



## Pharmacognostical Standardisation of Root, Stem, Leaf and Fruit of *Bhoomyamalaki* (*Phyllanthus amarus* Schumach & Thonn.)

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**ABSTRACT:** *Phyllanthus amarus* Schumach. & Thonn. (*Bhoomyamalaki*) is a well-known Ayurvedic plant widely used for liver diseases, metabolic problems, and infections. Although the whole plant is medicinally important, scientific descriptions of its individual parts are limited. This study was carried out to record basic pharmacognostic features of the root, stem, leaf, and fruit to help identify the raw drug correctly and ensure purity. Fresh plant material was collected and examined for external and internal characters. Colour, surface features, taste, and smell were first noted. Transverse sections were taken to observe important structures such as epidermis, vascular tissue, crystals, stomata, and other characteristic cells. The root was found to be straight, cylindrical, brownish, and attached with many fine branches. The stem was thin, erect, smooth, and branched. Leaves were simple, arranged alternately in two neat rows on branchlets, and had oblong or elliptic shapes with rounded tips. Fruits were small, smooth, round capsules that appeared green and trilobular. The microscopic examination of root showed starch grains and crystals mainly in the cortex and phloem. The stem contained rosette-shaped calcium oxalate crystals, especially in the pith region. Numerous anisocytic stomata were seen on the lower surface of the leaf. The fruit section showed a circular capsule with three ridges and wedge-shaped seeds inside each locule. Powder microscopy also revealed identifiable fragments useful for detecting adulteration. The observations from this study offer reliable features that can be used for authentication, quality control, and standardization of *Bhoomyamalaki* in Ayurvedic practice and research.

**KEYWORDS:** *Bhoomyamalaki*, *Phyllanthus amarus* Schumach. & Thonn., Pharmacognostical evaluation.

### INTRODUCTION

Medicinal plants constitute the foundation of traditional systems of medicine such as Ayurveda, where the therapeutic efficacy of a formulation depends fundamentally on the correct identification, purity, and quality of raw drugs. In the present era of increasing global acceptance of herbal medicines, challenges such as adulteration, substitution, and non-uniform quality of crude drugs have assumed significant importance. Pharmacognostical standardisation serves as a vital scientific tool to address these concerns by establishing

diagnostic parameters through macroscopic, microscopic, physicochemical, and powder analytical studies, thereby ensuring authenticity and reproducibility of herbal medicines.

*Bhoomyamalaki*, botanically identified as *Phyllanthus amarus* Schumach. & Thonn. of the family Euphorbiaceae,<sup>1</sup> is a widely distributed herb in tropical and subtropical regions. It occupies a prominent position in Ayurvedic literature due to its extensive therapeutic applications. Classical texts describe *Bhoomyamalaki* as an important drug in the management of *Yakrt vikara*, *Kamala*, *Paṇḍu*, *Jvara*, *Prameha*, *Kuṣṭha*, and other metabolic and inflammatory conditions.<sup>2</sup> It is also included in several classical formulations and is regarded as a valuable *Rasayana*, particularly for hepatic and metabolic health. Contemporary pharmacological investigations have substantiated these claims, reporting hepatoprotective, antiviral, antioxidant, anti-inflammatory, and immunomodulatory activities, thereby reinforcing its relevance in modern medicine.<sup>3</sup>

From an Ayurvedic pharmacodynamic perspective, *Bhoomyamalaki* possesses *Tikta* and *Kaṣaya Rasa*, which contribute to its *Ama pacana*, *Pittahara*, and *Raktaprasadana* actions.<sup>4</sup> The *Guṇa* are *Laghu* and *Rukṣa*, facilitating metabolic correction and tissue cleansing. *Bhoomyamalaki* is described as having *Sita Virya*, making it particularly effective in *Pitta*-dominant disorders, including inflammatory and hepatic conditions.<sup>5</sup> Its *Vipaka* is *Madhura*, supporting its *Rasayana* and tissue-nourishing effects.<sup>6</sup> The primary karma of *Bhoomyamalaki* includes *Pittahara*, *Yakṛduttejaka* (hepatoprotective), *Dipana-Pacana*, *Jvaraghna*, *Raktadoṣahara*, and *Rasayana*, which collectively justify its extensive classical and clinical use.<sup>7</sup> Therefore, the present study aims to establish comprehensive pharmacognostical standards of the root, stem, leaf, and fruit of *Bhoomyamalaki*.<sup>8</sup> Such part-wise standardisation will contribute to accurate identification, detection of adulterants, and development of robust quality control parameters, thereby strengthening Ayurvedic pharmacopeial documentation and ensuring the safety, purity, and therapeutic efficacy of *Bhoomyamalaki* based formulations.

