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PHARMACOGNOSTICAL, PHYTOCHEMICAL AND PHYSICOCHEMICAL EVALUATION OF *FILICIUM DECIPIENS* LEAF

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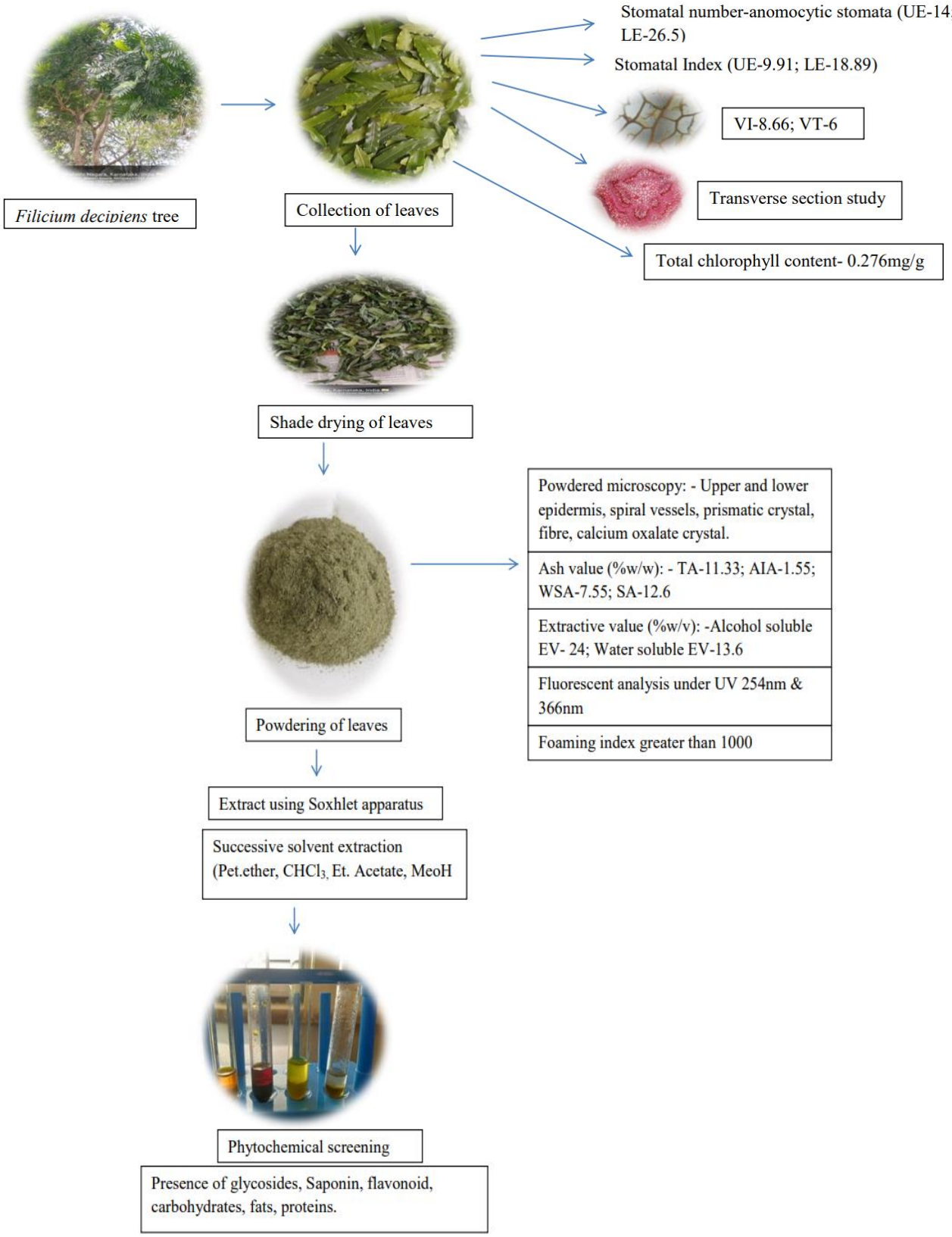
ABSTRACT

Background: *Filicium decipiens* is a medicinally important plant traditionally used for various therapeutic purposes; however, standardized quality control parameters for its leaves are limited. **Objectives:** This study aimed to establish comprehensive Pharmacognostical, phytochemical and physicochemical standards for the authentication and quality evaluation of F. decipiens leaves. **Methods:** Macroscopic and microscopic evaluations, including transverse section analysis and powder microscopy, were performed using standard procedures. Quantitative microscopy parameters such as Stomatal number, Stomatal index, vein islet and terminates number were determined. Physicochemical constants, including loss on drying, ash values, extractive values, foaming index, fluorescent analysis, were evaluated. Preliminary phytochemical screening and chlorophyll content estimation were also conducted. **Results:** The leaves exhibited characteristic morphological features such as compound imparipinnate arrangement with lanceolate leaflets. Microscopic analysis revealed a single layered epidermis, well-developed collenchyma, collateral vascular bundles, anomocytic stomata, and calcium oxalate crystal. Powder microscopy showed spiral vessels, fibers, and crystalline inclusions. Quantitative microscopy provided reliable identification markers. Physicochemical analysis indicated higher alcohol soluble extractive value (24%) compared to water soluble extractive value (13.6%). The foaming index greater than 1000, indicating significant Saponin content. Fluorescence analysis showed distinct color variations under UV light. Phytochemical screening confirmed the presence of flavonoids, glycosides, saponins, carbohydrates, proteins, and fats. **Conclusion:** The study establishes essential Pharmacognostical and physicochemical standards for F. decipiens leaves, supporting their identification, authentication and potential use in herbal drug development.

