

Anatomical studies on endemic *Lycium anatolicum* A. Baytop et R. Mill (Solanaceae) vegetative organs, distributed in Turkey

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Abstract

In this study, the species, *Lycium anatolicum* A. Baytop et R. Mill which is an endemic for Turkey has been investigated anatomically. Researchs have been carried out in different regions of Şanlıurfa, which locates in the C7 square according to the grid system in the Flora of Turkey. In anatomical studies, It's the first time that, the cross-sections taken from the stem and leaves have been investigated The surface sections taken from abaxial and adaxial parts of the leaves have been examined. In anatomical sections, stem and leaves aren't hair. In the stem; the primary vascular tissue is bicollateral The leaves are amphistomatic and mesophylles are isobilateral. The type of stomata is anisocytic or anomocytic. Parenchymatic pith contains the grains of starch.

Keywords: Solanaceae, *Lycium*, anatomy, bicollateral, endemic, Sanliurfa.

INTRODUCTION

Turkey has a rich vegetation due to its geological structure, geological position and climate characters. The family Solanaceae contains 90 genera and approximately 2500 species in the world [1]. There are 12 genera and 36 species of the family Solanaceae in Turkey and most of them are wild herbs [2, 3]. *Solanum* and *Lycium* are the genera which have the highest number of species in Solanaceae [1, 2].

Solanaceae is an important family for possessing countless ornamental, medicinal and nutritious species [4]. Generally, the family is herbaceous or woody [5]. This family is a wide and chemically rich family and has been reported to contain glucoalkaloids, solanine, solanidine, nicotine, somniferine, somniferine, somnine, withananine, withanine, withananine, volatile oil, tannin and considerable amount of potassium nitrate [6]. It has also been reported that the roots contain two saponoids, dulcameric acid, dulcamaretinic acid and a gluco-alkaloid solaceine.[7].

Lycium comprises approximately 70 species and ranges from the temperate to subtropical regions in South America, North America, southern Africa, Eurasia, and Australia [8]. Seven species of this genus are found in Turkey. Only in this taxa are endemic the species of *Lycium anatolicum* and endemism rate is %14 [3, 9, 10].

Studies on the anatomy of this genus are limited. Metcalfe & Chalk [11], Hawkes et.al. [12] and Watson & Dallwitz [13] explained the characteristic properties of the family Solanaceae. Norverto et.al [14] studied wood anatomy of six species of *Lycium* with comments on fibriform vessel elements. Fukuta et. al [8] investigated phylogeny and biogeography of the genus *Lycium*. Miller & Venable [15] studied floral morphometrics and the evolution of sexual dimorphism in *Lycium*

The anatomical properties of *Lycium anatolicum* have not

been studied. Therefore, the purpose of this paper was to investigate the anatomical properties of *L. anatolicum*

The present study describes the stem and leaf structure of the endemic species *Lycium anatolicum* in Turkey with the purpose of pointing out anatomical characters useful for the separation of this species.

MATERIALS and METHODS

Specimens were gathered from different parts of Şanlıurfa, which is located in the C7 square (fig. 1). A collectors number was given and the specimens were dried according to standard herbarium methods. The specimens are kept in the herbarium of Harran University, Şanlıurfa. The Flora of Turkey and the East Aegean Islands [2] was used to identify them. For anatomical analysis, specimens collected from the field were preserved in labelled bottles in 70% alcohol. Some of the samples were selected and cross-sections were taken from the stem and leaves by handle and the method was used; permanent preparations were made using gliserin-jelatin [16]. Their photographs were taken with a Zeiss- Germany Axioplan Universal microscope. The anatomical structure of the stem and leaves of these taxa are described for the first time in this paper.

Investigated locality: Turkey, C7 Sanliurfa: Birecik, around Mezra town, brook edge, N: 36° 70' 80" ; E: 38° 40' 50", 350 m, 05.06.2007, MA 4001.

