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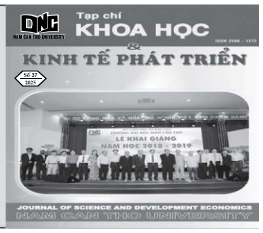

Survey of botanical characteristics and preliminary analysis of chemical composition of *Ficus pumila*

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ABSTRACT

The scientific name of the Ficus pumila L. belonging to the Moraceae family. Parts of the plant are used to treat many diseases such as rheumatism, anemia, dysentery, hemorrhoids, menstrual disorders, hepatitis and high blood pressure. Up to now, in Vietnam, there have been very few studies on the botany as well as the active ingredients in the extract of this plant. This is a medicinal herb with great potential, so the project aims to survey the botanical characteristics and preliminary analysis of the chemical composition of the Ficus pumila plant to provide additional data for identification and differentiation from other plant species, and to orient the groups of compounds contained in the stem and leaves. The whole plant of the plant was collected in An Khanh ward, Can Tho City, analyzed, described the morphological and anatomical characteristics, medicinal powder and preliminary chemical composition survey by the improved Ciuley method. The results showed the anatomical characteristics, medicinal powder characteristics and preliminary chemical composition in the stem and leaf parts. From the results of botanical characteristics, it helps to support the accurate identification of medicinal materials when used and orient the groups of compounds in the fruit, stem and leaf parts of the plant.

1. INTRODUCTION

Nowadays, with the advancement of science, the discovery of many medicinal plants through experimental studies has proven that plants contain many active ingredients and have various biological effects. This is a very favorable condition for the development of functional food production from natural medicinal sources,

contributing significantly to public health care, and also serving as input raw materials for other industries such as cosmetics, food processing, etc..

F. pumila L., belongs to the Moraceae family. Its roots, stems, branches, leaves, and fruits are used in traditional medicine and folk remedies as tonics and to treat rheumatism, back pain, anemia, chronic dysentery, hemorrhoids, menstrual disorders, blocked milk ducts, osteoporosis, erectile dysfunction, hepatitis, and high blood pressure (Vo, 2018). Previous studies on the chemical composition of *F. pumila* have shown that this species mainly contains terpenoids, flavonoids, sterols, and coumarins (Pistelli et al., 2023; Kitajima et al., 1999; Kitajima et al., 1998). Biological activity tests on extracts and various isolated compounds have shown antimicrobial, antioxidant, anti-inflammatory, anti-cancer cell growth, anti-hypertensive, and anti-dyslipidemic effects (Qi et al., 2021; Wang et al., 2017). To date, in Vietnam, there are very few studies on the botany as well as the biological activity of extracts from this plant.

To find scientific evidence, to advance a broader study where previous research on *F. pumila* has been limited, and to promote the value of this plant, our research group proposed this project to provide scientific data for studies on plant morphology and microscopic characteristics, along with preliminary results on the chemical composition of *F. pumila*, contributing to the database for identification and quality control of *F. pumila* medicinal materials.

2. MATERIALS AND METHODS

2.1 Materials

Whole *F. pumila* plants were collected at coordinates 10.03969°N, 105.75784°E, An Khanh ward, Ninh Kieu district, Can Tho city in December 2024. The plants were identified by observing botanical morphology, microscopic examination, and comparison with plant classification documents (Vo, 2018; Pham, 2006). Fresh roots, stems, leaves, and fruits were used for morphological observation and microscopic sections. Roots, stems, and leaves were shade-dried and finely ground, then stored at the Department of Botany - Medicinal Materials - Traditional Pharmacy, Faculty of Pharmacy, Nam Can Tho University, for microscopic observation and preliminary phytochemical analysis of the stem and leaf extracts.

The study used the following equipment and chemicals: Olympus microscope, Sartorius infrared moisture analyzer (MA37-1 (S/N 0035906021, Germany)), water bath, carmine red (Germany), iodine green (Germany), ethyl ether, 96% ethanol (Vietnam), and several specific reagents for each qualitative reaction.

2.2 Methods

2.2.1 Morphological and microscopic characteristics survey

Morphological characteristics survey: Whole fresh plants at different developmental stages were observed with the naked eye, described, and photographed. The scientific name of the sample was determined by comparing its morphological characteristics with the document by Vo Van Chi (2018).

Microscopic characteristics survey. Plant anatomical characteristics: Leaf epidermis was peeled off and examined under an optical microscope to observe stomatal characteristics.

