PLANT SCIENCE TODAY
Vol x(x): xx–xx
https://doi.org/10.14719/pst.10338

eISSN 2348-1900

RESEARCH ARTICLE

# Microscopic and powder characteristics of *Homalomena cochinchinensis* (Lour.) Schott for pharmacognostic identification and quality control

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Received: 28 June 2025; Accepted: 17 December 2025; Available online: Version 1.0: 10 January 2026

**Cite this article:** Thien HH, Ngoc TN, Thi TTL, VanTV . Microscopic and powder characteristics of *Homalomena cochinchinensis* (Lour.) Schott for pharmacognostic identification and quality control. Plant Science Today (Early Access). https:/doi.org/10.14719/pst.10338

## Abstract

This study examines the microscopic and powder characteristics of *Homalomena cochinchinensis*, a valued medicinal plant in Vietnam, which is widely used to treat arthritis, muscle pain, skin wounds and digestive issues. The aim was to pinpoint unique features for accurate species identification and quality control. Samples from Tay Ninh, Vietnam, were studied by slicing roots, rhizomes, leaves, petioles and leaf sheaths for microscopic analysis and processing rhizome powder. The findings revealed distinct markers, including thick tissue layers, ring-shaped vascular bundles and needle-shaped or rhombohedral calcium oxalate crystals. The rhizome powder, sifted through a 0.150 mm sieve, produced particles smaller than 9 µm, ideal for efficiently extracting medicinal compounds. These characteristics enable reliable identification of *H. cochinchinensis*, distinguish it from similar species, establish quality benchmarks for herbal products. The fine powder supports consistent extraction of active compounds, aiding the development of effective medicinal formulations. These findings provide a foundation for further pharmacological research to ensure safe and effective use traditional and modern medicinal.

**Keywords:** anatomical characteristics; calcium oxalate crystals; *Homalomena cochinchinensis*; medicinal plant identification; microscopic analysis; rhizome powder

## Introduction

*Homalomena* is a large and diverse genus in the Araceae family, comprising around 250 species distributed throughout tropical Asia, including Vietnam, India and China (1). Species in this genus are known for their diverse values, ranging from ornamental plants to species of importance in traditional medicine (2). Many *Homalomena* species have been reported to possess remarkable biological activities such as anti-inflammatory, antibacterial, antioxidant and anticancer activities, due to the presence of secondary compounds such as flavonoids, alkaloids, terpenoids and saponins (3–5). This has attracted the interest of scientists in exploring their medicinal potential.

Among the species of this genus, *H. cochinchinensis* stands out as an important folk medicinal plant in Vietnam. According to Vietnamese traditional medicine, this plant has been widely used to treat diseases such as arthritis, musculoskeletal pain, skin wounds and some gastrointestinal diseases (6). In traditional medicine, the rhizome is the principal part used, which aligns with the present study's focus on examining its micromorphological and powder characteristics for authentication and quality evaluation. Despite its long history of use and apparent medicinal potential, in-depth studies on the botanical and pharmacological characteristics of *H. cochinchinensis* are limited. Previous studies on *H. cochinchinensis* have focused mainly on preliminary screening of chemical constituents and evaluation of general biological activities. For example, several studies have identified the presence of groups of compounds such as flavonoids and phenols in the extracts of this species and have also reported in vitro antioxidant and antibacterial properties (7-9). It is the anatomical and powder characteristics that are crucial for the accurate identification of *H. cochinchinensis* and for distinguishing it from other *Homalomena* species or similar-looking plants (10). Yet, these important features have not been thoroughly studied, which remains a common challenge in pharmacognostic research and herbal quality control. Because the rhizome is the primary medicinal part that is typically dried and ground for therapeutic use, only rhizomes were subjected to powder analysis to ensure that the findings accurately reflect practical processing and quality-control conditions.

Several *Homalomena* species, such as *H. pendula* and *H. aromatica*, share similar rhizome shape, leaf form and aromatic characteristics with *H. cochinchinensis*. Because of these similarities, confusion during collection or trade is common, especially when the material is dried or fragmented. Such misidentification matters, as different species differ in chemical composition and therapeutic effects, which may lead to reduced efficacy or unintended safety risks. For this reason, clear anatomical and powder-based markers

are needed to ensure the correct identification and quality of *H. cochinchinensis* used medicinally.

This study was conducted to investigate the anatomical and powder characteristics of *H. cochinchinensis*, with the specific objective of establishing a set of diagnostic features through detailed morphological and microscopic analysis that would support both taxonomic identification and quality control of the medicinal plant. These data are expected to serve as a scientific basis for future pharmacological and phytochemical studies, thereby contributing to the safe and effective use of this species.

## Materials and Methods

### Plant materials

*H. cochinchinensis* were collected during the wet season (May to October) from Tan Hoa Commune, Tan Chau District, Tay Ninh province, Vietnam (11.61172°N, 106.38344°E). GPS coordinates were recorded using a Garmin GPSMAP 64s with an accuracy of ±3 m. Root, rhizome, leaf, petiole and leaf sheath samples were prepared for anatomical examination (Fig. 1). The study used roots, rhizomes, leaves, petioles and leaf sheaths as the primary materials for anatomical and powder analyses.

### Anatomical characteristics

The root, rhizomes and leaves of *H. cochinchinensis* were meticulously sectioned crosswise into fine slices. The samples were bleached using Javel water, then stained using a combination of iodine green and carmine dyes. After several washes with clean water, the tissue sections were stored in a solution containing 10 % glycerol (11). Microscopic observation was carried out with an Olympus BX53 upright digital microscope.

