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Morphological and microscopic study of *Elsholtzia griffithii* Hook

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Abstract

Elsholtzia griffithii, a member of the Lamiaceae family, is an important and widely used traditional Chinese medicine (TCM). However, no scientific studies have been conducted on its anatomy because it is a rare species in Chinese forests. It is also found in the state of Manipur, Eastern India. This study aimed to examine the morphological and microscopical features of *Elsholtzia griffithii* to support quality control of this herbal medicine. The methodology involved preparing anatomical sections and describing them in detail. The physiological study results are consistent with the typical patterns of plants in the Lamiaceae family. The findings suggest that its physiological structure can serve as a foundation for further quality control of this plant.

Keywords: *Elsholtzia griffithii*, botanical identification, traditional Chinese medicine, microscopy, Manipuri Lomba, east India mint

1. Introduction

Plants have been the main source of medicine for thousands of years; humans have depended on nature to provide for all of their basic needs, including medical supplies. Numerous traditional medical systems have developed and significantly influenced the growth of natural medicine [1], including the ancient Greek and Roman systems, Ayurvedic medicine in India, and Traditional Chinese Medicine [2]. One of the few traditional medical systems that has survived to this day is Ayurvedic medicine in India, which is a typical ethnomedicinal approach. Because of its low cost, consistent effectiveness, accessibility locally, and lack of known adverse effects, it has become more well-known and accepted in other nations [3]. However, the indistinct effects, poor quality control, and the differences concerning the modern medical system restrict its global use. The genus *Elsholtzia*, a member of the Lamiaceae family, comprises approximately 48 species, with 33 varieties distributed across East Asia, mainly in China. *Elsholtzia*, a green, aromatic herb [4], thrives at altitudes ranging from 400 to 1500 meters above sea level and is found in regions across East Asia, Africa, North America, and Europe. In Northeast India, particularly in states like Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura, it is widely cultivated and known by various vernacular names [5]. *Elsholtzia* has a rich history of traditional uses in Northeast India, serving as a flavoring agent in local cuisine and a remedy for various ailments such as cough, cold, skin inflammations, and menstrual disorders. Additionally, it has found applications in herbal tea, cosmetics, perfumery, and aromatherapy [6].



Fig 1: Manipuri lomba plant- flowers, leaves, stem, and fruits

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Elsholtzia griffithii Hook, belonging to the Lamiaceae family, has no scientific studies on its anatomy because this is a rare species of Chinese forest. It is also found in the state of Manipur, Eastern India. [7] It is called East India Mint. East-Indian Mint is an annual herb up to 50 cm tall, with a strong lemony fragrance. Stems are erect, sometimes purple-red, densely covered with white velvet-hairy, much branched at the base. Leaf-stalks are 2-5 mm, densely white velvet-hairy. Leaves are ovate to oblong, above white hairy, below velvet-hairy, yellowish glandular, margin sawtoothed. Tiny lilac or white flowers are borne in spikes at branch ends, which are cylindric, compact, 1-4.5 cm long, 0.8-1 cm wide. Axis is densely white hairy; bracts linear, up to 3.5 mm, densely white hairy. Flower stalks are about 1 mm, densely white hairy. Calyx is tubular, up to 4 mm in fruit, tip recurved, densely gray woolly-hairy outside; teeth nearly equal, slightly closed in fruit. Flowers are funnel-shaped [8]. *Elsholtzia griffithii* Hook is morphologically similar to *E. cyprianii* Pavol. But can be distinguished from the former by its lanceolate bracts exceeding the flowers, 3.0-4.0 mm long; five calyx-lobes unequal, of which the anterior two lobes are shorter than the three posterior lobes vs. bracts up to 3.0 mm, generally shorter than flowers, calyx teeth equal in *E. cyprianii*. The flower is white and usually contains 3-4 pistils, in which the lower lobe is longer than the upper lobe. *Elsholtzia griffithii* bears flowers in May-August session, and bears fruits in August-October session [9].