Fresh roots, stems, leaves, and petioles were transversely cut into thin slices with a razor blade. Microscopic sections were bleached with 50% Javel water and stained using the Carmin-Iodine Green double staining method. After staining, the sections were rinsed multiple times with water and preserved in distilled water. Satisfactory sections were selected for observation under an optical microscope at 10x and 40x objectives, photographed, and analyzed for microscopic characteristics.

Powder characteristics: After collection, roots, stems, and leaves were washed, dried, ground into powder, and sieved through a 32-mesh sieve to obtain powder with uniform fineness. The sensory characteristics of each root, stem, and leaf powder sample were observed under normal light. The powder was examined under an optical microscope at 10X and 40X objectives and photographs of the components were taken.

2.2.2 Preliminary phytochemical analysis of the stems and leaves

This was performed according to the Ciuley method, improved and modified by the Faculty of Pharmacy, University of Medicine and Pharmacy, Ho Chi Minh City (2016) (Tran et al, 2016)

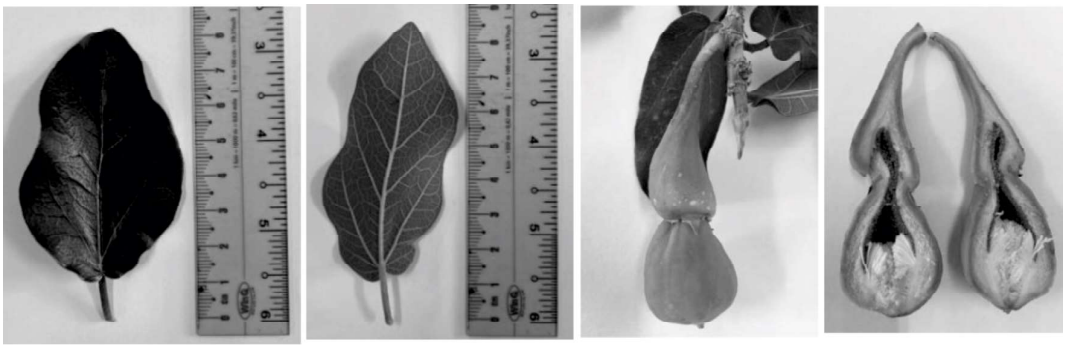
Fifteen grams of dried, powdered stems and leaves were used, and the moisture content of the powder was determined using a Sartorius infrared moisture analyzer (MA37-1 (S/N 0035906021, Germany). The medicinal material was sequentially extracted with three solvents of increasing polarity (diethyl ether, 96% ethanol, water). A portion of the 96% ethanol extract and water extract was hydrolyzed with 10% hydrochloric acid. The extracts were qualitatively analyzed using characteristic color or precipitation reactions.

3. RESULTS AND DISCUSSION

3.1 Results of morphological and microscopic characteristics survey

3.1.1 Morphological characteristics of F. pumila

F. pumila Root Fruit-bearing



Leaf (upper side) Leaf (underside) Fruit Fruit (longitudinal)

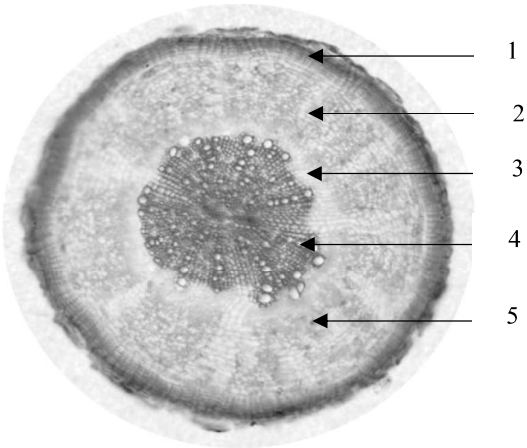
Figure 1. External morphology of *F. pumila*

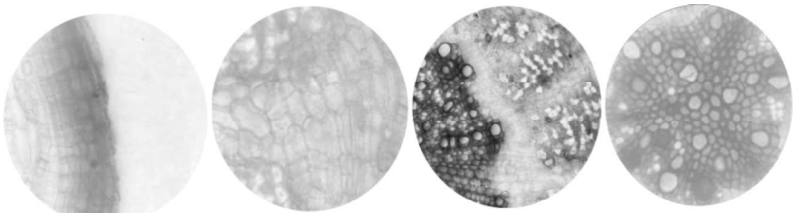
Morphological analysis (Figure 1) showed that the stem of *F. pumila* is a woody vine, 4 m or more tall, with rough bark and unevenly long and short nodes. Roots grow from the nodes. There are two types of branches: non-flowering branches have small leaves, 0.6-2.5 cm long, resembling snail shells, hence the name "Vay oc" (snail scales). Flowering branches have large, thick leaves, 2.5-10 cm long, 1.5-4 cm wide, with entire margins and rough leaf surfaces. When broken, young stems and leaves exude white latex. The leaves are dark green on the upper surface, oval, heart-shaped, asymmetrical, with wavy blades, pinnate venation, and many prominent secondary veins on the lower surface. The petiole is about 1-1.5 cm long, and the leaf blade has various sizes. The fruit is egg-shaped with a slightly pointed base, a false fruit, about 6-8 cm long and 3-4 cm wide. The fruit is composed of a concave, cup-shaped receptacle with a closed opening, bearing many flowers of various lengths, with a small hole in the center. Inside the false fruit are many "seeds" adhering to the inner surface of the fruit, which are the true fruits. The young "fruit" is green, turning red when ripe, and contains abundant white latex.

