Original Article

Pharmacognostic, Physicochemical, and Preliminary Phytochemical Evaluation of the Leaves of Jatropha gossypiifolia Linn.

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ABSTRACT

Background: *Jatropha gossypiifolia Linn.* is a medicinal plant of the family Euphorbiaceae for which pharmacognostic and quality-control information is useful for authentication of crude leaf material. **Objective:** The present study evaluated the pharmacognostic, physicochemical and preliminary phytochemical characteristics of *J. gossypiifolia* leaves. **Materials and Methods:** Leaves were collected from Nellikuppam, Cuddalore, Tamil Nadu, India, in January 2026 and authenticated by a botanist. Macroscopic and organoleptic characters, transverse anatomical features, leaf constants and powder microscopy were examined. Foreign organic matter, loss on drying, ash values and solvent-soluble extractive values were determined. A hydroalcoholic leaf extract was subjected to preliminary phytochemical screening using qualitative chemical tests. **Results:** The leaves were alternate and palmately lobed, with a deeply cordate base, glandular margins and a relatively long petiole. Anatomical examination showed a dorsiventral lamina, distinct vascular bundles, glandular and nonglandular trichomes, calcium oxalate crystals and characteristic latex-containing tissues. The leaf was hypostomatic, with anomocytic stomata on the lower surface. Stomatal number on the lower epidermis was 225–275/mm² and stomatal index was 15.78–17.46. Powder microscopy revealed epidermal cells with stomata, trichomes, xylem vessels with scalariform, spiral and pitted thickenings, fibres, crystals, palisade tissue, petiole fragments and oil droplets. Foreign organic matter was reported as nil and loss on drying as 18%. Extractive values ranged from 2.70% to 16.20% w/w. Preliminary screening indicated alkaloids, carbohydrates, saponins, tannins, mucilage, flavonoids, coumarins and volatile oils, while glycosides, phytosterols, terpenoids, triterpenoids, fixed oils/fats and gums were reported as absent. **Conclusion:** The documented morphological, anatomical, physicochemical and preliminary phytochemical characteristics provide reference data for authentication and quality assessment of *J. gossypiifolia* leaves.

Key words: Jatropha gossypiifolia, leaf constants, powder microscopy, physicochemical evaluation, phytochemical screening, Euphorbiaceae.

Medicinal plants remain important sources of crude drugs and traditional preparations. *Jatropha gossypiifolia Linn.* (Euphorbiaceae), commonly known as bellyache bush or black physic-nut, is a shrub distributed in tropical and subtropical regions. The plant is traditionally used in different regions for a range of ethnomedicinal purposes, and leaves, roots, seeds and latex have been described in traditional preparations. Previous literature has reported several classes of secondary metabolites from different parts of the plant, including alkaloids, flavonoids, diterpenoids, tannins, steroids, saponins and phenolic compounds [1–5].

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Earlier pharmacological literature describes antimicrobial, anti-inflammatory, antioxidant, haemostatic, antidiarrhoeal and other activities for different extracts and plant parts [6–15]. These reports support continued investigation of the plant but do not substitute for authentication and quality-control data on the crude drug. Pharmacognostic evaluation provides a combination of macroscopic, microscopic and physicochemical characters that can be used to authenticate plant material and detect substitution or adulteration. The present study was therefore undertaken to document the pharmacognostic characteristics, leaf constants, physicochemical parameters and preliminary phytochemical profile of *J. gossypiifolia* leaves.

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2. MATERIALS AND METHODS

2.1 Plant material and authentication

Leaves of *Jatropha gossypiifolia Linn*. were collected from Nellikuppam, Cuddalore, Tamil Nadu, India, during January 2026. The plant material was authenticated by Dr. S. Dhanam, P.G. & Research Department of Botany, Arignar Anna Government Arts College, Villupuram. The collected leaves were shade-dried, powdered using a mixer, and sieved before analysis.

2.2 Pharmacognostic evaluation

Macroscopic characteristics were recorded by direct observation and with a low-magnification hand lens. Organoleptic characteristics, including colour, odour, taste and physical appearance, were recorded. For anatomical examination, hand sections of the plant material were stained with safranin and mounted in glycerin. Sections were examined under 10× and 40× objectives. Leaf constants were determined from fresh mature leaves. The portion between the midrib and margin from the middle region was cut into small pieces, treated with 10% sodium hydroxide until clear, rinsed with water, mounted in glycerin, and examined microscopically. Stomatal number, stomatal index, epidermal cell number, palisade ratio, vein-islet number, and vein-termination number were recorded. Approximately 0.5 g of finely powdered leaf material was mounted in glycerin for 2 h at room temperature and examined under 10× and 40× objectives using a bright-field microscope. Photomicrographs of diagnostic characters were captured using the attached camera.

