

Survey of botanical characteristics and preliminary analysis of chemical composition of *Abutilon indicum*

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ABSTRACT

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Abutilon indicum belonging to the Malvaceae family, is a medicinal plant widely used in traditional medicine for the treatment of dysentery, fever, allergies, diuresis, toothache, back pain, inflammation, diabetes, bronchitis, diarrhea, gonorrhoea, helminthiasis, rheumatism, numbness, bone and joint pain, and detoxification. The leaves are also crushed and applied topically to treat boils and snake bites. However, research on *A. indicum* in Vietnam is limited. Therefore, to provide scientific evidence, to advance a broader research scope that previous studies have restricted, focusing on individual parts such as roots, stems, and leaves of *A. indicum*, and to promote the value of this species, the entire *A. indicum* plant, collected in Vinh Long province, was analyzed. Morphological, anatomical, and powdered drug characteristics were described, and preliminary chemical composition was surveyed using the modified Ciuley method. The results revealed the anatomical characteristics, powdered drug characteristics, and preliminary chemical composition in the roots, stems, and leaves. These morphological, anatomical, powdered drug and preliminary chemical composition findings support accurate identification and quality control of the medicinal material. Additionally, they provide a valuable reference for further research.

1. INTRODUCTION

A. indicum belonging to the Malvaceae family, is a medicinal plant widely used in

traditional medicine in many regions worldwide.

Especially in India, all parts of the plant such as roots, stems, leaves, flowers, and seeds are used

to treat various ailments including dysentery, fever reduction, allergies, diuresis, toothache, back pain, inflammation, diabetes, bronchitis, diarrhea, gonorrhoea, helminthiasis, laxative, expectorant, rheumatism, numbness, muscle and joint pain, ecchymosis, heat-clearing and detoxification, and crushed leaves are applied to boils and snake bites (Gaikwad, 2011). Many studies have been published globally on the medicinal value of *Abutilon indicum*, such as antioxidant, antibacterial, hypoglycemic, hepatoprotective, wound healing, anti-inflammatory, antimalarial, anticancer, immunomodulatory, anticonvulsant, antidiarrheal, acetylcholinesterase inhibitory, and α -amylase and α -glucosidase inhibitory activities (Mangla et al., 2012). The chemical composition of *A. indicum* includes common bioactive compounds such as phenols, tannins, alkaloids, flavonoids, saponins, steroids, α -tocopherol, gallic acid, fumaric acid, p-coumaric acid, vanillic acid, and caffeic acid (Sohel, 2015). Although *A. indicum* is easy to cultivate and possesses significant medicinal value, research in Vietnam remains limited, particularly regarding its morphological, anatomical, and chemical characteristics. Therefore, this study was conducted to provide scientific data for the identification and quality control of the medicinal material. Simultaneously, the research focuses on individual parts of the plant, such as the roots, stems, and leaves, to identify the part with the highest potential for application, contributing to the development of natural health-supporting products.

2. MATERIALS AND METHODS

2.1 Materials

A. indicum was collected in Vinh Long province. The material was identified by observing its botanical morphology, conducting microscopic examination, and comparing it with plant classification documents (Do, 2022; Pham, 2006; Vo, 2018). Fresh whole plants were primarily used for morphological observation and microscopic sections. The whole *A. indicum* plant material was shade-dried and ground into powder, then stored at the Department of Pharmacognosy - Medicinal Materials, Faculty of Pharmacy, Nam Can Tho University for powder microscopy and phytochemical analysis.

2.2 Methods

2.2.1 Survey of Morphological and Microscopic Characteristics

Survey of Morphological characteristics:

Characteristics such as growth habit and morphology of the roots, stems, and leaves were observed with the naked eye, described, and photographed. The characteristics, shape, size, and color of the *A. indicum* plant were recorded. The scientific name was determined by comparing morphological characteristics with plant classification documents and reference materials (Do, 2022; Pham, 2006; Vo, 2018).