3.1.2 Microscopic characteristics of F. pumila

Plant anatomical characteristics.

Root Cross-Section:





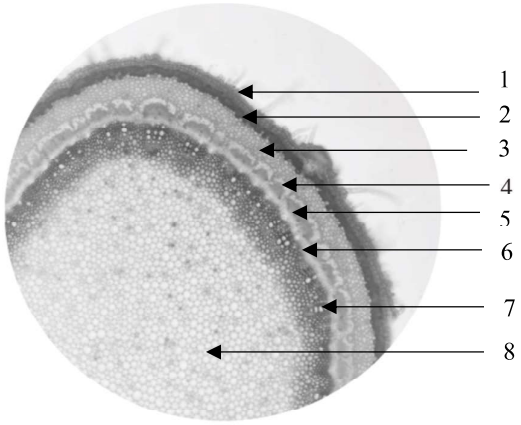
Cork Parenchyma Sclerenchyma Secondary xylem

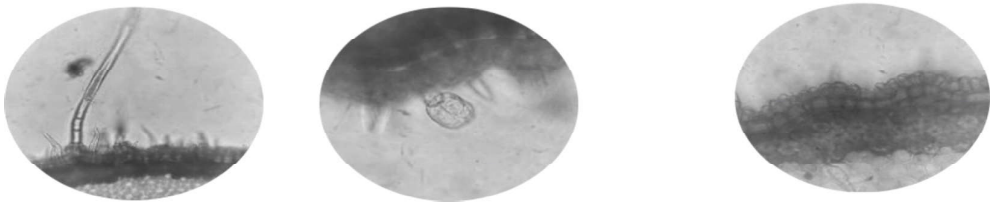
Figure 2. Detailed structure of *F. pumila* root cross-section

1. Cork, 2. Parenchyma, 3. Secondary phloem, 4. Secondary xylem, 5. Sclerenchyma

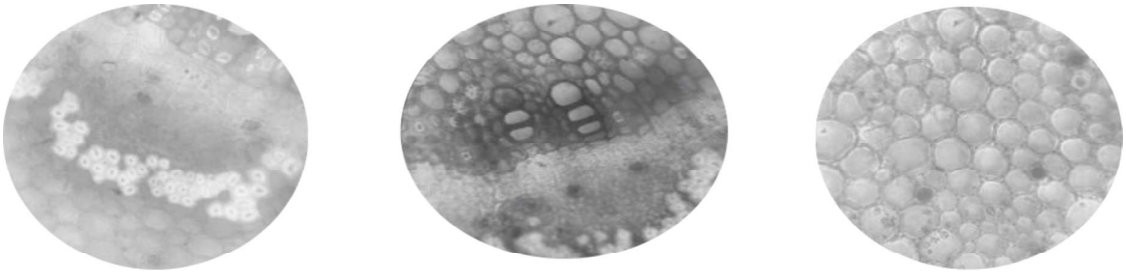
The root cross-section (Figure 2) is nearly circular. From the outside in, it consists of: cork composed of 4-5 layers of lemon-yellow stained, rectangular cells, arranged radially in straight rows, often peeling off. The secondary cortex parenchyma is pink, consisting of slightly elongated polygonal cells, arranged nearly radially in straight rows. The endodermis and pericycle are not clearly visible. Scattered sclerenchyma clusters with thick walls are irregularly arranged in groups. Secondary phloem is formed, with flat rectangular cells arranged radially in straight rows. Secondary xylem is formed and occupies the center.