KEYWORDS: *Filicium decipiens*, ornamental plant, Pharmacognosy, physicochemical parameters.

Graphical abstract



1. INTRODUCTION

Traditional remedies use medicinal plants to treat a wide range of illnesses.[1] However, a major barrier that has impeded the spread of alternative medicine use in affluent nations is the lack of documentation and strict quality control procedures. All studies related to traditional medicines should be properly documented and standardized. Because of this disadvantage, it is crucial to ensure that the plant and its parts utilized as medication are standardized. Pharmacognostical and

phytochemical investigations are two examples of the various approaches and methodologies we might employ for the standardization process in order to accomplish our aim in a gradual manner. The identification and uniformity of the plant material are aided by these procedures. In order to guarantee the repeatable quality of herbal medicine, which will enable us to support its efficacy and safety, proper characterization and quality assurance of the beginning material are crucial.[2-5]

The use of medicinal plants for the alleviation of human ailments is as old as human civilization itself. For more than 5,000 years, people in China and India have been using plants in structured medical regimens. A large portion of the world's population, particularly in poor nations, depends on traditional medicine to address everyday health needs since it is non-toxic, has no side effects, and is readily available at reasonable rates. The World Health Organization (WHO) estimates that more than 80% of the populations in developing countries rely on traditional medicine for their primary health care.[6-7]

The fern tree, *Filicium Decipiens*, is a member of the Sapindaceae family. It is a big tree that may reach a height of 25 meters. It is indigenous to Sri Lanka, the Western Ghats of southern India, and minor highland regions of East Africa, where it may be found in evergreen and semi-evergreen forests. In Sri Lanka and India, *Filicium Decipiens* has long been utilized as an anti-diabetic medication.[8]

The tree, called locally as "kiarapayung" in Indonesia, is frequently grown as an ornamental, windbreak, and noise barrier plant in gardens and along roadsides.[9] The plant is also known as "kisabun," which translates to "detergent plant," in Indonesia's West Java province because when raining, the rain water looks foamy under the tree.[10] The tree also showed a variety of biological activities, such as anti-fungal, anti-bacterial, anti-inflammatory, anti-oxidant and mollusicicidal activities.[11,9] The chemical constituents present in the plant such as triterpenoidal saponins, norneophane caffeate, sitosterol and flavonol glycosides.[9,12]

The leaves are enormous and complex. Each leaf has 12–16 leaflets, each of which is 4-6 inches long, somewhat narrow, long, and glossy. Typically, they have paripinnate leaves, which are pinnately compound leaves that terminate in two leaflets. Light green and easily discernible on both sides is the conspicuous midrib, which is the major rib of a leaf or leaf-like portion and a continuation of the petiole. The rachis, an outgrowth of the petiole of a compound leaf that eventually bears the leaflets, is found in the spaces between the widely separated leaflets. Here, there are noticeable green, leaf-like wings that can reach a width of 1.5 cm. There are up to 11 pairs of glabrous (hairless) leaflets, each up to 15 x 3 cm and widely separated.[13]

Taxonomical Classification[14]
Kingdom: Plantae
Division: Angiosperms
Class: Magnoliopsida
Order: Sapindales
Family: Sapindaceae
Genus: Filicium
Species: F. decipiens
Synonyms: *Filicium decipiens*
Filicium elongatum Radlk.ex Taub.
Jurighas decipiens (Wight & Arn.) kuntze
Rhus decipiens Wight & Arn.
Pteridophyllum decipiens (Wight & Arn.) Thwaites

Vernacular Names[15, 16, 17]
English: - Fern tree, soap berry.
Sinhala: - Pihimbiya.
Tamil:- Chitteraivempu, Kattupuvarasu, Ningal, Athadali, Eruvillipaalai.
Malayalam:- Irumbarakki, Neeroli, Valmuriccha, Muriccha, Sanimaram, attali.
Kannada: - Kaadu hoovarasi, neeroli.
Telugu: - Patta kunkudu.

2. MATERIALS AND METHODS

Collection of plant material

In November 2025, the plant material was collected from Botanical garden of Bharathi College Bharathinagara, Karnataka, India. The plant was identified and authenticated by Dr.Thejesh Kumar, HOD, Department of Botany, and Bharathi College Bharathinagara. A herbarium voucher specimen was prepared and preserved in the Department of Pharmacognosy, Bharathi College of Pharmacy, Bharathinagara, for future reference.

Drying and size reduction of the Leaf

Filicium decipiens leaves were collected and shade-dried at room temperature until they reached a consistent weight. The shade dried leaves were coarsely powdered using a mechanical grinder and passed through a sieve No. 80 to achieve a uniform particle size, and stored in an airtight container in a cool and dry environment for further experimental tests.

3. Experimental procedure

Macroscopical studies

The leaves of *Filicium decipiens* were examined macroscopically to determine their color, texture, size, shape, fracture, odor, and taste. The crude drug was evaluated with the naked eye by placing the individual raw samples on a clean white paper surface for proper observation and assessment.

Microscopical studies

Microscopic analysis offers a thorough examination of the plant material, allowing the identification of organized drugs based on their histological characteristics. Enlarging minute structures provides comprehensive information on crude medicine and helps

validate the structural characteristics of the plant material being studied.