2.3 Physicochemical evaluation

Physicochemical evaluation included foreign organic matter, loss on drying, ash values, and solvent-soluble extractive values. The procedures were reported in the research as being based on WHO guidelines (2001). For foreign organic matter, 100 g of air-dried coarse drug was spread in a thin layer, examined visually and with a 6× lens, and foreign material was separated and weighed. Total ash was determined by incinerating 2 g of air-dried powder at a temperature not exceeding 450 °C until free from carbon. Water-soluble and acid-insoluble ash were determined from the total ash fraction using the procedures described in the research. For loss on drying, 1 g of powdered leaf was dried at 100–105 °C for 1 h, cooled in a desiccator, and reweighed. Extractive values were determined by macerating 5 g of coarse powder with 100 mL of solvent for 24 h, with frequent shaking during the first 6 h, followed by filtration and evaporation of an aliquot. The reports extractive values for aqueous, chloroform, acetone, petroleum ether and n-butanol extracts.

2.4 Preliminary phytochemical screening

A hydroalcoholic extract of *J. gossypiifolia* leaves was subjected to qualitative preliminary phytochemical screening using standard chemical tests described. Tests were performed for alkaloids, carbohydrates, glycosides, phytosterols, saponins, tannins, mucilage, terpenoids, triterpenoids, flavonoids, coumarins, fixed oils and fats, gums and volatile oils.

3. RESULTS

3.1 Macroscopic and organoleptic characteristics

Jatropha gossypiifolia is a small shrub with dark green to purplish-red leaves. Young leaves were dark purple and became dark green with maturity. The leaves were alternate and palmately lobed, generally with three to four lobes, an ovate to suborbicular outline and a deeply cordate base. The apex was acute to acuminate, and the margins were glandular. The leaf surfaces were described as rough because of hairs. The petiole was approximately 6–9 cm long, purple, and covered with branched brown glandular hairs (Figure 1).

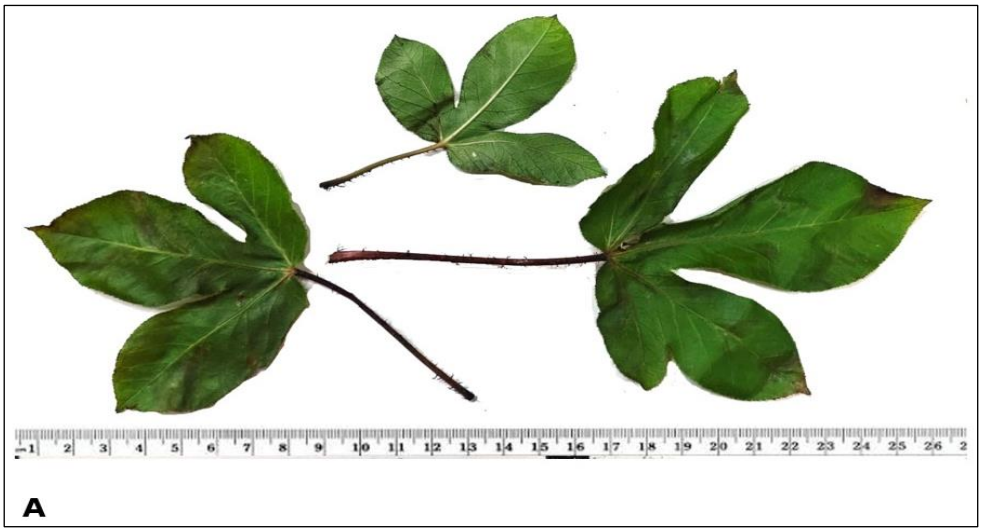


Figure 1. Jatropha gossypiifolia leaf morphology: mature leafy branch showing the characteristic palmately lobed leaves and long petioles.