## MATERIALS AND METHODS

### Collection of the Drug

The medicinal plant *Bhoomyamalaki*, scientifically known as *Phyllanthus amarus* Schumach & Thonn., was collected in its entirety from the Chengamanad Panchayath area in Ernakulam district, Kerala. The whole plant, including its Root, stem, leaves, and fruits, was harvested early in the day between 6:00 and 8:00 AM. The specimen I collected was identified and confirmed by experts in the Department of *Dravyaguna Vijnanam* at Government Ayurveda College, Tripunithura. Additional verification of the plant was done at St. Albert's College (Autonomous), Department of Botany, Ernakulam. The voucher number – 608.

### Macroscopic evaluation of the whole Plant of *Bhoomyamalaki* (*Phyllanthus amarus* Schumach & Thonn.).

The Fresh samples of the whole plant of *Bhoomyamalaki* were carefully collected and cleaned under running water to eliminate any adhering soil or impurities. After thorough washing, the material was shade-dried. Initial identification was carried out using direct visual observation and sensory evaluation. The macroscopic features of the freshly collected Root, Stem, leaf and fruit were studied, and photographs of the sample were captured using a digital camera.

### Powder macroscopic evaluation of the whole Plant of *Bhoomyamalaki*.

The *Bhoomyamalaki Churna* (powder) was individually spread on white paper and examined visually, both with the naked eye and under a magnifying lens. Observations were made regarding their colour, texture, odour, and taste as part of powder macroscopy. The texture was evaluated by rubbing the powder between the fingers, followed by assessment of smell and taste. Digital photographs of both samples were also captured for documentation.

**Microscopic evaluation of fresh Plant of *Bhoomyamalaki* (*Phyllanthus amarus* Schumach & Thonn.)**

A small quantity of *Bhoomyamalaki churna* was taken and placed on a clean glass slide. A few drops of water were added, and the mixture was gently blended using a fine brush to ensure even distribution and minimise overlapping of structural components. A coverslip was carefully placed over the preparation, and the slide was examined under a compound microscope at 10X magnification. Photographic documentation was done using a digital camera.

**OBSERVATIONS****Pharmacognostical evaluation****A. Macroscopic features of the fresh root**

Macroscopic features of the freshly collected fresh root of *Phyllanthus amarus* Schumach & Thonn. was assessed and tabulated as follows.

**Table No: 1 Macroscopic features of fresh root of *Phyllanthus amarus* Schumach & Thonn.**

Observation	Fresh Root
Shape	Cylindrical, branched; tapers gradually at the ends.
Size	5.5 centimetres long, 5 mm in diameter
External surface	fine longitudinal striations and wrinkles on the outer surface
Cut surface	Smooth; outer region darker, central region lighter, and fibrous.
Fracture	fibrous fracture when broken.
Texture	Smooth or slightly rough on the outer surface; firm and fibrous internally.
Odour	mild characteristic odour
Taste	Bitter

**B. Macroscopic features of fresh stem**

Macroscopic features of the freshly collected fresh stem of *Phyllanthus amarus* Schumach & Thonn. was assessed and tabulated as follows.

**Table No: 2 Macroscopic features of the stem of *Bhoomyamalaki* (*Phyllanthus amarus* Schumach & Thonn.)**

Observation	Stem
Shape	Slender, cylindrical, and erect, with numerous spreading branches
Size	25cm tall.
External surface	The surface is smooth (glabrous) and slightly striated with fine longitudinal lines.
Fracture	fibrous fracture
Texture	Soft and herbaceous
Odour	without any distinct odor.
Taste	Bitter

**C. Macroscopic features of fresh leaf**

Macroscopic features of the freshly collected fresh leaf of *Phyllanthus amarus* Schumach & Thonn. was assessed and tabulated as follows.

**Table No: 3 Macroscopic features of the leaf of *Bhoomyamalaki* (*Phyllanthus amarus* Schumach & Thonn.)**

Observation	Leaf
Type	Simple
Arrangement	Alternate and distichous (in two rows) on the lateral branchlets.
Shape	Oblong, elliptic, or obovate with a rounded apex and tapering base.
Size	6–12 mm long and 3–6 mm wide.
External surface	Smooth (glabrous) on both upper and lower surfaces.
Margin	Entire
Venation	Pinnate with a distinct midrib and fine lateral veins.
Petiole	Very short or almost sessile
Texture	Thin, delicate, and herbaceous
Colour	Bright green on upper surface
Odour	without any distinct odor.
Taste	Bitter and astringent.

**D. Macroscopic features of fresh fruit**

Macroscopic features of the freshly collected fresh fruit of *Phyllanthus amarus* Schumach & Thonn. was assessed and tabulated as follows.