In the studying area, steppe vegetation is widespread. This area as geographic and topographic is hilly, uneven and main rock is calcereous and lime stone. The plants which dries in summer are majority. Dominant species are as fallow; *Astragalus russelii*, *A. tigris*, *A. diptheritis*, *Verbascum orientale*, *V. siniatum*, *Hypericum capitatum*, *Prosopis farcta*, *Gundelia tournefortii*, *Echinops viscosus*, *Anchuza azurea*, *Teucrium polium*, *Thymbra spicata*, *Aegilops biuncialis*, *Eromopyrum bonaepartis*, *Hordeum spontaneum* and *Poa bulbosa*.



Fig. 1. General appearance of *Lycium anatolicum*.

RESULT and DISCUSSION

Stem

Transverse sections taken from the middle part of the stem were observed as follows (Fig. 2- 4). The epidermis is composed of a single layer and the cells are rectangular or oval. They are covered with a thin cuticle. Glandular or nonglandular trichom on the epidermis is absent. The upper and lower walls of the epidermis are thicker than the lateral walls. Peridermis is present under epidermis. Periderm is 2-5 layered. Its cells are hexagonal in shape. There are brachysclereid cells between cortex and periderm region. Parenchymatous cortical cells are 2-5 layered. Endodermis is 1 - 2 layer and distinguishable. The pericycle, located under the endodermis and indistinguishable. Vascular bundle is bicollateral. The external phloem is 3-5-layered and consists of irregular or rectangular cells. The cambium is not observed. The xylem forms a large ring that comprises the trachea and tracheids. Trachea cells are round or ovoid, while tracheids are polyhedral. The perforations in ray cells are simple. The internal phloem is 5-8 layered. The pith consists of large orbicular or polyhedral parenchymatous cells which is thin-walled. Parenchymatous pith cells contain the grains of starch.

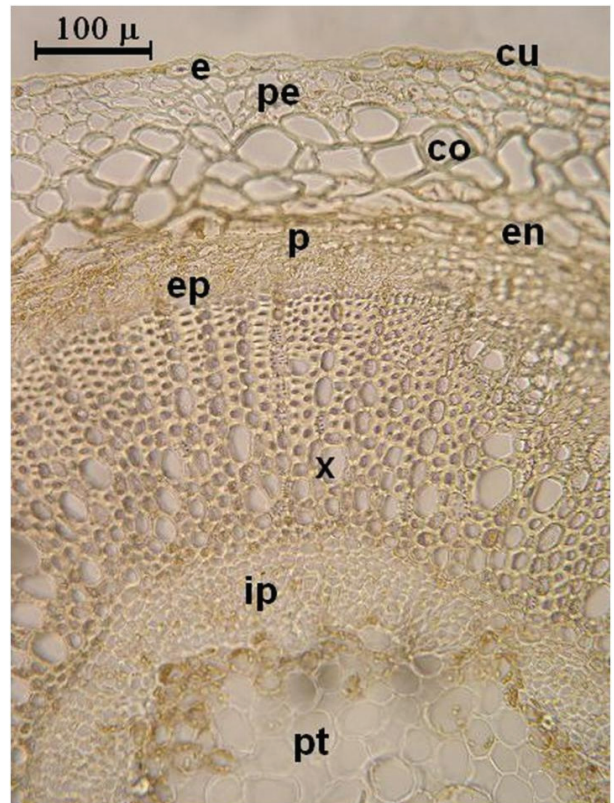


Fig.2. Cross-section of stem of *L. anatolicum*. Cu: cuticle, e: epidermis; pe: periderm, co: cortex parenchyma, en: endodermis; p: pericycle, ep: external phloem, x: xylem; ip: internal phloem, pt: pith region.