Survey of Plant anatomical characteristics:

Fresh samples were peeled for epidermal observation under an optical microscope. Stems, roots, and leaf blades were cross-sectioned into thin slices using a razor blade. Microscopic sections were bleached with Javel water and stained using the double staining method with Carmin - Iodine Green. After staining, the slices were washed repeatedly with water and preserved in 10% glycerol. The slices were observed under an optical microscope, photographed, and their anatomical characteristics recorded.

Survey of Powdered drug characteristics:

After collection, the raw material was washed, dried at 50 °C until dry, ground into powder, and sieved through a 32-mesh sieve to obtain a homogeneous fine powder. The sensory characteristics of the powdered drug were observed under normal light. The powder was examined under a microscope and the components were photographed using an optical microscope.

Preliminary Phytochemical analysis:

This was performed according to the modified Ciuley analysis procedure (Bucharest University of Pharmacy, Romania) (Tran et al., 2016). A mixture of compounds from the plant material was extracted sequentially with three solvents of increasing polarity (diethyl ether, ethanol, water). The diethyl ether extract contained less polar compounds, while the alcoholic and aqueous extracts contained more polar compounds. The presence of compound groups in the extracts was confirmed by specific color or precipitation reactions. Hydrolysis was performed by heating

the extracts with 10% HCl acid to further analyze the aglycone portion.

3. RESULTS AND DISCUSSION**3.1 Botanical survey results***3.1.1 Botanical morphological characteristics*

Morphological analysis results show that the *A. indicum* plant grows as a bush, 1-2 meters tall, branching extensively to form dense bushes, with soft hairs covering the entire stem and plant parts. Leaves are simple, alternate, heart-shaped with a pointed tip, irregularly serrated margins, dark green on the upper surface and lighter on the lower surface, with fine hairs on both surfaces. Flowers are yellow, hermaphroditic, pentamerous, growing in leaf axils, with long pedicels comparable to petiole length. The fruit consists of up to 20 carpels fused together, shaped like a rice grinding mill. The schizocarp is green when young, turning black when mature, containing many small kidney-shaped seeds, dark brown or black. The taproot is pale brown, penetrating deep into the soil.

