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COMPREHENSIVE PHARMACOGNOSTIC PROFILING OF *GARCINIA GUMMI GUTTA (L). N. ROBSON* LEAF

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ABSTRACT

The present investigation aimed to standardize the leaf of *Garcinia gummi-gutta (L.) N. Robson* (Clusiaceae) through detailed pharmacognostical and physicochemical evaluation. The plant was authenticated by Dr. V. Rama Rao, Research Officer (Botany), Central Ayurveda Research Institute, Bengaluru. Microscopic studies of the leaf transverse section revealed a uniseriate epidermis with a thin cuticle and paracytic stomata restricted to the lower epidermis. The lamina showed a distinct palisade and compact spongy mesophyll with cluster crystals, while the midrib exhibited collenchymatous tissues, vascular bundles arranged in a ring, pericyclic fibers, resin canals, and prismatic and styloid crystals. Powder analysis confirmed the presence of epidermal cells, stomata, guard cells, palisade cells, starch grains, cluster and rosette crystals, scalariform and spiral vessels, and xylem fibers. Physicochemical parameters such as leaf constants, moisture content, ash values, extractive values and fluorescence analysis were determined to support quality assessment. These parameters can be used for the identification and standardization of the plant, providing valuable information for future research and applications.

KEYWORDS: Garcinia gummi gutta Morphology Microscopy Physico chemical parameters.

1. INTRODUCTION

Traditional medicine, as described by the World Health Organization, encompasses the collective knowledge, skills, and practices rooted in the theories, beliefs, and cultural experiences of different communities. Whether scientifically explained or not, these practices are applied to maintain health and to prevent, diagnose, improve, or treat physical and mental illnesses.[1] For many centuries, people have relied on plants for healing. Plant-based products whether consumed as food or prepared as botanical potions and powders have been used throughout history, with varying degrees of success, to treat and prevent diseases.[2]

Garcinia is the largest genus of the Clusiaceae family comprising nearly 250 species. *Garcinia gummi-gutta (L.) Roxb.* (Syn.*: Garcinia cambogia (Gaertn.)* Desr; Common name: *Malabar tamarind*), is one of the most important members of the Clusiaceae family.[3] Nine Garcinia species were distributed wildly in the Western Ghats region *(G. gummi-gutta, G. imberti, G. indica, G. morella, G. pushpangadaniana, G. rubro echinata, G. talbotii, G. travancorica and G. wighti).*[4]

Among the different *Garcinia* species, *G. gummi-gutta* is the most widely distributed *Garcinia* species in Kerala, south India. The fruit is used as culinary spice, preservatives and also as a source of several nutraceutical products. The fruit contains 10% to 30% (-) hydroxycitric acid (HCA), a well-known hypo-lipidemic agent and an important constituent of food supplement for weight management. The species is a rich source of the bioactive benzophenones camboginol (garcinol) and cambogin (isogarcinol).

Different plant parts of *Garcinia* species, mostly fruit, fruit rind, leaves and bark have been used worldwide as traditional medicine in the treatment of various ailments such as obesity, inflammation, microbial infection, abdominal pain, dysentery, diarrhea, infected wound, leucorrhea, chronic ulcer, gonorrhea, oxidative stress and cancer.

Numerous pharmacological activities such as anticancer, antiobesity, diuretic, anti-inflammatory, antibacterial, antiviral, antifungal, anti-HIV, antidepressant and antioxidant have been reported for the *Garcinia* species. Previous chemical investigations on the leaves, bark and fruits of *Garcinia* species have shown that the major constituents included biologically active biflavonoids, xanthones, benzophenones and organic acids and the minor constituents were terpenoids, steroids, flavonoids and phenolic acids.[5]

Leaves: Elliptic, obelliptic-ovate, 6-13 x 2.5-6 cm.[6]

Due to the limited scientific data available on *Garcinia gummi-gutta* leaves, the present study was undertaken to carry out detailed macroscopical, microscopical, and quantitative evaluations. The microscopical examination included transverse sections (T.S.), longitudinal sections (L.S.), and analysis of the powdered leaves. Quantitative analysis of the dried crude powder involved determining moisture content, total ash, water-soluble ash, acid-insoluble ash, sulphated ash, as well as extractive values in water and alcohol as a solvent.

