

Anatomical Structure of the Root of *Tetradium Daniellii* (Benn.) T.G. Hartle

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ABSTRACT

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In this article, the root of *Tetradium daniellii* (Benn.) T.G. Hartley, a plant belonging to the Rutaceae family, was anatomically studied under the conditions of Andijan region. The purpose of the study was to identify internal diagnostic features important for assessing the quality of medicinal raw materials. Root samples were fixed in 70% ethanol, hand-made cross sections were prepared, stained with safranin, and analyzed under a microscope. As a result of the observations, it was determined that the root structure is characterized by a well-developed periderm, large parenchyma cells, clearly expressed endodermis, formation of lateral roots from the pericycle, distinctly differentiated xylem and phloem, and the presence of sclerenchyma elements. It was observed that starch grains accumulate in the parenchyma tissues as reserve substances. According to measurement results, root diameter, and the thickness of periderm, endodermis, and parenchyma were recorded as species-specific anatomical indicators. The obtained data demonstrate that the morpho-anatomical structure of the root of *Tetradium daniellii* is important for identification of medicinal raw materials, quality assessment, and pharmacognostic studies.

Introduction

It is known that in plants, the root mainly performs two functions. First, it serves as a support in the soil; second, it absorbs water and mineral salts from the soil and transports them to all plant organs.

Roots grow deeply, branch extensively, and penetrate the soil, absorbing mineral substances. Thousands of root hairs emerging from young roots absorb substances from the soil. Therefore, when grass or seedlings are pulled out, soil often comes out together with the root hairs.

Tetradium daniellii (Benn.) T.G. Hartley, sometimes called “Korean evodia” or “Abeel tree,” belongs to the Rutaceae family and is a deciduous tree species. Synonym: *Euodia daniellii*, which is why it is sometimes referred to as “Evodia.” Native habitat: East Asia (China, Korea). The tree can reach 7–15 meters in height. Leaves are oppositely arranged, pinnate, consisting of 5–11 leaflets. Flowers are located in large inflorescences, small, white, bloom in July–August, are very fragrant and rich in nectar. Fruits are black, capsule-like with four seeds, ripening in autumn. The tree is also called the “honey tree” and is of great importance in beekeeping.

It grows well in sunny or semi-shaded places. It tolerates various soils but develops faster in well-drained, fertile soils. It has moderate water requirements and is resistant to dry conditions. In the USA, it corresponds to USDA zones 5–9, indicating cold resistance down to -20°C .

Although naturally distributed in Korea and China, it is also cultivated in other regions as an ornamental and nectar-producing plant (1–5). Due to its attractive leaves, flowers, and fruits, it is widely used in landscaping. Because of its late flowering, it serves as a valuable nectar source for bees even in September–October.

Phytochemical studies have shown that the seeds are the main raw material and contain 131 chemical compounds including alkaloids, phenols, and saponins with medicinal properties (6, 7). These compounds are used in the prevention of gastrointestinal diseases, against bacteria and colds, and in improving the endocrine system.

Morphogenesis, seed germination, morphological parameters of leaves, and formation features of primary and secondary lateral roots have been analyzed. The good growth and development of seedlings depend on shoot formation, root system, climate, soil factors, and agrotechnical practices (8).

Despite its wide use in economy, industry, and official medicine, the morpho-anatomy, bioecology, and agrotechnics of this plant have not been sufficiently studied. Therefore, under introduction conditions in Andijan region, the study aimed to determine internal anatomical diagnostic features of the root.

For anatomical study, roots were fixed in 70% ethanol. Cross sections were prepared manually, stained with safranin, and mounted in glycerin-gelatin (9). Tissue and cell descriptions were based on the works of K. Esau (1969), N.S. Kiseleva (1971), epidermis description by S.F. Zakharevich (1954), and stomatal types by M.A. Baranova (1981). Microphotographs were taken using a Motic B1-220A-3 microscope and Canon A123 digital camera.

The cross section of the root is oval-rounded and covered externally with root hairs (Fig. 1).

After the beginning of secondary growth, the epidermis is replaced by periderm, which protects the plant from the external environment and prevents water loss. Below

the periderm lies the cortex composed of parenchyma cells storing starch and other reserve substances. It also contains tissues capable of regeneration. The endodermis is the inner layer of the cortex, characterized by Casparian strips, ensuring controlled transport of water and nutrients into the central cylinder. Inside it is the pericycle, from which lateral roots arise. In some cases, it also performs mechanical functions together with conducting tissues. Between xylem and phloem, sclerenchyma tissues are located. Xylem conducts water and minerals, located centrally, performing mechanical and transport functions. In young roots, it has a radial arrangement with rays extending outward. Phloem conducts organic substances and is located between xylem rays.

The central cylinder (stele) consists of xylem and phloem arranged in a continuous axial structure. Well-developed xylem elements provide strength and stability. Starch accumulates in cortex and parenchyma tissues. The pericycle produces lateral roots, enabling adaptation. Controlled movement of substances occurs through the endodermis.