Qualitative Microscopy

Transverse section of the Leaves

To prepare thin transverse sections, mature *Filicium decipiens* leaves were collected, washed thoroughly with water, and sectioned from the middle portion of the lamina. These thin sections were kept in water to preserve their moistness. To make interior structures more visible, staining agents such as safranin, Phloroglucinol, and diluted hydrochloric acid (HCl) were applied.[18, 19]

Powder Microscopy

A few drops of chloral hydrate were applied to a glass slide containing a small amount of leaf powder. After that, the slide was heated to prevent the chloral hydrate from evaporating. A coverslip was carefully placed to avoid air bubbles, and excess chloral hydrate was removed using blotting paper. The sample was stained with Phloroglucinol and concentrated HCl to confirm lignified tissues. A mixture of Phloroglucinol and concentrated HCl (1:1 ratio) was applied on a separate slide, and the Preparation was examined under the microscope.[18, 19]

Physicochemical constants

Physicochemical constants were determined according to the standard procedures prescribed in the Indian Pharmacopoeia. The evaluated parameters included leaf constants, percentage of moisture content, total ash, acid-insoluble ash, water-soluble ash, Sulphated ash, water-soluble and alcohol-soluble extractive values, and loss on drying.

Preliminary phytochemical studies

Preliminary phytochemical screening of the leaves of *Filicium decipiens* was carried out using standard procedures described by Kokate C.K., Purohit A.P., and Gokhale S.B. The tests were performed to identify the presence of various phytochemical constituents in the plant material.

4. RESULTS AND DISCUSSION

Macroscopical studies

A **B**

Fig. 1.1 A. Measurement of Fresh Leaves. B. Leaf Powder.

Table 1: Macroscopical character of leaf of *Filicium decipiens* includes.

S. No.	Organoleptic Characteristics	Observation
1	Size and Shape	Compound, imparipinnate, leaflets opposite, lanceolate, punctate, glossy, base attenuate, margin entire & wavy, apex acute, rachis broadly winged leaf stalk long, and reticulate.
2	Color	Green to dark green on the adaxial side and light green and glabrous on the abaxial side.
3	Surface & texture	Smooth and brittle
4	Odour	Not characteristic
5	Taste	Slightly astringent

Microscopical Character
Transverse section of leaf

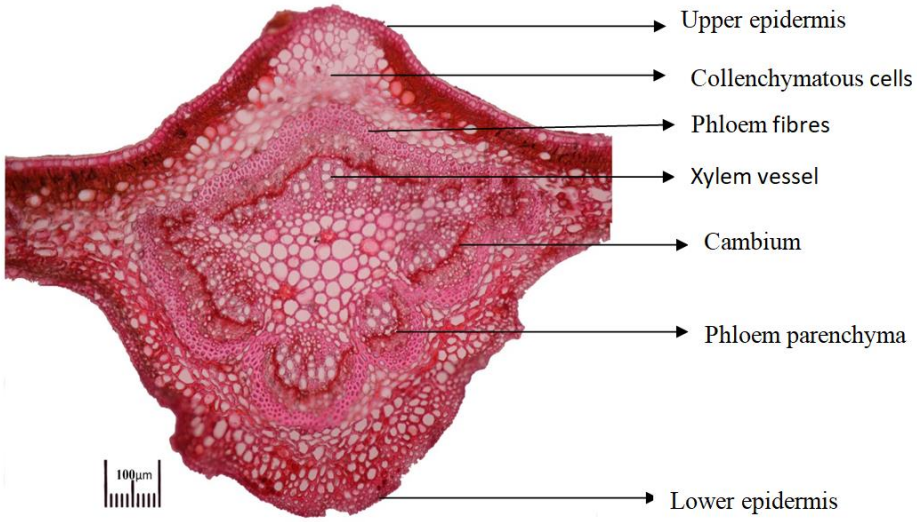


Fig. 1.2. TS of leaf.

Transverse section of petiole

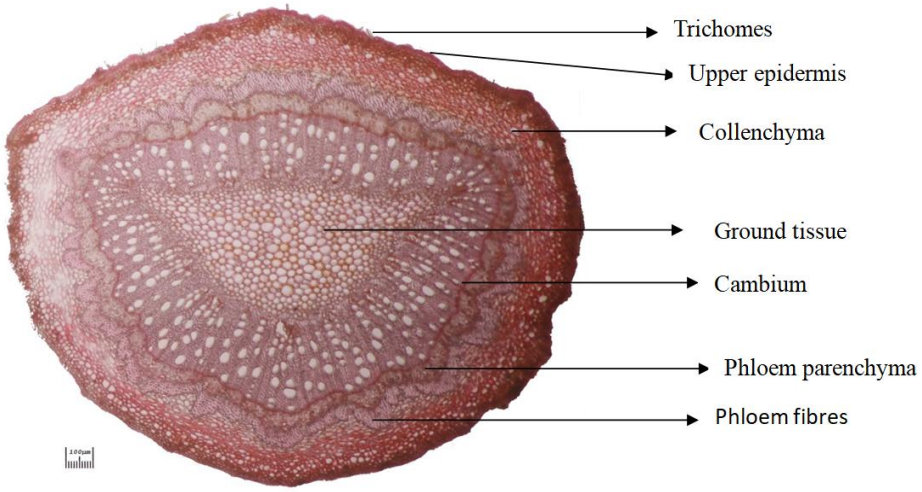


Fig. 1.3. TS of petiole.