### powder characteristics

A total of 1 kg of fresh *H. cochinchinensis* rhizomes was collected, washed and sliced into 2-3 mm thick pieces. The slices were dried in a convection oven at 50 °C for 24–48 hr until reaching approximately 10 % moisture content, as measured by a moisture analyzer. This yielded 250 g of dried material, giving a fresh-to-dry ratio of 4:1, typical for rhizomatous medicinal plants with 75-80 % water content. The dried material was then ground into powder by a high-speed grinder (Model 1000; 220 V, 50 Hz; 2800W; 2800 rpm) and a stone disc mill (Model SDM-150; 220 V, 50 Hz; 100-200 kg/hr; 1450 rpm). The resulting powder was sieved using mesh sizes ranging from 0.150 mm to 0.450 mm. Particle morphology and size were observed under an Olympus BX53 digital upright microscope (10).

## Results and Discussion

### Micro-morphology

#### Root

In cross-section, the root shows an almost round shape. Internally, it is divided into two clearly distinguishable zones (Fig. 2). About two-thirds of the radius is taken up by the cortex, with the stele occupying the rest.

The piliferous layer in the cortex is made up of thin walled, unevenly shaped cells arranged in a single row, with root hairs appearing sporadically. The exodermis has one layer of polygonal cells with cork-impregnated walls. The cortex includes two distinct regions. The external zone is made up of 8 to 10 layers of loosely arranged cells, often with irregular shapes and occasionally distorted walls; in the inner part of the parenchyma, there are about 8 to 10 layers of almost square cells, usually aligned in both straight lines from the centre and circular bands. The endodermis is clearly visible and includes a casparian strip.

In the stele, just below the endodermis, there is a thin layer of 1-2 rows of unevenly shaped cells with thin cellulose walls. Inside this layer, the

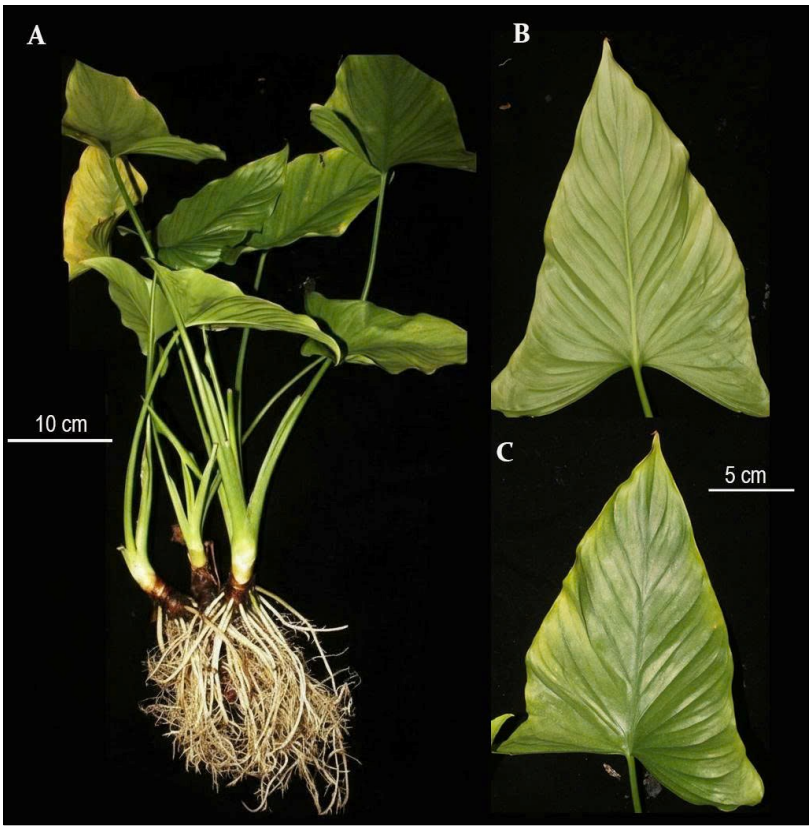


**Fig. 1. A.** Whole plane, **B.** Under sides of lamina, **C.** Upper sides of lamina.

transport tissues include about 14 to 18 groups of phloem and the same number of xylems, arranged in a circle, taking turns with each other. These bundles are separated by soft tissue called medullary rays. Xylem cells are typically larger with thick, lignified walls, whereas phloem cells are smaller and possess thinner, non-lignified cellulose walls, allowing easy distinction between the two tissues. The phloem bundles appear as oval clusters of irregular polygonal cells. Each protoxylem bundle contains 2-5 polygonal xylem vessels showing centripetal differentiation. Below these, 18-22 metaxylem vessels forming one to two rings, which may or may not contact the protoxylem bundles. Medullary rays are made of 1-2 rows of horizontally flattened polygonal parenchyma cells. In the pith region, the cells are closely arranged, mostly polygonal, with cellulose-rich thin walls and varied in both shape and size.

The root cross-section exhibits a well-defined cortex, stele and vascular system, displaying organizational patterns commonly reported in medicinal plant roots (12). The arrangement of primary xylem and phloem, along with clearly visible medullary rays, contributes to species-level identification.

The presence of the casparian strip in the endodermis confirms its role as an apoplastic barrier, constraining uncontrolled ion and water flow into the vascular stele (13, 14). The concentric arrangement of vascular tissues and the presence of medullary rays represent structural patterns commonly described in many medicinal plant roots, contributing to both structural integrity and efficient transport. The centripetal differentiation of protoxylem vessels further reflects a typical developmental pattern observed in several root types (15). Detailed anatomical features such as cork-containing exodermis, stratified cortical parenchyma and a precise number of vascular bundles are reliable markers for the identification of *H. cochinchinensis*. These features strengthen the microscopic method of authentication, which is essential for quality control and purity assessment during medicinal plant processing.

These root anatomical markers offer consistent criteria that can be integrated into regulatory pharmacognosy for authentication of raw materials. Their stability across samples makes them useful reference points in standardization protocols (Fig. 2).

**Leaf**

The transverse section of the leaf shows a dorsiventral structure with a clear distinction between the upper and lower surfaces (Fig. 3). The main vein appears slightly sunken on the top side and slightly raised on the bottom side. Both the upper and lower epidermis are made up of one layer of polygon-shaped cells, with thin outer cell walls covered by a cuticle.