2. Materials and Methods

2.1. Collection, identification, and authentication of plant

The plant of *Elsholtzia griffithii* was collected from the area of Manipur (East India) in May 2025 by a farmer, and the plant was identified, confirmed, and authenticated by Dr. Pradeep Tiwari, Botanical Department of H.S. Gour University, Sagar (MP), and the identification number is BOT/H/05/123/15

2.2 Macroscopic study

To conduct morphological and histological analysis, fresh leaves, stems, and roots of *E. griffithii* were collected and examined for macroscopic parameters, including apex, margin, lamina, and base.

2.3 Microscopic evaluation

Transverse sections of the leaves, root, and stem were cut, stained with safranin and methylene blue, hydrated with glycerin, covered with a coverslip, and then observed under an optical microscope [10].

3. Results

3.1. Anatomic Study

The plants of *E. griffithii*, including leaves, stem, and root, have been investigated systematically, encompassing morphological and Microscopic studies. A literature survey revealed that little work has been done on this plant. Therefore, it was thought worthwhile to conduct the Morphological and Microscopic work.

3.1.1 Morphology of Plant leaf, stem, flower, fruits, and roots

Table 1: Morphology of *Elsholtzia griffithii*

Characteristics	<i>Elsholtzia griffithii</i>	Characteristics	<i>Elsholtzia griffithii</i>
Herb	Annual herb up to 50 cm tall, herbaceous.	Stems	erect, 4-angled, much-branched, green purplish, sub-quadrangular, woody, covered with soft spreading hairs
Leaf color	Dark green	Flower	White in color, cylindrical in shape, 1-4.5 mm
Leaf-stalk	2-5 mm	Fruit	Size-up to 4mm, funnel-shaped.
Shape & Size	leaf blade oblong to ovate-oblong, 2.5-5 cm long, up to 2.5 cm wide	Root	Fibrous root structure
Odour	Aromatic, strong lemony fragrance	Flowering	May-August
Taste	Pungent, aromatic, and sharp	fruiting	August -October



Fig 2: *Elsholtzia griffithii* Plant leaf and stem

3.1.2 Microscopy of the *Elsholtzia griffithii*

Transverse sections (TS) were prepared using the leaves, stems, and roots of *Elsholtzia griffithii*. Slides with the TS were then observed under the microscope, resulting in the following findings (Figures 3-6)

The leaf blade of *Elsholtzia griffithii* proved to be amphistomatic with anisocytic and anomocytic stomata. The Anomocytic type predominated in the front view. The epidermis showed sinuous anticlinal walls in both adaxial and abaxial surfaces [Figure 3A, B]. The analysis of the

epidermis by compound microscopy (CM) revealed a smooth cuticle surface with three types of trichomes: simple multicellular trichomes [Figure 3C, D], peltate glandular trichome (Figure 3E), and simple unicellular (Figure 3F), being observed on both surfaces. The simple multicellular trichomes are non-glandular and consist of 1-5 cells with an aduncous contour at the end, the capitate glandular has six cells in the ovate multicellular secretory head.

In the cross-section, the leaf margin is curved towards the abaxial surface with a uniseriate epidermis. (Figure 4A).

Palisade parenchyma is followed by small collateral vascular bundles surrounded by 2-4 layers of spongy parenchyma cells. The petiole shows a concave-convex contour, forming two ribs. Several small collateral vascular bundles are distributed throughout the mesophyll, surrounded by a parenchymatic sheath. (Figure 4B). Stomata showed the same level of epidermal cells according to their arrangement. In the cross-section, midrib is of a concave-convex shape, with epidermal cells of smaller sizes in the region of the leaf blade. one to two layers of collenchyma are present. The vascular tissue is collateral and arranged in a single bundle. The collenchyma is dorsiventral with 1 stratified palisade parenchyma (Figure 4C). Three types of trichomes are present: multicellular, capitate glandular, and simple trichomes (Figure 4D,E.). Midrib has concave-convex contour and one collateral vascular bundle (Figure 4F).

The epidermis is uniseriate (with covering and glandular trichomes similar to those described for the leaf blade) on the epidermal surface. The cortex is composed of discontinuous lacunar collenchyma. Below the collenchyma, there are about three to four layers of homogeneous chlorenchyma. The vascular system is collateral, arranged in

three vascular bundles, having a central, larger bundle with an open arch and two other auxiliary, smaller and cylindrical bundles.