3.2 Anatomical characteristics

The transverse section of the petiole was almost circular. The epidermis consisted of a single layer of rectangular cells with a thick cuticle, followed by 3–4 rows of collenchymatous hypodermis and 2–3 rows of chlorenchyma. The ground tissue consisted of thin-walled polygonal parenchyma. Branched glandular and a few nonglandular trichomes were observed in the epidermal region. Vascular bundles were arranged in a wavy ring; seven prominent vascular bundles and smaller bundles were described as conjoint, collateral, and open. Small calcium oxalate crystals were observed in the phloem region, and the pith occupied a large central area. Representative anatomical sections are shown in Figure 2.

The leaf was dorsiventral. The epidermis was single-layered and strongly cuticularized. The midrib contained collenchymatous tissue and a central arc-shaped vascular bundle with accessory bundles. Calcium oxalate crystals and pink-coloured contents were reported in the ground tissue and vascular region. The lamina showed a single layer of compact upper palisade cells and 6–7 rows of spongy parenchyma with some intercellular spaces. Anomocytic stomata were mainly observed on the lower epidermis, together with glandular and nonglandular trichomes.

The research also records diagnostic microscopic features in the stem and root, including collateral vascular bundles, laticifers, xylem vessels with spiral and pitted thickening, lignified fibres, a cork layer in the root, starch grains and occasional calcium oxalate crystals. These observations provide additional anatomical characters for plant-material identification.

3.3 Leaf constants

The leaf was hypostomatic, with anomocytic stomata reported on the lower surface. The measured stomatal number and stomatal index, together with the palisade ratio, vein-islet number and vein-termination number, were recorded as diagnostic leaf constants (Table 2).

3.4 Powder microscopy

Powder microscopy revealed epidermal cells with stomata, trichomes including multicellular trichomes, xylem vessels with scalariform, spiral and pitted thickenings, veins, palisade tissues, fibres, crystals, petiole cells and oil droplets. These microscopic fragments constitute useful diagnostic characters of the powdered leaf drug. Representative powder-microscopy fields are shown in (Figure 3) (Table 1).

Table 1. Organoleptic characteristics of Jatropha gossypiifolia Linn leaf powder.

Parameter	Observation
State	Solid
Nature	Fine
Odour	Characteristic odour
Touch	Soft
Appearance	Brownish green
Taste	No characteristic taste

3.5 Physicochemical parameters

The report's absence of foreign organic matter and a loss on drying of 18%. Among the reported extractive values, chloroform gave 16.20 ± 0.117% w/w, followed by aqueous extract (14.10 ± 0.042% w/w), n-butanol (6.76 ± 0.565% w/w), acetone (5.93 ± 0.357% w/w), and petroleum ether (2.70 ± 0.042% w/w) (Table 3).