Beneath the lower epidermis lies a region of angular collenchyma, composed of 5 to 7 layers of unevenly sized cells with walls containing cellulose. The surrounding parenchyma contains many large air spaces. It is composed of cells with many angles and thin walls made of cellulose. These cells are arranged close together around the vascular bundles.

Two to three layers of compact parenchyma cells occur beneath the upper epidermis and 4-6 layers lie above the collenchyma. These cells are more densely packed, forming small intercellular spaces. The vascular bundles are collateral, with the xylem located above the phloem and are arranged in a row within the parenchyma. The size of the vascular bundles gradually increases toward the centre. Each xylem bundle contains 2-5 polygonal vessels.

Lamina: On both sides of the lamina, the epidermal tissue consists of one layer of cells that are polygon-shaped and have walls made from cellulose. Beneath the epidermis are 1–2 layers of

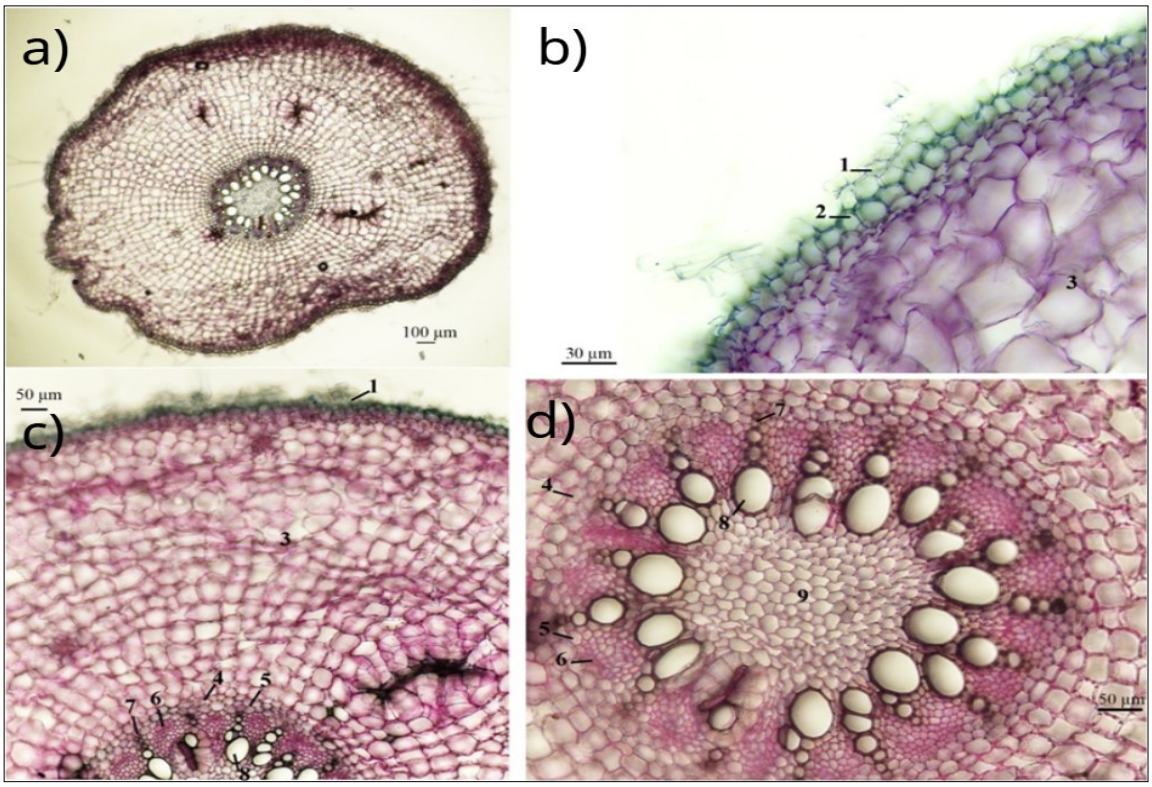


**Fig. 2.** The root cross-section of *H. cochinchinensis*, showing piliferous layer, cortex, stele and vascular elements. (a) Overview of the transverse root section. (b) Detail of the piliferous layer and exodermis. (c) Cortex and endodermis region. (d) Vascular tissues showing primary phloem, primary xylem, metaxylem and medullary parenchyma. (1: piliferous layer, 2: exodermis, 3: cortical parenchyma, 4: endodermis, 5: pericycle, 6: primary phloem, 7: primary xylem, 8: metaxylem, 9: medullary parenchyma).