Whole plant of *A.**indicum**A. indicum*

Root



Leaves

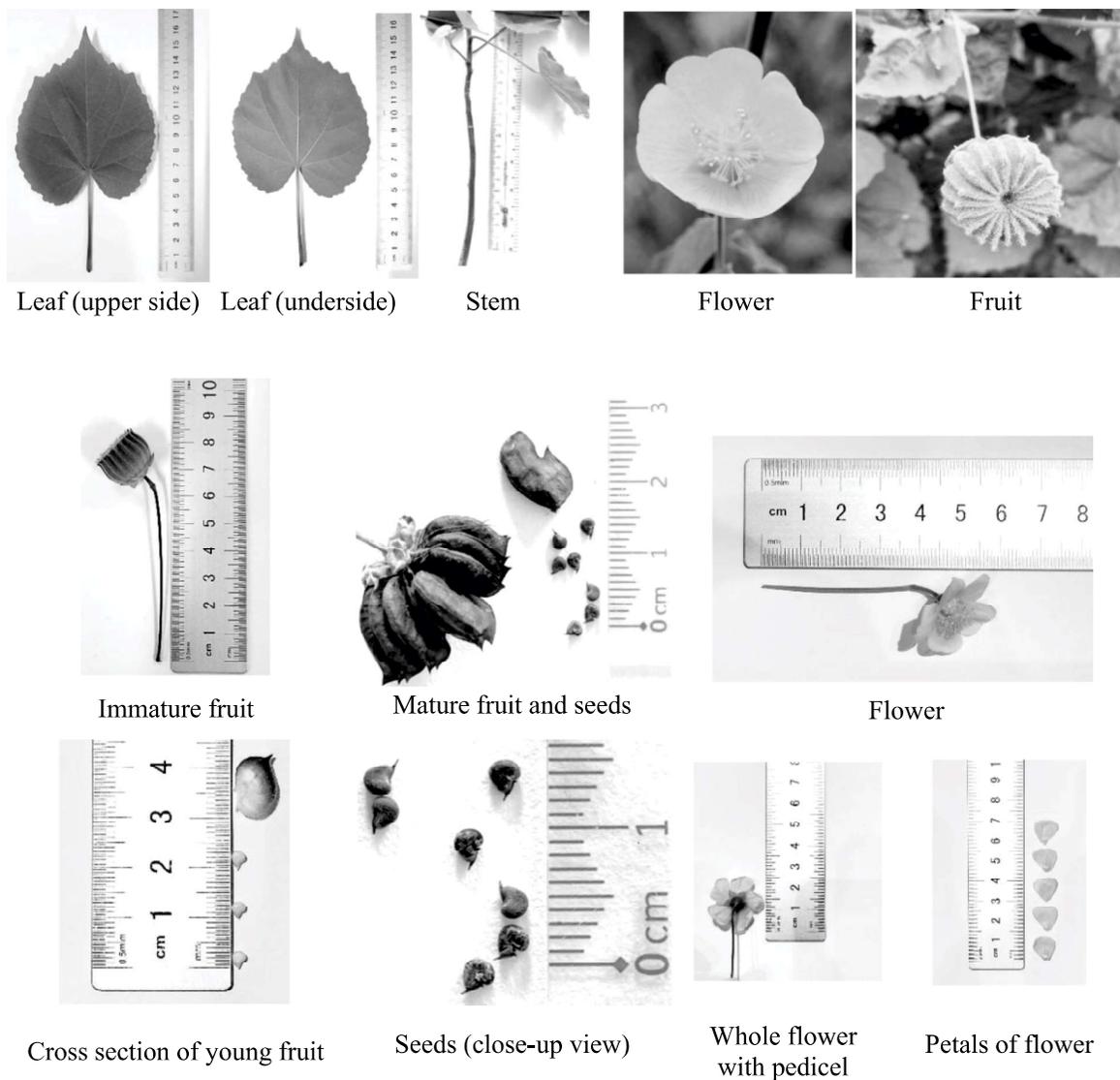


Figure 1. External morphology of *A. indicum*

3.1.2 Anatomical characteristics

Root Cross-section (Figure 2) consists of an outermost cork layer with tightly packed, rectangular, brown cells. Following this is a layer of cortical parenchyma interspersed with sclerenchyma. Sclerenchyma is concentrated in 2-3 concentric rings around the center. The root

center occupies 2/3 of the area and consists of vascular bundles, including irregularly arranged secondary xylem and tightly packed, rectangular phloem surrounding the xylem. Spheroidal calcium oxalate crystals are scattered in the cortical parenchyma, less numerous than in the leaves and stems.

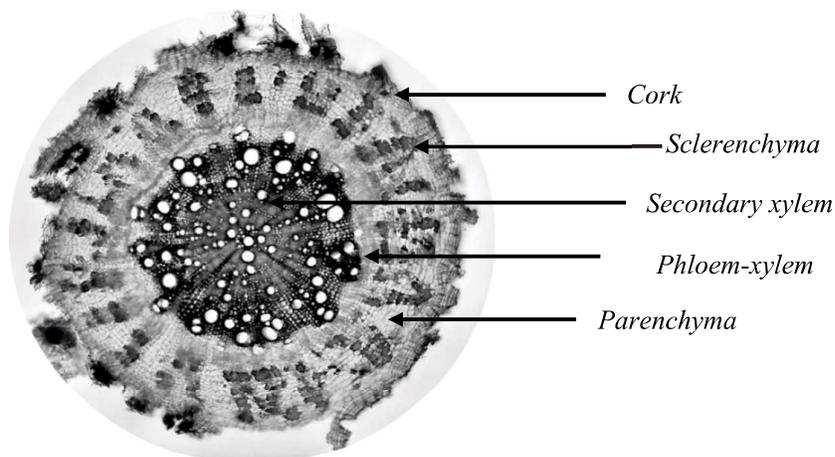


Figure 2. Anatomical features of *A. indicum* root

Stem Cross-section (Figure 3) consists of an epidermis composed of 2-3 layers of rectangular, elongated, brown cells, bearing multicellular, star-shaped branched covering hairs and unicellular glandular hairs with multicellular bases, swollen in the middle. Below the epidermis are 1-2 layers of polygonal parenchyma. Angular collenchyma consists of 5-6 layers of dark pink polygonal cells, with slightly undulating walls in the innermost layer. Cortical parenchyma consists of 1-3 layers of