The stem is four-prismatic in shape. In primary structure, the stem shows a uniseriate epidermis with tabular cells the cortex has 2-3 layers of parenchyma cells and discontinuous layers of lacunar collenchyma. In collenchyma of more internal cells, collenchyma undergo sclerification, differing in fiber (Figure 5A). The vascular tissue is arranged in a single cylinder, with collateral surrounding the parenchyma pith (Figure 5B,). The secondary growth is the development of secondary vascular tissue and periderm. The cross-sections showed a 4-8-layered periderm, with rectangular cells, with compact phellem formed by uniform, thickened cells and phelloderm containing about 1-3 layers of parenchyma cells (Figure 5C). The collateral vascular tissue has diffused and poriferous vessel elements with circle elliptical contour, having two different diameters wide and narrow, multicellular and simple trichomes are present (Figure 5D). The rays are generally composed of uniseriate parenchyma consisting of square cells. The pith is formed by parenchyma cells in the central portion.

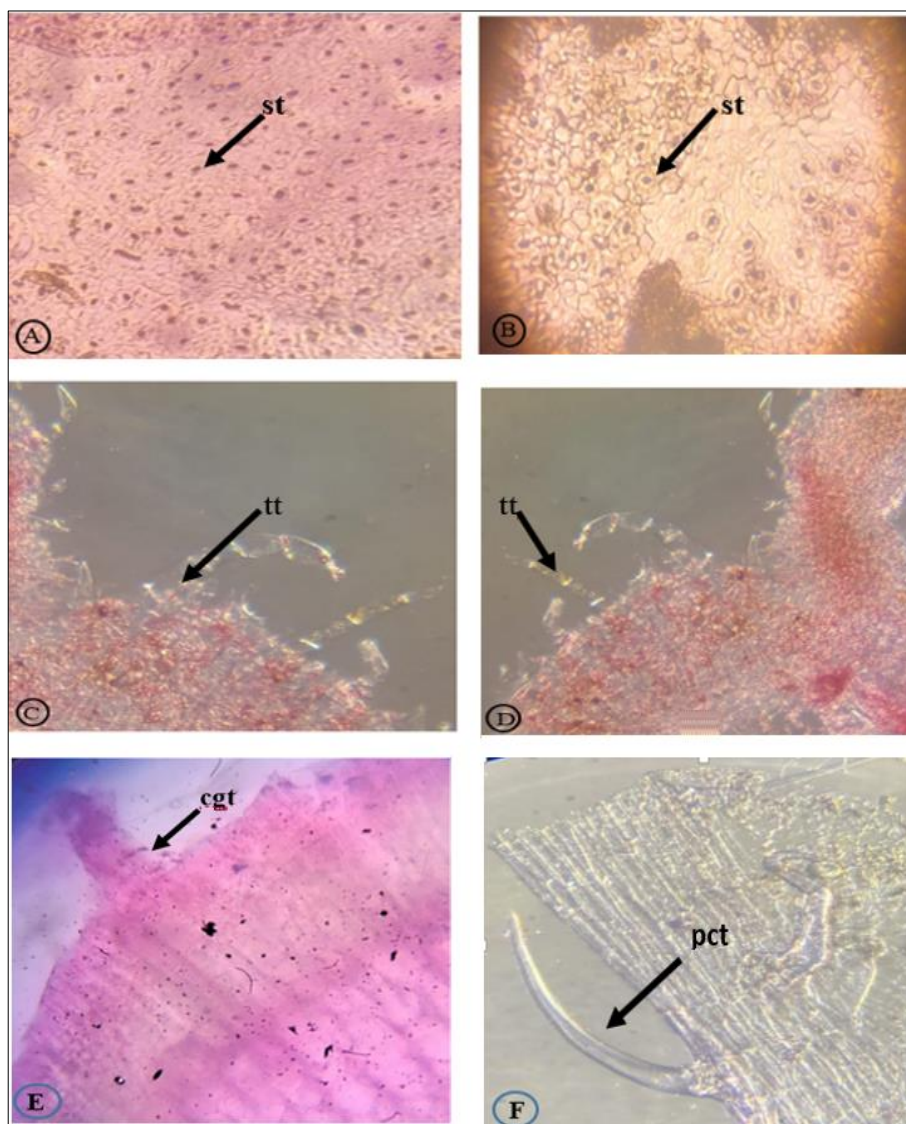