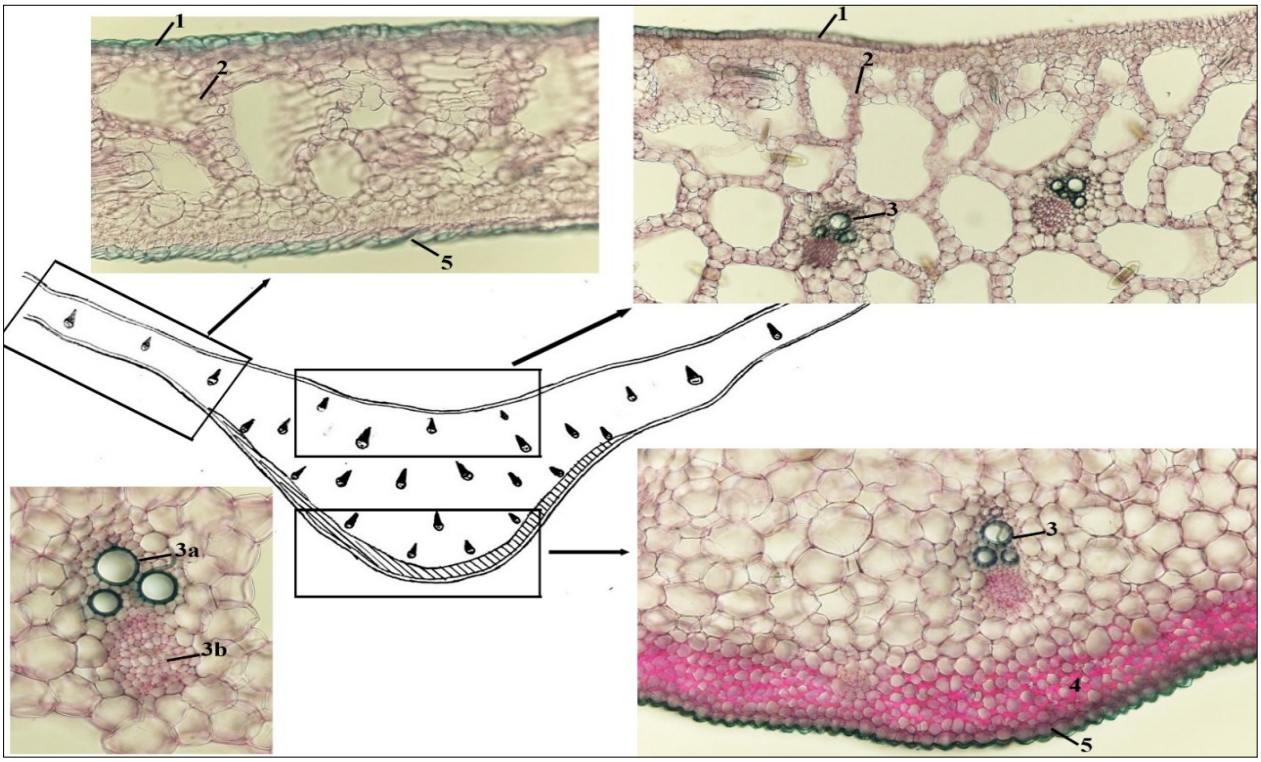


**Fig. 3.** Cross-section of the midrib of the leaf of *H. cochinchinensis*, showing upper epidermis, spongy parenchyma, collenchyma and vascular bundles. (1: upper epidermis, 2: spongy parenchyma, 3: vascular bundle (3a: primary xylem, 3b: primary phloem), 4: collenchyma, 5: lower epidermis).

oval chlorenchyma cells containing abundant chloroplasts, oriented perpendicularly to the surface. Below this is the spongy parenchyma, consisting of irregular, loosely arranged polygonal cells with large intercellular spaces. Small vascular bundles are arranged in rows within this parenchymatous region.

Structural features such as cuticle, angular thickening, differentiated parenchyma and vascular system are reliable markers. They are consistent with the typical medicinal plant leaf pattern and help in the accurate identification of *H. cochinchinensis* in medicinal research, supporting microscopic authentication and quality assessment of herbal materials.

The dorsiventral leaf structure, characterized by organized palisade and spongy parenchyma and angular collenchyma under the midrib, is consistent with known typical leaf anatomical patterns. These features are essential in identifying plant species microscopically for pharmacognostic purposes (16).

The distinct organization of epidermal and mesophyll tissues provides reliable indicators that can support routine microscopic quality control. Such structural markers allow straightforward differentiation from closely related species in herbal standardization frameworks.

**Petiole and leaf sheath**

The transverse section of the petiole curves inward on the top side and bulges outward on the bottom side (Fig. 4). The outermost layer is the epidermis, consisting of a single layer of polygonal cells with thin cellulose walls. Just below the epidermis are 5 to 7 layers of collenchyma, which comprise unevenly shaped, many-angled cells whose walls are composed of cellulose. These cells are loosely arranged and show no obvious organization.

The parenchyma forms aerenchyma, consisting of loosely arranged irregular cells with large, interconnected air spaces, giving the tissue a sponge-like appearance. The vascular system consists of multiple vascular bundles. A ring of small vascular bundles lies beneath the collenchyma, while larger bundles are distributed irregularly throughout the central medullary parenchyma. Each phloem bundle is partially surrounded by 1-2 layers of sclerenchyma cells, which are polygonal with thick, lignified walls.

The transverse section of the leaf sheath is thickest at the centre, with a rounded and convex abaxial (lower) surface (Fig. 5). The central portion of the sheath displays an anatomical structure similar to that of the petiole, characterized by a prominent vascular system embedded in parenchyma tissue. In contrast, the lateral extensions on both sides resemble the lamina, showing features such as upper and lower epidermis and differentiated mesophyll.

The petiole's scattered vascular bundle arrangement and partial sclerenchyma support structural stability, a trait commonly reported in petiole anatomy across plant species (16). The leaf sheath shows a blend of petiole-like and lamina-like features, indicating functional adaptation and further reinforcing its diagnostic value at the tissue level.

**Calcium oxalate crystals**

Numerous idioblasts containing needle-shaped (raphide) or occasionally rhombohedral calcium oxalate crystals were observed in the parenchymatous tissues of the leaf sheath, petiole and lamina. These crystals were clearly visible under polarized light microscopy (Fig. 6).

Observation of needle-shaped and rhombohedral calcium oxalate crystals in idioblasts across the leaf sheath, petiole and lamina is significant. These crystals are widely accepted as diagnostic markers in pharmacognosy due to their shape and tissue-specific distribution (17).

Because these crystals remain intact even after processing, they serve as robust diagnostic characters for inspection of