rectangular, elongated cells, larger than collenchyma cells, pale pink. Spheroidal calcium oxalate crystals are scattered in the collenchyma, cortical parenchyma, pith, and phloem, in large quantities. Primary phloem consists of 5-6 layers of small polygonal cells, irregularly arranged in clusters. Primary xylem is concentrated in bundles, arranged in straight lines, with 3-5 vessels per bundle. Pith parenchyma occupies most of the center, with large polygonal or nearly round cells.

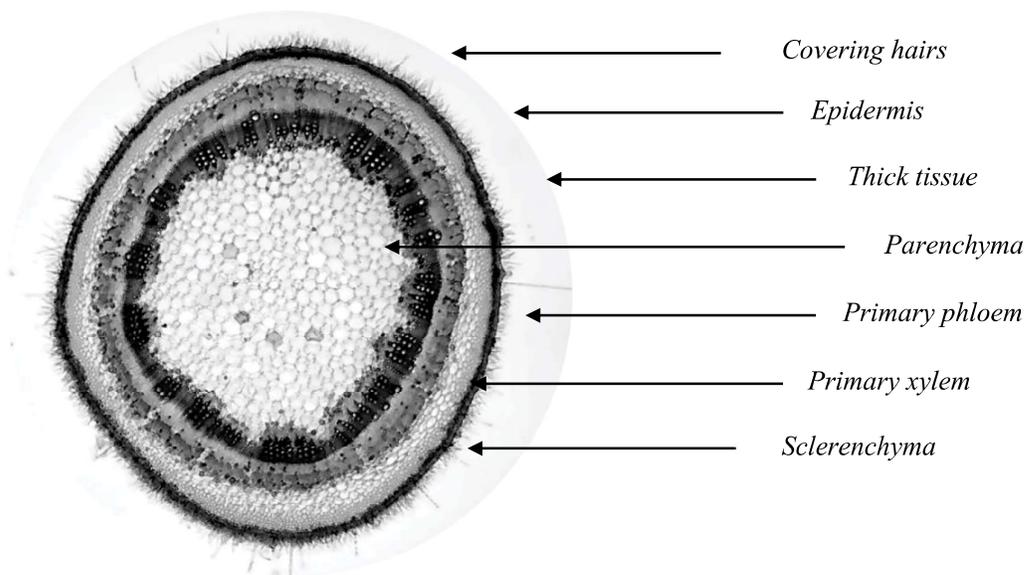


Figure 3. Anatomical features of *A. indicum* stem

Leaf Cross-section (Figure 4) includes two main parts: the petiole and the leaf blade. The

petiole has a complex structure with epidermis, angular collenchyma, dense parenchyma,

sclerenchyma, collateral vascular bundles, central parenchyma, and calcium oxalate crystals. The leaf blade has upper and lower epidermis. The upper epidermis has covering hairs and glandular hairs, while the lower epidermis contains more stomata. Below the upper

epidermis is the palisade parenchyma layer containing few chloroplasts. The main veins in the leaf blade have a structure similar to the petiole, with vascular bundles arranged in an arc shape, primary xylem located above, and primary phloem below.