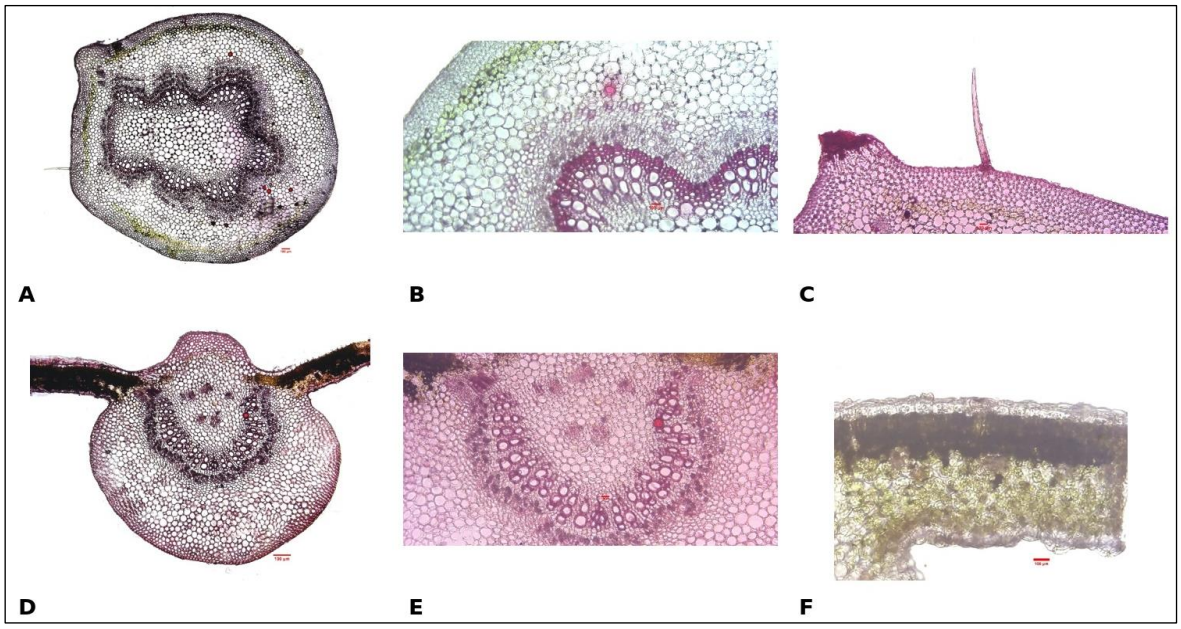


Figure 2. Anatomical features of Jatropha gossypiifolia leaf material. Representative transverse sections illustrating petiole and leaf tissues, vascular bundles and epidermal features. Panels A–F were selected from the micrographs.

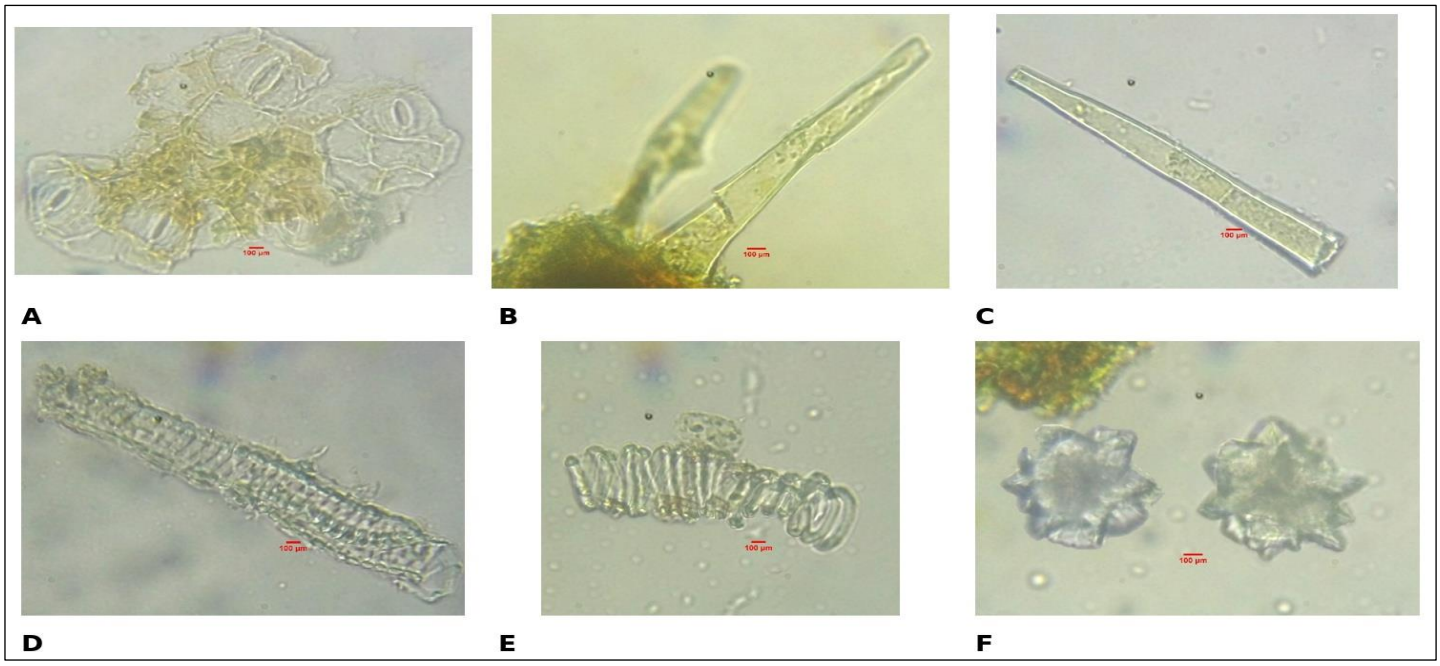


Figure 3. Powder microscopy of Jatropha gossypiifolia leaves. Representative diagnostic fragments including epidermal tissue, trichomes, xylem vessels, and other powdered-drug characters. Panels A–F were selected from the micrographs.