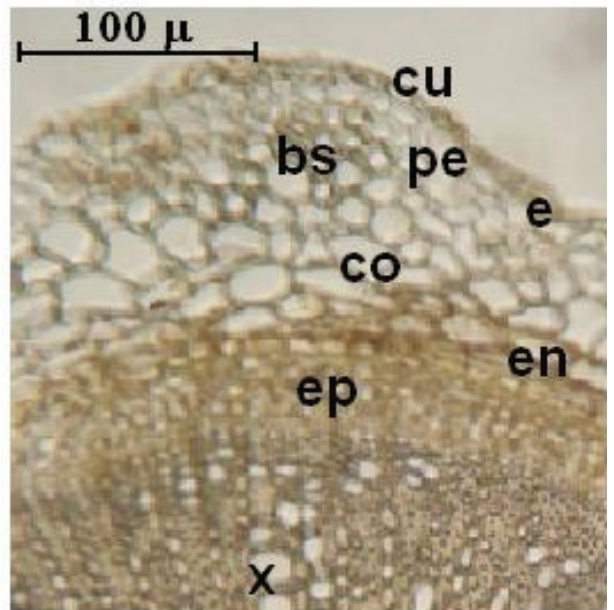


Fig.3. Cross-section of stem of *L. anatolicum*. Brachysclereids in cortex parenchyma. Cu: cuticle, e: epidermis; pe: periderm, bs: brachysclereid, co: cortex parenchyma, en: endodermis, ep: external phloem, x: xylem.

Leaf

Transverse sections taken from the middle part of the leaf were observed as follows (Fig. 5- 7). The epidermis is composed of a single layer of cells, and the cells are rectangular or hexagonal. The upper wall of epidermis is thicker than the lateral and lower walls. The cells of upper epidermis are larger than lower epidermis ones. Epidermal cells are covered with a thick cuticle. Anticlinal cell wall on the adaxial and abaxial surface are straight to slightly undulating (fig. 7). Stomata type is anisocytic and occurs on both surfaces (amphistomatic leaves). Generally the stomata are more on the abaxial surface than on the adaxial surface. They are located almost on the same level as epidermis cells.

The leaf is equifacial. Palisade parenchyma cells are 2- (-3) layered on the upper surface and 1-2 layered on the lower surface. Spongy parenchyma cells are 2-4 layered. The shape of the palisade parenchyma in transverse section is cylindrical. The spongy parenchyma cells are circular or ovoid, Vascular bundles are collateral. The xylem faces towards the lower surface, while the phloem faces the upper epidermis. The upper part vascular bundles are covered with 2-5 layered sclerenchymatous cells. Middle vein on leaf is surrounded by parenchymatic cells and upper and lower parts of vascular bundles are accompanied by collenchyma (fig.5, 6).

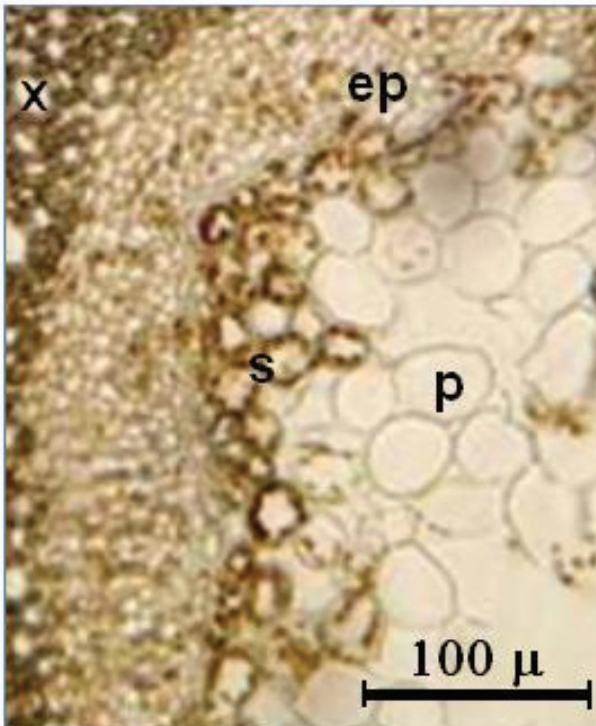


Fig.4. Cross-section of stem of *L. anatolicum*. Starch grain in parenchymatic pith. ep: external phloem, x: xylem, s: starch grain, p: pith region.