Stem Cross-Section:





Covering trichome Secretory trichome Epidermis, Cork, and Sclerenchyma ring



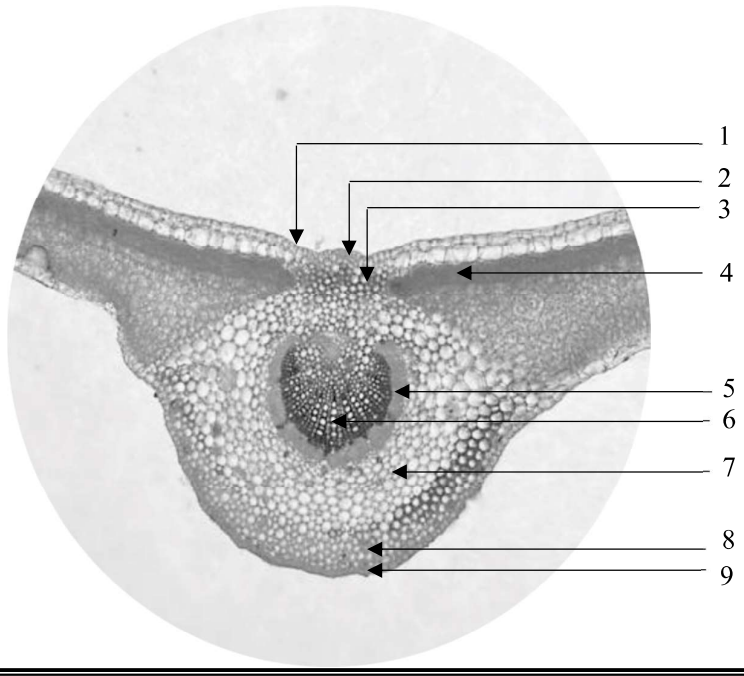
Sclerenchyma Primary phloem, Secondary phloem Pith parenchyma

Figure 3. Detailed structure of *F. pumila* stem cross-section

1. Epidermis, 2. Sclerenchyma ring, 3. Parenchyma, 4. Sclerenchyma, 5. Primary phloem, 6. Secondary phloem, 7. Primary xylem, 8. Pith parenchyma

The stem cross-section (Figure 3) is nearly circular. The outermost layer is the epidermis, with tightly arranged cells. There are many multicellular covering hairs and multicellular glandular hairs with rounded tips. The cork consists of rectangular cells, arranged radially. A sclerenchyma cell ring is located immediately beneath the cork layer. The cortex parenchyma consists of 6-7 layers of round cells of uneven size, irregularly arranged, leaving small intercellular spaces. Primary phloem consists of dark pink cell clusters, arranged in a ring, with small gaps between the bundles. Sclerenchyma clusters surround the outside of the primary phloem bundles. Secondary phloem consists of about 2-3 layers of flat rectangular cells, arranged radially. Primary xylem is arranged in straight rows. Secondary xylem vessels begin to appear, with secondary xylem parenchyma arranged in straight rows. The pith parenchyma consists of polygonal cells of uneven size, irregularly arranged, with scattered secretory cells.

Leaf Cross-Section:



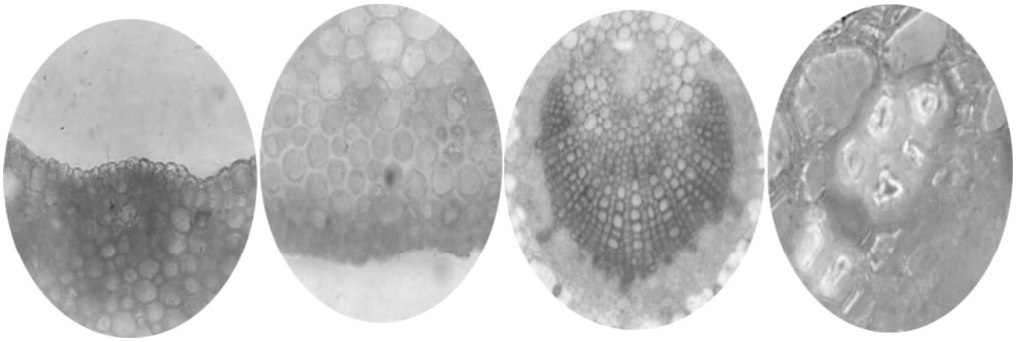


Figure 4. Detailed structure of *Ficus pumila* leaf cross-section

1. Upper epidermis, 2. Upper collenchyma, 3. Sclerenchyma, 4. Palisade parenchyma, 5. Phloem, 6. Primary xylem, 7. Parenchyma, 8. Lower collenchyma, 9. Lower epidermis