Transverse section of Leaf (Lamina)

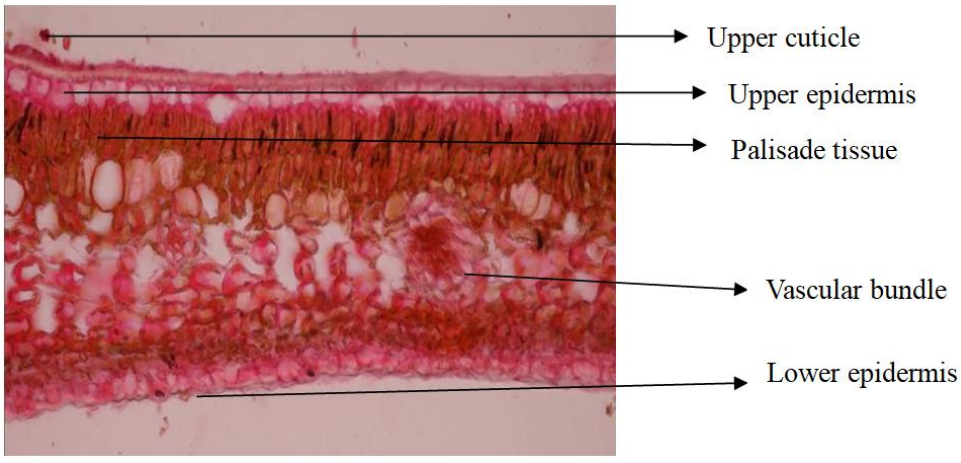


Fig. 1.4. TS of Lamina.

TS of leaf

The epidermis of the leaf shows a single layer of compact, rectangular cells covered with a thick cuticle, indicating protective adaptation. Beneath the epidermis, the collenchyma tissue is well developed. In the leaf, it encircles the vascular bundle and contains prismatic crystals. The phloem is continuous, encircles the xylem regions. Phloem fibers are up to 07 layers. Phloem parenchyma found below the phloem fibers are up to 07 layers. Two to three layers of compressed cambium separate the xylem and phloem region. Prismatic crystal is observed in cambium region. Up to 07 patches of xylem layers, with a large arc shaped xylem patch found at the upper region. The xylem regions comprise of vessels arranged vertically up to 04 layers along with fibers layers in parallel. The ground tissue is present in the central region (midrib or petiole Centre) and is composed mainly of parenchymatous cells, contributing to storage and basic metabolic functions. The lower epidermis of the leaf also consists of a single layer of rectangular cells covered with a thick cuticle, similar to the upper epidermis.[20-22]

TS of Petiole

In the petiole, a similar single-layered epidermis is observed with a thick cuticle and very few trichomes. Collenchyma is more prominent, extending up to 15 layers and composed of collenchymatous cells interspersed with prismatic crystals, providing mechanical support. Phloem is continuous and encircles the xylem region. Phloem fibers thick walled and up to 07 layers. Below the phloem fibers, up to 07 layers of phloem parenchyma is found. Prismatic crystal scattered over the phloem parenchyma region. A single compressed cambium layer separates the xylem and phloem region. Where xylem is Continuous, and encircles ground tissue. The xylem region comprises of vessels and xylem fibers. Vessels are arranged in vertical manner in between fibers layers. Ground tissue composed of parenchymatous cells. Located at Centre of the midrib.

TS of Lamina

Lamina consists of Epidermis, Mesophyll and vascular bundle. Epidermis is a single layer of compact, rectangular cells, covered with a distinct cuticle. Cells appear tightly packed with no intercellular spaces. It is differentiated into upper and lower epidermis. Upper epidermis consists of thick cuticle whereas in lower epidermis thin layer cuticle is present. Mesophyll consist of two types of parenchymatous cells namely palisade parenchyma and spongy parenchyma. The palisade tissue composed of bi-layered, elongated, columnar cells arranged vertically and mostly rich in chloroplast whereas the lower side of leaf lamina showed loosely arranged, irregular in shape and fewer chloroplasts than palisade tissue in spongy parenchyma. In-between palisade and spongy parenchyma cell contents are present. Vascular bundle Seen embedded within the mesophyll, collateral type (xylem above, phloem below) and surrounded by a parenchymatous bundle sheath.

