



## Leaf anatomy of *Quercus macranthera* subsp. *sypirensis* (K.Koch) Menitsky

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### Abstract

The genus *Quercus* L. (Fagaceae) is represented by 461 species worldwide. Its distribution ranges from the temperate northern hemisphere to Malaysia and Colombia. *Quercus* bark is rich in tannins and is used as an astringent. *Quercus macranthera* subsp. *sypirensis* (K.Koch) Menitsky is endemic to Turkey and is known as "ispir meşesi". The plant is a small deciduous tree up to 7 m tall. Leaves obovate with 5-9 short lobes, stipules filiform, primary veins 6-10 and petiole 5-20 mm.

The plant material was collected from Kastamonu-Araç (Turkey). A voucher specimen was deposited in the Ankara University Faculty of Pharmacy Herbarium (AEF). The samples for anatomical studies were protected in 70% alcohol. The transverse and surface sections were cut by hand with razor blade into microscopic preparat form. The Sartur solution was used in microscopic examinations. Leica DM 4000B microscope was used for anatomical analysis and micro photographing.

According to the results of the anatomical study, the leaf is bifacial. Numerous stellate hairs are found on the upper and lower epidermis. Stomata are located only on the lower epidermis. The leaf and petiole contain solitary crystals. The petiole is characterized by a numerous stellate hairs. The sclerenchymatous tissue surrounds the vascular bundles in the form of a ring.

**Keywords:** *Quercus macranthera* subsp. *sypirensis*, Fagaceae, leaf, anatomy, endemic

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## *Quercus macranthera* subsp. *sypirensis* (K.Koch) Menitsky'in yaprak anatomisi

### Özet

*Quercus* L. (Fagaceae) cinsi dünya genelinde 461 tür ile temsil edilir. Yayılış alanları ılıman kuzey yarımküreden Malezya ve Kolombiya'ya kadardır. *Quercus* gövde kabukları tanen bakımından zengindir ve astrenjan olarak kullanılır. *Quercus macranthera* subsp. *sypirensis* (K.Koch) Menitsky Türkiye için endemik olup "ispir meşesi" olarak bilinir. Bitki 7 m boylanan, yaprak dökken küçük ağaçtır. Yapraklar 5-9 kısa loblu, obovat, filiform stipulalı, 6-10 primer damarlı ve 5-20 mm uzunluğunda yaprak saplıdır.

Bitki materyali Kastamonu-Araç (Türkiye)'tan toplandı. Bir örneği Ankara Üniversitesi Eczacılık Fakültesi Herbariyumu (AEF)'na kaydedildi. Anatomik çalışmalar için numuneler %70 alkolde korundu. Enine ve yüzey kesitleri el ile jilet kullanılarak mikroskobik preparat haline getirildi. Mikroskobik incelemelerde Sartur solüsyonu kullanıldı. Anatomik analiz ve mikro fotoğraflama için Leica DM 4000B mikroskobu kullanıldı.

Anatomik çalışma sonucuna göre, yaprak bifasiyaldir. Üst ve alt epidermada çok sayıda yıldız tüy bulunur. Stomalar sadece alt epidermada yer alır. Yaprak ve yaprak sapı kristaller içerir. Yaprak sapı çok sayıda yıldız tüy ile karakterizedir. İletim demetlerini sklerenkimatik doku halka şeklinde sarmıştır.

**Anahtar kelimeler:** *Quercus macranthera* subsp. *sypirensis*, Fagaceae, yaprak, anatomi, endemik

### 1. Introduction

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Fagaceae Dumort. is a family of evergreen or deciduous trees or shrubs [1]. The family includes 8 accepted genera (*Castanea* Mill., *Castanopsis* (D.Don) Spach, *Chrysolepis* Hjelmq., *Fagus* L., *Lithocarpus* Blume, *Notholithocarpus* Manos, Cannon & S.H.Oh, *Quercus* L., *Trigonobalanus* Forman) [2]. The genus *Quercus* is represented by 461 species worldwide, its distribution ranges from the temperate northern hemisphere to Malaysia and Colombia [2]. *Quercus* genus consists of deciduous or evergreen trees, rarely shrubs; the leaves are arranged sessile or petiolate, penninerved, serrate, dentate, pinnatifid or lobed; fruit a nut (acorn), subglobose to oblong or cylindrical, surrounded at base by cupule; pericarp thin or thick, endocarp glabrous or pubescent [1].

Oak bark is rich in tannins and is used as an astringent [3]. *Quercus* species also known to contain (-)-epicatechin, (-)-epigallocatechin, (+)-catechin, (+)-gallocatechin, gallic acid, caffeic acid, ferulic acid, ellagic acid [4-9] and used traditionally in the treatment of dermatitis, burns, hemorrhoids, abscesses, ulcers and toothache [10-14]. *Quercus* species are medically important and show antibacterial, anticancer, gastroprotective, antiviral, cardioprotective and hepatoprotective activity [15-24]. In Turkey, *Quercus* species are traditionally used in the treatment of diabetes, wounds, respiratory diseases, diarrhea, obesity and fungus [25-33].