Taxonomical classification
Kingdom: Plantae
Division: Tracheophytes
Class: Magnoliopsida
Order: Malpighiales
Family: Clusiaceae
Genus: *Garcinia*
Species: *G. gummi gutta*
Common name: *Malabar tamarind, kudampuli, brindle berry, upagi mara, simai hunase, Kodakkapuli.*

Synonyms
- *Cambogia gummi-gutta L.*
- *Cambogia gutta L.*
- *Garcinia affinis.*
- *Garcinia cambogia Desr.*
- *Garcinia gutta Roxb.ex wall.*
- *Mangostana cambogia Gaertn.*[7]

Vernacular names[8]
- Kannada- *Upagi mara, simai hunase.*
- Telugu- *Simachinta*
- Marathi- *Dharambe*
- Tamil- *Kodakkapuli*
- Sanskrit- *Vrukshamlah*
- Hindi- *Bilatti-amli*
- Malayalam- *Kadumpuli, kodapuli, marapuli, meenpuli, perumpuli, pinumpuli, pinar.*

2. MATERIALS AND METHODS

Collection of plant material
In October 2025, the plant material was collected from Ponnampet in the southern part of the Kodagu district, Karnataka, India. The plant was identified and authenticated by Dr. V. Rama Rao, Research Officer (Botany), Central Ayurveda Research Institute, Bengaluru. An 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 leaves
The collected leaves of Garcinia gummi-gutta were shade-dried at room temperature until a constant weight was obtained. The dried material was then coarsely powdered using a mechanical grinder, passed through sieve No. 80 to obtain a uniform particle size, and stored in an airtight container in a cool and dry place for further experimental studies.

3. Experimental procedure: Macroscopical studies[9]
The leaves of *Garcinia gummi-gutta* 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[10]
Free-hand transverse sections of fresh leaves were prepared for microscopic studies. The sections were cleared with chloral hydrate solution, washed with water, stained with safranin, and examined under a microscope.

Similarly, the powdered drug prepared from dried leaves was treated with chloral hydrate solution, washed with water, stained with safranin, and observed under the microscope for powder microscopy analysis.

Physicochemical constants[11-13]
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[14]
Preliminary phytochemical screening of the leaves of *Garcinia gummi-gutta* 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

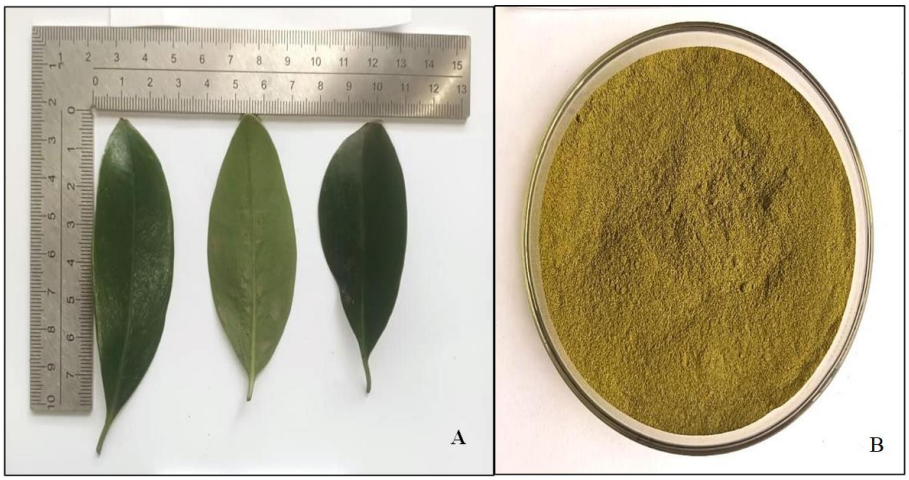


Fig. 1.1 A. Measurement of Fresh Leaves. B. Leaf Powder.

