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Phytochemical Profiling, Morpho-Anatomic Characterization, and Pharmacognostic Potential of *Dolichandrone falcata*

Research Article

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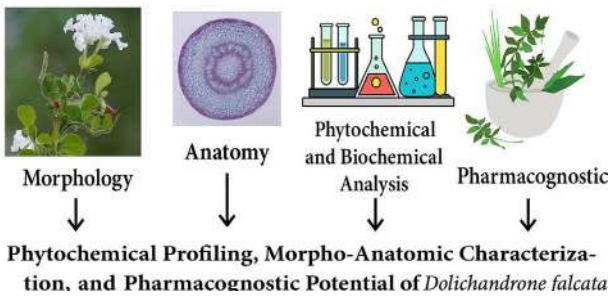
Abstract

Dolichandrone falcata (Bignoniaceae) is a medicinally significant tree known for its diverse pharmacological properties. This study provides a comprehensive evaluation of its phytochemical profile, morpho-anatomical characteristics, and pharmacognostic potential. Morphological and anatomical analyses revealed distinctive features of the stem, leaves, and roots, aiding in species authentication and quality control. Phytochemical screening confirmed the presence of steroids, amino acids, alkaloids, flavonoids, saponins, polyphenols, terpenoids, and cardiac glycosides. Quantitative analysis showed chlorophyll a and b concentrations of 0.0282 mg/g and 0.0560 mg/g in the alcoholic extract, respectively, and extractive values of 68.75% (alcohol) and 100% (water). These bioactive compounds exhibited antioxidant, anti-inflammatory, antimicrobial, and hepatoprotective activities. The study provides up-to-date information on the traditional uses, phytochemistry, and pharmacology of the species, supporting its relevance in both traditional and modern medicine. These findings emphasize the need for further pharmacological and clinical investigations to validate therapeutic efficacy and develop novel plant-based formulations.

Keywords: *Dolichandrone falcata*; Phytochemical Profiling; Morpho-Anatomy; Pharmacognostic Evaluation; Microscopic Analysis; Medicinal Plants



Graphical Abstract

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Introduction

Dolichandrone falcata Seem synonym (Markhamia falcata) belonging to Bignoniaceae. The plant is also called 'medhshingi' in Hindi and 'mesasinghi' in Sanskrit. *Dolichandrone falcata* Seem has a long history of use by indigenous and tribal peoples all over the world, including India, for medicinal purposes and various pharmacological effects.The exploration of medicinal plants has been an integral part of traditional medicine, with modern pharmacognosy playing a crucial role in validating their therapeutic potential through scientific methods. *Dolichandrone falcata* (Wall. ex DC.) Seem., a lesser-known but pharmacologically significant species from the Bignoniaceae family, has been widely used in traditional Indian medicine for treating various ailments, including inflammatory disorders, gastrointestinal disturbances, and respiratory conditions (Patel et al., 2021). However, despite its ethnomedicinal relevance, comprehensive phytochemical profiling and morpho-anatomic characterization remain largely underexplored. Phytochemical investigations of *D. falcata* have suggested the presence of bioactive compounds such as flavonoids, alkaloids, tannins, and glycosides, which contribute to its pharmacological properties (Sharma & Verma, 2020). The standardization of herbal drugs necessitates a thorough understanding of their morphological, anatomical, and physicochemical characteristics, which serve as essential diagnostic tools for authentication and quality control (Rao et al., 2019). Pharmacognostic studies, including morpho-anatomical and physicochemical evaluations, are essential for the identification and quality assurance of herbal drugs. These parameters ensure the consistency, safety, and efficacy of plant-derived formulations. Similarly, phytochemical profiling aids in identifying the bioactive compounds responsible for therapeutic effects, thereby bridging traditional knowledge and modern evidence-based medicine.

Medicinal plants have played a crucial role in the traditional healthcare systems of many cultures and continue to serve as a vital source for drug development in modern pharmacology. The resurgence of interest in plant-based remedies has emphasized the need for comprehensive scientific evaluation of lesser-known yet potentially therapeutic species. One such plant is *Dolichandrone falcata* (Wall. ex DC.) Seem., a member of the family Bignoniaceae, which has long been used in various traditional and folk medicinal systems in India for its therapeutic properties.Morphological studies provide insights into macroscopic features such as leaf structure, bark texture, and floral characteristics, while anatomical analysis aids in the identification of unique cellular and tissue patterns that distinguish the plant from adulterants and substitutes (Kumar & Singh, 2018). Pharmacognostic evaluation is an essential aspect of herbal medicine research, ensuring the safety, efficacy, and consistency of medicinal plant-based formulations (Gupta et al., 2022). Standardized protocols for extraction, isolation, and characterization of phytochemicals further strengthen the scientific validation of plant-based therapeutics. Advances in chromatographic and spectroscopic techniques, such as HPLC, GC-MS, and FTIR, have significantly improved the identification and quantification of bioactive constituents (Mishra et al., 2023).Given the increasing global interest in plant-based drug discovery, this study aims to provide a comprehensive analysis of *Dolichandrone falcata*, encompassing its phytochemical composition, morpho-anatomical characteristics, and pharmacognostic attributes. This integrated approach will contribute to the standardization, authentication, and pharmacological validation of *D. falcata* for future medicinal applications.