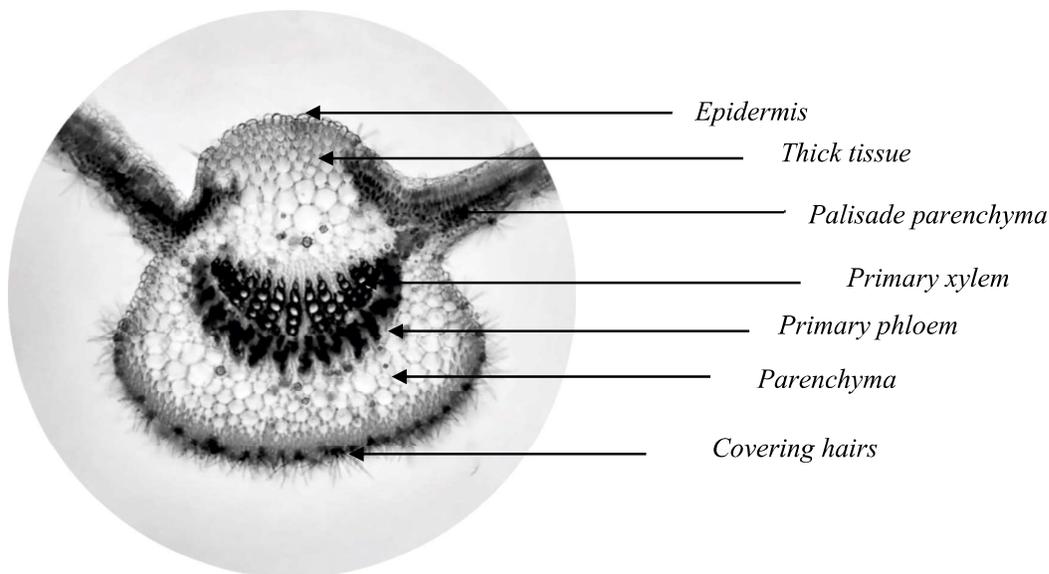


Figure 4. Overview of *A. indicum* leaf cross-section

Petiole:

Petiole Cross-section (Figure 5) with the outermost epidermal layer consisting of rectangular, uniform, brown cells, bearing many covering hairs (multicellular, star-shaped, green) and glandular hairs (unicellular head, multicellular base, swollen in the middle). Below the epidermis is dark pink angular collenchyma, consisting of 5-6 layers of polygonal cells,

followed by 2-4 layers of pale pink dense parenchyma cells. Sclerenchyma fibers are bluish-purple, polygonal, concentrated in clusters surrounding the vascular bundles. Collateral vascular bundles with phloem (1-2 layers, dark pink) located above xylem (6-8 rows of round cells, dark blue). Polygonal parenchyma in the center of the petiole. Spheroidal calcium oxalate crystals are scattered throughout the tissues.

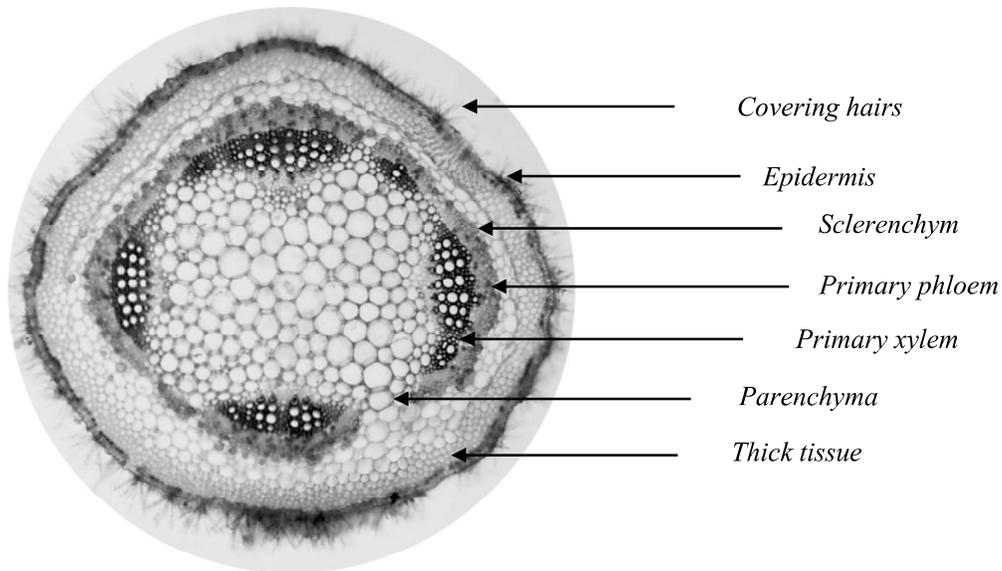


Figure 5. Overview of *A. indicum* petiole cross-section

Leaf blade:

The leaf blade section, from top to bottom in the image, has a single epidermal layer similar to the vein part, with covering hairs and glandular hairs, though stomata are less visible. Immediately below the epidermis are 2-3 layers of cylindrical palisade parenchyma cells, reddish-

brown due to abundant chloroplasts, tightly packed and extending to occupy a portion on both sides of the leaf vein. Finally, the lower epidermal layer is only half the size of the upper epidermal layer, but contains more stomata. Stomata are small, located between the epidermal cel

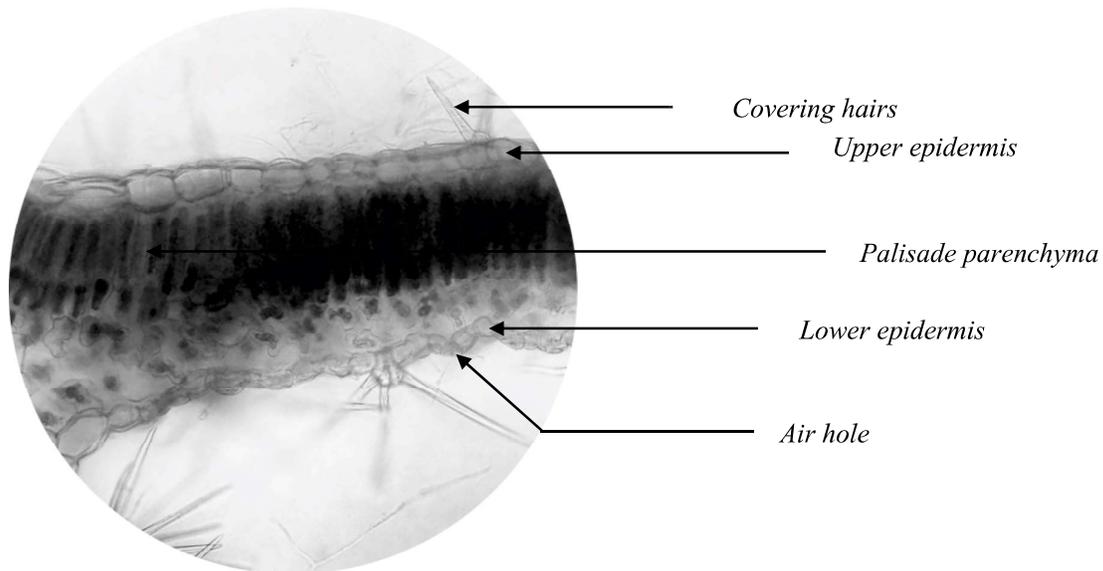


Figure 6. Overview of *A. indicum* leaf blade cross-section

Epidermal peel:



Figure 7. Epidermal peel of the lower leaf surface

3.1.3 Powdered drug characteristics

The powdered root of *A. indicum* is light brown, fine, and has a characteristic odor. Microscopic examination at 40x magnification

reveals the following components: Cork fragments, fibers, starch grains, pitted vessels, root hairs, sclerenchyma, and spheroidal calcium oxalate crystals.



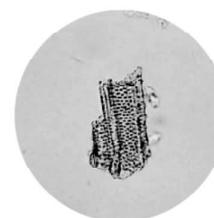
Powdered root



Fibers, starch grains



Starch grains



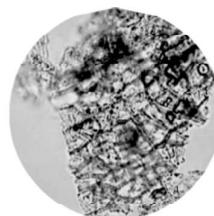
Pitted vessels



Root hairs



Sclerenchyma



Cork fragments

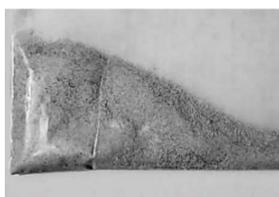


Spheroidal calcium oxalate crystals

Figure 8. Components in *Abutilon indicum* root powder

The powdered stem of *A. indicum* is brown, fine, and has a characteristic odor. Microscopic examination of the stem powder reveals components such as: Spiral vessels, pitted

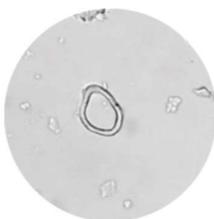
vessels, annular vessels, parenchyma, sclerenchyma, covering hairs, and spheroidal calcium oxalate crystals.