Table 2. Quantitative leaf constants of Jatropha gossypiifolia Linn.

Parameter	Upper epidermis (/mm²)	Lower epidermis (/mm²)
Stomatal number	0	225–275
Epidermal cell number	1050–1175	1200–1300
Stomatal index	0	15.78–17.46
Palisade ratio	12–17	—
Vein-islet number	6–10	—
Vein-termination number	15–25	—

Table 3. Physicochemical parameters of Jatropha gossypiifolia Linn. leaf powder.

Parameter	Result
Foreign organic matter	Nil
Loss on drying	18%
Aqueous extractive	14.10 ± 0.042 % w/w
Chloroform extractive	16.20 ± 0.117 % w/w
Acetone extractive	5.93 ± 0.357 % w/w
Petroleum ether extractive	2.70 ± 0.042 % w/w
N-butanol extractive	6.76 ± 0.565 % w/w
Total ash	7.80 ± 0.46 % w/w
Water-soluble ash	9.38 ± 0.065 % w/w
Acid-insoluble ash	8.46 ± 0.107 % w/w

3.6 Preliminary phytochemical screening

Table 4. Preliminary phytochemical screening of Jatropha gossypiifolia Linn. leaves.

Phytochemical group	Result
Alkaloids	Present
Carbohydrates	Present
Glycosides	Absent
Phytosterols	Absent
Saponins	Present
Tannins	Present
Mucilage	Present
Terpenoids	Absent
Triterpenoids	Absent
Flavonoids	Present
Coumarins	Present
Fixed oils and fats	Absent
Gums	Absent
Volatile oils	Present

4. DISCUSSION

4.1 Macroscopic and microscopic characters

The macroscopic characters observed in the present study are broadly consistent with earlier pharmacognostic descriptions of *Jatropha gossypiifolia*. The alternate, palmately lobed leaves with a cordate base, acute to acuminate apex, rough surface and glandular margins agree with the description reported by Khyade and Vaikos in authenticated material from Aurangabad, Maharashtra, and with the study of Pande et al., which also described a cordate base, glandular margin, subacute apex and rough surfaces with rigid hairs [16,17]. These similarities support the usefulness of gross morphology for preliminary identification. At the same time, differences in leaf size, colour intensity and degree of pubescence between collections are expected because the earlier studies and the present work used material from different geographic locations and collection conditions.

4.2 Leaf anatomy and quantitative microscopy

The anatomical observations also show substantial agreement with previous reports. The present study recorded a dorsiventral lamina, a single-layered epidermis with a pronounced cuticle, glandular and nonglandular trichomes, collenchymatous tissue in the midrib/petiole, vascular bundles and calcium oxalate crystals. Khyade and Vaikos similarly described a thickly cuticularized epidermis, glandular and nonglandular trichomes, collenchymatous tissue, a dorsiventral leaf and calcium oxalate crystals, while Pande et al. reported anomocytic stomata, secretory structures, calcium oxalate crystals and glandular and simple covering trichomes [16,17]. A notable difference is stomatal distribution and terminology: the present material was hypostomatic with anomocytic stomata concentrated on the lower epidermis, whereas Khyade and Vaikos described an amphistomatic leaf with paracytic stomata occurring on both surfaces, more abundantly below [16]. Such differences may reflect genuine intraspecific variation, different sampling conditions, or differences in microscopic interpretation and preparation; therefore, they should not be treated as contradictions without examination of the original specimens. The present stomatal number (225–275/mm²) and stomatal index (15.78–17.46) add quantitative reference values to the qualitative characters. Earlier work likewise emphasized stomatal index, palisade ratio, vein-islet number and vein-termination number as useful quantitative parameters for crude-drug identification [16]. The distinctive occurrence of stalked glands in *J. gossypiifolia* is also consistent with comparative epidermal work on Jatropha, in which stalked marginal glands were reported as a useful species-level character [18].

4.3 Powder microscopy

The powder-microscopy profile in the present study, including epidermal fragments with stomata, trichomes, xylem vessels with spiral, scalariform and pitted thickenings, fibres, crystals, palisade tissue and petiole fragments, is consistent with the general diagnostic value reported in earlier pharmacognostic studies of *J. gossypiifolia*. Khyade and Vaikos reported polygonal epidermal fragments, mainly lower-surface stomata, glandular and nonglandular trichomes, calcium oxalate crystals, xylem with spiral and pitted thickening, palisade and spongy tissues and laticiferous elements [16]. Pande et al. likewise identified trichomes, calcium oxalate crystals and other microscopic tissues in the leaf powder [17]. The agreement of several microscopic fragments across studies supports their use as complementary markers when the crude drug is supplied in powdered form.