Materials and Methods

Plant Material Collection

Dolichandrone falcata (Family: Bignoniaceae) was collected from the **Ahilyanagar District region, Maharashtra, India, in August 2024.** The specimen was authenticated using regional floras, including the *Flora of Ahmednagar*, and cross-verified with relevant botanical references. **A voucher specimen (Voucher No.: DFP-2024-01)** has been deposited at the **Herbarium of the Department of Botany, Sanjivani Arts, Commerce and Science College, Kopargaon, Maharashtra, India.** Fresh plant material was washed, shade-dried at room temperature (25–28°C) for 10–12 days, and ground into a fine powder for further analysis.

Morphological Study

Morphological characteristics of *D. falcata* were examined using fresh plant material. Key features including leaf arrangement, flower structure, stem characteristics, and bark morphology were documented. Observations were compared with descriptions from the *Flora of Ahmednagar* and other published literature to ensure accurate identification and characterization.

Anatomical Study

Microscopic anatomical studies were performed on the leaf, stem, and root tissues. **Thin sections (20–30 µm)** were prepared using a hand microtome, followed by **double staining with safranin (1% w/v, 5–10 min) and fast green (0.5% w/v, 2–3 min).** Sections were mounted in glycerin and observed under a **compound microscope at 10×, 40×, and 100× magnifications**. Key features such as epidermal cells, trichomes, stomata, vascular bundles, mesophyll arrangement, and secretory structures were recorded and photomicrographed.

Pharmacognostic Evaluation

Pharmacognostic parameters were determined following AOAC guidelines. Parameters included:

- **Extractive values:** alcohol-soluble and water-soluble fractions
- **Ash values:** total ash, acid-insoluble ash, water-soluble ash
- **Moisture content:** loss on drying

These evaluations provide quality control and standardization benchmarks for crude plant material.

Biochemical and Phytochemical Analysis

Biochemical analysis: Chlorophyll content was estimated spectrophotometrically in both aqueous and alcoholic extracts following standard protocols.

Phytochemical screening: Preliminary screening using TLC and paper chromatography was performed to detect major secondary

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metabolites. Qualitative tests for alkaloids, flavonoids, saponins, tannins, glycosides, phenols, and steroids were conducted as described by Harborne (1998).

Extraction details for reproducibility:

- **Solvents used:** hexane, ethyl acetate, ethanol, and distilled water
- **Solvent-to-powder ratio:** 10:1 (v/w)
- **Maceration duration:** 48 h at room temperature for each solvent
- **Filtration:** using Whatman No. 1 filter paper
- **Concentration:** extracts were concentrated under reduced pressure using a rotary evaporator
- **Percentage yield:** calculated as (weight of extract / weight of dried plant powder) × 100

Result and Discussion

Morphology

Dolichandrone falcata Seem (synonym: Markhamia falcata), belonging to the family Bignoniaceae, is a medium-sized tree, approximately 15 m in height, with dense foliage and profuse flowering. The tree produces highly scented, creamish-white flowers that bloom in the evening and fall the following morning. Mature fruits from the previous year often remain on the tree while new flowers bloom.Leaves are opposite, measuring 1.3–3.8 cm × 1.1–3.8 cm, suborbicular to obovate, and glabrous or slightly pubescent. The leaf base is cuneate or rounded and generally unequally sided, with main veins in pairs and prominent beneath. Petiolules of lateral leaflets are 0–0.5 mm long. Flowers are arranged in terminal few-flowered racemes with pedicels 1.3 cm long. The calyx is pubescent with a short, stout mucro at the apex. The corolla is white, ≥2.5 cm long, with a narrow basal tube (~2.5 mm) gradually widening upward; limb lobes are obovate-oblong with crisped, undulate margins.Fruits are flat, falcate, curved capsules, measuring 25–45 cm long × 2 cm wide, glabrous. Seeds are rectangular, winged at both ends, approximately 2.5 cm × 6 mm. The bark is dark brown, covering a substantial portion of the trunk in mature trees. The plant *Dolichandrone falcata* (Bignoniaceae) was collected from the Akurakhe–Rahata region, Maharashtra, India, in August 2024. The specimen was authenticated using regional floras, including the Flora of Ahmednagar, and verified with relevant botanical references. A voucher specimen (Voucher No.: DFP-2024-01) has been deposited at the Herbarium of the Department of Botany, Sanjivani Arts, Commerce and Science College, Kopargaon, Maharashtra, India, ensuring proper authentication and future reference.

