

# The Anatomical Features of Endemic *Hypericum spectabile* Jaub. & Spach from Türkiye

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**ABSTRACT:** *Hypericum* L. genus is used as a soothing, antiseptic and antispasmodic agent under the name of “kantaron, kılıçotu, kanotu, yaraotu, kuzukıran, koyunkıran, binbirdelik” otu in Turkish folk medicine.

This study reveals the anatomical features of *H. spectabile* belonging to Drosanthe sections of *Hypericum* L. genus. The stem, leaf and root anatomical features of the plant is investigated for the first time in this study. In the stem sections of stem there are two rows of epidermal tissue. The epidermis is surrounded by a thick cuticle layer. Just below the cortex, parenchyma covers a large area. Phloem has A type secretory cells. Xylem is composed of sclerenchymatic cells and tracheary elements in vascular bundles. The pith is composed of parenchymatic cells. In the section of the root there are four-five rows of periderm. Below this tissue there is cortex parenchyma with intercellular spaces. Inward, there are phloem and xylem tissues. The pith consists of parenchymatic cells. Leaf mesophyll layer has palisade parenchyma on both surfaces. Leaf is equifacial. Collenchyma tissue is in four-five rows on the upper and lower surfaces of the middle vein. The leaf is amphistomatic. Stomata belong to anisocytic types.

**KEYWORDS:** *Hypericum spectabile* Jaub. & Spach; endemic; plant anatomy; Türkiye.

## 1. INTRODUCTION

*Hypericum*, one of the most important genera of the Hypericaceae family, is represented by nearly 500 species adapted to almost all conditions, except for the poles, deserts and low-lying tropical regions (1). In Türkiye, there are 95 taxa from 19 sections, 45 of which are endemic to Türkiye (2, 3). *Hypericum spectabile* Jaub. & Spach is represented in the section Drosanthe Robson of the genus *Hypericum* (4).

*Hypericum* species contain many types of biologically active compounds such as naphthodianthrones, phloroglucinols, flavonoids, procyanidins, tannins, essential oils, amino acids, phenylpropanoids, xanthenes and other water-soluble compounds (5). Among these, pseudohypericin and hypericin known as naphthodianthrones are found in the petals, stamens, leaves and small black glandular structures of the plant (6, 7). Increased interest in the hypericin compound is based on its pharmaceutical potential as antiviral, antiretroviral, antiviral, antibacterial, antipsoriatic, antidepressant and antitumor effects (8).

*Hypericum* extracts are also used to treat mild to moderate depression and various clinical studies have shown that “kantaron” is as effective as known synthetic antidepressants (9). In Turkish folk medicine, *Hypericum* is used as a soothing, antiseptic and antispasmodic agent under the name of “kantaron, yara otu, kuzukıran, binbirdelikotu” (10). In addition, the oil obtained by holding the flowered aerial parts in olive oil for two-three weeks is used in the treatment of wounds and burns in Turkish folk medicine thus it is called “yara otu” or “mayasıl otu”. On the other hand, the infusion prepared from flowering aerial parts is used as stomachic and anthelmintic (11).

In a recent study, in-vitro activities of three endemic *Hypericum* species (*Hypericum pseudolaevae* N. Robson, *H. thymbrifolium* Boiss. & Noe, and *H. spectabile*) from Anatolia were evaluated. *Hypericum spectabile* showed the highest antioxidant activity. Also, *H. thymbrifolium* and *H. spectabile* were found to have strong

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anti-inflammatory activity compared to reference drug Aspirin 500 µg/mL concentration. The high quercetin content of *H. spectabile* was thought to have effect on the in-vitro activities of the plant (12).

The suggestions about the relationships between the species belonging to the genus *Hypericum* was given in detail firstly in a monograph study by Robson. This study was based on the morphology, distribution, flower vascularity and limited cytology of the *Hypericum* species (13).

Heaps of time, morphological data may not be sufficient to determine the taxonomic locations of the species. Therefore, leaf, stem and root features of *H. spectabile* were examined anatomically in this study for the first time and the data have been presented to the scientific world.

## 2. RESULTS and DISCUSSION

In this study, anatomical properties of stem, root and leaf of *Hypericum spectabile* were examined (Figure 1).