Table 1: Macroscopical character of leaf of *Garcinia gummi gutta* includes. (Fig. 1)

Colour	Dark green
Odour	Characteristic
Taste	Slightly sour and astringent
Size	5–15 cm in length and 3–6 cm in width
Shape	Elliptical-oblong or obovate
Fracture	Short and slightly fibrous
Texture	Thick, smooth and leathery

Microscopical Character

Transverse section of leaf

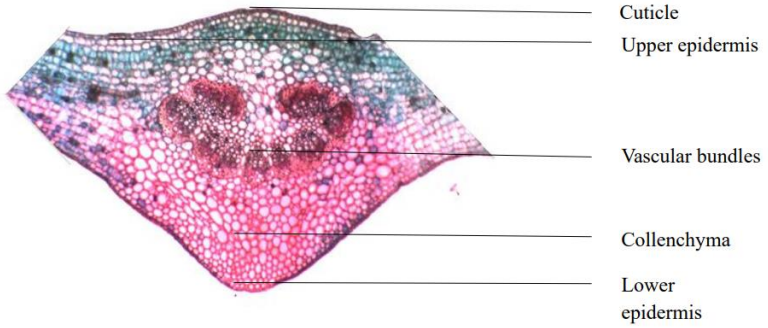


Fig. 1.3 TS of Leaf.

Adaxial and abaxial Surface view of leaf

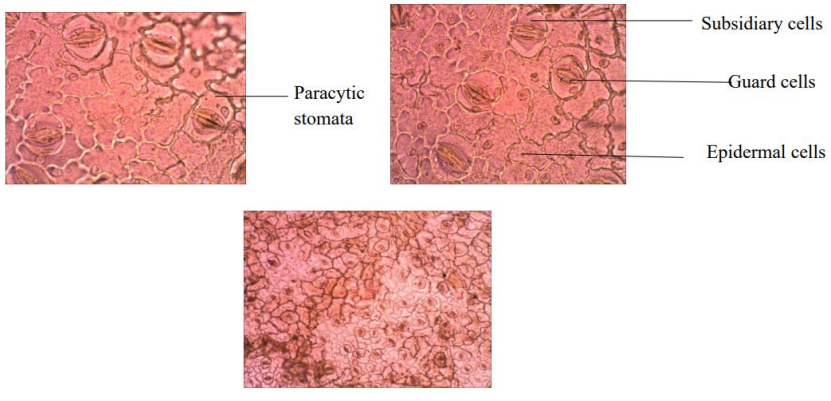


Fig. 1.2. Adaxial and abaxial Surface view of leaf.

TS of Leaf (Lamina)

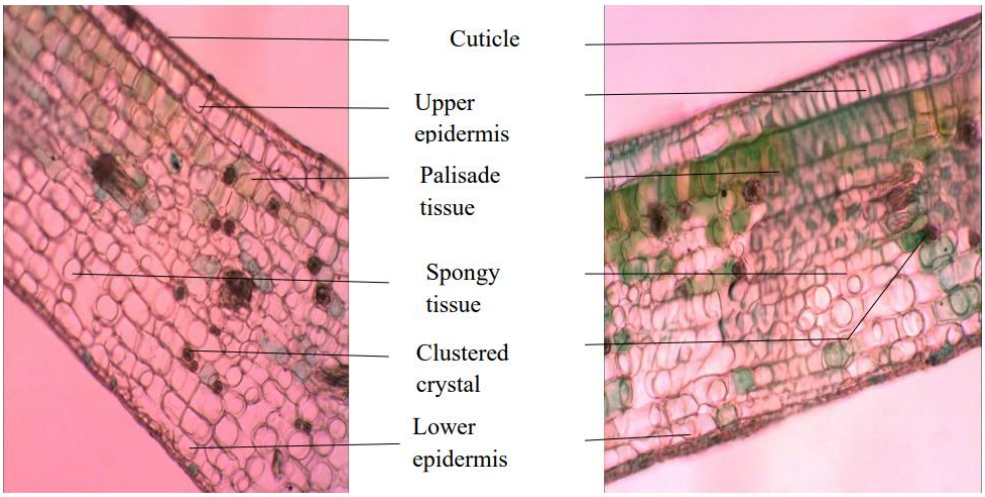


Fig. 1.3.1 TS of Leaf (Lamina)

TS of Leaf (Lamina)

