



Comparative Anatomical Study in the Genus *Sambucus* (Adoxaceae) Distributed in Turkey

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Abstract

In this study, *S. nigra* L. and *S. ebulus* L. (Adoxaceae) species belonging to the *Sambucus* genus were examined. Species of the genus were collected from northern Turkey and anatomical comparisons were made. Stem and leaf anatomy were examined by light microscopy. The plants have woody stem anatomy. The druse crystals which are the main anatomical characters of the genus were observed in the examined taxa. Differences were found in the number of cells of the vascular bundles, the arrangement of the druse crystals, and the shapes of the abaxial and adaxial epidermis cells in the leaf. In addition, differences were observed in the margin shape and collenchyma cell numbers on the stem.

Keywords: *Sambucus*, Adoxaceae, Anatomy, Turkey.

Türkiye'de Yayılış Gösteren *Sambucus* (Adoxaceae) Cinsinin Karşılaştırmalı Anatomisi

Öz

Bu çalışmada *Sambucus* cinsine ait *S. nigra* L. ve *S. ebulus* L. (Adoxaceae) türleri incelenmiştir. Cinsin türleri Türkiye'nin kuzeyinden toplanmış ve anatomik karşılaştırmalar yapılmıştır. Işık mikroskobu ile gövde ve yaprak anatomisi incelenmiştir. Bitkiler odunsu gövde anatomisine sahiptir. Cinsin anatomik ana karakteri olan kalsiyum oksalat kristalleri incelenen taksonlarda gözlenmiştir. Yaprakta iletim demetlerinin hücre sayıları, druz kristallerinin dizilişleri, alt ve üst epidermis hücrelerinin şekillerinde farklılıklar bulunmuştur. Ayrıca gövdede kenar şekli ve kollenkima hücre sayılarında farklılıklar gözlenmiştir. Sonuçlar cins içinde tartışılmış ve karşılaştırılmıştır.

Anahtar Kelimeler: *Sambucus*, Adoxaceae, Anatomi, Türkiye.

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1. Introduction

Sambucus (Adoxaceae) is a deciduous genus with a small number of taxa, in the form of shrubs or trees [1,2]. While *Sambucus* was previously included in the Caprifoliaceae family, it was later included in the Adoxaceae family according to the results of genetic and classification studies [3,4].

Sambucus is a genus with difficult taxonomy. Representatives of the genus are geographically widespread, morphologically complicated and often present great variability within particular species [5]. Schwerin (1920) tentatively recognized 28 species and numerous varieties [6]. Bolli (1994) reduced the number of recognized species worldwide to nine [7, 8]. Turkey is very rich in terms of plant species due to its different climatic diversity [9]. There are two species in Turkey belonging to the genus *Sambucus* [10]. *S. ebulus* L. and *S. nigra* L. are perennial herb known locally as murver, sultanotu, sahmelemleri, agac murver and hekimana [10-12].

S. nigra is a plant with a sharp smell, 1-8 meters tall, in the form of a bush or tree. There are cracks and deep clefts in the bark and it is brown. The leaves are opposite, 5-7 elliptical-lanceolate, and the leaflets are toothed. Its flowers are umbrella-shaped and milky white in color. The fruits are black-purple shiny, spherical. The plant can be found at sea level or at higher levels, in forest or open areas (1400 m a.s.l.). The plant can grow in different parts of the world [13]. It is rarely seen in Western-Northern European countries [14,15].

S. ebulus plant is a perennial herb with erect and unbranched stems, growing up to 1-2 m in height, with a rhizome root structure. The leaves of the plant are opposite each other, with 5-9 leaflets, 15-30 centimeters in length, hairy and fragrant. The stems bear flowers that are white (rarely pink) with a crown of 10-15 centimeter corimbo. The fruits are dark blue or purple in color. *S. ebulus* grows naturally in south-central Europe, northwest Africa, and southwest Asia throughout the world [16].

Since the *Sambucus* genus has medicinal properties, it is also used for healing purposes in diseases. Plants of this genus have a perspiration-increasing and diuretic effect [17,18]. And it is also used as a folk medicine in the treatment of intestinal disorders, flu infections and rheumatic diseases [2,17,19].

In the anatomical studies, it is noteworthy that the cranial tissue consisting of mesophyll and bundle sheaths, which are morphologically and functionally different, is found. Kranz tissue is widely used to explain the C4 photosynthetic phenomenon in anatomical studies in plants [20-22].

In literature, there is not any anatomical study on *Sambucus* species in naturally growing in Turkey. Therefore, I have encouraged to study the patterns of anatomical structure among *Sambucus* taxa. This paper is first report and aimed at comparison of anatomical difference of *S. ebulus* and *S. nigra* naturally growing in Sinop province located in North of Turkey.

2. Material and Method

2.1. Plant Material

The plant specimens were collected during spring and summer from natural habitats of Sinop, Turkey from 2020 (Table

1). The taxonomic identification of the plant was made using Flora of Turkey [23].