**Table No: 4 Macroscopic features of the fruit of *Bhoomyamalaki* (*Phyllanthus amarus* Schumach & Thonn.)**

Observation	Fruit
Type	Capsule
Shape	Globose to Subglobose
Size	1.5–2 mm in diameter
Colour	Green
Surface	Smooth and glabrous
Ridges	Often shows faint longitudinal ridges
Texture	Dry and brittle after drying
Odour	Slight or indistinct

**E. Powder macroscopic evaluation of *churna* (powder)**

The Powder macroscopic features including the colour, texture, odour and taste of *churna* (powder) was tabulated as follows.

**Table No: 5 Powder macroscopy of *Bhoomyamalaki* *churna***

Characters	<i>Churna</i>
Colour	Greenish-brown
Texture	Fine, smooth
Odour	Characteristic
Taste	Bitter

#### **F. Microscopic evaluation of the fresh root of *Bhoomyamalaki***

The *Phyllanthus amarus* (Root) is circular in outline and shows the outermost cork. It is followed by a multilayered cortex. Cortex is wide, composed of parenchymatous cells. The phloem layer can be seen below the cortex region. The xylem region is wide and lignified. It includes xylem vessels. Medullary rays are present, which are uniserated. Pith is absent.

#### **G. Microscopic evaluation of the fresh stem of *Bhoomyamalaki***

Transverse section of *Phyllanthus amarus* (Stem) is round in outline. It shows epidermis with thick cuticle. It is followed by chlorenchymatous cortex. Cortex is multilayered, collenchymatous. Crystals of calcium oxalate can be seen in the cortex region. Pericycle is characterized by a discontinuous group of lignified fibers. Phloem is narrow and parenchymatous. It is followed by a wide, lignified xylem region that consists of xylem fibers and other usual xylem elements. Pith is wide and parenchymatous. Rosette crystals of calcium oxalate can be found in pith region.

#### **H. Microscopic evaluation of fresh leaf of *Bhoomyamalaki***

Transverse section of *Phyllanthus amarus* (Leaf) is very small. Mid rib is slightly elevated in the lower epidermis and flattened in upper epidermis. Cells of upper epidermis are slightly larger than lower epidermis. It shows upper and lower papillose epidermis, covered with thin cuticle. Leaves showed numerous anisocytic stomata on the lower surface. Mesophyll includes palisade and spongy parenchyma. Vascular bundle can be seen in the midrib region, which includes xylem and phloem. Crystals of calcium oxalate are present in laminar region.

#### **I. Microscopic evaluation of fresh fruit of *Bhoomyamalaki***

The transverse section of the fruit is circular in outline, with a 3-ridged margin. It shows a narrow pericarp surrounding 3 locules occupying the major portion of the fruit, with two triangular endospermic seeds embedded in them. Pericarp is composed of the epicarp, mesocarp, and endocarp. Epicarps consisting of narrow rectangular parenchymatous cells. It is followed by mesocarp, which consists of radially arranged, compactly placed big large-sized rectangular thick-walled parenchymatous cells. Endocarp and testa are also present.

#### **J. Powder microscopy of *Bhoomyamalaki churna* (powder)**

Powder microscopy of *Bhoomyamalaki choorna- Phyllanthus amarus* shows lignified xylem vessel with bordered pits, macro sclereid, lignified annular xylem vessel, and lignified tracheid. Non-lignified fibre with narrow lumen, lignified xylem vessel scalariform thickening, a crystal of calcium oxalate, a fragment of medullary ray, oil globules, and reddish brown coloured content are found. Elongated and oval, simple and 2 compound starch grains are present.

## **RESULTS**

The Pharmacognostical evaluation of *Phyllanthus amarus* Schumach. & Thonn. revealed characteristic diagnostic features across the root, stem, leaf, and fruit. Macroscopically, the root was found to be cylindrical, brownish, and finely striated with secondary branching; the stem was slender, glabrous, and erect; the leaves were small, alternate, distichous, and oblong; and the fruits were globose, smooth, and trilocular. Microscopic examination confirmed species-specific structures, including a broad parenchymatous cortex with starch grains and crystals in the root; rosette calcium oxalate crystals, lignified xylem, and discontinuous pericyclic fibres in the stem; anisocytic stomata and distinct palisade-spongy mesophyll in the leaf; and a three-loculed capsule containing wedge-shaped endospermic seeds in the fruit. Powder microscopy demonstrated lignified vessels, sclereids, medullary ray fragments, calcium oxalate crystals, and starch grains, supporting identification at the powdered stage. Together, these findings provide consistent diagnostic markers for authentication and quality assessment of *Bhoomyamalaki*.