Powder microscopy of leaf

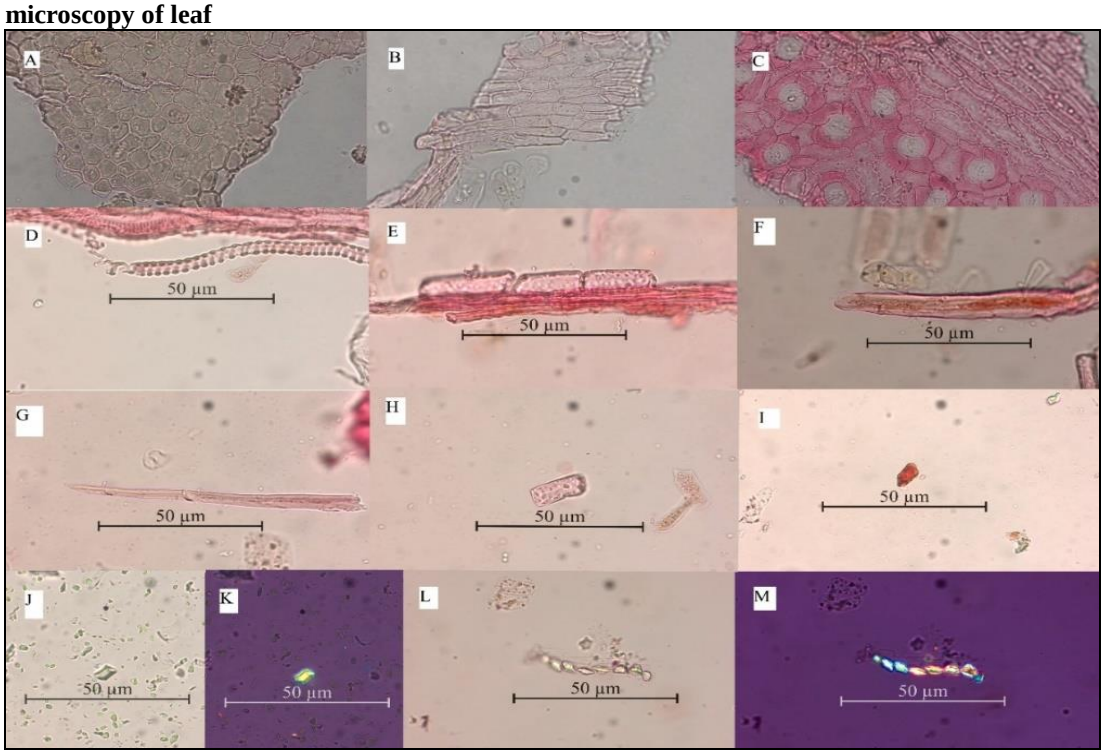


Fig. 1.5. Powder microscopy of *Filicium decipiens* (Wight & Arn.) Thwaites leaf.

A) Upper epidermis, **B)** Lower epidermis **C)** Lower epidermis with Anomocytic stomata, **D)** Spiral vessel, **E)** parenchymatous cells attached with fibres **F)** thick wall blunt end with broad lumen fibre **G**) Pointed end fibre

with narrow lumen **H)** Simple pitted parenchymatous cells **I)** Brownish content **J)** Prismatic crystal in visible light **K)** Prismatic crystal under polarizer **L & M)** Fibre crystals of calcium oxalate embedded in visible light and under polarizer.

Powder Microscopy

Leaf powder is in green colour. (Fig.1.1.B)

Thick walled, polygonal shaped cells of epidermis are present, whereas lower epidermis contains rectangular shaped cells with Anomocytic stomata. Spiral vessels are present, simple pitted parenchymal cells are present. The upper epidermis is devoid of stomata, whereas lower epidermis bears anomocytic stomata.

Prismatic crystals of calcium oxalate are present (Fiber prismatic crystals are found). Brownish content of secretions are found. Two types of thick walled, septate fibers namely pointed end fiber with narrow lumen and blunt end with broad lumen.

Physicochemical Parameters

The results of the present study are summarized in Tables 2 and 3. Determination of leaf constants forms an essential part of the pharmacognostic evaluation of crude drugs, as these parameters provide reliable quantitative standards for identification and authentication. The evaluated leaf constants, including Stomatal number, Stomatal index, vein-islet number, and veinlet termination number, serve as diagnostic features for confirming the identity of the plant material and differentiating it from closely related species or possible adulterants.

Moisture content determination is a critical parameter in maintaining pharmacopeial standards. Excess moisture can promote microbial growth and chemical degradation, thereby affecting the stability, safety, and shelf life of the crude drug. Hence, the observed moisture content indicates the quality and proper storage condition of the plant material.

Ash values also play a significant role in the evaluation of crude drugs. The total ash value provides an estimate of the total inorganic content present in the sample. It is particularly useful in detecting the presence of foreign inorganic matter such as silica, sand, soil, or metallic salts, which may indicate contamination or adulteration.

Fluorescent analysis revealed characteristic color changes under different reagents and UV light, which can helpful for identification of correct drug material (Table 6). Determining the Saponin content is helpful to know the presence of Saponin and it also helpful for carry out any other formulation. (Table 5)

Furthermore, extractive values are important indicators of the quantity of active constituents present in the crude drug. In the present study, the alcohol-soluble extractive value (24% w/v) was found to be higher than the water-soluble extractive value (13.6% w/v), suggesting that a greater proportion of phytoconstituents are soluble in alcohol. These extractive values serve as useful parameters for evaluating the solvent-soluble components and overall quality of the crude drug.

Leaf constants

Stomatal number and Stomatal index

- **Stomatal number:** The average number of stomata present per square millimeter of the epidermis is known as Stomatal number.
- **Stomatal index:** The ultimate divisions of the epidermis of a leaf percentage which have been changed into stomata is termed the Stomatal index.

$$S\ I = \frac{S}{E+S} \times 100$$

Where,

S = quantity of stomata per unit area

E = amount of ordinary epidermal cells in the same unit area.

- **Vein-islet number:** Vein-islets per sq. mm calculated from four contiguous squares in the central portion of the lamina, midway in the middle of the midrib and the margin.
- **Veinlet termination number:** The number of veinlet termination per sq.mm of the leaf surface, midway between the midrib of the leaf and its margin.