Table 1. Taxa used for anatomical studies and localities of specimen collection

Tablo 1. Anatomik çalışmalar için kullanılan taksonlar ve örnek toplama yerleri.

Taxa	Collection areas and collector's number
<i>S. nigra</i>	Turkey, A4, Sinop: Korucuk village, roadside, 50m, 15.05.2020, ÖE-1150.
<i>S. ebulus</i>	Turkey, A4, Sinop: Ordu village, roadside, 20m, 16.05.2020, ÖE-1155.

2.2. Anatomical Study

Anatomical studies were carried out on aerial parts (stem and leaf) of taxa kept in 70% ethanol. The sections were studied and photographed from the preparations were taken with a LEICA (DFC 450C & DM 2500) microscope.

3. Results and Discussion

3.1. Stem Anatomy

Sambucus nigra: In the section taken from the stem, there is a thick cuticle layer outside the stem. The margin of stem is straight in *S. nigra*. There are glandular hairs on the epidermis. The epidermis is composed of a single row of regularly arranged epidermal cells. The vascular bundles in the body of the plant are regular. Collenchyma is located under the epidermis. Collenchyma is composed of 7-12 layers. Cortex 8-10 layered and the cells are ovoidal or circular. Phloem is composed of 4-8 layers of cells. Xylem is composed of 9-12 layers of cells. Cambium is distinguishable and 3-5 layered. The sclerenchymatic cells in the stem are thickened and their spaces are narrow. The pith in the stem is composed of large cells and there is little or no intercellular space. (Figure 1).

Sambucus ebulus: In the cross section taken from the stem of the plant, the cuticle layer was seen on the outer part of the stem. The margin of stem is most partly straight and partly wavy in *S. ebulus*. Epidermis cells are arranged in a single row and there are glandular hairs on them. Epidermal cells are also found under the cortex layer. Collenchyma is composed of 3-7 layers. Phloem is composed of 4-7 layers of cells. Xylem is composed of 6-9 layers of cells. Cambium is distinguishable and 3-4 layered. The vascular bundles in the stem of the plant are arranged regularly. There are large parenchymatic cells in the pith region and little or no pith cavity (Figure 2).



Figure 1. Cross-section of stem of *S. nigra* (ph: phloem, xy: xylem, t: trachea, pr: pith region, cu: cuticula, e: epidermis, co: collenchyma, en: endodermis, c: cambium)

Şekil 1. *S. nigra* gövde enine kesiti (ph: floem, xy: ksilem, t: trake, pr: öz bölgesi, cu: kutikula, e: epidermis, co: kollenkima, en: endodermis, c: kambiyum)

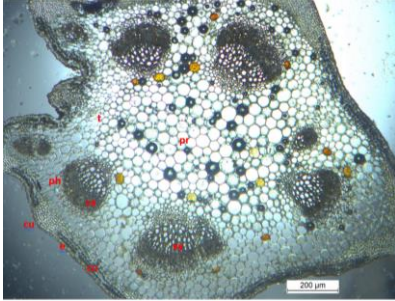


Figure 2. Cross-section of stem of *S. ebulus* (ph: phloem, xy: xylem, t: trachea, pr: pith region, cu: cuticula, e: epidermis, co: collenchyma, en: endodermis, ca: cambium)

Şekil 2. *S. ebulus* gövde enine kesiti (ph: floem, xy: ksilem, t: trake, pr: öz bölgesi, cu: kutikula, e: epidermis, co: kollenkima, en: endodermis, c: kambiyum)

3.2. Leaf Anatomy

Sambucus nigra: In upper and lower cross section of leaf, there is a thin cuticula layer in the outermost of leaf. The stomata are anemocytic type and they observed on the abaxial surface. The leaf showed a bifacial leaf anatomical structure. There are glandular hairs on the adaxial surface. Glandular hairs are mostly seen in the adaxial surface and not in the abaxial surface. The vascular bundles are surrounded by a parenchyma cells consisted of druse crystals. The epidermis cell shape were examined puzzle-shaped on abaxial and adaxial surface of the leaf (Figures 3,4).

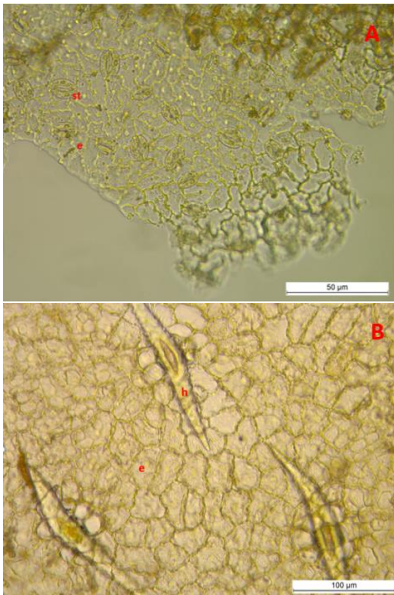


Figure 3. Superficial section of lower surface (A) and upper surface (B) of leaf of *S. nigra* (st: stoma, e: epidermis, h: hair)