Anatomy

The epidermis lined with cuticle was visible in the transverse section of a *Dolichandrone falcata* Seem leaflet. A dorsiventral structure was visible in the transverse region. The epidermal cell was observed in a single layer covered with a thick cuticle. Unicellular trichomes

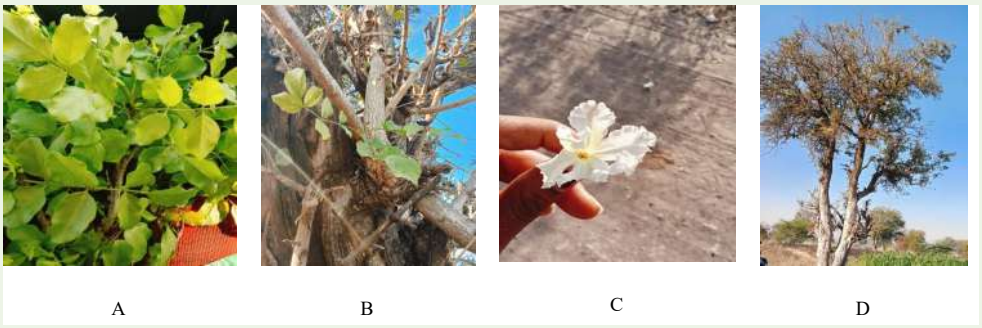

Figure 1 Morphological feature of Dolichandrone falcata: A: Leaf, B: Branches, C: Flower, D: Tree

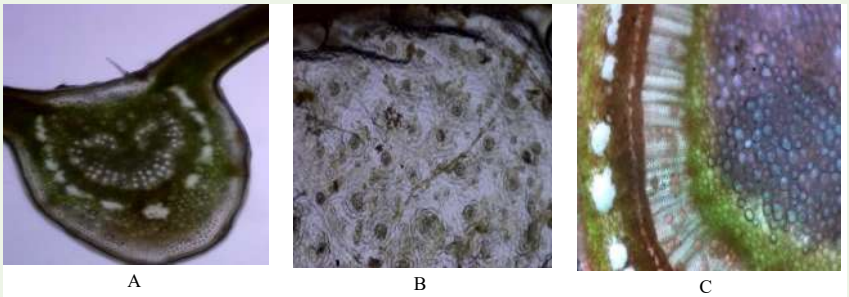

Figure 2 Anatomical feature of *Dolichandrone falcata*: A: Leaf, B: Stomata, C: Stem

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Figure 3 Phytochemical and Pharmacognostic Analysis of Dolichandrone falcata: A: Chromatographic Analysis, B: Extractive Value, C: Extraction, D: Extraction.

Table 1: Biochemical Analysis of *Dolichandrone falcata*

Sr.No	Particulars	Aqueous	Alcohol
1	Chlorophyll a	0.0181 mg/g	0.0282 mg/g
2	Chlorophyll-b	0.0410 mg/g	0.0560 mg/g
3	Total Chlorophyll	0.0598 mg/g	0.0650 mg/g
4	TLC (Rf)	0.50	0.68
5	Paper Chromatography	0.80	0.90

Table 2: Phytochemical Screening of *Dolichandrone falcata*

Sr.No	Particulars	Aqueous	Alcohol
1	Carbohydrates	+++	+
2	Proteins	++	++
3	Amino acids	++	+
4	Saponin	+++	+
5	Alkaloid	+++	++
6	Flavonoids	++	++
7	Tannin and Phenolic compounds	++	++

Table 3: Pharmacognostic Analysis of *Dolichandrone falcata*

Sr.No	Particulars	Results
1	Alcohol Extractive value	68.75%
2	Water Extractive Value	100%
3	Ash	40%
4	Moisture	65%

interrupted the epidermis. Amphistomatic stomata is included in anomocytic stomata. The anatomical study of *Dolichandrone falcata* reveals distinct structural adaptations across its leaf, stem, root, and bark, aiding in identification and pharmacognostic standardization. The leaves are hypostomatic, with a thick cuticle, paracytic stomata, and non-glandular trichomes for protection, while the mesophyll is differentiated into palisade and spongy parenchyma for photosynthesis and gas exchange. The stem exhibits primary growth in young plants and secondary growth in mature ones, with a well-defined epidermis, cortex, vascular bundles arranged in a ring, and a central pith storing nutrients. The root system comprises an epidermis with root hairs for absorption, a parenchymatous cortex, an endodermis with Casparian strips regulating water movement, and a radial vascular arrangement of xylem and phloem. The bark, essential for protection and secondary growth, consists of periderm layers (phellem, phellogen, and phelloderm), a supportive cortex, and secondary phloem responsible for nutrient transport.