## DISCUSSION

The present pharmacognostical study on *Phyllanthus amarus* Schumach. & Thonn. provides a comprehensive account of diagnostic characters of the root, stem, leaf, and fruit, thereby supporting correct identification and standardisation of Bhoomyamalaki as a raw drug. The findings obtained from macroscopic and microscopic assessment align closely with previous botanical descriptions of the species, confirming the authenticity of the collected material and validating classical Ayurvedic identification parameters.

Macroscopic observations revealed characteristic morphological features, including a slender erect stem, distichously arranged simple leaves, a cylindrical taproot with secondary branching, and distinctly globose trilobular fruits. Such attributes are valuable for preliminary differentiation from closely related *Phyllanthus* species, which are often confused in commercial crude drug supply. Notably, features such as leaf size, arrangement, and fruit morphology are practical field-level markers accessible to both students and raw drug handlers.

Microscopic evaluation further established definitive anatomical characters. The presence of abundant parenchymatous cortex in the root, lignified xylem, medullary rays, and absence of pith correspond with published descriptions of *Phyllanthus amarus* root anatomy. In the stem, rosette crystals of calcium oxalate within the cortex and pith, as well as discontinuous pericyclic fibres, are considered reliable diagnostic markers. The leaf profile demonstrated anisocytic stomata on the lower epidermis, a feature repeatedly cited for species authentication within the genus. Identification of palisade and spongy mesophyll, together with scattered calcium oxalate crystals, adds further validation.

The fruit anatomy, which is comparatively less documented in literature, revealed three distinct locules, each containing wedge-shaped seeds with endosperm. This highlights the importance of part-specific evaluation, because fruits and seeds are increasingly used in formulations and raw drug trade. The powder microscopy findings identified structural fragments including sclereids, lignified vessels, medullary rays, and starch grains, providing essential markers for detecting adulteration and confirming purity when bulk raw drug materials are processed into powders.

This study thereby reinforces the value of comprehensive pharmacognostic profiling, particularly for species like Bhoomyamalaki that are widely used and frequently substituted with similar taxa. Establishing definitive diagnostic standards contributes to strengthening Ayurvedic quality assurance practices and supports regulatory bodies in developing pharmacopeial monographs. Future investigations incorporating physicochemical parameters and chromatographic fingerprinting may further advance the standardisation of *Phyllanthus amarus*, ensuring safe, authentic, and therapeutically effective use across classical and contemporary clinical settings.

## CONCLUSION

The present pharmacognostical study establishes definitive macroscopic and microscopic characteristics of the root, stem, leaf, and fruit of *Phyllanthus amarus* (*Bhoomyamalaki*). The findings document diagnostic features such as crystal types, stomatal pattern, vascular organization, and fruit locule structure, which together provide reliable criteria for correct identification of the plant in raw and powdered forms. These observations strengthen quality control measures, help prevent adulteration and substitution, and support the standardisation of *Bhoomyamalaki* for Ayurvedic formulations. The study also contributes foundational data for future pharmacopeial inclusion and further research, ensuring safe and authentic use of this important medicinal herb.