RESULTS

Calibration

Standard scale length of stage micrometer = 1mm

1mm divided into 100divisions

Therefore 1 division of stage micrometer = 1/100 = 0.01mm or 10µm

5 divisions of eye piece micrometer = 4 divisions of stage micrometer

The value of one division of eye piece micrometer is calculated as follows

1 division of stage = 0.01mm = 10µm

4 division of stage = 40µm

Now, 5 division of eye piece = 4 division of stage i.e. 40 µ

1 division of eye piece micrometer = 40 / 5

= 8 µ

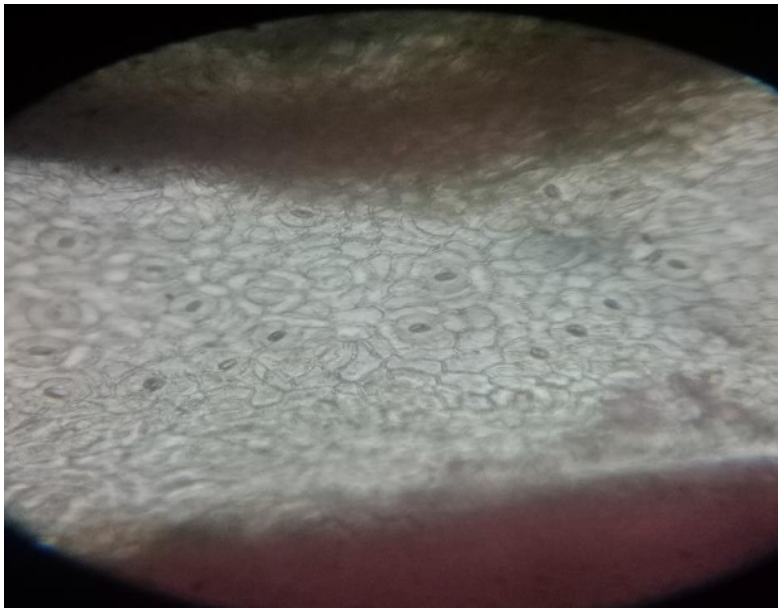


Fig. 1.6 Microscopic image of stomata (anomocytic stomata)

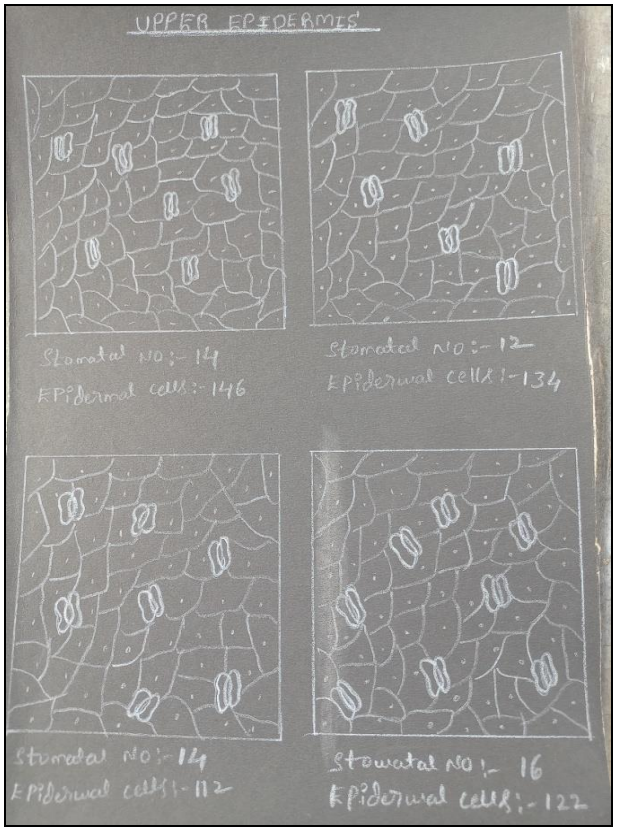


Fig. 1.6.1 Upper epidermis.

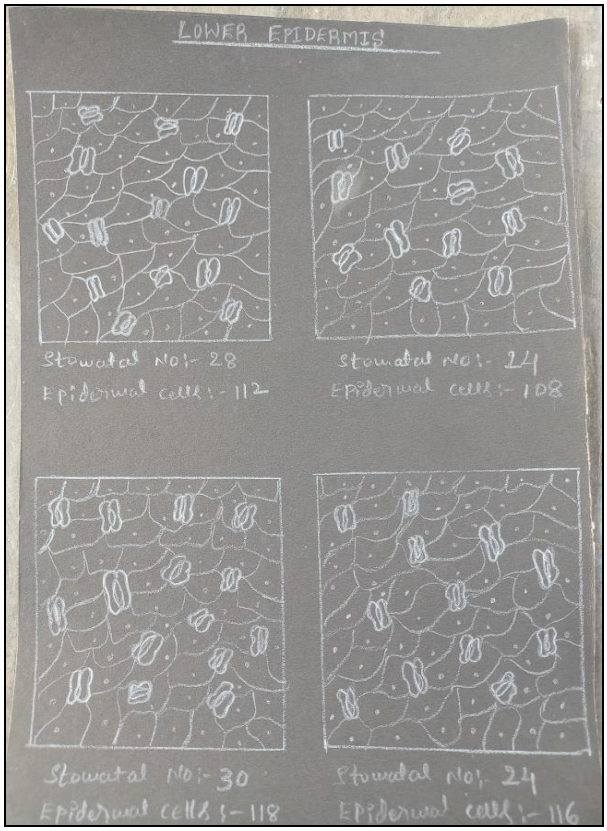


Fig. 1.6.2 Lower epidermis.