Fig 3: Cross section of the epidermis of *Elsholtzia griffithii* (Hook.) (A) Adaxial surface with stomata anisocytic (B) Abaxial surface with detail of anomocytic stomata. (C, D) Detail of multicellular tector trichome; (E) Detail of capitate glandular trichome; (F) Detail of peltate simple cellular trichome. Legend: capitate glandular trichome (cgt); peltate simple cellular trichome (pct); stomata (st); multicellular tector trichome (tt).

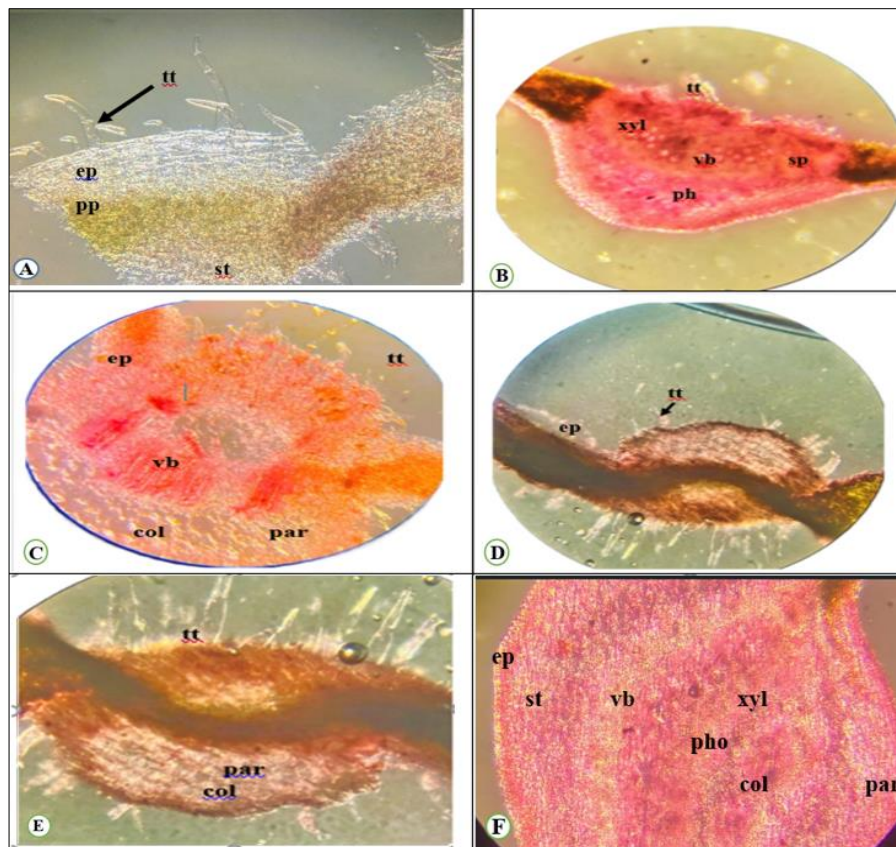


Fig 4: Cross sections of leaf of *Elsholtzia griffithii* (Hook). (A) Detail of mesophyll with uniseriate epidermis, (B) uniseriate palisade parenchyma and several layers of spongy parenchyma, Midrib has concave-convex contour and one collateral vascular bundle, (C) Mesophyll dorsiventral with small collateral vascular bundles, (D) Margin with circular contour, presence of multicellular tector trichome, (E) uniseriate palisade parenchyma and several layers of spongy parenchyma, (F) Midrib has concave-convex contour and one collateral vascular bundle, Legend: collenchyma (col); epidermis (ep); parenchyma (par); phloem (pho); spongy parenchyma (sp); stomata (st); tector trichome (tt); vascular bundle (vb); xylem (xyl); Stomata (st).