The main anatomical indicators include root diameter, thickness and width of periderm, size and width of parenchyma, endodermis thickness, pericycle size, and stele size. Measurements showed: root diameter $25.9\pm 0.9\ \mu\text{m}$; periderm thickness $5.4\pm 0.4\ \mu\text{m}$; endodermis thickness $7.3\pm 0.4\ \mu\text{m}$; parenchyma size $9.5\pm 0.7\ \mu\text{m}$ (table).

The root part is very strong and constitutes two-thirds of the plant body, increasing viability (14). Currently, there are no special studies on leaf, stem, and root anatomy of this species, though several studies exist on flower anatomy (15). Literature indicates that this species is considered medicinal due to the presence of biologically active compounds. Root anatomical structure is important for pharmacognostic identification and quality assessment of medicinal raw materials

In conclusion, the developed periderm, clearly differentiated xylem and phloem, presence of sclerenchyma cells, and starch grains in parenchyma tissues are diagnostic features characteristic of this species. Studying the root anatomy under Andijan conditions provides important data for identification, analysis, and quality evaluation of medicinal raw materials and for understanding biological processes in the plant.

Fig.1 Cross section of the root of *Tetradium daniellii*: A – general view, B – cortex, C – stele; ЭН – endodermis, П – periderm, Па – parenchyma, Пц – pericycle.

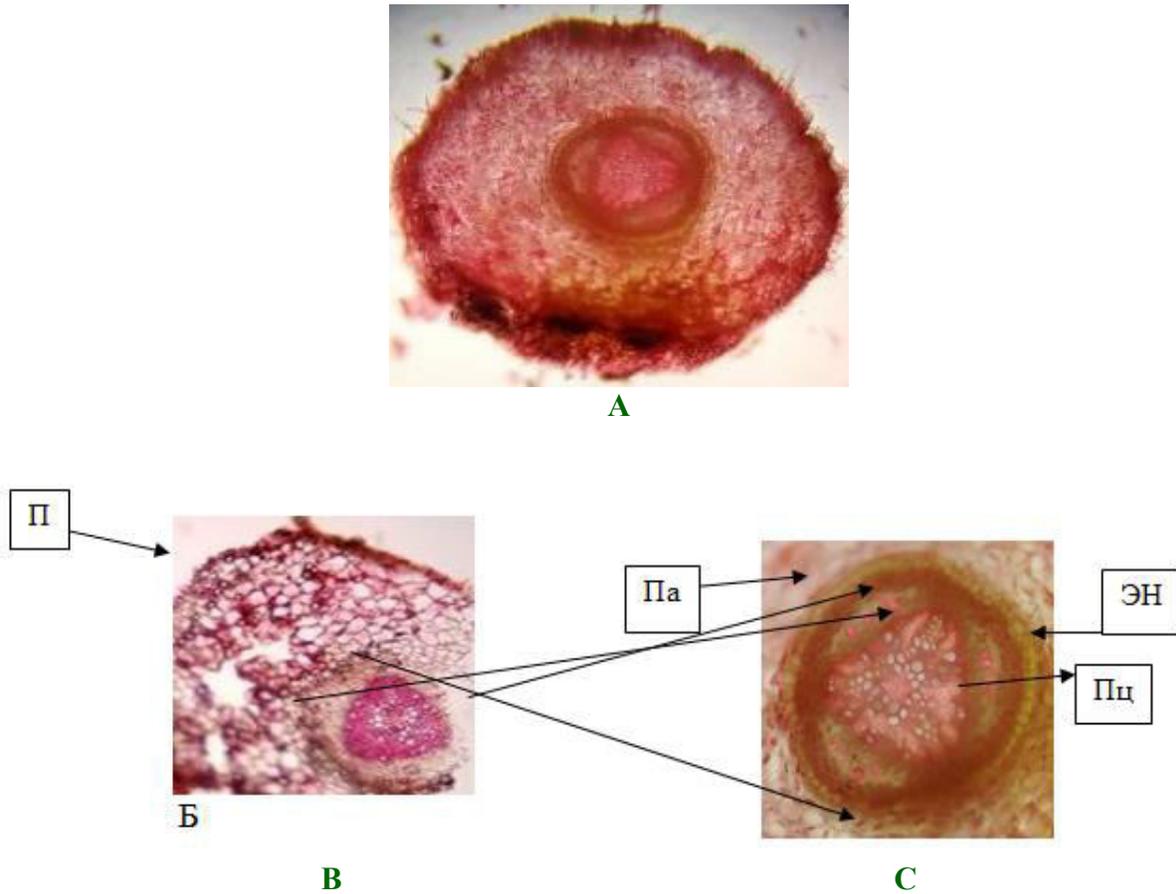


Table.1 Anatomical parameters of the root structure of *Tetradium daniellii* (Benn.) T.G. Hartley

SN№	Signs	Indicators, μm
1	Root diameter	25,9±0,9
2	The thickness of the periderm	5,4±0,4
3	Endosperm thickness	7,3±0,4
4	The size of the parenchyma	9, 5±0,7

Author Contributions

Mamadjanova Munavvar Abduraxmanovna:
Investigation, formal analysis, writing—original draft.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

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