The leaf cross-section (Figure 4) consists of two parts: the midrib and the leaf blade. The midrib part is slightly convex on the upper side and swollen on the lower side. The external structure consists of one layer of upper and lower epidermis, with polygonal, nearly round cells, tightly arranged, extending across the leaf blade. Below the upper epidermis and above the lower epidermis is angular collenchyma in the convex and swollen parts of the main vein, with more layers of lower collenchyma than upper collenchyma. Below the upper collenchyma and above the lower collenchyma is sclerenchyma, either in clusters or continuous in an arc, followed by ground parenchyma, consisting of layers of polygonal cells of uneven size, irregularly arranged. The primary phloem-xylem bundles are arranged in an arc, with primary xylem located above and primary phloem below. The leaf blade part has upper and lower epidermis. Below the upper epidermis, there is a distinct cell layer with a shape and size different from the epidermal layer. Following this is the palisade parenchyma with rectangular cells, arranged perpendicular to the epidermal layer, and below the palisade parenchyma is the spongy parenchyma.

Petiole:

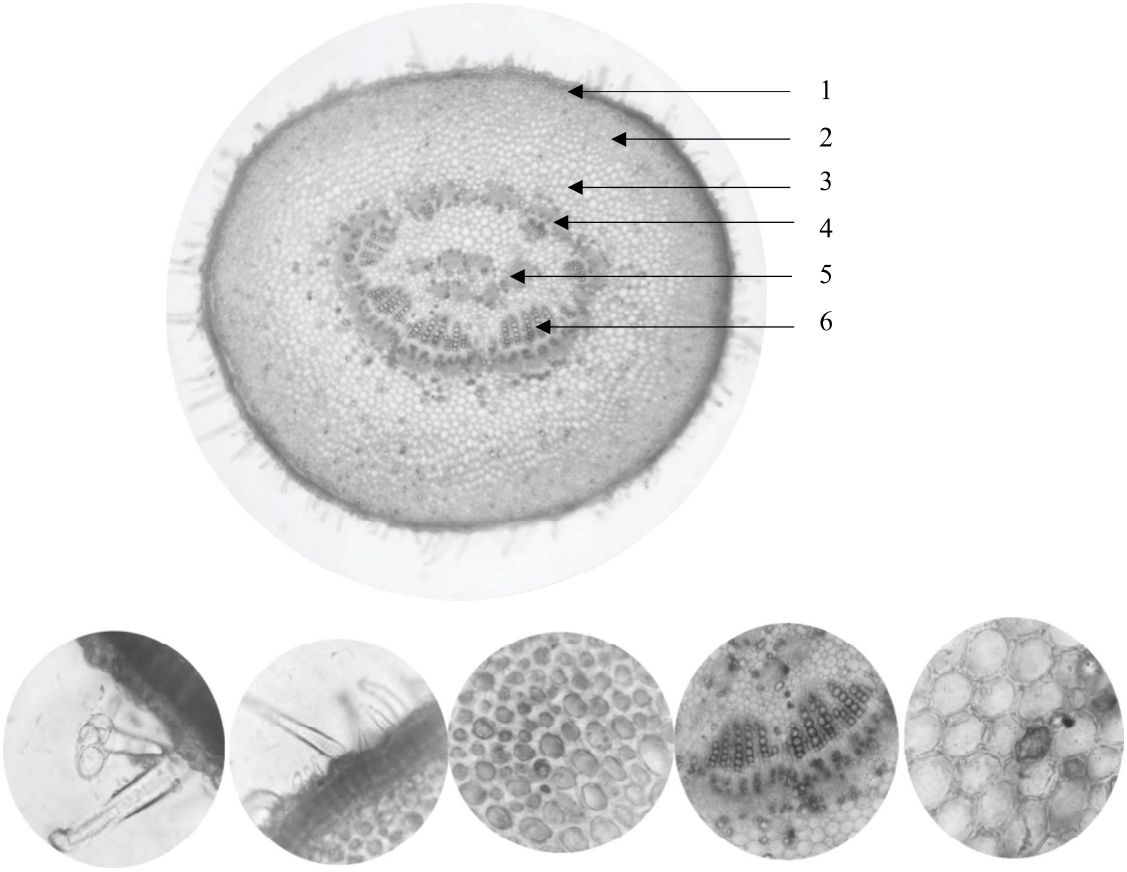


Figure 5. Detailed structure of *F. pumila* petiole cross-section

1. Epidermis, 2. Collenchyma, 3. Parenchyma, 4. Primary phloem (outside xylem), 5. Primary phloem (inside xylem), 6. Primary xylem

The petiole cross-section (Figure 5) is nearly circular. The epidermis is a single layer of polygonal, tightly arranged cells. There are many multicellular covering hairs and glandular hairs. The collenchyma consists of 9-10 layers of oval cells, of uneven size, irregularly arranged. The parenchyma consists of 4-5 layers of round cells, of uneven size, irregularly arranged. Primary phloem is arranged in clusters, consisting of small polygonal cells, irregularly arranged. Primary xylem is located internally, consisting of cellulose-walled, round cells of uneven size, arranged in straight rows. Phloem-xylem bundles are densely concentrated on the lower surface of the petiole.