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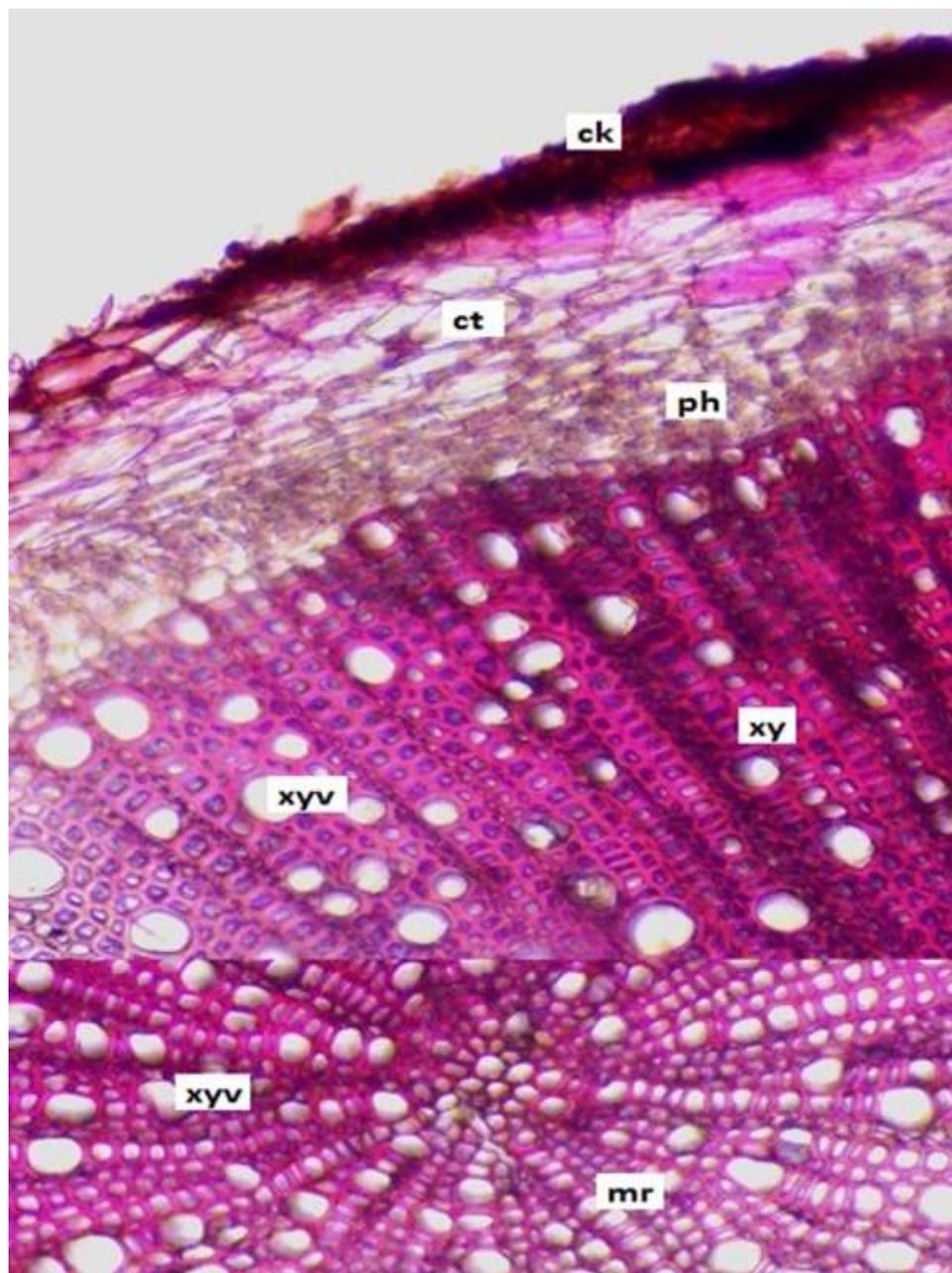
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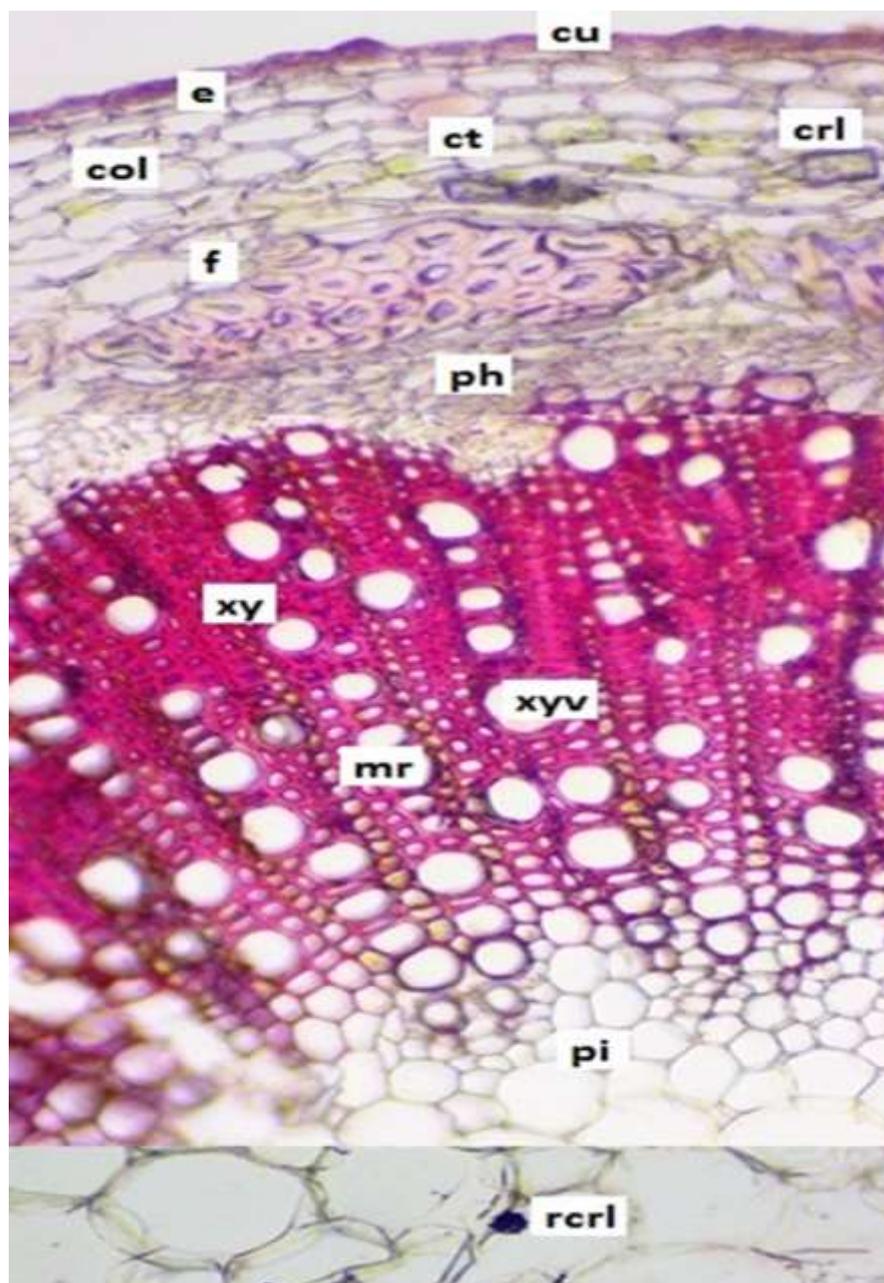


