

**The anatomical structure of endemic *Peucedanum
graminifolium* Boiss.
(Apiaceae / Umbelliferae)**

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Abstract: The anatomical features of *Peucedanum graminifolium* Boiss. have been studied. This species is an endemic for Flora of Turkey. Root, stem and leaf cross-sections are investigated for anatomical studies and leaf surfaces are investigated for micromorphological studies. Outwards of stem are filled with sclerenchymatous cells. Paranchymatic cortex structure carry secretory canals. Vascular bundles are in groups and their relation is provided by sclerenchyma cells. Leaf mesophyll is paranchymatic and secretory canals are in vascular bundles on the lower surface side.

Key words: Apiaceae / Umbelliferae, *Peucedanum* L., anatomy

Introduction

Peucedanum L. is an heterogeneous genus of 100-120 species, distributed in the Old World, mainly in Eurasia and Africa (Pimenov & Leonov, 1993). Taxonomically *Peucedanum* is the most complex genus in the Apiaceae and it is usually defined in a broad sense, as in the majority of modern floras. Only few characters are common to all of the species and the genus exhibits a great diversity of life-form, leaf structures and chemical constituents (Solov'eva et al., 1985). In Turkey *Peucedanum* is represented by 16 species, and 17 taxa, including six endemic taxa (Chamberlain, 1972; Bernardi, 1979; Davis et al., 1988; Pimenov & Leonov, 2004; Parolly & North, 2004; Parolly & North, 2005; Akpulat & Akalın, 2010).

In this study, the anatomical characteristics of *Peucedanum*

graminifolium Boiss. (Apiaceae / Umbelliferae) which is endemic for Flora of Turkey are investigated.

Materials and methods

The plant samples were stored by keeping them inside 70% alcohol in the field studies conducted with the purpose of determining the anatomical structure of the species. The samples were turned into permanent with glycerin-gelatin by taking cross-sections from their root, stem, and leaf (Vardar, 1987). The features of the sections, which are examined by light microscope, were determined. Taking the photographs of the sections and transferring them to the digital media with Olympus microscope were actualized by using Spot in-sight color digital camera. The scales suitable for the lens size, of which the photographs are taken, were added to the images within the same program.

The general anatomical characteristics of the Apiaceae family were determined by Metcalfe and Chalk (1950). The most comprehensive anatomical literary work regarding this family is the study conducted by Oskolski and Wyk (2008).

Results

Root has an exodermis, which is not so very thick. Cortex consists of parenchymatic cells and carries secretory canals which are small size. Unlike some other *Peucedanum* species, the phloem of *P. graminifolium* does not carry secretory canals. The cambium is distinguishable in the form of 1-2 layered. Xylem elements extend towards the pith. Trachea are small cells. The rays are distinguishable with 2-3 cells wide (Figure 1).

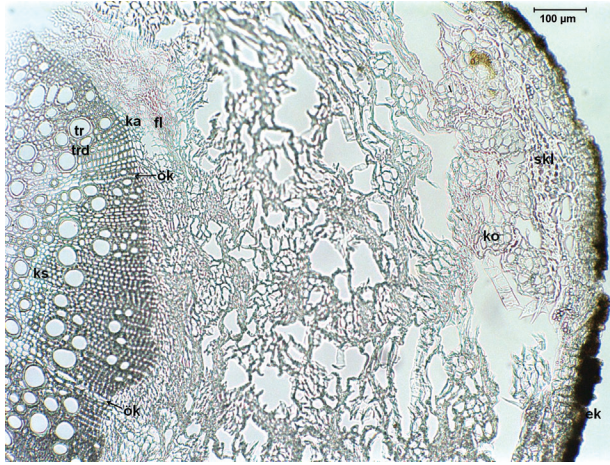


Figure 1. Root cross section. ek: exodermis, ko: cortex, skl: sclerenchyma, fl: phloem, ka: cambium, tr: trachea, trd: tracheid, ök: rays, ks: xylem.

Stem is surrounded by square-rectangular shaped epidermis cells. The ridges of the stem are filled with sclerenchymatous cells; and secretory canals exist below this region. Cortex is rather wide and consists of parenchymatic cells. Vascular bundles exist in groups and surrounded by sclerenchymatous cells. Trachea cells are large. The pith that fills a large section of the stem is parenchymatic (Figures 2 and 3).



Figure 2. General view of stem cross section.