Epidermal peeling:

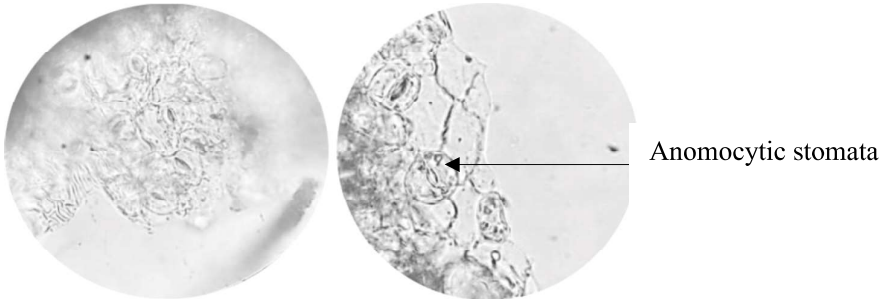


Figure 6. Peeling the lower epidermis of the *F. pumila* leaf

Powder sample characteristics. Root powder:

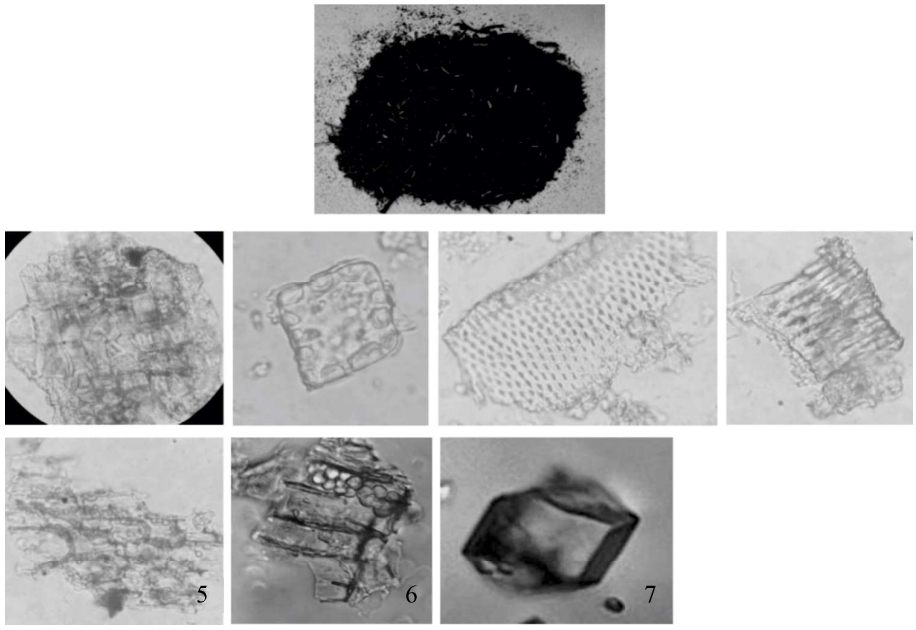


Figure 7. Components in *F. pumila* root powder

1. Cork fragments, 2. Sclerenchyma, 3. Pitted vessels, 4. Reticulate vessels, 5. Parenchyma, 6. Starch-containing parenchyma, 7. Block-shaped calcium oxalate crystals

F. pumila root powder is brown and fine. Examination under a microscope at 40x objective reveals the following components: cork fragments, sclerenchyma, parenchyma, starch-containing parenchyma, pitted vessels, reticulate vessels, and block-shaped calcium oxalate crystals.