Vein-islet and Vein termination

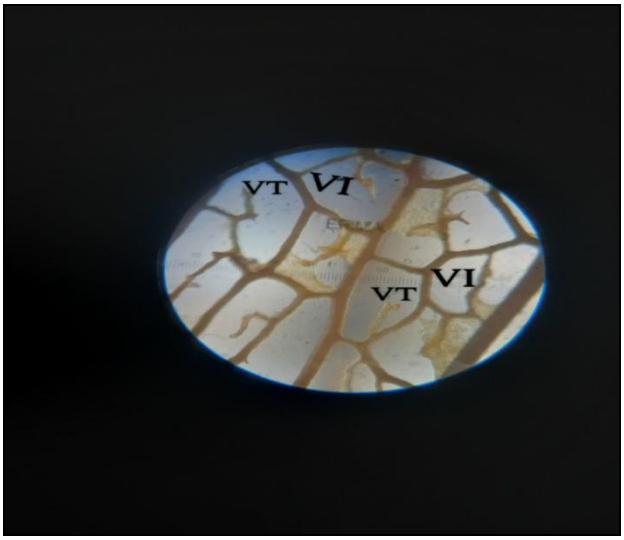


Fig.1.6.3 Microscopic image.

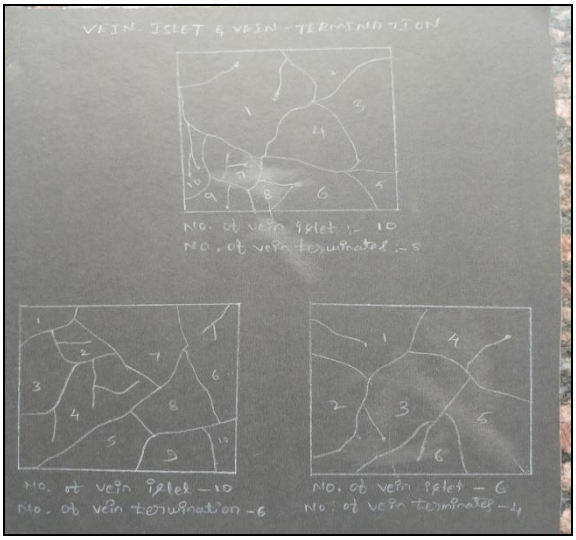


Fig.1.6.4 VI and VT drawn by using camera Lucid.

VI – VEIN ISLETS
VT – VEIN TERMINATES

Table 2: Results Of Leaf Constants of *Filicium decipiens* leaf.

Leaf constants	Value per sq. mm
Stomatal Number Upper epidermis	14
Lower epidermis	26.5
Stomatal Index Upper epidermis	9.915
Lower epidermis	18.89
Vein Islet Number	8.66
Vein Termination Number	6

Table 3: Showing Results for Quantitative Evaluation of the Leaf of *Filicium decipiens*.

Evaluation parameter	Leaf (%W/W)
Moisture content Fresh sample	52.77
Powdered sample	9
Total ash	11.33
Acid insoluble ash	1.55
Water soluble ash	7.55
Sulphated ash	12.6

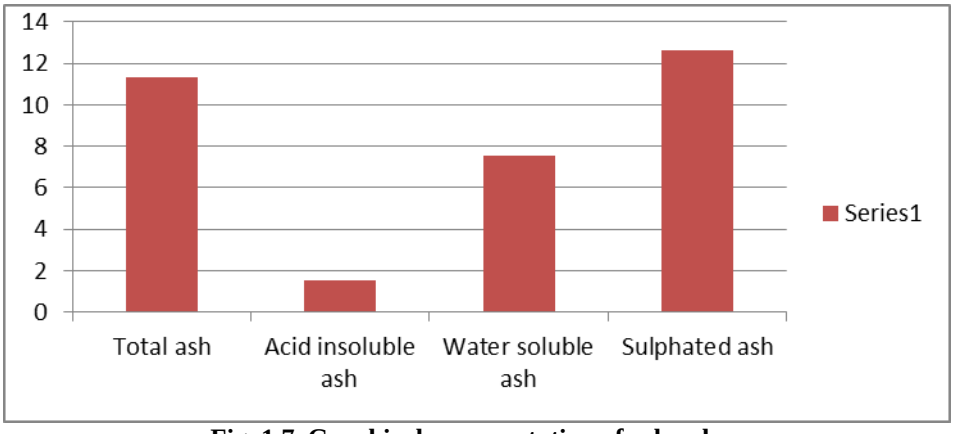


Fig. 1.7. Graphical representation of ash value.

Table 4: Extractive Values of Leaf of *Filicium decipiens.*

Evaluation parameter	Leaf (%W/V)
Alcohol soluble extractive value	24
Water soluble Extractive value	13.6

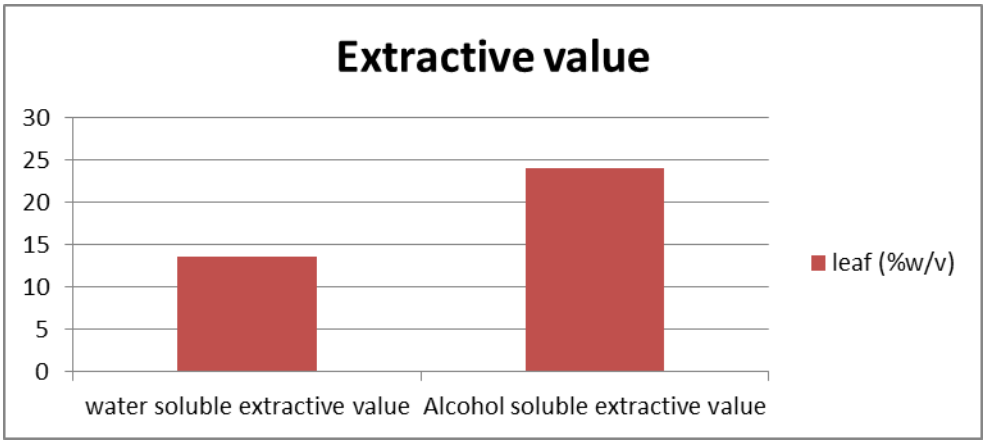


Fig. 1.8. Graphical representation of extractive value (The result shows higher amount of phytoconstituents dissolves in alcohol than the water**)**