Figure 1. The general view of *Hypericum spectabile* Jaub. & Spach, 11.06.2017, Erzincan (Dutluca area)

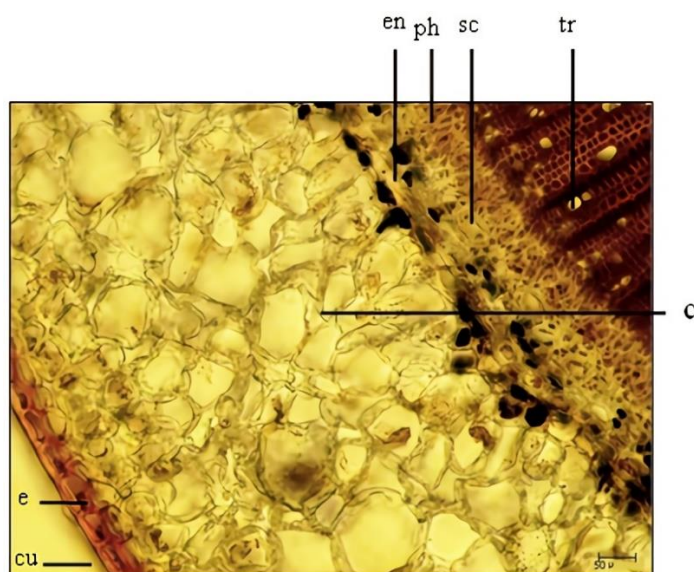
### 2.1. Stem

Stem shows secondary growth and is circular shaped in transverse section. There is one layer of epidermal tissue at the outermost part of the stem cross section. The epidermis cells are small and they are not regular shaped. The epidermis cell has an average size of  $19.07 \pm 3.1 \times 36.49 \pm 5.68 \mu$ . Also, the epidermis layer is covered by cuticle. One layered hypodermis is under the epidermis.

The cortex consists of parenchymatic cells which has large gaps. Cortex layer is approximately  $512.43 \pm 240.25 \mu$  thick. Below cortex there is one layer of endodermis. Endodermis is rich in stored starch and it covers the vascular bundles. There are A type secretory cells in the phloem tissue. Phloem tissue thickness is an average  $95,58 \pm 11,15 \mu$ . Xylem is composed of sclerenchymatic cells and there are tracheary elements in stem. The diameter of the xylem tracheary elements is approximately is  $20.34 \pm 6.02 \mu$ . (Figure 2) (Table 1).

Table 1. The anatomical measurements of *H. spectabile*

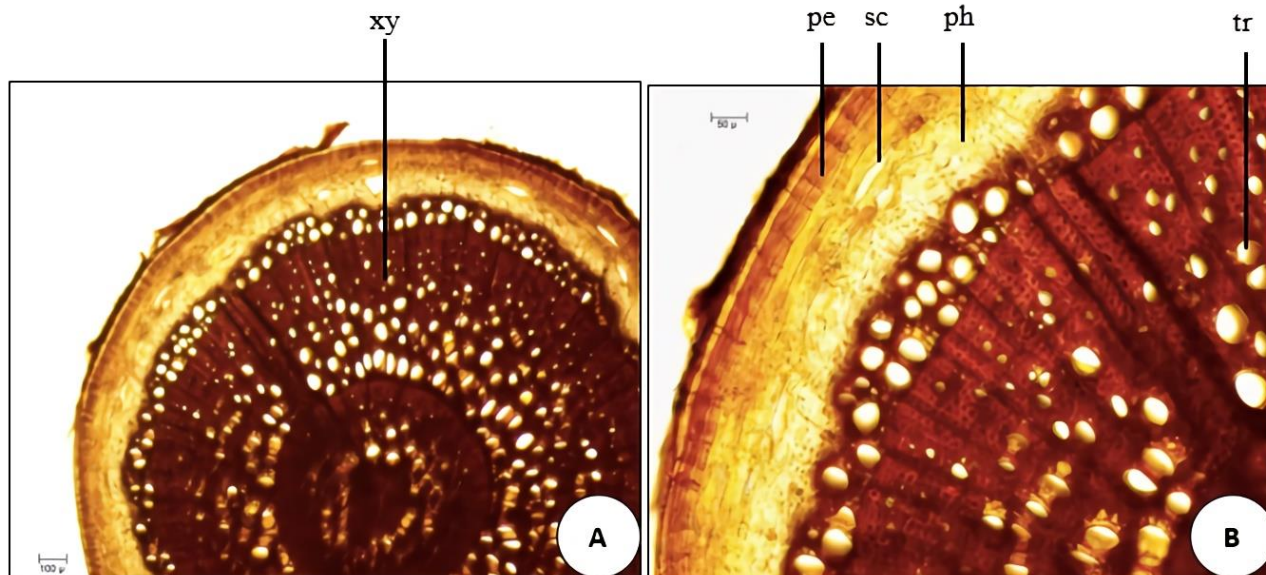
Vegetative organs		<i>Hypericum spectabile</i>								
		Length (µ)			Width (µ)			Diameter/Thickness (µ)		
		Min	Max	Avg ± SD	Min	Max	Avg ± SD	Min	Max	Avg ± SD
Root	Periderm							38,067	48,073	44,12 ± 3,84
	Phloem							93,42	146,056	129,89 ± 17,29
	Trachea							16,91	60,49	34,26 ± 13,55
Stem	Cortex									512,43 ± 240,25
	Phloem							85,30	123,64	95,58 ± 11,15
	Epidermis			36.49 ± 5.68			19.07 ± 3.1			
	Trachea							10,20	29,37	20,34 ± 6,02
	Pith							37,94	89,29	65,68 ± 14,24
Leaf	Stomata	18,44	26,87	23,92 ± 2,66	25,91	37,93	30,72 ± 4,21			