Stem powder:

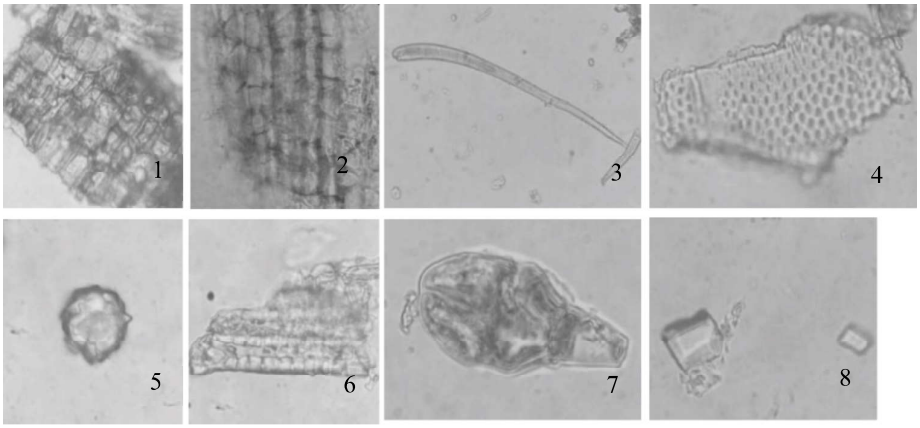


Figure 8. Components in *F. pumila* stem powder

1. Cork fragments, 2. Parenchyma, 3. Covering hairs, 4. Pitted vessels, 5. Sphaerocrystalline calcium oxalate crystals, 6. Sclerenchyma, 7. Multicellular glandular hairs, 8. Block-shaped calcium oxalate crystals

F. pumila stem powder is fine and yellowish-brown. Examination under a microscope at 40X objective reveals the following components: cork fragments, parenchyma, covering hairs, pitted vessels, sphaerocrystalline calcium oxalate crystals, sclerenchyma, multicellular glandular hairs, and block-shaped calcium oxalate crystals.

Leaf powder:

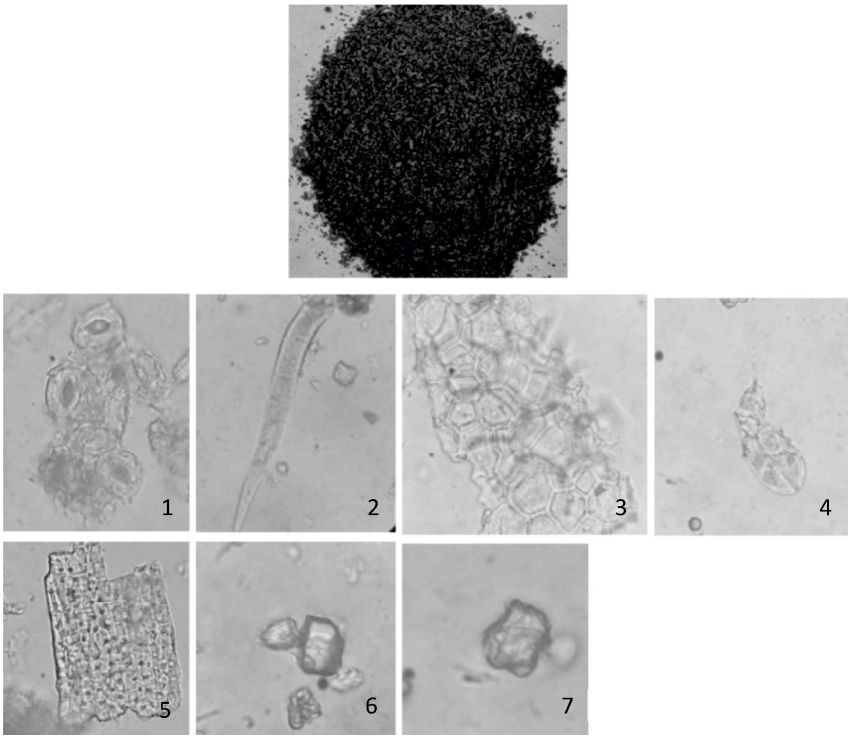


Figure 9. Components in *F. pumila* leaf powder

1. Epidermal fragments with stomata, 2. Covering hairs, 3. Upper epidermal fragments, 4. Multicellular glandular hairs, 5. Sclerenchyma, 6. Block-shaped calcium oxalate crystals, 7. Sphaerocrystalline calcium oxalate crystals

F. pumila leaf powder is greenish-brown and fine. Examination under a microscope at 40X objective reveals the following components: epidermal fragments with stomata, covering hairs, upper epidermal fragments, multicellular glandular hairs, sclerenchyma, block-shaped calcium oxalate crystals, and sphaerocrystalline calcium oxalate crystals.

3.2 Results of preliminary phytochemical analysis

The moisture content of the leaf powder was 10.24%, and that of the stems powder was 8.58%. Qualitative determination of compound groups using characteristic chemical reactions on the stem and leaf extracts was performed, and the results are presented in Table 1.