Picture No: 1 Plant of *Bhoomyamalaki* (*Phyllanthus amarus* Schumach & Thonn.)



**Fig.1: Transverse section of *Phyllanthus amarus* (Root), a portion enlarged: ck.: cork; ct.: cortex; mr.: medullary rays; ph.: phloem; xy .: xylem; xyv .: xylem vessels.**

**Picture No: 2 T.S of root of *Phyllanthus amarus* Schumach & Thonn.**



**Fig.2: Transverse section of *Phyllanthus amarus* (Stem), a portion enlarged: col.: collenchyma; crl.: crystal of calcium oxalate; ct.: cortex; cu.: cuticle; e.: epidermis; f.: fiber; mr.: medullary ray; ph.: phloem; pi.: pith; rcrl.: rosette crystal of calcium oxalate; xy.: xylem; xyv.: xylem vessels.**

**Picture No: 3 T.S. of stem of *Phyllanthus amarus* Schumach & Thonn.**

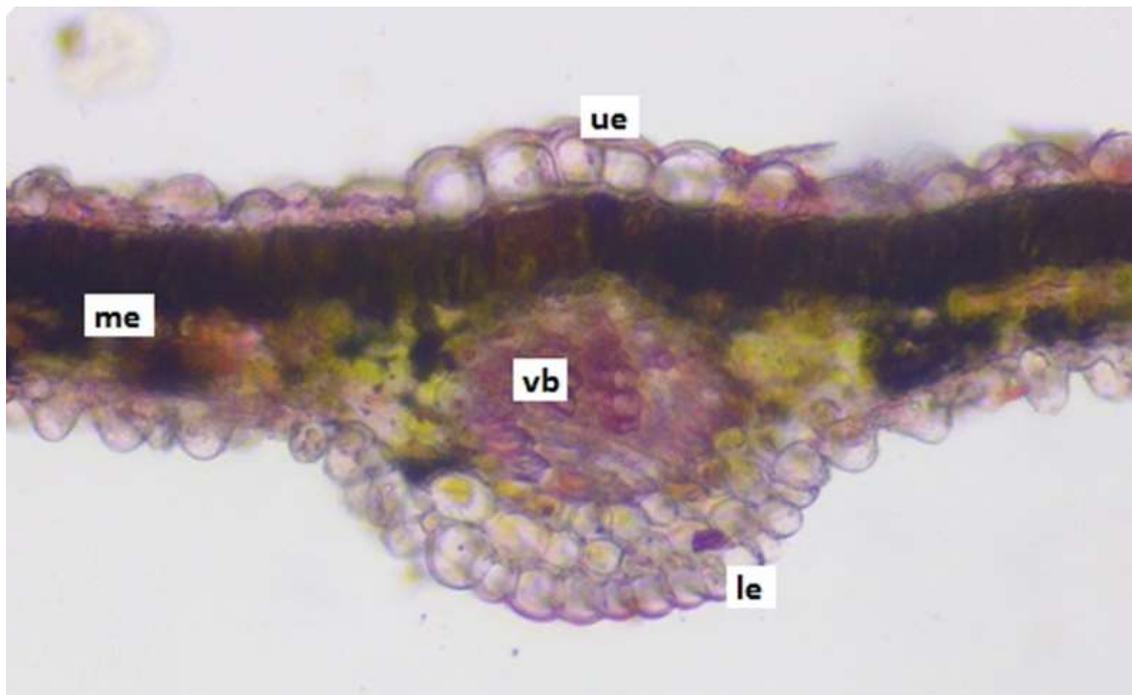
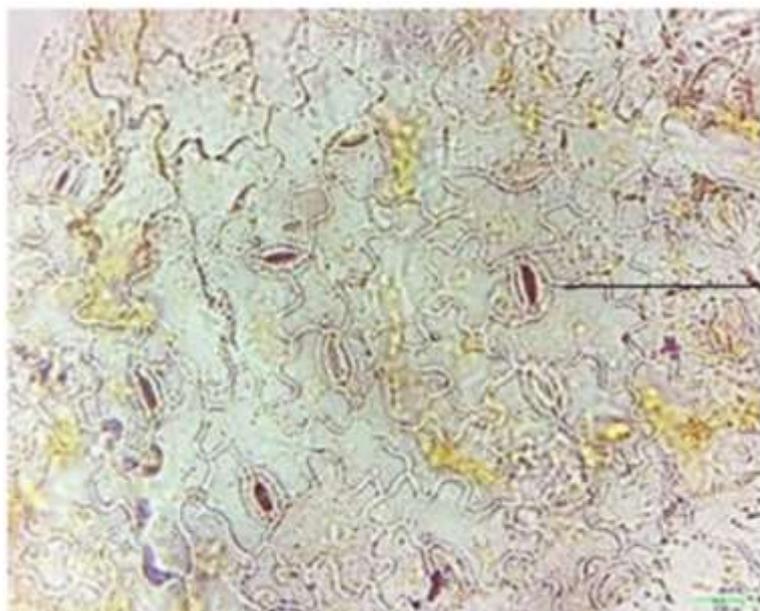