**Figure 2.** The cross section of stem of *Hypericum spectabile* cortex and vascular bundles; c cortex, e epidermis, cu cuticle, ph phloem, sc secretory canal, tr trachea, en endodermis.

## 2.2. Root

There are four-five rows of peridermal layer on the outermost part. Periderm cells are rectangular shaped and tightly stacked. Periderm tissue is approximately  $44,12 \pm 3,84 \mu$  thick. Below this tissue, the cortex parenchyma covers a large area and it has numerous type A secretory canals. The phloem is between the cortex and the xylem tissue. Phloem tissue is  $129,89 \pm 17,29 \mu$  thick. Xylem tracheary elements are an average diameter of  $34,26 \pm 13,55 \mu$ . The pith consists of large and cylindrical parenchymatic cells (Figure 3)



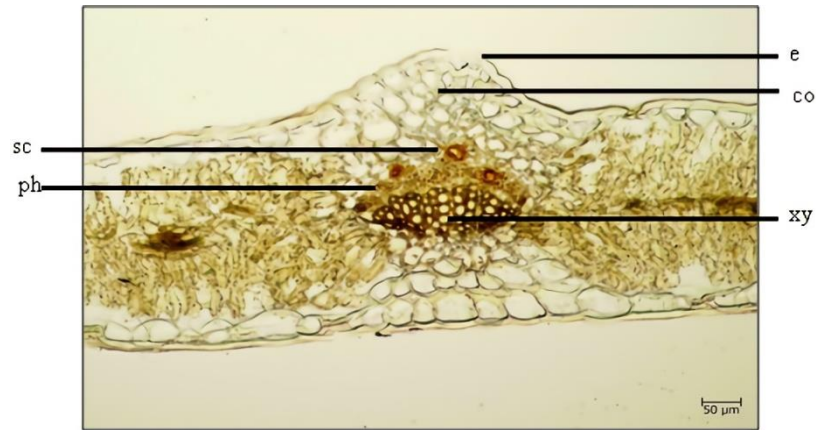
(Table 1).

**Figure 3.** The cross section of root of *H. spectabile* A general view B cortex and vascular bundles; pe periderm, sc secretory canal, ph phloem, tr trachea, xy xylem