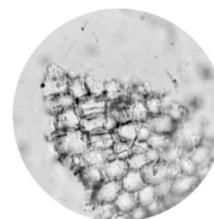
Powdered stem



Spiral vessels



Annular vessels



Parenchyma

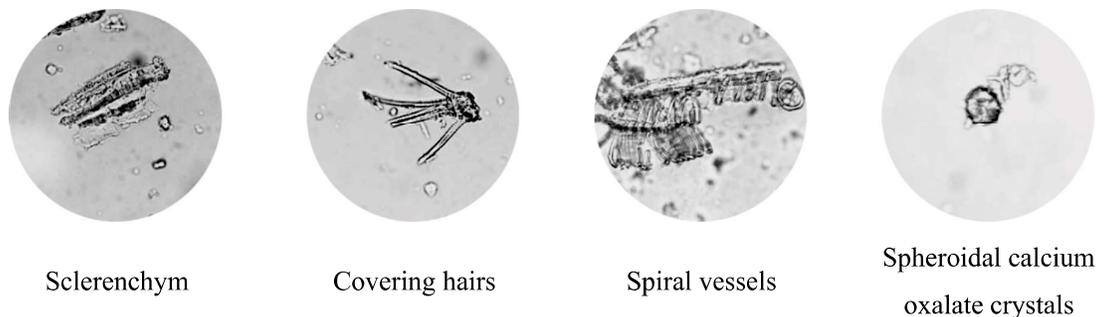


Figure 9. Components in *A. indicum* stem powder

The powdered leaf of *A. indicum* is green, fine, and has a characteristic aromatic odor. Microscopic examination of the leaf powder reveals components such as: Spiral vessels,

annular vessels, epidermal fragments with stomata, covering hairs, parenchyma, spheroidal calcium oxalate crystals, and starch grains.