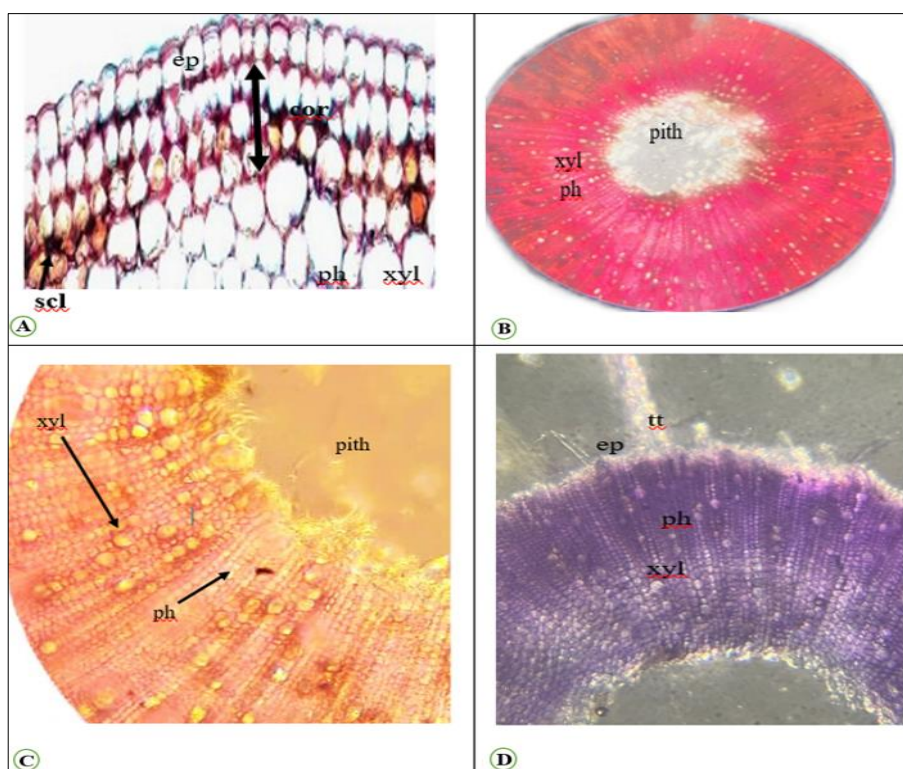


Fig 5: Cross sections of the stem of *Elsholtzia griffithii* (Hook). (A) Stem primary growth, with uniseriate epidermis; (B) Detail of xylem; Detail of vascular tissue and a parenchyma large pith; xylem arms arranged like spokes of a wheel (C) Stem secondary growth, with secondary vascular tissue and several layers of periderm; (D) Detail of secondary vascular tissue divided by parenchyma rays; Detail of Phloem tissue. Legend: cortex (cor); epidermis (ep); periderm (per); phloem (pho); pith (pt); xylem (xyl); sclereids (scl); vascular ray (vr); xylem (xyl). Sclerinchyma (Scl)