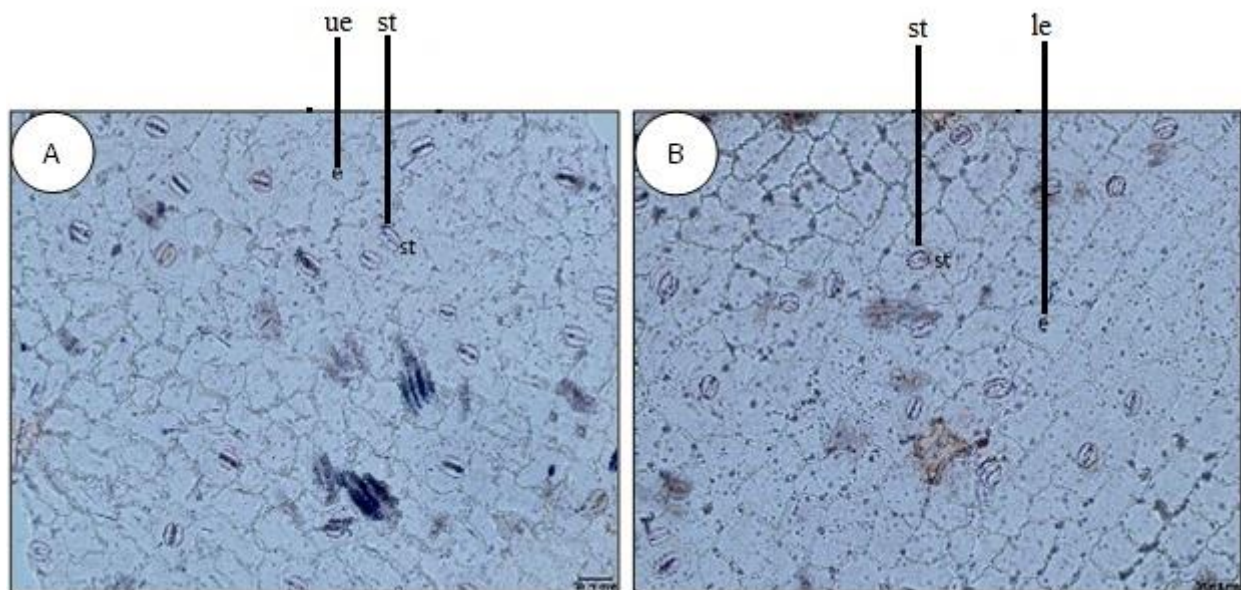
## 2.3. Leaf

There is one layered epidermis on the both surfaces of the leaf. In transverse section the leaf, mesophyll has palisade tissue on both surface so leaf is isobilateral. Collenchyma tissue is in four-five rows on the upper and lower surfaces of the midrib. The vascular bundles in the mesophyll have one or more type A secretory canals in the phloem. The midrib abaxial surface is plain and adaxial surface is protruding. The

cambium is not distinguishable and the vascular bundle is collateral. In the superficial section, there are stomata on both surfaces of the leaf, so the leaf is amphistomatic. Epidermal cells on the upper surface of the leaf are more wavy-walled than the lower surface. Stomata on the lower surface have an average size of  $23,92 \pm 2,66 \times 30,72 \pm 4,21 \mu$ . Stomata on the upper surface have an average size of  $24,33 \pm 2,32 \times 32,92 \pm 4,61 \mu$ . Stomata index of upper surface is 12. Stoma index on the lower surface is 10. Stomata are in anisocytic type. (Figure 4) (Figure 5) (Table 1) (Table 2).



**Figure 4.** The cross section of leaf of *H. spectabile* sc secretory canal, e epidermis, co collenchyma, ph phloem, xy xylem



**Figure 5.** The surface section leaf of *H. spectabile* A upper surface of the leaf B lower surface of the leaf; st stomata, ue upper epidermis, le lower epidermis

**Table 2.** Stomata structure and stomata index of *H. spectabile*

Stomata structure	Lower surface	Anisocytic
	Upper surface	Anisocytic
Stomata index	Lower surface	10
	Upper surface	12

### 3. CONCLUSION

The anatomy of the stem has the characteristics of the typical anatomy of dicotyledonous stems. Under a thick cuticle layer on the outermost, there is a layer of epidermis. Between the epidermis and the phloem is a thick layer of cortex. In the phloem layer there are many type A secretory ducts surrounded by four cells. The vascular bundles are collateral and are located in a large part of the stem cross-section. The xylem tissue consists of tracheae and tracheids.

In the study (Yüce, 2009) on *Drosanthe* sections, the anatomy of *Hypericum spectabile* is examined. The cortex consists of three or four layers under the epidermis (14). However, in our study, the layers in the cortex are indistinguishable because of the irregular shape of the parenchymatous cells, so we measured the thickness of the cortex. In addition, no sclerenchyma cells were found under the cortex layer. However, according to (Yüce, 2009), there are four or five rows of sclerenchymatous cells between the parenchymatous cells in the cortex. In contrast to Yüce's study, the cambium layer was not clearly visible in the stem section in our study.

**Anatomy of the root:** On the outermost layer there is a thick peridermal layer. Under this layer, the bark has many types A secretory ducts. The cambium is not clearly visible. Under the bark layer, the phloem is thick. The xylem layer has tracheae and tracheids and the pith contains parenchymatous cells.

**Leaf anatomy;** transverse and surface sections of the leaf mesophyll are examined. In the transverse sections of the mesophyll, the photosynthetic tissues are abaxial and adaxial in *H. spectabile*, so that the leaf is equilateral. The cuticle covers the upper epidermal layer on the outermost side. The collenchyma tissue is thick and surrounded by phloem and xylem in the main vein.

In the superficial portions of the leaf, stomata are seen on both surfaces of the epidermis, making the leaf amphistomatic. The stomata are of the anisocytic type. The results of the stomata in our study are similar to those of (Yüce, 2019).

### 5. MATERIALS AND METHODS

The materials used in this study are obtained through field studies. *Hypericum spectabile* were collected from Erzincan-Dutluca village (GPS: 39°08'27.2"N 38°36'37.9"E) by Onur Altınbaşak and identified by Prof. Dr. Şükran Kültür. The herbarium specimens are prepared and protected in Istanbul University, Faculty of Pharmacy Herbarium (ISTE) with the number 115029. Also, plant materials are stored in 70% ethanol for the anatomical investigations. Transverse and superficial sections were taken from plant materials held in 70% alcohol. The sections were taken manually using a razor blade. The samples were examined using the Sartur reagent and the photographs were taken with the help of a Canon A640 digital camera attached to an Olympus BH-2 microscope.

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