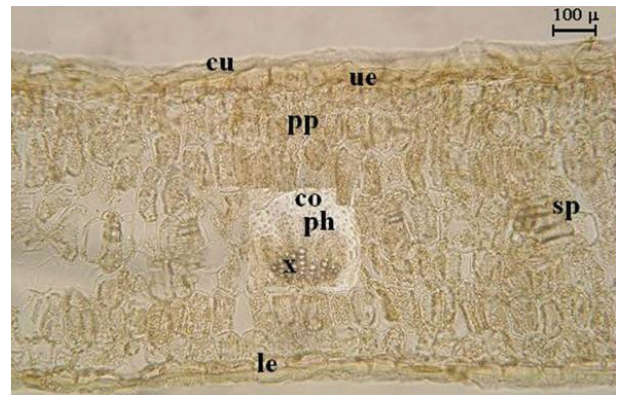


Fig. 5. Cross-section of leaf. cu: cuticle, ue: upper epidermis, pp: palisade parenchyma, sp: spongy parenchyma, co: collenchyma, ph: phloem, x: xylem, le: lower epidermis.

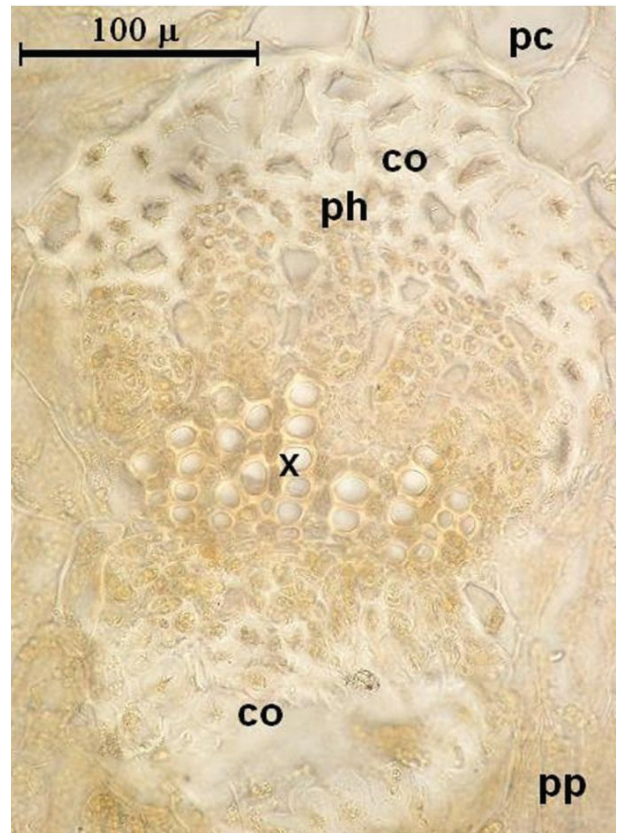


Fig. 6. Cross- sections taken from the middle part of the leaf of *L. anatolicum*. Pc: parenchyma cell, co: collenchyma, ph: phloem, x: xylem, pp: palisade parenchyma.