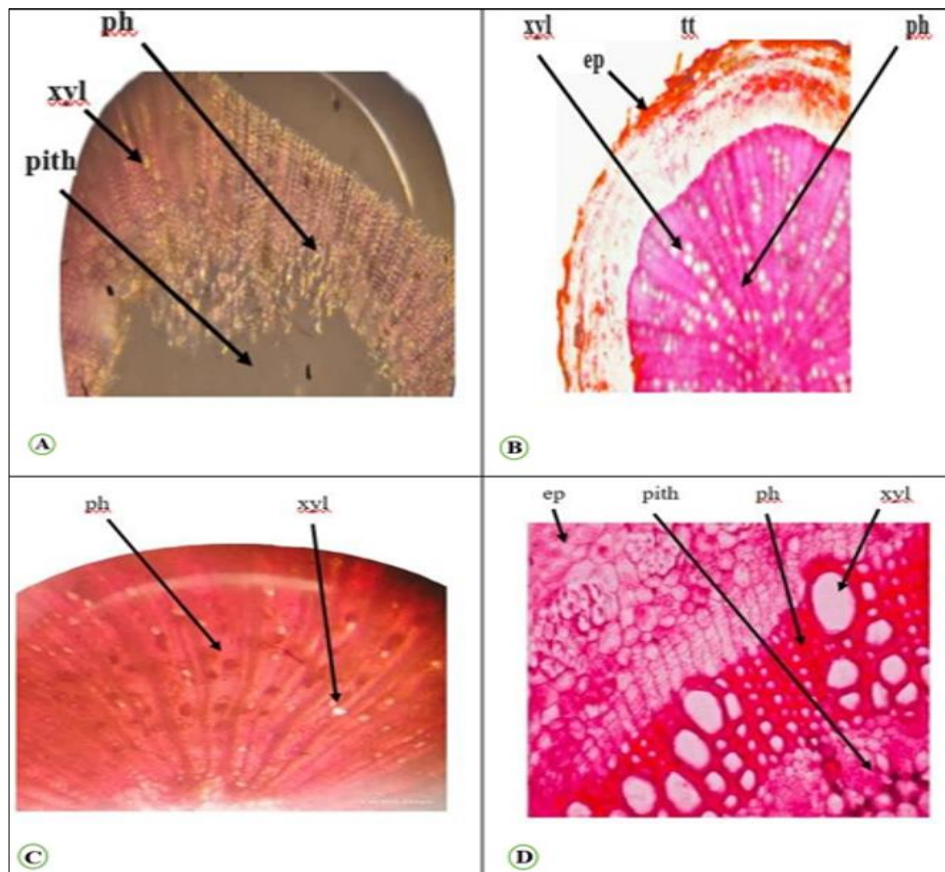


Fig 6: Cross sections of the root of *Elsholtzia griffithii* (Hook). (A) Root is prismatic in shape (B) uniseriate epidermis; thin and lightly stained in brown with tector trichomes (C) radial vascular bundles, xylem arms arranged like spokes of a wheel. (D). Well-developed pith in the center. Legend: epidermis (ep); phloem (ph); xylem (xyl). Tector trichomes (tt).

The root has a prismatic form. Located near the vascular bundle's outer edge, phloem aids in the movement of nutrients (Figure 6A). A uniseriate epidermis with tector trichomes is the root's principal structure (Figure 6B). Near the center lies xylem, which conducts minerals and water and forms radiating threads. Organized like a wheel's spokes (Figure 6C). The outermost layer of the root's defense, thickened tissue, may be endodermis or pericycle, inside the cortex, in a circle. Near the vascular cylinders outside border, phloem is visible. Xylem vessels are arranged in a well-defined radial pattern that extends toward the center. pith that is well-developed in the middle (Figure 6D).

This study provides important anatomy and morphology information of *Elsholtzia griffithii* (Hook). Although some basic descriptions in the eFlora of India ^[8] as well as a similar anatomic study of some Chinese species were previously performed ^[11], the current work provides more specific and systematic anatomic characteristics for this species. This is a rare species of China. The new record provided by China *Elsholtzia griffithii* is similar to *Elsholtzia cyprini* ^[12].

Conclusion

The present investigation on the leaf stem and root of *Elsholtzia griffithii* provided valuable, practical, and reliable data on this plant's pharmacognostic examination, based on botanical aspects for further scientific studies. The plant exhibited distinct characteristics such as green color, oblong to ovate Shape, white flowers, creamy fruits, and aromatic odor. The stem is four-prismatic in shape, the roots are fibrous in nature, and specific anatomical features. The presence of anomocytic and anisocytic types of stomata in

leaves, vascular bundles, multicellular, unicellular, and glandular trichomes, the stem shows a uniseriate epidermis, the cortex has 2-3 layers of parenchyma cells and discontinuous layers of collenchyma, roots are prismatic in shape, Wheel like structure, can be utilised to identify a species. Microscopy revealed the detailed structure of the leaves, stem, and root, which contribute to botanical identification and quality assessment. The description of *E. griffithii* anatomy would aid in the quality control of this herb because it features distinctive anatomical traits typical of Lamiaceae plants.

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