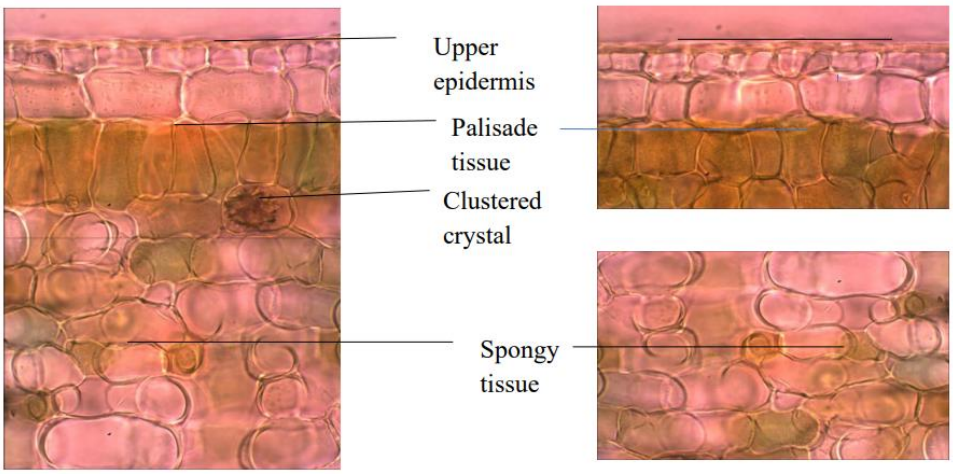


Fig. 1.3.2 TS of Leaf (Lamina)

TS of Leaf (Vascular Bundles)

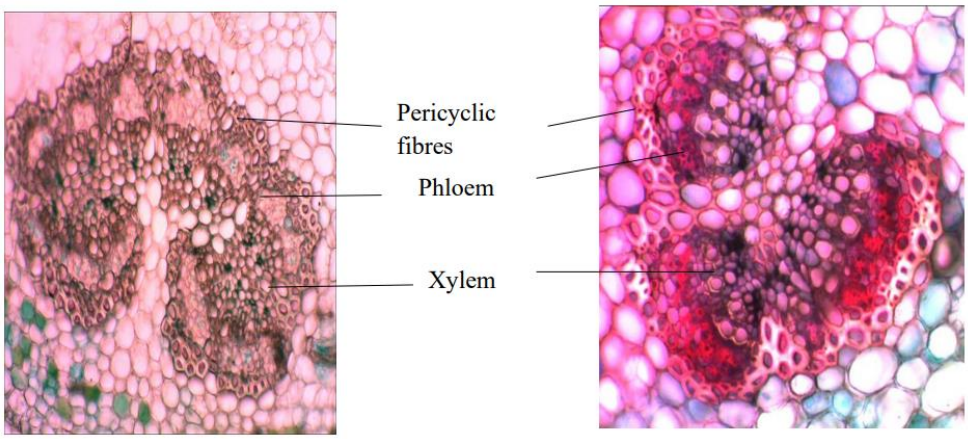


Fig. 1.3.3 TS of Leaf (Vascular Bundles)

TS of Leaf (Midrib)

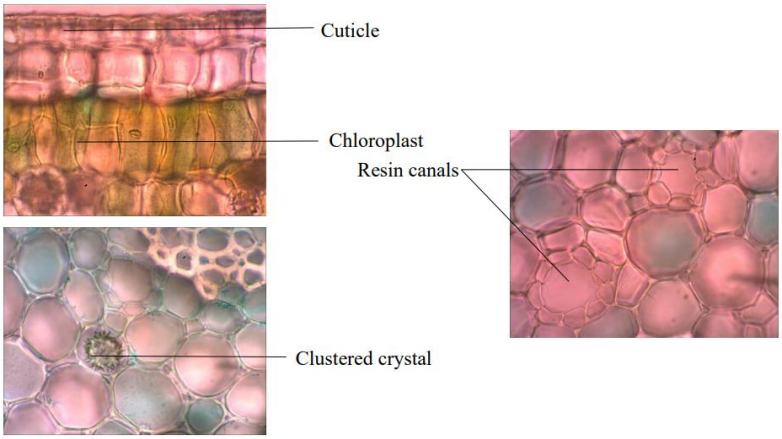


Fig. 1.3.4 TS of Leaf (Midrib)

TS of Leaf

Diagnostic characteristics

Uniseriate epidermis, dominant paracytic type of stomata present only on the lower epidermis, wavy lower epidermal cells (Fig.1.2), much of the leaf interior is occupied with spongy mesophyll without much air spaces.

Lamina

The upper and lower epidermis is uniseriate, consisting of smaller, compactly arranged cells. Thin cuticle is present above the upper and lower epidermis. There is a single layer hypodermis present beneath the upper epidermis.