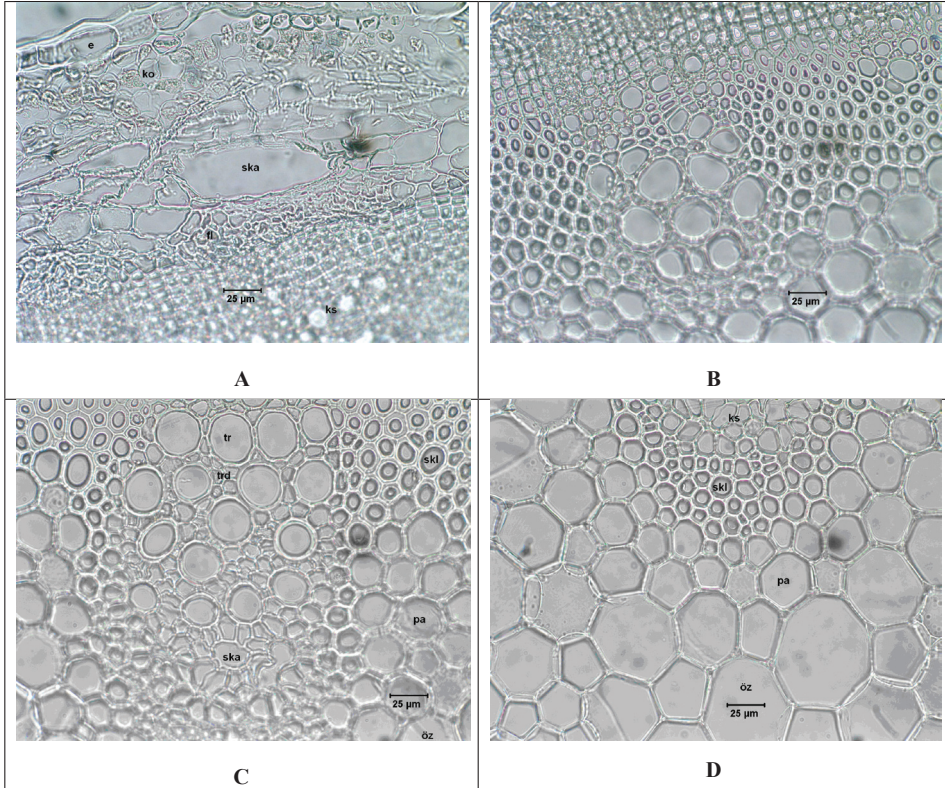


Figure 3. Stem cross section. **A.** e: epidermis, ko: cortex, ska: secretory canal, fl: phloem, ks: xylem. **B.** Vascular bundles. **C.** tr: trachea, trd: tracheid, ska: secretory canal. **D.** ks: xylem, skl: sclerenchyma, pa: parenchyma, öz: pith.

Leaf; the epidermis cells of the leaf are shaped square-rectangular, and they display a distinctive thickening especially in the lower epidermis. The mesophyll consist of large paranchymatic cells. Vascular bundles are dense in the mesophyll. No bundle sheath is observed around the vascular bundles. The xylem cells do exist towards upper epidermis whereas phloem cells are contained in the lower epidermis. 2-3 layers of sclerenchyma cells are contained in the epidermis section of the xylem. The secretory canals are with large diameters existing between the phloem and lower epidermis (Figure 4). The micromorphological structure of the leaf surface contain wavy surface. Stomata are large and exist in both upper and lower epidermis (Figure 5).