Table 1. Preliminary phytochemical analysis results of *F. pumila* stem and leaf

Compound Group	Qualitative Results on extracts										Conclusion	
	Diethyl ether extract		Ethanol 96% extract				Aqueous extract					
			Unhydrolyzed		Hydrolysis		Unhydrolyzed		Hydrolysis			
	T	L	T	L	T	L	T	L	T	L	T	L
Lipids	-	-									-	-
Carotenoid	-	-									-	-
Essential oils	-	-									-	-
Free Triterpenoids	+	+			+	+			+	-	+	+
Alkaloid	-	-	+	-			-	-			+	-
Coumarin	+	-	-	-	-	-					+	-
Anthraquinon	+	-			+	-			-	-	+	-
Flavonoid	+	- /+	++	++	+	+	-	++	-	+	++	++
Anthocyanosid			-	-			-	-			-	-
Proanthocyanidin			-	-			-	-			-	-
Glycosid tim			-	-	-	-	-	-	-	-	-	-
Polyphenol			+	+			+	+			+	+
Tanin			+	-			++	++			++	++
Saponin			+	+			++	++			++	++
Organic Acids			+	+			+	-			+	+
Reducing Compounds			+	+			+	+			+	+
Polyuronids							+	+			+	+

(T): Stems, (L): Leafs

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

The preliminary phytochemical analysis results showed that the stems and leaves of *F. pumila* contain many compounds, with flavonoids, tannins, and saponins being clearly positive. In addition, the stem also contains other compounds such as alkaloids and coumarins.

3.3 Discussion

In Vietnam, *F. pumila* usually grows wild or is cultivated as an ornamental plant and to provide a cool atmosphere when it climbs on fences. This study described in detail the morphological characteristics, anatomical characteristics of the root, stem, petiole, leaf, and the powder characteristics of the root, stem, and leaf of *F. pumila* collected at coordinates 10.03969∘N, 105.75784∘E, An Khanh ward, Ninh Kieu district, Can Tho city. The results of the morphological analysis are similar to those published in specialized literature in Vietnam (Vo, 2018; Pham, 2006). Therefore, these results help in identification, differentiation, and avoiding confusion during use.

The preliminary phytochemical analysis results of the stem and leaf parts of *F. pumila* showed that they contain many compounds, among which flavonoids, tannins, and saponins are notable, and specifically in the stem, alkaloids and coumarins are also present. These results are consistent with previous research. Therefore, these research results contribute to guiding further in-depth research on the isolation of compounds as well as testing the biological effects of the stem and leaf of *F. pumila*.

4. CONCLUSION

The results regarding morphological characteristics, anatomical characteristics, and medicinal powder components provide additional information to help identify and differentiate *F. pumila* from other species within the genus Ficus. Preliminary qualitative analysis of the chemical composition in the stem and leaf has identified the main chemical components. Therefore, these research results contribute to guiding further in-depth research on the isolation and biological effects of the stem and leaves of *F. pumila*.

REFERENCES

Kitajima, J., Kimizuka, K., & Tanaka, Y. (1998). New sterols and triterpenoids of *Ficus pumila* fruit. *Chem. Pharm. Bull, 46,* pp. 1408–1411.

Kitajima, J., Kimizuka, K., & Tanaka, Y. (1999). New dammarane-type acetylated triterpenoids and their related compounds of *Ficus pumila* fruit. *Chem. Pharm. Bull, 47,* pp. 1138–1140.

Pham, H. H. (2006). *Plants of Vietnam, Vol. 2*. Youth Publishing House, Ho Chi Minh city.

Pistelli, L., Chiellini, E., & Morelli, I. (2023). Flavonoids from *Ficus pumila*. *Biochemical Systematics and Ecology,* 28, pp. 287- 289.

Qi, Z., Zhao, J., Lin, F., Zhou, W., & Gan, R. (2021). Bioactive compounds, therapeutic activities, and applications of *Ficus pumila* L. (review). *Agronomy, 11,* pp. 89-119.

Tran, H., Nguyen, V. K., Bui, M. L., Vo, V. L., Ngo, T. X. M., Pham, T. T., Huynh, N. T., & Vo, T. B. T. (2016). *Methods of medicinal plant research. Department of Pharmacognosy.* Faculty of Pharmacy. University of Medicine and Pharmacy. Ho Chi Minh City.

Vo, V. C. (2018). *Dictionary of Vietnamese medicinal plants, Vol. 1*. Medical Publishing House. pp. 1070-1071.

Wang, J., Qin, J., Liu, C., & Tang, H. (2017). Alpha-Glucosidase and acetylcholinesterase inhibitory potency of extract from rhizome of *Ficus pumila* L. *J. Guangxi Nor. Univ. (Nat. Sci. Edi.). 35,* pp. 69–74.