The mesophyll is differentiated into the upper palisade and lower spongy zone. The palisade mesophyll consists of 1-2 layers of densely packed, columnar parenchyma cells with abundant chloroplasts. Clusters crystals are present in both palisade and spongy tissue. The parenchyma cells of the spongy mesophyll have very few chloroplasts and compactly arranged without large intracellular spaces. (Fig.1.3.1, Fig.1.3.2).

The lower epidermis consists of paracytic stomata (Fig.1.2).

Midrib

Single layer of upper and lower epidermal cells with cuticle; upper epidermis contains styloid and prismatic crystals. The upper epidermis is followed by 6-7 layers of collenchyma tissues, which is also continued as a band above the lower epidermis. The vascular tissue is resolved into a ring of unequal-sized vascular bundles. Each vascular bundle is covered with pericyclic fibres, clustered crystals and resin canals are present in the collenchyma tissue at the lower epidermis of the midrib (Fig.1.3, Fig.1.3.3, Fig.1.3.4).

Powder microscopy of Leaf

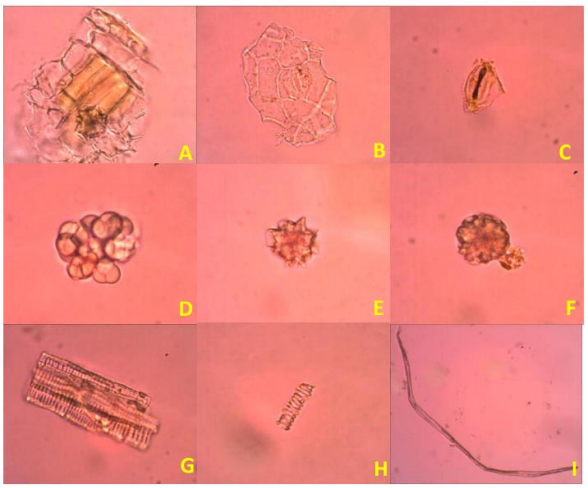


Fig. 1.4 Powder microscopy of Leaf.

A- Upper epidermis and palisade cells; **B**- Epidermal cells and stomata; **C**- Guard cells; **D**- Starch grains; **E**- Clustered Crystal; F- Rosette crystal; **G**- Group of Scalariform vessels; **H**- Spiral xylem vessel; **I**- Xylem fibre.

Powder microscopy

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

microscopy of the leaf showed the presence of upper epidermis and palisade cells; Epidermal cells and stomata; Guard cells; Starch grains; Clustered crystal; Rosette crystal; Group of scalariform vessels; Spiral xylem vessel and xylem fibre (Fig. 1.4).

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.

Fluorescence analysis is used to identify and authenticate crude drugs based on their characteristic fluorescence under Ultraviolet Light. It also helps in detecting adulteration and ensuring the quality and purity of herbal drugs.

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 (16.8% w/w) was found to be higher than the water-soluble extractive value (15.2% w/w), 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[8]

Stomatal number and stomatal index

- **Stomatal number:** The average amount of stomata per square millimeter of epidermis is termed the 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 quantity of veinlet terminations was determined per sq. mm of the leaf surface.

RESULTS

Calibration

Calibration of one division of eye piece micrometer 1 division of stage micrometer = 0.01mm ~10µ.

6 divisions of eye piece micrometer =5 divisions of stage micrometer The value of one division of eye piece micrometer is calculated as follows. Therefore,

1 division of stage = 0.01mm ~ 10µ. 5 divisions of stage = 0.05mm ~ 50µ.

Now, 6 division of eye piece = 5 divisions of stage i.e. 50µ. 1 division of eye piece micrometer = 50 / 6 = 8.3µ.

Fig. 1.5 Microscopic image of stomata.