32 *Quercus* taxa (5 endemic) grow naturally in Turkey, *Quercus macranthera* subsp. *sypirensis* (K.Koch) Menitsky is endemic to Turkey and is known as "ispir meşesi" [34]. The plant is a small deciduous tree up to 7 m tall; leaves obovate with 5-9 short lobes, stipules filiform, primary veins 6-10 and petiole 5-20 mm [1]. Revealing the anatomical features and differences of organs is of great importance in taxonomically distinguishing species from each other. There is no comprehensive anatomical study on the *Q. macranthera* subsp. *sypirensis* until now. In this study, the anatomical features of *Q. macranthera* subsp. *sypirensis* leaf and petiole were examined in detail.

## 2. Materials and methods

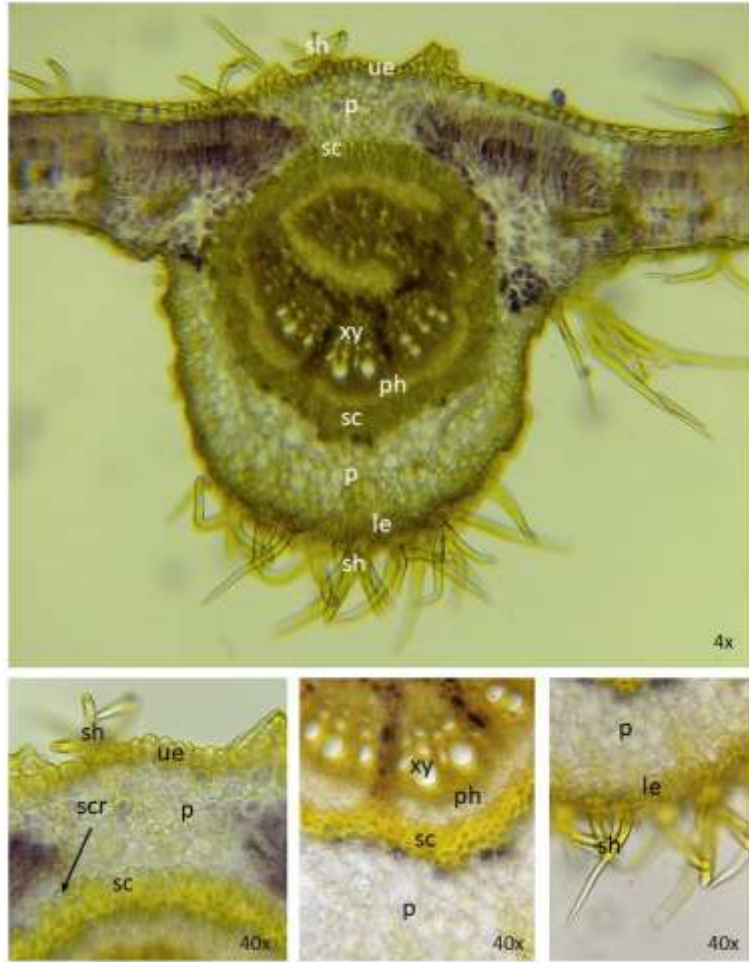
The plant material was collected from Araç (Kastamonu/Turkey) in 2020 and described by M. Mesud Hürkul. A voucher specimen was deposited in the Ankara University Faculty of Pharmacy Herbarium (AEF 30737) in Turkey. The samples for anatomical studies were protected in 70% alcohol. The transverse and surface sections were cut by hand with razor blade into microscopic preparation form. The Sartur solution [35] was used in microscopic examinations. Leica DM 4000B microscope was used for anatomical analysis and micro photographing.

## 3. Results

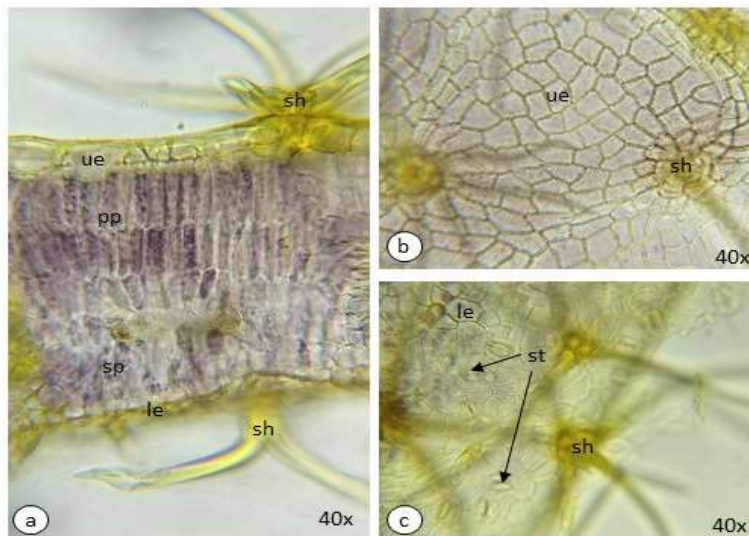
In the transverse section of the leaf, the midrib is highly domed in the abaxial side. The upper epidermis layer consists of square-oval cells and is surrounded by a thick cuticle layer. The outer walls of upper epidermal cells are sinuous. The base of the epidermis layer is filled with 5-10 rows of parenchymatous cells. In the midrib, the vascular bundle is completely surrounded by sclerenchymatous cells in a ring. The xylem and phloem is arc-type arranged but tend to a circle form. The abaxial side of vascular bundle in the midrib is filled with 8-15 rows of parenchymatous cells. The lower epidermal cells are oval-square shaped, crushed and smaller than the upper epidermal cells. The lower epidermis is covered with a thick cuticle. Both the upper and lower epidermis include numerous stellate hairs. The midrib contains sparse solitary crystals (Figure 1).