Şekil 3. *S. nigra* yaprak alt yüzey (A) ve üst yüzeyin (B) yüzeysel kesiti (st: stoma, e: epidermis, h: tüy)



Figure 4. Cross-section of leaf of *S. nigra* (pp: palisade parenchyma, sp: spongy parenchyma, h: hair, dr: druse crystals)

Şekil 4. *S. nigra* yaprak enine kesiti (pp: palizat parankiması, sp: havalandırma parankiması, h: tüy, dr: druz kristalleri)

Sambucus ebulus: There is a thin cuticle for both upper and lower epidermis in the cross-sections of leaf. Stomata are observed in the lower part of the leaf which type of anomocytic. The leaf showed a bifacial leaf anatomical structure. There are not glandular hairs on the upper surface. The vascular bundles are surrounded by a parenchyma cells consisted of druse crystals. There are glandular or eglandular hairs on the lower and upper epidermis. The glandular and eglandular hairs are denser in the lower epidermis than in the upper epidermis. The epidermis cell shape were examined puzzle-shaped on abaxial surface and oblong on adaxial surface of the leaf (Figures 5, 6).

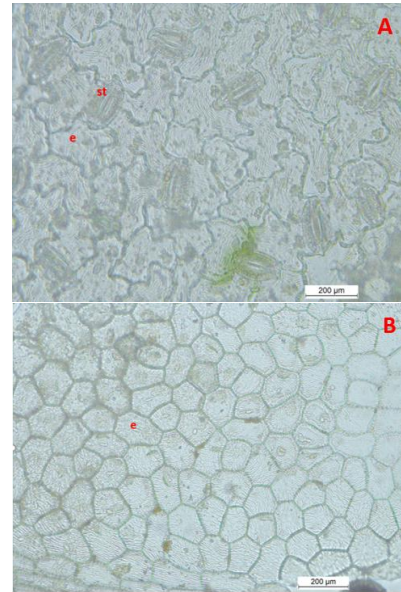


Figure 5. Superficial section of lower surface (A) and upper surface (B) of leaf of *S. ebulus* (e: epidermis, st: stoma)

Şekil 5. *S. ebulus* yaprak alt yüzey (A) ve üst yüzeyin (B) yüzeysel kesiti (e: epidermis, st: stoma)

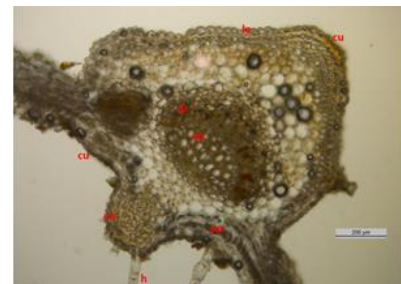


Figure 6. Cross-section of leaf of *S. ebulus* (cu: cuticle, le: lower epidermis, ue: upper epidermis, pp: palisade parenchyma, sp: spongy parenchyma, vb: vascular bundle, h: hair; dr: druse crystals)

Şekil 6. *S. ebulus* yaprak enine kesiti (cu: kutikula, le: alt epidermis, ue: üst epidermis, pp: palizat parankiması, sp: havalandırma parankiması, vb: iletim demetleri, h: tüy, dr: druz kristalleri)

Taxonomic studies of the *Sambucus* genus have been carried out in different parts of the world, but this study was carried out for the first time with samples from Turkey [4,8]. According to the results of the study, taxa showed great similarities and no significant anatomical differences were observed. Both species showed a bifacial leaf anatomical structure and anomocytic stomata. The number of vascular bundles, arrangement of druse crystals, adaxial and abaxial cell shapes of leaf, margin of stem, the number of collenchyma were showed differences characters for taxa. In cross section of stem of *S. nigra*, the number of vascular bundles and collenchyma were thicker than *S. ebulus*. Also, in *S. nigra* arrangement of druse crystals were more regular than *S. ebulus*. Some scientific reports have shown that stomata type, leaf anatomical structure, cell shape similarity as our study. As a result of anatomical studies, the long-term secondary growth is understood from the composition of the cortex structure. When the literature was examined, it was seen that this issue was emphasized in the studies [24-29]. Anatomical studies of this genus have shown that crystals are a taxonomically important character for the genus [4, 30-33].

The results of present and others studies show that the number of vascular bundles, anomocytic stomatas and existence the druse crystals are diagnostic characters in studied species. Although, many features in two species are identical, there are some anatomical variations between *S. nigra* and *S. ebulus*. Our observations are in accordance with previous records in other Adoxaceae or Caprifoliaceae elements [2,34,35].

4. Conclusions and Recommendations

In this study, comparative anatomical were investigated taxa of *Sambucus*. The data obtained from the current anatomical study will facilitate the identification of two taxa and will provide new taxonomic contributions. It will also be a reference for new studies on this genus. In future studies, it is recommended to take SEM photographs of seed and glandular hairs in order to increase anatomical similarities and differences.

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