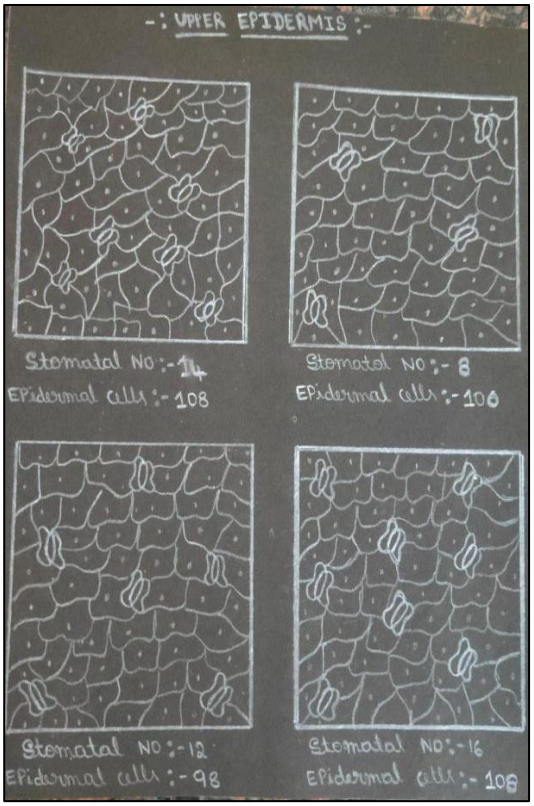


Fig. 1.5.1 Upper epidermis.

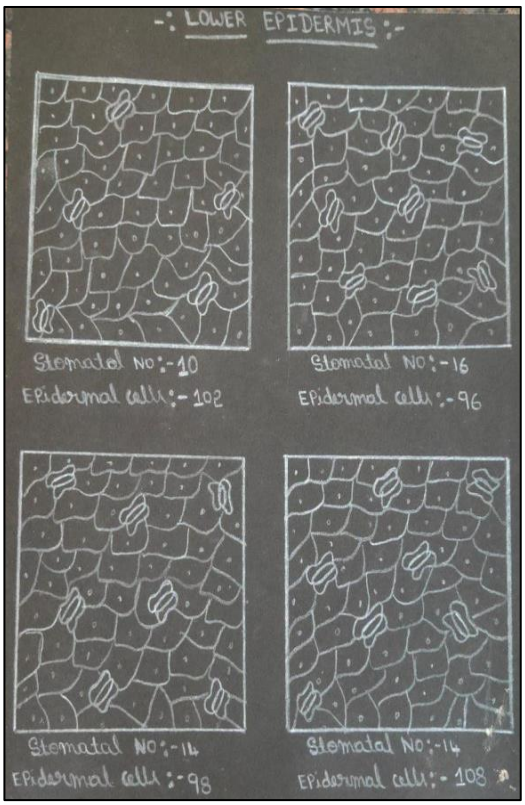
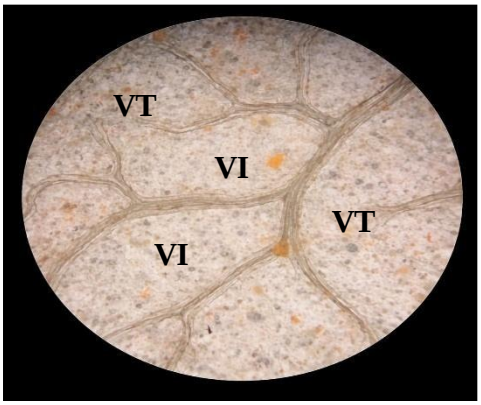


Fig. 1.5.2 Lower epidermis.



VI – VEIN ISLETS
VT – VEIN TERMINATES

Fig.1.5.3 Microscopic image.

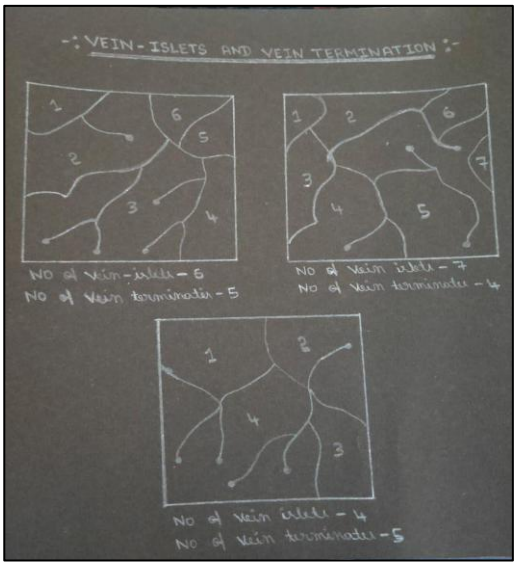


Fig.1.5.4 VI and VT drawn by using camera lucida.