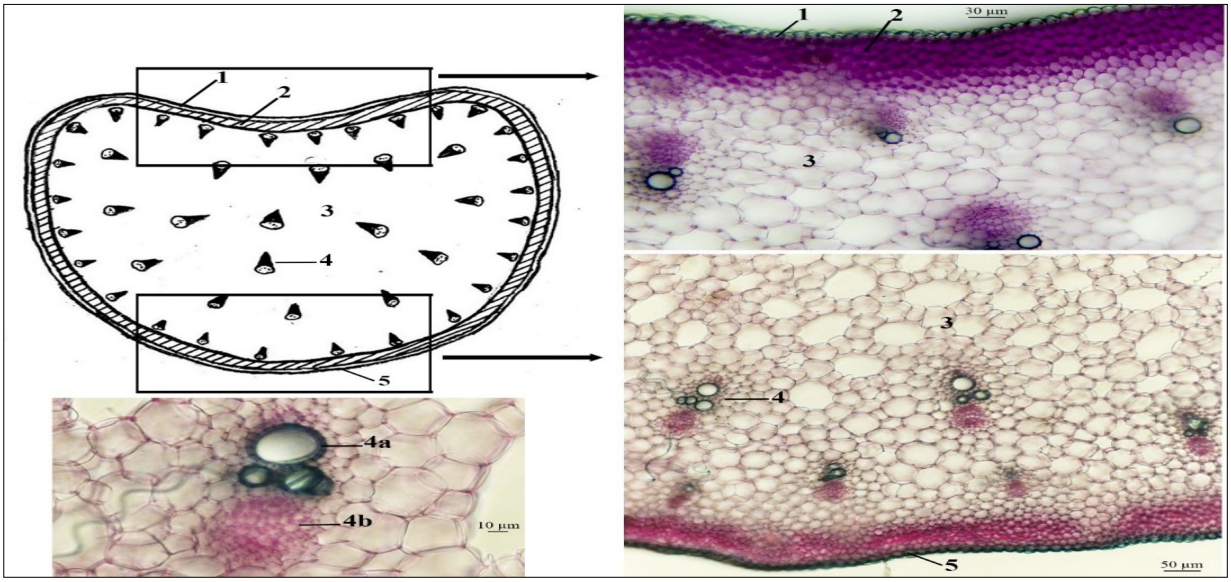


**Fig. 4.** Petiole cross-section of *H. cochinchinensis*, illustrating epidermis, collenchyma, parenchyma, sclerenchyma and vascular bundles. (1: epidermis, 2: collenchyma, 3: aerenchyma, 4: vascular bundles, 5: sclerenchyma).

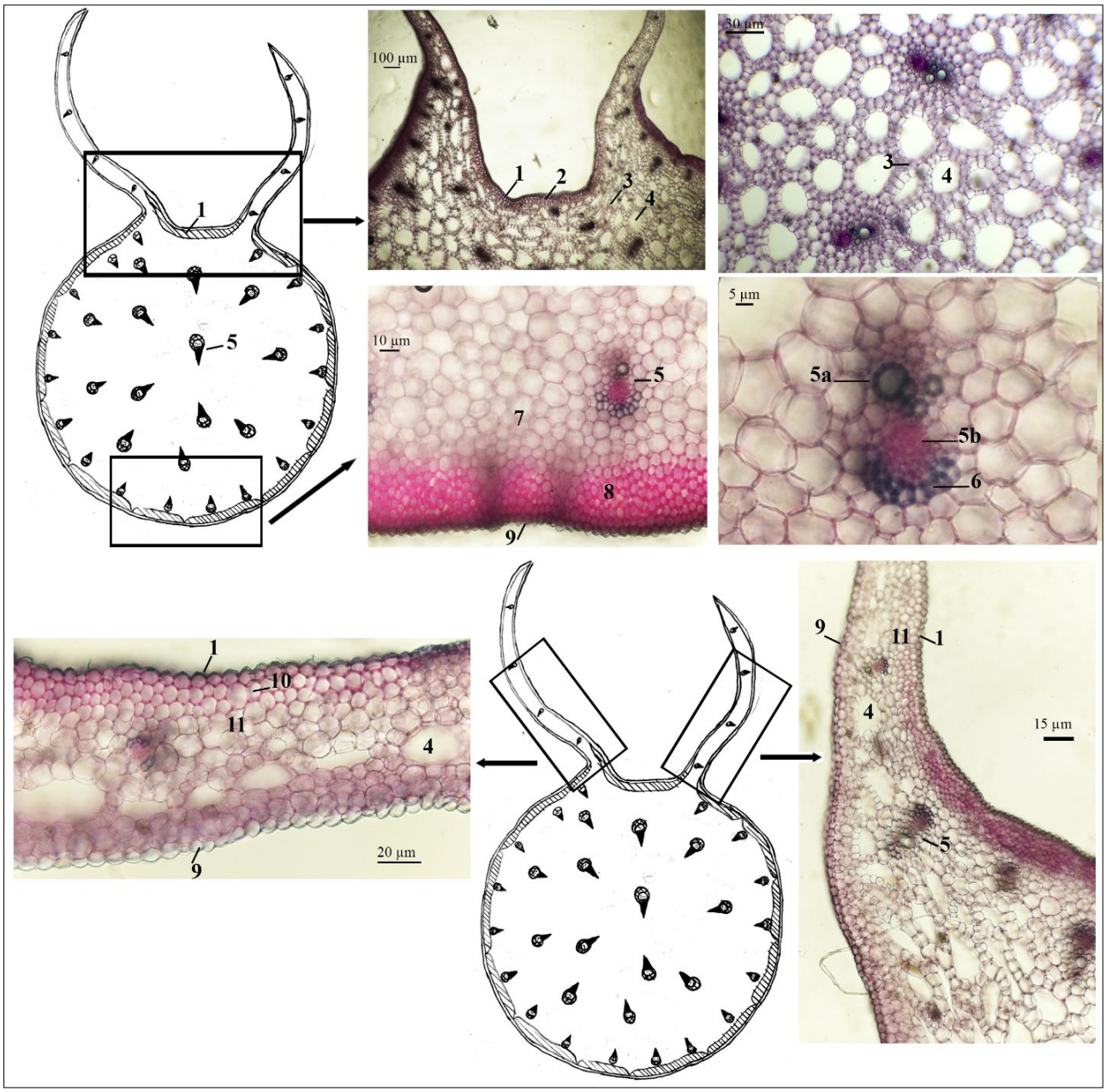


**Fig. 5.** Cross-section of leaf sheath displaying upper and lower epidermis, angular collenchyma, parenchyma, air cavities, sclerenchyma and vascular bundles. 1: upper epidermis, 2: angular collenchyma, 3: aerenchyma, 4: large air chamber, 5: vascular bundle (5a: primary xylem, 5b: primary phloem), 6: sclerenchyma, 7: parenchyma, 8: angular collenchyma, 9: lower epidermis.