The transverse section of leaf lamina showed that the leaf was bifacial. The upper epidermis layer consists of a single layered of square-rectangular epidermal cells. The epidermis layer covered with thick cuticle and many stellate hairs. The mesophyll is characterized by 3 rows of longitudinal elongated, starch containing palisade parenchyma and 3-8 rows of spongy parenchyma. The lower epidermis layer consists of square cells and the lower epidermal cells are much smaller than the upper cells. The lower epidermis layer covered by thick cuticle layer and numerous stellate hairs. The mesophyll contains sparse solitary crystals (Figure 2-a). The leaf surface sections showed stomata only in the lower epidermis. The stomata is surrounded by 5 subsidiary epidermal cells. Both upper and lower epidermis covered with numerous stellate hairs (Figure 2-b,2-c).

The transverse section of the petiole is a disc shape. Numerous stellate hairs cover the surface. The epidermis consists of a single layer, oval cells and is covered by a thick cuticle. The vascular bundle, surrounded by sclerenchymatous tissue, contains xylem and phloem in a ring form. Between the epidermis and the vascular bundle, 8-15 rows of parenchymatous tissue are included. The parenchymatous tissue contains numerous solitary crystals (Figure 3).



**Figure 1.** The transverse section of the midrib (le: lower epidermis, p: parenchyma, ph: phloem, sc: sclerenchyma, scr: solitary crystal, sh: stellate hair, ue: upper epidermis, xy: xylem)



**Figure 2.** The anatomical features of leaf lamina (a: transverse section of lamina, b: surface section of upper epidermis, c: surface section of lower epidermis, le: lower epidermis, pp: palisade parenchyma, sh: stellate hair, sp: spongy parenchyma, st: stomata, ue: upper epidermis)



**Figure 3.** The transverse section of petiole (e: epidermis, p: parenchyma, ph: phloem, sc: sclerenchyma, scr: solitary crystal, sh: stellate hair, xy: xylem)

#### 4. Conclusions and discussion

*Quercus* species are traditionally used in folk medicine [10-14, 25-33]. The correctly describe and determine of plants is very important, which are herbal medicine candidates and continue to be used in traditional folk medicine. Microscopic analysis of the anatomical structures of plants could provide useful information for the taxonomic classification. Light microscopy analysis is a common and effective method for the identification of medicinal plants [36].

In this study, leaf and petiole anatomy of *Quercus macranthera* subsp. *sypirensis* was studied in detail. In the leaf transverse section, the midrib is domed abaxially, the epidermal layer is covered with a thick cuticle and numerous stellate hairs. The vascular bundle is arc-shape arranged, mostly tend to ring shape and confined by sclerenchymatous tissue. The parenchymatous tissue covers between the epidermis tissue and the vascular bundle. The parenchyma includes sparse solitary crystals. In the lamina transverse section, the upper epidermis cells are clearly larger than the lower epidermal cells. The epidermis layer is covered with a thick cuticle and carries many stellate hairs. The mesophyll is characterized by 3 rows of palisade parenchyma and 3-8 rows of spongy parenchyma, additionally contains abundant starch grains. In the leaf surface sections, the stomata are located in the lower epidermis with 5 subsidiary cells. The upper epidermis is free of the stomata. Numerous stellate hairs were observed on both surfaces. The petiole is disc-shaped in the transverse section. The monolayer epidermis is surrounded by a thick cuticle and contains numerous stellate hairs. The vascular bundle surrounded by sclerenchyma is embedded in parenchymatous cells. The petiole contains relatively denser solitary crystals than leaf.

According to the previous study [37] on the anatomical structures of the Fagaceae family, *Quercus* leaves include a variety of hair types, such as simple-unicellular, stellate hairs; in several species of *Quercus* has uniseriate and/or capitate glands; epidermis composed of cells with straight or sinuous anticlinal walls, sometimes tend to be papillose on the lower surface; the stomata located on the lower surface as ranunculaceous; the vascular bundle is surrounded by arcs of sclerenchyma; the vascular system is consisting of a continuous or dissected cylinder. In our study, stellate hairs were densely detected both on the leaf and on the petiole, and stomata were observed in the lower epidermis. Simple-unicellular hairs and glandular hairs, noted in the previous study [37], were not observed. The

epidermal cells with papilla not detected in our study. According to our study, the sclerenchymatous tissue surrounding the vascular bundles is not in the form of an arc, but in the form of a ring.

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