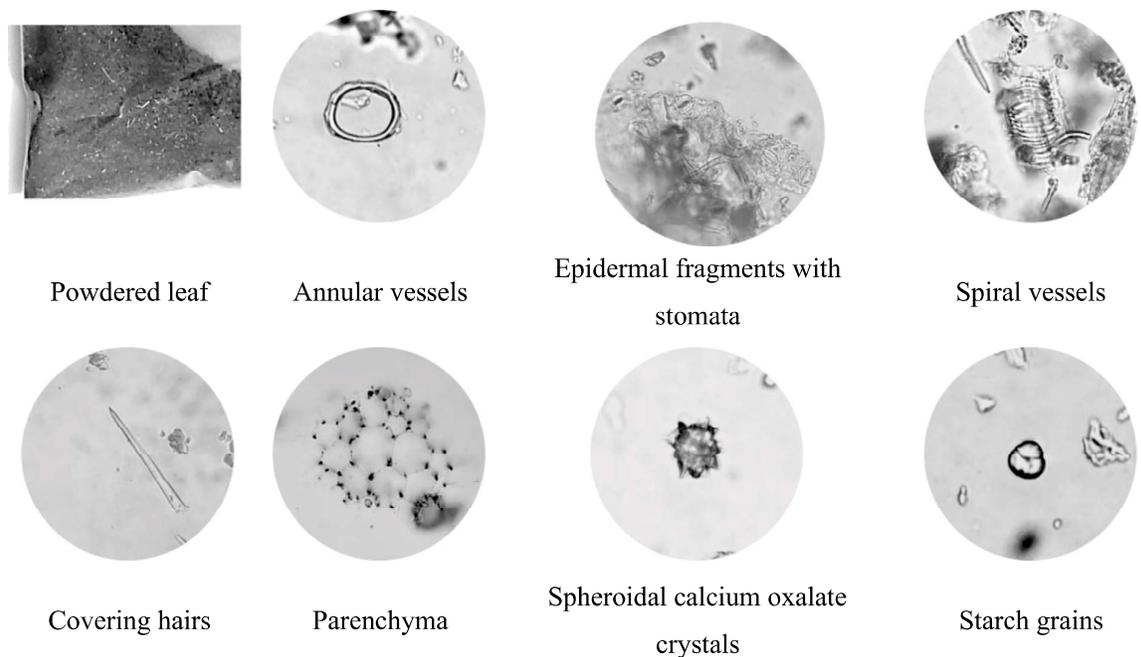


Figure 10. Components in *A. indicum* leaf powder

3.2 Preliminary chemical composition

A mixture of compounds from the plant material was extracted sequentially with three solvents of increasing polarity (diethyl ether, 96% ethanol, water). A portion of the 96% ethanol extract and the aqueous extract was then

hydrolyzed with 10% hydrochloric acid. Qualitative analysis of compound groups was performed using characteristic chemical reactions on the extracts, and the results are presented in Table 1.

Table 1. Preliminary chemical composition analysis results of *A. indicum*

Compound group	Reagent/Method	Chemical reaction	General conclusion
Lipids	Drop solution on paper	Translucent spot	-

Carotenoid	Carr-price	Blue changes to red	+
Essential Oils	H ₂ SO ₄	Dark blue or greenish-blue turning to blue	+
Triterpenoid	Evaporate to residue	Has an aromatic smell	++
Alkaloid	General alkaloid reagent	Precipitation	-
Coumarin	Fluorescence in alkali	Stronger fluorescence	+
Anthraquinon	NaOH 10%	Pink to red alkaline solution	-
Flavonoid	Mg/conc. HCl	Pink to red solution	+++
Glycosid tim			
Cardiac Glycosides	Lactone ring reagent	Purple	-
	TT Baljet	Plum red	-
Tanin	FeCl ₃ solution	Moss green or black (polyphenol)	+
	Gelatin salt solution	White flocculent precipitate (tannin)	-
Hydrolyzed Triterpenoids	Liebermann-burchard	Red-brown-purple, upper layer green	+
	Vigorously shake aqueous solution		
Saponin		Stable foam for 15 minutes	+
Organic Acids	Na ₂ CO ₃	Effervescence	+
Reducing Substances	TT Fehling	Brick-red precipitate	+
Polyuronid Compounds	Dilute with 90% alcohol	White to yellow-brown flocculent precipitate	++

(-): Not detected; (±): Suspected; (+, ++, +++ and ++++): Present with increasing intensity

The preliminary phytochemical analysis results show that various parts of the *A. indicum* plant contain numerous compounds, notably flavonoids, triterpenoids, reducing substances, and polyuronid compounds.

3.3 Discussion

The botanical morphological characteristics, anatomical characteristics of the roots, stems, leaves, and petioles, and the powdered drug components of the roots, stems, leaves, and petioles of *A. indicum* are described in detail in this report. These characteristics are similar to specialized documents published in Vietnam

(Do, 2022; Pham, 2000; Vo, 2018). This indicates no morphological changes when growing in Vietnam. However, the *A. indicum* species in Vinh Long province, as published, includes more complete details on the component characteristics in the root, stem, and leaf powder. These results further aid in identification, differentiation, and avoiding confusion during use.

The preliminary phytochemical analysis results indicate the presence of diverse compound groups in *Abutilon indicum*, including flavonoids, triterpenoids, reducing substances, and polyuronid compounds. Compared to previous

research results, most show similarity (Do, 2022; Pham, 2000; Vo, 2018). This report contributes to guiding further research on compound isolation as well as testing biological activities in the future.

4. CONCLUSION

The botanical morphological characteristics, anatomical features, and powdered drug components provide additional detailed information for identifying and differentiating the *A. indicum* species. Initial survey results have identified the main chemical components in *A. indicum*. Among these, flavonoid, triterpenoid, reducing substances, and polyuronid compounds all showed positive results in specific reactions. These results serve as a premise for deeper chemical and biological activity research, and contribute to the standardization of the parts of this potential medicinal material.

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