Fig. 3: Transverse section of *Phyllanthus amarus* (Leaf): me.: mesophyll; le.: lower epidermis; ue.: upper epidermis; vb.: vascular bundle.

Picture No: 4 T.S. of Leaf of *Phyllanthus amarus* Schumach & Thonn.



Anisocytic  
stomata

Picture No: 5 Anisocytic stomata of Leaf of *Phyllanthus amarus* Schumach & Thonn.



Fig. 5: Transverse section of *Phyllanthus amarus* (Leaf): me.: mesophyll; le.: lower epidermis; ue.: upper epidermis; vb.: vascular bundle.

Picture No: 6 T.S of lamina of *Phyllanthus amarus* Schumach & Thonn.

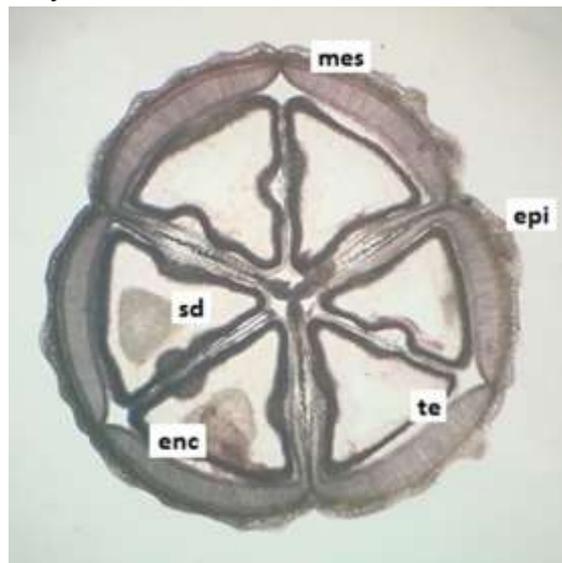


Fig. 6: Ground plan of *Phyllanthus amarus* (Fruit); enc.: endocarp; epi.: epicarp; mes.: mesocarp; sd.: seed; te.: testa.

Picture No: 7 T.S of fruit of *Phyllanthus amarus* Schumach & Thonn.

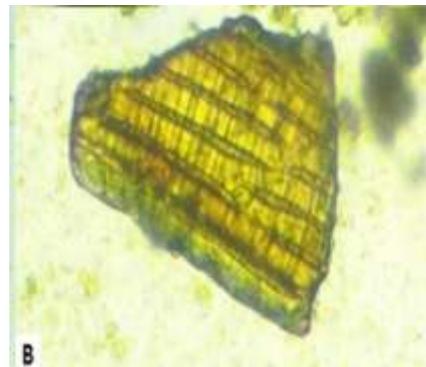


Fig.7: Transverse section of *Phyllanthus amarus* (Fruit); enc.: endocarp; epi.: epicarp; mes.: mesocarp; sd.: seed; te.: testa.

Picture No: 8 T.S of Fruit of *Phyllanthus amarus* Schumach & Thonn.