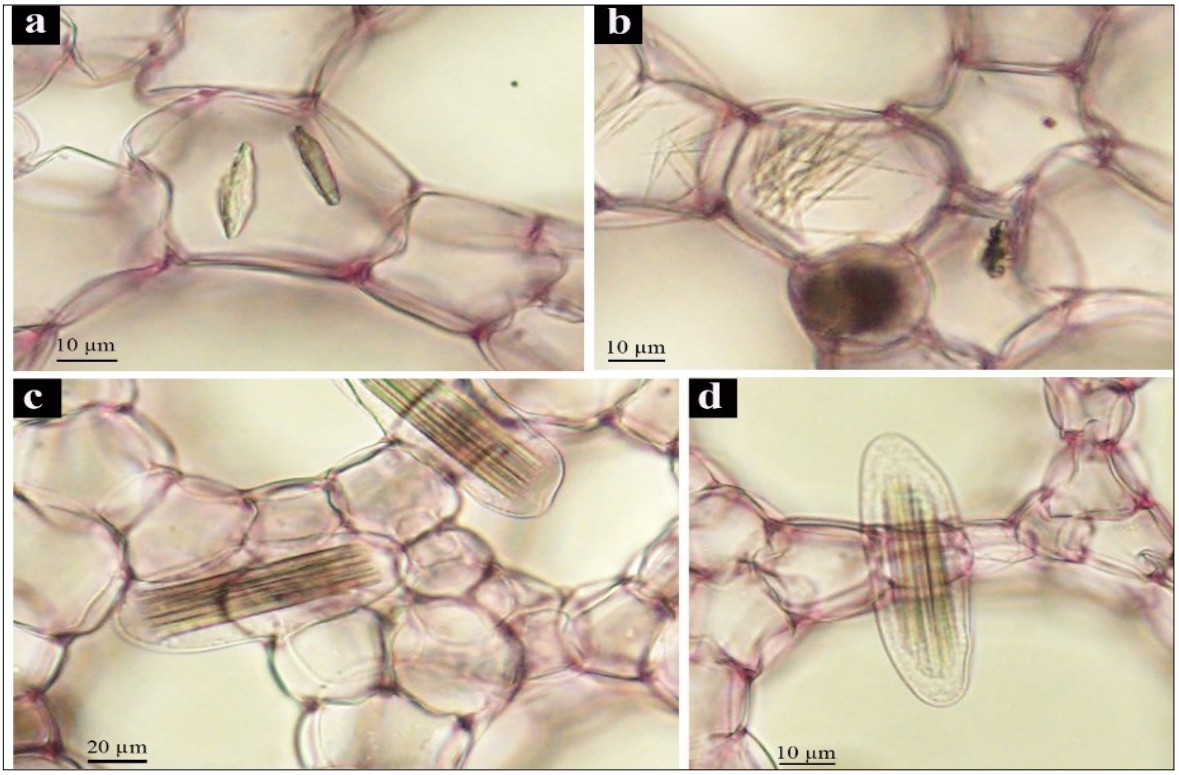


**Fig. 6.** Calcium oxalate crystals. Rhombohedral (a) and needle-shaped crystals (b) in the leaf sheath; needle-shaped crystals in the petiole (c) and in the leaf (d).

powdered materials. Their shape and distribution can therefore contribute directly to regulatory identification procedures and anti -adulteration controls.

**Rhizome powder**

Observation revealed that the rhizome powder of *H. cochinchinensis* was light brown in colour and possessed a characteristic fragrant odor. Particle size testing using different sieves demonstrated that the powder passed through a 0.150 mm sieve exhibited a fine and homogeneous texture, suitable for standardized pharmaceutical preparation (Fig. 7).

Microscopic examination under low magnification (4-fold and 10-fold) of rhizome powder ground using a conventional machine revealed the presence of coarse plant tissues such as fragments of cork cells, scattered fiber bundles with thick walls and elongated cells larger than 40 µm (Fig. 8). These characteristics suggest incomplete breakdown of the plant matrix, potentially limiting the efficiency of extraction.

In contrast, powder processed using a stone disc mill showed significantly finer particle size under magnifications of 4-fold, 10-fold and 100-fold. Most particles measured less than 9 µm and plant cell structures appeared more evenly fragmented (Fig. 9). This level of refinement may enhance extractive efficiency and consistency in pharmaceutical formulations, making it more suitable for quality herbal preparations.

The analysis of rhizome powder characteristics serves as a crucial component of quality control in herbal medicine. Fine, homogeneous particles observed after sieving at 0.150 mm and the refined microstructure seen in stone-milled powder support efficient extraction and formulation. Such diagnostic features of powdered material, alongside anatomical data, help define quality standards and ensure the reproducibility of medicinal preparations from *H. cochinchinensis* (18, 19).

The fine powder produced by stone milling improves extractability and ensures better uniformity for