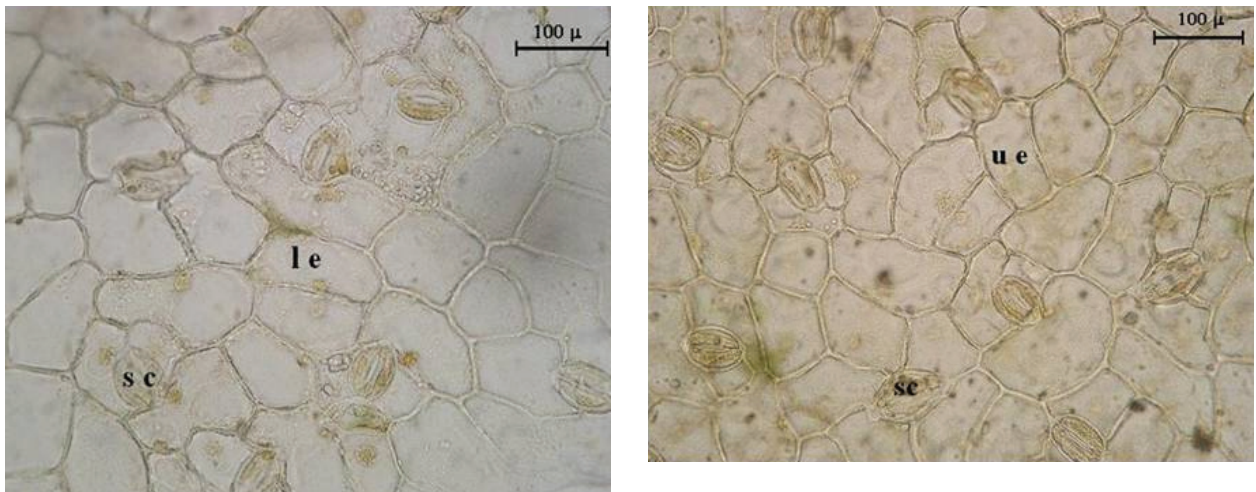


Fig 7. Surface-section of a part of abaxial and adaxial in leaf of *L. anatolicum*. a: abaxial part, b: adaxial part. le: lower epidermis, ue: upper epidermis, sc: stoma cell.

DISCUSSION

In this paper we report a study on stem and leaf anatomy of Turkish *Lycium anatolica* in order to improve our knowledge of its anatomy for systematics and to help separate similar species.

This is the first study to show the anatomical properties of the endemic species *L. anatolicum*. No information on *L. anatolicum* was found in the literature for anatomical properties. This is an original study on *L. anatolicum* an endemic species for Turkey.

The stem has a primary structure with the beginning of a secondary one. The vascular bundles are bicollateral with phloem islands emerging in the pith area as Metcalfe and Chalk [11] reported. A starch layer is present in not only endodermis but also paranchymatic pith cells.

Type of the perforation in ray cells is simple. They occur in the body of multiseriate rays among procumbent cells. The similar results have also been reported by Norverto [14]

Anatomical analysis of the transverse and surface sections of the leaf showed that stomata is generally anisocytic but sometimes tending to be of the anomocytic (Fig. 6). Stomata is generally present on both surfaces of the leaves. These findings reported also Metcalfe and Chalk [11]. Upper and lower parts of vascular bundles are usually accompanied by collenchyma (fig. 5, 6).

Metcalfe & Chalk [11] and Esau [17] have reported that Brachysclereids were recorded in the cork some species of Solanaceae family. Our results are in agreement with their findings.

In the study; that the trichoms, which are the characteristic features of Solanaceae, aren't present in the stems and leaves is a striking characteristic. The fact that there are sand crystals in parenchyma cells of the Solanaceae's root, stem and rarely leaves is regarded as a typical character [1, 11, 15, 20]. However; in our studies, the presence of these crystals hasn't been encountered.

The endemic species were categorized according to IUCN Red data categories [18, 19]. Ekim and et al. [19] has represented in their study that *L. anatolicum* is considered as "Least concern" (LC).

The anatomical studies carried out about the genus of Solanaceae are insufficient [11, 14, 20]. In order to make up for this lack, we have examined such vegetative organs of the endemic species of *Lycium anatolicum* as stem and leaf in terms of anatomy. We have the sense that this study will serve as a background information for the anatomical studies to be carried out in the future.

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