4.4 Physicochemical parameters

The physicochemical results provide reference values for the present Cuddalore collection, but comparison with earlier studies shows that the numerical values are not interchangeable. The present loss on drying was 18%, whereas Khyade and Vaikos reported a moisture content of 4.15% for leaves collected in Maharashtra [16]. Pande et al. also evaluated loss on drying, ash values, and solvent extractives, but used a different set of solvents and reported the highest extractive values with the more polar methanol and water fractions [17]. In the present study, the chloroform extractive value was the highest (16.20%), followed by aqueous extractives (14.10%), whereas acetone, N-butanol and petroleum ether gave lower values. These differences can reasonably be associated with differences in extraction procedure, solvent system, geographical source, season, drying conditions, and plant material. Therefore, the present values are best interpreted as collection-specific quality-control data rather than universal species constants. The research reports water-soluble ash (9.38 ± 0.065%) as higher than total ash (7.80 ± 0.46%); because this relationship is unusual for ash fractions, the original laboratory calculations and raw records should be checked before publication rather than assuming that the reported value is correct.

4.5 Preliminary phytochemical screening in comparison with previous studies

The preliminary phytochemical profile shows both agreement and disagreement with earlier reports, illustrating the variability of qualitative screening results. The present leaves were positive for alkaloids, carbohydrates, saponins, tannins, mucilage, flavonoids, coumarins and volatile oils, and negative for glycosides, phytosterols, terpenoids, triterpenoids, fixed oils/fats and gums. Dubey et al. reported alkaloids, flavonoids, phenols, saponins and terpenoids in methanolic leaf extracts, while tannins, steroids and glycosides were reported as absent [1]. Thus, the present findings agree with Dubey et al. for alkaloids, flavonoids and saponins, but differ for tannins and terpenoids. Pande et al. reported alkaloids, tannins, saponins,

phlobatannins, triterpenes and flavonoids in *J. gossypiifolia* leaves, again showing overlap for alkaloids, tannins, saponins and flavonoids but differences for terpenoid-related constituents [17]. Khyade and Vaikos also detected flavonoids, phlobatannins, phenolics, saponins, tannins and terpenoids [16]. The broader literature review by Félix-Silva et al. documents alkaloids, flavonoids, saponins, tannins, terpenoids and other chemical classes from different parts and extracts of *J. gossypiifolia*, confirming that the chemical profile depends strongly on plant part and extraction approach [2].

4.6 Interpretation of differences among studies

The differences between the present phytochemical results and previous reports should therefore be interpreted cautiously. Qualitative tests indicate the detectable presence or absence of broad chemical classes under the particular test conditions; they do not establish absolute absence of a compound class. Differences may arise from geographic origin, season and developmental stage, drying and storage, extraction solvent, extraction time, test sensitivity and the specific qualitative reaction used. This is especially relevant because previous investigations have used methanol, hydroalcoholic and other solvent systems, while the present work combined crude-drug evaluation with preliminary screening [1,2,16,17]. The comparative evidence supports the value of the present study primarily as a pharmacognostic and quality-control reference for the investigated Cuddalore leaf sample. Confirmation of individual constituents would require chromatographic or spectrometric methods, preferably with authenticated reference standards.

CONCLUSION

The present study documents macroscopic, microscopic, leaf-constant, physicochemical and preliminary phytochemical characteristics of *Jatropha gossypiifolia Linn*. leaves collected from Cuddalore, Tamil Nadu. Diagnostic features include the palmately lobed leaf, glandular and nonglandular trichomes, hypostomatic leaf with anomocytic stomata, characteristic vascular tissues, laticifers and calcium oxalate crystals. The physicochemical evaluation provides reference values for foreign organic matter, loss on drying, extractive values and ash parameters. Preliminary screening identified alkaloids, carbohydrates, saponins, tannins, mucilage, flavonoids, coumarins and volatile oils. Together, these observations provide baseline reference data for authentication and quality assessment of the crude leaf drug and support further phytochemical and pharmacological investigation.

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