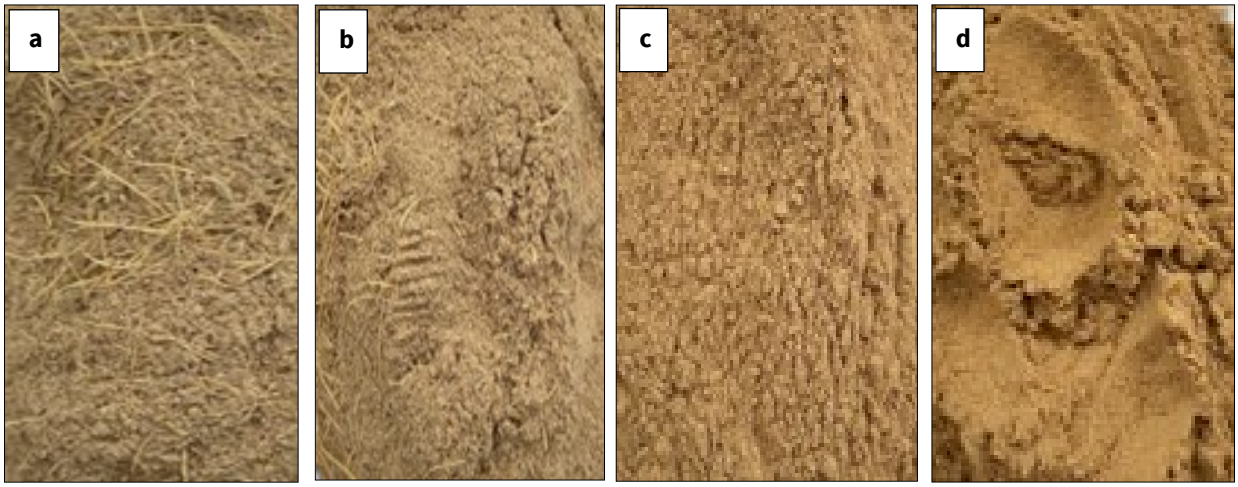


**Fig. 7.** Rhizome powder of *H. cochinchinensis*. (a. unsieved powder, moisture content 10.1 %; b. powder passed through 0.450 mm sieve; c. powder passed through 0.300 mm sieve; d. powder passed through 0.150 mm sieve).

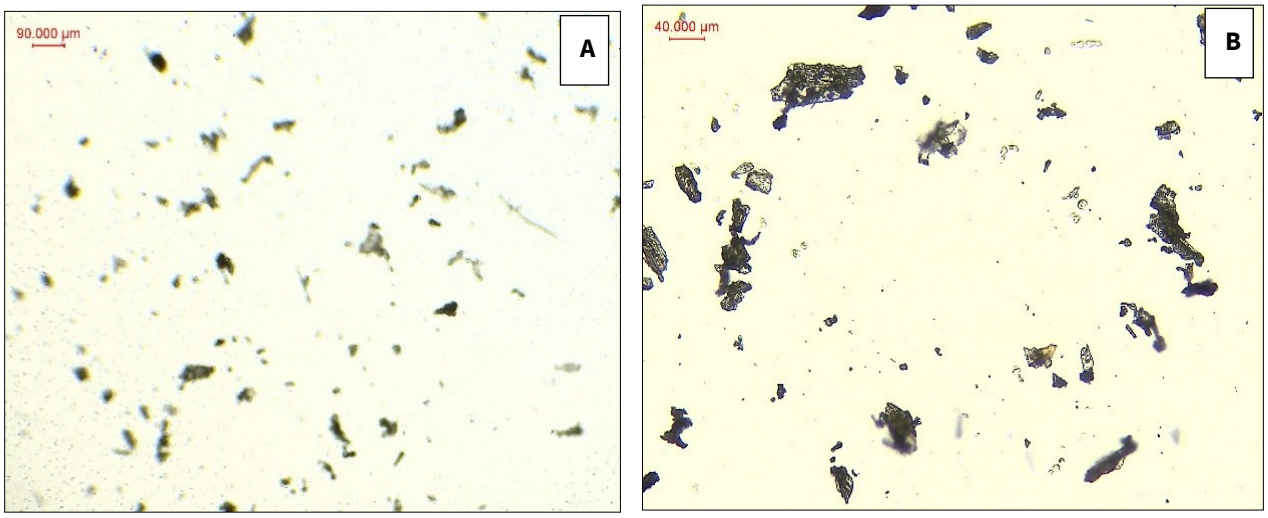


**Fig. 8.** Microscopic appearance of rhizome powder ground by a conventional machine (A: 4-fold ; B: 10-fold magnification).

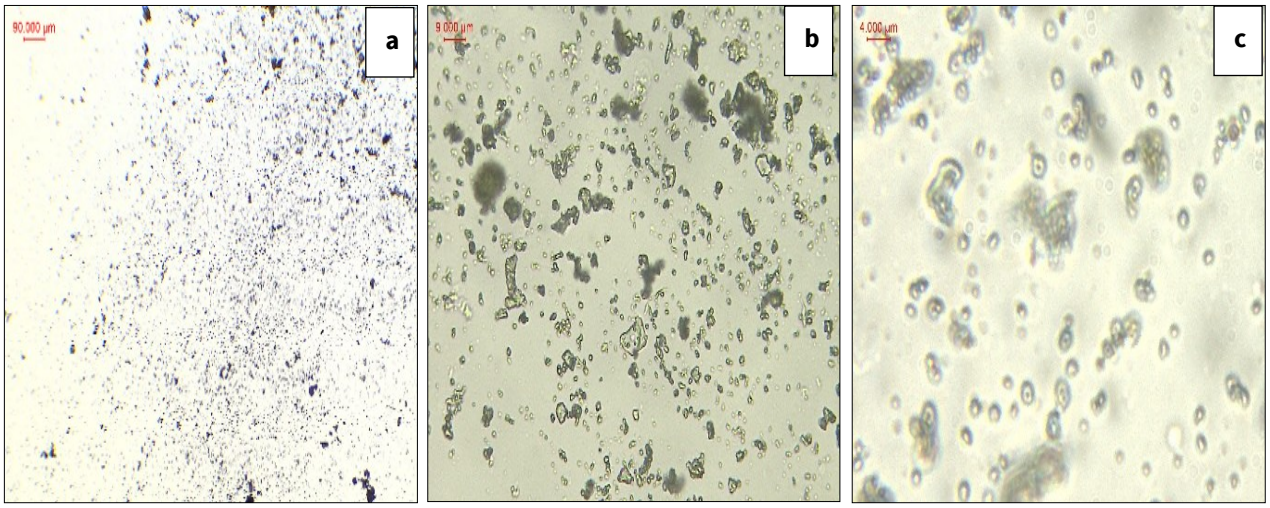


**Fig. 9.** Microscopic appearance of rhizome powder ground by a stone disc mill (a. 4-fold; b. 10-fold; c. 100-fold magnification).

phytopharmaceutical formulation. This microstructural profile can be adopted as a reference parameter in quality standards for processed *H. cochinchinensis* materials.