Table 5: Foaming index of leaf powder of *Filicium decipiens.*

Concentration (ml)	Height/length of the foam in cm	Foaming index
1	2.2 cm	Greater than 1000
2	2.1 cm	
3	2.9 cm	
4	3.1 cm	
5	3.0 cm	
6	2.8 cm	
7	3.3 cm	
8	2.6 cm	
9	2.2 cm	
10	3.6 cm	

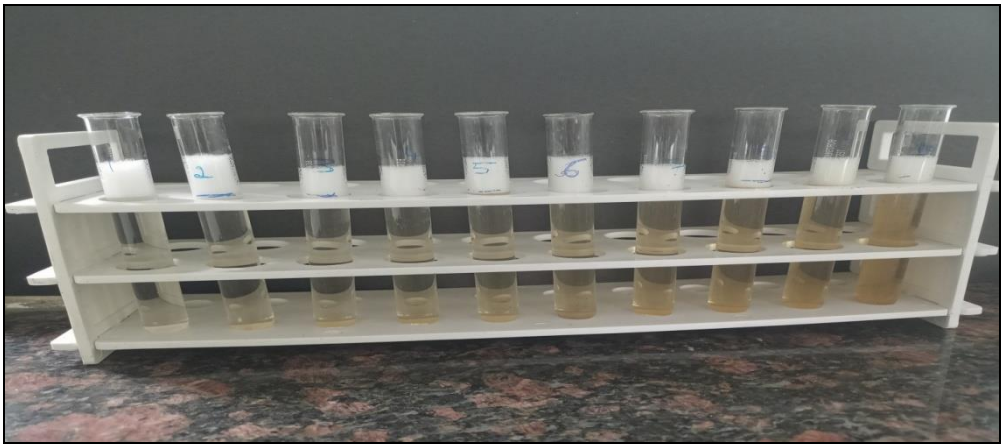


Fig. 1.9. Picture showing the height/ length of the foam.

From this above data we clearly understand that height of the foam in every test tube is greater than 1, so the foaming index is found to be greater than 1000.

Table 6: Fluorescent analysis of leaf powder of *Filicium decipiens* at 254nm and 366nm.

	Color		
Reagents	**Daylight**	**At 254nm**	**At 366nm**
Dist. Water	Light green	violet	Greenish purple

Conc. HNO_3	Light red	Dark purple	Purplish black
1% KOH	Light green	Blackish purple	Sky blue
1N. aq. NaoH	Dark green	purple	Violet purple
50% H_2SO_4	Light green	Purplish green	Dark purple
50% HNO_3	Brown	Dark purple	Blackish purple
50% HCl	Light green	Dark purple	Whitish purple
Methanol	Dark green	Light red	Red
Benzene	Dark green	Dark purple	Red

Table 7: Total chlorophyll content of fresh leaf of *Filicium decipiens.*

Chlorophyll a (mg/g)	Chlorophyll b(mg/g)	Total chlorophyll (mg/g)
0.099	0.177	0.276

Table 8: Qualitative Analysis of Phytochemicals in Leaf of *Filicium decipiens.*

PHYTOCONSTITUENTS	PE	CL	EA	ME
Alkaloids	-	-	-	-
Glycosides	-	-	-	+
Saponin	-	-	-	++
Flavonoid	-	-	-	+
Carbohydrates	-	+	-	+
Fats and oil	+	-	-	-
Proteins and amino acid	-	-	+	+
Steroid and Triterpenoid	-	-	-	-

Note: (+) = Present; (-) = Absent
PE- Petroleum ether; CL- Chloroform; EA- Ethyl acetate; ME- Methanol

CONCLUSION

The present study provides a comprehensive Pharmacognostical, physicochemical, and phytochemical evaluation of *Filicium decipiens* leaves, establishing key parameters for their identification and standardization. Macroscopic and microscopic analyses confirmed the diagnostic features of the leaf, while quantitative microscopy (Stomatal index, vein islet, and vein termination) supported its authentication. Physicochemical parameters such as ash values, loss on drying, extractive values, and foaming index offer reliable standards for assessing the purity and quality of the crude drug. The observed alcohol- and water-soluble extractive values indicate the presence of significant bioactive constituents. Fluorescence analysis further contributed characteristic features useful for drug identification. Preliminary phytochemical screening revealed the presence of important secondary metabolites, including flavonoids, saponins, glycosides, and fats, proteins which may be responsible for the plants reported therapeutic activities. Additionally, chlorophyll estimation provides supportive biochemical data. Overall, this study establishes a scientific basis for the proper identification, quality control, and standardization of *Filicium decipiens* leaves, supporting their traditional medicinal use and paving the way for future research and development of herbal formulations.

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CONFLICTS OF INTEREST

No conflicts of interest.

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