Table 2: Leaf Constants of *Garcinia Gummi Gutta.*

LEAF CONSTANTS	VALUE PER SQ. MM
Stomatal Number Upper epidermis	10.66
Lower epidermis	11.8
Stomatal Number Upper epidermis	12.5
Lower epidermis	13.5
Vein Islet Number	5.66
Vein Termination Number	4.66

Table 3: Quantitative Evaluation of the Leaf of *Garcinia Gummi Gutta.*

EVALUATION PARAMETER(%W/W)	LEAF (%W/W)
Moisture content Fresh sample	69.53
Powdered sample	8.6
Total ash	8.6
Acid insoluble ash	2.76
Water soluble ash	3.53
Sulphated ash	1.2

Table 4: Extractive Values of Leaf of *Garcinia Gummi Gutta.*

EVALUATION PARAMETER(%W/W)	LEAF (%W/W)
Alcohol soluble extractive value	16.8
Water soluble Extractive value	15.2

Table 5: Fluorescence analysis of leaf powder of *Garcinia Gummi Gutta.*

SI.NO	SOLVENTS	DAY LIGHT	254 nm	366 nm
1.	Distilled water	Light green	Dark purple	Light purple
2.	Concentrated HNO_3	Orange red	Dark purple	Blackish purple
3.	1 % KOH	Yellowish green	Dark purple	Blackish purple
4.	1 N aqueous NaOH	Orange green	Black	Blackish purple
5.	50 % H_2SO_4	Light green	Purple	Green
6.	50 % HNO_3	Light green	Dark purple	Light purple
7.	50 % Hcl	Reddish brown	Dark purple	Dark purple
8.	Methanol	Light green	Dark purple	Red
9.	Benzene	Green	Blackish red	Reddish pink

Preparation of Leaf Extracts

Preparation of leaf extracts by Soxhlet apparatus using different polar and non polar solvents such as petroleum ether, ethyl acetate, chloroform, methanol.

Percentage yield = $\frac{\text{Weight of the extract}}{\text{weight of packing material}}$ x 100

Table 6: Percentage of leaf extract of *Garcinia Gummi Gutta.*

SI.NO	SOLVENTS	PERCENTAGE YIELD (%)
1.	Petroleum ether	6.33
2.	Chloroform	5.80
3.	Ethyl acetate	1.38
4.	Methanol	21.40

Fig. 1.6.1. Leaf extracts.

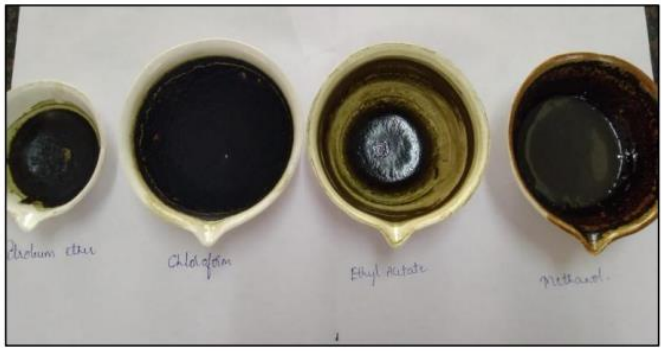


Fig. 1.6. Soxhlet apparatus.

Preliminary Phytochemical Studies[15]

The preliminary phytochemical investigation of the petroleum ether, chloroform, ethyl acetate, methanol extract of leaf of Garcinia gummi gutta showed the presence of alkaloids, glycosides, saponin, flavonoid, carbohydrate, fat and oil, proteins and amino acid, steroid, triterpenoid presented in Table 7.

Table 7: Qualitative Analysis of Phytochemicals in Leaf of *Garcinia Gummi Gutta.*

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

5. CONCLUSION

Standardizing crude drugs is essential to ensure their unique identification and quality. Most standard parameters are determined through a plant's physicochemical properties and microscopic features. Before inclusion in the Pharmacopoeia, plants should have established standards. Therefore, standardization is crucial for maintaining the quality of crude drugs and their formulations. This study aims to develop pharmacognostical standards such as macroscopic and microscopic characteristics and physicochemical constants to support the efficacy of Ayurvedic medicine and encourage further scientific investigation into traditional plant-based claims.

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CONFLICTS OF INTEREST: No conflicts of interest.

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