## Conclusion

This research provides a detailed description of the micromorphological and powder characteristics of *H. cochinchinensis*. Several anatomical features, such as the arrangement of vascular bundles, the presence of thick-walled tissues and the distinct forms of calcium oxalate crystals, were identified as reliable diagnostic markers for distinguishing this species from related taxa. The comparative analysis of rhizome powder also showed that stone-milled material forms consistently finer particles, offering helpful guidance for choosing appropriate processing methods in future phytochemical or pharmaceutical studies.

Although the results supply essential reference data for species authentication and quality evaluation, the study was limited to samples collected from a single locality and chemical correlations were not examined. Broader sampling and integrated phytochemical analyses will help strengthen and expand the applicability of these findings.

## Acknowledgements

The authors would like to thank Associate Professor Van Hong Thien for his support throughout the study.

## Authors' contributions

THH supported the design of the study and performed the experiments and statistical analysis. NTN and TTTL performed experiments and handled the research data. VTV drafted the manuscript, participated in the study design and performed the experiments and statistical analysis. All authors read and approved the final manuscript.

## Compliance with ethical standards

**Conflict of interest:** Authors do not have any conflict of interest to declare.

**Ethical issues:** None

## References

1. Boyce PC, Wong SY. Studies on Homalomeneae (Araceae) of Borneo I. Four new species and preliminary thoughts on informal species groups in Sarawak. Gardens' Bulletin Singapore. 2008;60(1).
2. Mayo SJ, Bogner J, Boyce PC. The genera of Araceae. Springer

Nature; 1998. https://doi.org/10.1007/978-3-662-03531-3_7

3. Barua CC, Talukdar A, Phukan B, Hazarika S, Barua AG, Baishya G. Phytochemical screening and in vitro antioxidant activity of ethanolic extract of *Homalomena aromatica* (Araceae) root. Der Pharma Lett. 2014;6(1):128-38.
4. Ali MS, Sayem SAJ, Habibullah, Quah Y, Lee EB, Birhanu BT, et al. Investigation of potential antioxidant, thrombolytic and neuropharmacological activities of *Homalomena aromatica* leaves using experimental and in silico approaches. Molecules. 2021;26 (4):975. https://doi.org/10.3390/molecules26040975
5. Dam SM, Van HT. Chemical profiles and biological activities of essential oils of *Arisaema* and *Homalomena* species (Araceae). Journal of Phytology. 2022;14:41-49. https://doi.org/10.25081/jp.2022.v14.7444
6. Loi DT. Vietnamese medicinal plants and herbs. Medical Publishing House; 2004.
7. Nguyen LTK, Doan TQ, Nguyen PQD, Nguyen CBH, Tran LTT, Tran TVA, et al. Phytochemical composition and bioactivities of essential oils from rhizomes of *Homalomena pendula* and *Homalomena cochinchinensis*. Nat Prod Commun. 2023;18(5):1-6. https://doi.org/10.1177/1934578X231175263
8. Nguyen LTK, Nguyen PQD, Doan NAT, Nguyen CBH, Doan TQ, Tran LTT, et al. Volatile components and biological activities of n-hexane extract from rhizomes of *Homalomena cochinchinensis*. Nat Prod Commun. 2023;18(4):1-5. https://doi.org/10.1177/1934578X231168481
9. Van HT, Le NT, Nguyen DL, Tran GB, An Huynh NT, Vo HS, et al. Chemical profile and antibacterial activity of acetone extract of *Homalomena cochinchinensis* Engl. (Araceae). Plant Sci Today. 2021;8(1):58-65. https://doi.org/10.14719/pst.2021.8.1.971
10. Pandey A, Tripathi S. Concept of standardization, extraction and pre -phytochemical screening strategies for herbal drug. J Pharmacogn Phytochem. 2014;2(5):115-19.
11. Schmelzer GH, Gurib-Fakim A, Schmelzer GH. Medicinal plants. Vol. 11. Prota; 2008.
12. Zhou M, Bai W, Li Q, Guo Y, Zhang WH. Root anatomical traits influence leaf-level physiology and responses to precipitation changes in herbaceous species of a temperate steppe. New Phytologist. 2021;229(3):1481-91. https://doi.org/10.1111/nph.16797
13. Pfister A, Barberon M, Alassimone J, Kalmbach L, Lee Y, Vermeer JEM, et al. A receptor-like kinase mutant with absent endodermal diffusion barrier displays selective nutrient homeostasis defects. ELife. 2014;3:e03115. https://doi.org/10.7554/eLife.03115
14. Lee Y, Rubio MC, Alassimone J, Geldner N. A mechanism for localized lignin deposition in the endodermis. Cell. 2013;153(2):402-12. https://doi.org/10.1016/j.cell.2013.02.045
15. Lindsay P, Swentowsky KW, Jackson D. Cultivating potential: Harnessing plant stem cells for agricultural crop improvement. Molecular Plant. 2024;17:50-74. https://doi.org/10.1016/j.molp.2023.12.014
16. Kumar D, Kumar K, Kumar S, Kumar T, Kumar A, Prakash O. Pharmacognostic evaluation of leaf and root bark of *Holoptelea integrifolia* Roxb. Asian Pac J Trop Biomed. 2012;2(3):169-75. https://doi.org/10.1016/S2221-1691(12)60036-7
17. Franceschi VR, Nakata PA. Calcium oxalate in plants: Formation and function. Annu Rev Plant Biol. 2005;56:41-71. https://doi.org/10.1146/annurev.arplant.56.032604.144106
18. Azwanida NN. A review on the extraction methods use in medicinal plants, principle, strength and limitation. Med Aromat Plants. 2015;4(196):2167-412.
19. WHO. Quality control methods for herbal materials. World Health Organization; 2011.

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