Phytochemical and Biochemical Analysis

Chlorophyll Estimation: The spectrophotometric estimation of chlorophyll pigments demonstrated higher concentrations in the alcoholic extract compared to the aqueous extract. Chlorophyll a and b concentrations were 0.0282 mg/g and 0.0560 mg/g respectively in the alcoholic extract, while they were 0.0181 mg/g and 0.0410 mg/g in the aqueous extract. Total chlorophyll content was found to be 0.0650 mg/g in alcohol and 0.0598 mg/g in water. These findings suggest that ethanol is a more effective solvent for extracting chlorophyll due to its ability to disrupt cellular membranes and dissolve hydrophobic pigments efficiently. The higher pigment content in the alcoholic extract may also indicate a better preservation of photosynthetic activity in the sampled tissue, which can be relevant in nutraceutical or cosmetic formulations.

Chromatographic Profiling: Chromatographic analysis using TLC and paper chromatography revealed variation in Rf values between the aqueous and alcoholic extracts. The Rf value in TLC was 0.50 for the aqueous extract and 0.68 for the alcoholic extract, while in paper chromatography it was 0.80 (aqueous) and 0.90 (alcoholic). These differences are attributed to the distinct polarity of compounds present in each solvent system and confirm the presence of multiple phytoconstituents with varying solubility profiles. TLC and paper chromatography also serve as reliable fingerprinting tools for compound identification and quality assurance.

Phytochemical Screening: Qualitative phytochemical analysis indicated the presence of various bioactive compounds in both extracts. Carbohydrates, saponins, and alkaloids were abundantly present in the aqueous extract, while the alcoholic extract showed moderate levels of proteins, flavonoids, and phenolic compounds. These findings align with the polarity preferences of secondary metabolites—saponins and alkaloids tend to be more water-soluble, whereas phenolic compounds and flavonoids are more readily extracted in alcoholic solvents.The presence of diverse phytoconstituents highlights the medicinal potential of *Dolichandrone falcata*. Alkaloids and saponins are known for their antimicrobial and anti-inflammatory properties, while phenolics and flavonoids

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contribute antioxidant activity. The combination of these metabolites supports the traditional usage of the plant in herbal formulations and justifies further pharmacological investigation.

Pharmacognostic

The pharmacognostic evaluation of *Dolichandrone falcata* revealed critical parameters essential for the standardization and quality assessment of its crude drug material. A notably high water-soluble extractive value (100%) indicates a rich presence of hydrophilic phytoconstituents, while the alcohol-soluble extractive value (68.75%) highlights the abundance of bioactive compounds like phenolics, flavonoids, and alkaloids. The total ash content, recorded at 56%, may reflect the presence of essential minerals or potential contamination from environmental sources, underscoring the importance of assessing purity. Additionally, the moisture content of 65% suggests a significant level of water retention, necessitating proper drying and storage to prevent microbial growth and degradation. These pharmacognostic benchmarks serve as a foundation for selecting appropriate solvents and conditions in phytopharmaceutical formulations and further research applications.

Conclusion

Dolichandrone falcata (Bignoniaceae) is a medicinally valuable tree with diverse pharmacological properties. This study provides a detailed evaluation of its phytochemical composition, morpho-anatomic characteristics, and pharmacognostic parameters, which together support species identification, quality assessment, and standardization of the crude drug. Phytochemical and biochemical analyses confirmed the presence of bioactive compounds such as flavonoids, alkaloids, tannins, phenolics, saponins, and chlorophyll, which are associated with antioxidant, anti-inflammatory, antimicrobial, and hepatoprotective activities.These findings highlight the therapeutic potential of *D. falcata* in both traditional and modern medicine. Future research should focus on the isolation, purification, and structural characterization of its bioactive compounds, as well as in vivo and clinical studies to validate their pharmacological efficacy. Such studies could pave the way for the development of novel phytopharmaceuticals and nutraceuticals derived from this species.

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