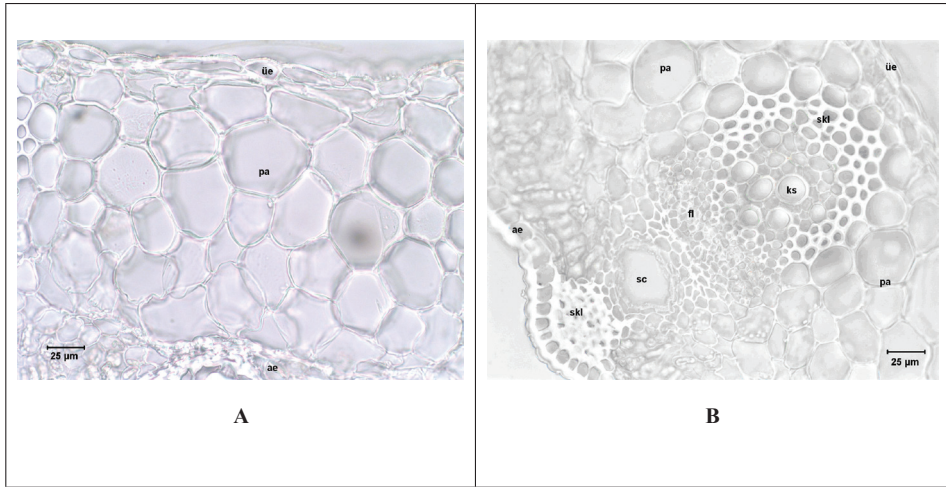


Figure 4. Leaf cross section. **A.** Leaf mesophyll. üe: upper epidermis, pa: parenchyma, ae: lower epidermis. **B.** Leaf midrib. üe: upper epidermis, pa: parenchyma, skl: sclerenchyma, ks: xylem, fl: phloem, sc: secretory canal, ae: lower epidermis.

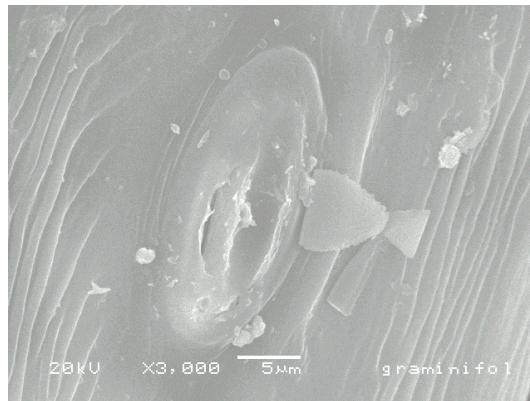


Figure 5. The micromorphological structure of the leaf surface and stomata.

Discussion

The root cortex of *P. graminifolium* contains small secretory canals. This condition isn't reported by Metcalfe and Chalk (1950). Unlike some other *Peucedanum* species in which only phloem was observed in secretory canals, or both xylem and phloem were found, this canals in studied *P. graminifolium* could not be distinguished. The rays are very wide, is also

reported by Oskolski and Wyk (2008). But root rays of *P. graminifolium* are only 2-3 cells wide.

The ridges of the stem are not big, and their inside is filled with sclerenchymatous cells. *Peucedanum* genus are generally filled with sclerenchymatous cells except for *P. ozhatayiorum*, which is lacunar collenchymatous cells (Akpulat & Ataşlar, 2010). This condition, which is reported to be rarely encountered in Apiaceae family, is frequently encountered in the genus *Peucedanum* (Metcalf & Chalk, 1950). Paranchymatic cortex carries secretory canals. Different characteristics are encountered in the central cylinder species of the genus *Peucedanum*; and this condition is considered to have a diagnostic significance and can be used in the identification key of the species which is to be newly formed. The sequence of the cells that comprise the vascular bundle and the display of the differences among the species in the pith of the stem have a taxonomic significance. Phloem cells extend as a continuous line in some of the species whereas they form groups over the xylem cells in some other species. The sequence of the xylem cells likewise display differences also among the species (Akpulat et al., 2009; Akpulat & Ataşlar, 2010). Vascular bundles are located in groups and their relation is provided by sclerenchyma cells. The pith of the stem is filled with paranchymatic cells; and no secretory canals are encountered in this section. Although having hollow pith of the stem for the species belonging to the Apiaceae family is a frequently encountered condition (Metcalf & Chalk 1950), no void in the stem was encountered in this species.

Leaf mesophyll consist of large paranchymatic cells. Vascular bundles are dense in the mesophyll. No bundle sheath is observed around the vascular bundles. The secretory canals are with large diameters existing between the phloem and lower epidermis. It is considered that this condition has a diagnostic significance; and the genus could be used in the species identification key which is to be newly formed. The locations of the secretory canals in the leaves could be grouped in three: (a) mesophyll, (b) vascular bundles, and (c) petiole. *P. aegopodioides* and *P. ozhatayiorum* have secretory canals in the mesophyll, which is dorsiventral structure. In the species of *P. longifolium* and *P. ruthenicum* the canals are contained inside the vascular bundles, surrounding also by bundle sheaths, whereas no bundle sheath exists such as *P. obtusifolium*, secretory canals

are contained after the phloem towards the lower epidermis direction. The secretory canals located inside the petiole have the most significant differences among the species as regards to both size and cells surrounding the canals (Akpulat et al., 2009; Akpulat & Ataşlar, 2010).

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