Pitted xylem vessels



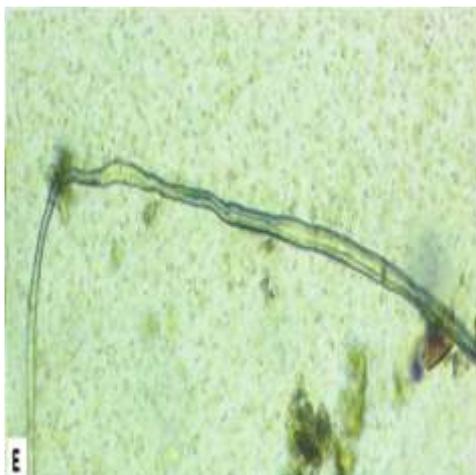
Macrosclereid



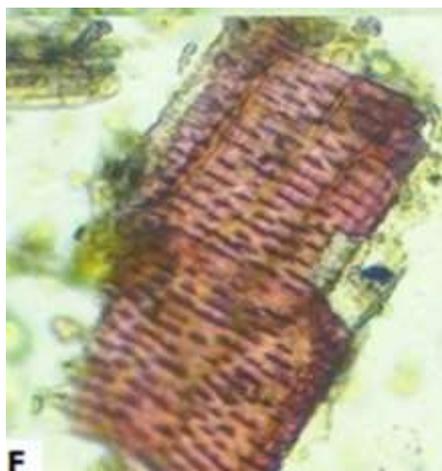
Annular vessel



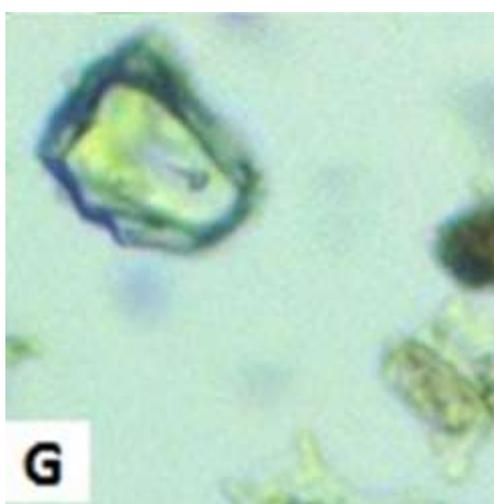
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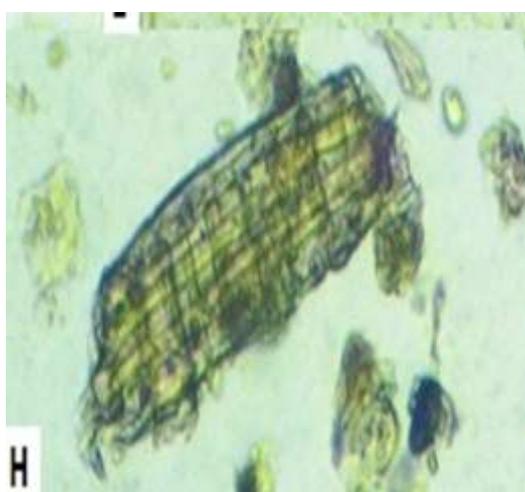
**E**  
Non-lignified fibre



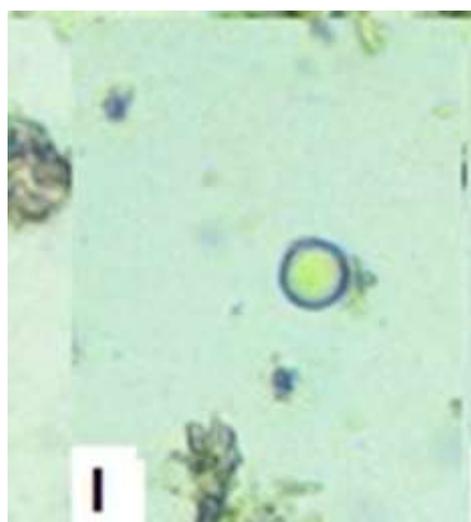
**F**  
Scalariform vessel



**G**  
Crystal of calcium oxalate



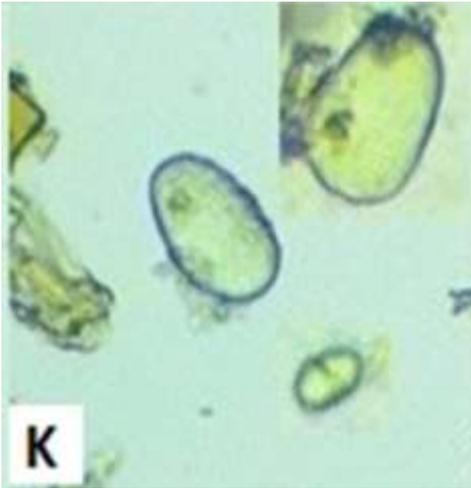
**H**  
Medullary ray



**I**  
Oil globules



**J**  
Coloured content



Starch grains

Picture No:9 Powder microscopy of *Bhoomyamalaki churna*