - rugose 1. *olusatrum*
1. Upper stem leaves undivided; dorsal ridges of mericarp obscure
 2. Upper stem leaves alternate
 3. Stem winged, at least in the mid-region; upper stem leaves crenate-serrate, mericarp surface ruminata 2. *perfoliatum* subsp. *perfoliatum*
 3. Stem ridged but not winged; upper stem leaves usually entire, sometimes slightly crenate-serrate, mericarp surface rugulose 3. *perfoliatum* subsp. *rotundifolium*
 2. Upper stem leaves opposite
 4. Upper stem leaves entire to obscurely serrulate
 5. Upper stem leaves with cordate base, free; styles in fruit erect, mericarp surface reticulate-rugose 4. *cordifolium*
 5. Upper stem leaves connate; styles in fruit reflexed, mericarp surface reticulate-rugose 5. *connatum*
 4. Upper stem leaves serrate-dentate, mericarp surface reticulate-rugose 6. *creticum*

4. Conclusions

All six taxa of *Smyrniium* were collected from natural habitats in Turkey. Taxa were grown in cool, shady empty areas as a group. Some herbarium samples (EGE, AEF, ANK, GAZI, K and E) of the collected taxa were investigated.

S. galaticum is defined as a species the presence of which is not known in the flora of Turkey (Stevens, 1972). Through this study, field works were performed to the locations where this species is grown and all samples were identified as *S. cordifolium*. After these identifications, the samples of *Smyrniium* species agreed with the studies performed in Royal Botanic Garden Edinburgh Herbarium (E), 2012 (Figure 3). In Edinburgh Herbarium, the diagnosis of *S. galaticum* samples was observed (A4 Çankırı. Eldivan, above Bakırlı. 1700 m, 18.vii. 1976, ISTF 35371, E 40991, A4 Çankırı. Eldivan, above Bakırlı. 1400 m, 18.VII.1976 40992) as the *S. cordifolium* and their findings matched our research.



Figure 3. Specimen of *Smyrniium cordifolium* (*S. galaticum*) in Royal Botanic Garden Edinburgh Herbarium (E00040991!)

Hartvig (1986), in his taxonomical study, recorded *S. rotundifolium* as subspecies of *S. perfoliatum*. In literature searches and on the International Plant Nomenclature (IPNI) site it was observed that both names are used. In this study, species were evaluated according to Hartvig (1986). *S. rotundifolium* and *S. perfoliatum* were very similar taxa morphologically. *S. perfoliatum* differs in its entirely ridged stems which are only rarely stellate-hairy, and in the orbicular, entire or only slightly serrate upper stem leaves with cordate base. The differences in the length values of taxa were observed between the Flora of Turkey and our measured values. In the records, shorter plant lengths were found

than our measured values. The reason for this is thought to be the young phase collection of the taxa or that taxa were collected in the young phase or invalid data was entered.

The mericarp of all the taxa are similar, dark brown and reniform type, differentiate in size. of *S. cordifolium* were found to be the largest. The mericarps of all taxa's surface types are convex, in terms of surface ornament; *S. olusatrum* is foveolate-rugose, *S. perfoliatum* subsp. *perfoliatum* ruminant, *S. perfoliatum* subsp. *rotundifolium* rugulose, *S. cordifolium*, *S. connatum* and *S. creticum* is reticulate-rugose (Figure 2). Based on these data, the mericarp's features were added to the identification key. In the differentiation of the species in the Flora of Turkey, characters such as the condition of upper leaves, mericarps' dorsal ridges being apparent or unclear and stem's having wings are used and the identification key is made. In addition, mericarp micromorphology is added as a distinctive character.

In short, in this study it was found that *S. galaticum* is synonymous with *S. cordifolium*. It supports the view that *S. rotundifolium* is a subspecies of *S. perfoliatum* with obtained results (Hartvig, 1986).

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