



Establishment of Pharmacognostic Standards and Phytochemical Screening of *Adenium Arabicum* Leaves.”

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Abstract

Adenium Arabicum (Family: Apocynaceae) is an ornamental succulent native to the Arabian Peninsula that remains scientifically underexplored despite its taxonomic proximity to several pharmacologically active species. The present study aimed to generate baseline pharmacognostic and phytochemical data on the leaves of *A. arabicum* to support their identification, standardization, and future medicinal evaluation. Fresh leaves were collected and authenticated, followed by detailed macroscopic and microscopic characterization, powder microscopy, and physicochemical analyses using standard WHO protocols. Extractive values in different solvents were determined, and preliminary phytochemical screening of ethanol and aqueous extracts prepared via maceration, Soxhlet, and ultrasound-assisted extraction was performed. Morphological evaluation revealed thick, leathery, oblong to elliptic leaves with reticulate venation. Microscopy showed dorsiventral leaf structure with an epidermis, distinct palisade and spongy mesophyll, collateral vascular bundles, and stomata. Physicochemical constants were within acceptable pharmacopoeial limits. Qualitative phytochemical tests indicated the presence of alkaloids, flavonoids, phenolics, glycosides, tannins, proteins, carbohydrates, resins. The study provides the first comprehensive pharmacognostic report on *A. arabicum* leaves, offering essential reference standards for their quality control and supporting future phytochemical and pharmacological investigations.

Keywords

(*Adenium arabicum*; pharmacognosy; microscopic evaluation; physicochemical analysis; phytoconstituents; quality control.)

1. Introduction

Medicinal plants are an invaluable source of bioactive compounds and have been extensively utilized in traditional systems of medicine worldwide. The growing global interest in herbal remedies highlights the need for scientific validation, standardization, and quality control of plant-based medicines. Pharmacognostic studies including macroscopic, microscopic, and physicochemical analysis form the foundation for the correct identification and authentication of medicinal plants. These evaluations, when complemented by preliminary phytochemical investigations, help in understanding the chemical profile and potential therapeutic relevance of the plant material.

Adenium arabicum (Family: Apocynaceae) is a succulent plant native to the arid and semi-arid regions of the Arabian Peninsula. Though primarily cultivated for ornamental purposes, it belongs to a family known for its rich diversity of secondary metabolites, including alkaloids, glycosides, and flavonoids, many of which possess significant pharmacological activities. While related species such as *Adenium obesum* have been studied to some extent, *Adenium arabicum* remains largely unexplored in terms of its pharmacognostic and phytochemical characteristics.

Given the lack of comprehensive scientific documentation on this plant, a detailed investigation is warranted to establish standard parameters for its identification and further utilization.

The present study aims to establish a thorough pharmacognostic account of *Adenium arabicum*, including macroscopic and microscopic evaluation, powder microscopy, and physicochemical parameters. In addition, preliminary phytochemical screening has been carried out to identify the presence of key classes of bioactive compounds. This combined approach is intended to provide essential baseline data for the proper identification, standardization, and future research on this species. Due to its taxonomic proximity to several pharmacologically active Apocynaceae members and the absence of published data on its pharmacognostic attributes, *A. arabicum* was selected for the present investigation.

Adenium arabicum: Plant Profile

Scientific Name: *Adenium arabicum* Balf. f.

Common Names: Desert rose, Adenium, Al-‘Ushar (Arabic), Sabi star

Family: Apocynaceae

Genus: *Adenium*

Kingdom: Plantae

Order: Gentianales

Species: *A. arabicum*

2. Materials and Methods

2.1 Plant Material Collection and Authentication

Fresh Plants of *Adenium arabicum* were procured from an online store and subsequently identified and authenticated by a qualified botanist at the Department of Botany, Dr. Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajnagar, Maharashtra, India.



Figure 1. Photographic Representation of the *Adenium arabicum* A) Flowers of *Adenium arabicum* B) Seed Pod of *Adenium arabicum* C) Whole plant of *Adenium arabicum*

2.2 Drying and Powdering

Fresh leaves were washed thoroughly, shade-dried at room temperature for 10–15 days until crisp and brittle, and then powdered using a mechanical grinder. The powder was passed through a 40-mesh sieve, stored in airtight containers protected from light and moisture, and used for pharmacognostic and phytochemical studies.

2.3 Morphological (Macroscopic) Evaluation

Macroscopic characters such as type, shape, size, color, surface, margin, apex, base, venation, odor, and taste were recorded according to standard pharmacognostic procedures.

2.4 Microscopic Evaluation

Transverse sections (TS) of the *A. Arabicum* leaves were made using sharp section cutter. TS were mounted on glass slide using suitable media and observed under a photographic microscope. Transverse sections of leaves were studied for different microscopic characters like epidermis, xylem, phloem, Stomatal cells etc. Photographs of observed microscopic characteristics of leaves were captured and stored for further referencing.

2.5 Physicochemical Parameters

All determinations were performed in triplicate, and mean values were recorded. Standard WHO-recommended procedures were used to determine:

Ash values

1. Total Ash

1 grams of accurately weighed air-dried powdered leaf material was incinerated in a previously ignited muffle furnace at 600°C until free from carbon (a white or grey ash was obtained). The crucible was cooled in a desiccator and weighed. The percentage of total ash was calculated with reference to the air-dried sample.

2. Acid-Insoluble Ash

The total ash obtained was boiled with 25 mL of dilute hydrochloric acid (40 %) for 30 minutes. The insoluble matter was collected on an ashless filter paper, washed with hot water, ignited in a silica crucible, cooled, and weighed. The residue represents the acid-insoluble ash, which was calculated as a percentage of the air-dried drug.

3. Water-Soluble Ash

The total ash was boiled with 25 mL of distilled water for 30 minutes. The insoluble matter was collected on an ashless filter paper, washed with hot water, ignited in a crucible, cooled, and weighed. The weight of the insoluble ash was subtracted from the weight of total ash to obtain the water-soluble ash. The percentage was calculated with reference to the air-dried sample.

4. Sulphated Ash

1 grams of powdered sample were accurately weighed in a silica crucible. 1 mL of concentrated sulfuric acid was added, and the mixture was gently heated until white fumes ceased. The material was ignited at 600°C in a muffle furnace until all carbon was burned off. The crucible was cooled in a desiccator and weighed. The percentage of sulphated ash was calculated with reference to the air-dried drug.

Moisture Content

The moisture content of *Adenium arabicum* leaves was determined using the Loss on Drying (LOD) method, following standard pharmacopeial procedures. This gravimetric technique involves measuring the weight loss of a sample upon drying, which corresponds to the amount of moisture and volatile substances present.

Foaming Index

One gram of coarsely powdered *Adenium arabicum* leaves was boiled in 100 mL of distilled water for 30 minutes. After cooling and filtering, the decoction was diluted to 100 mL. Ten test tubes were prepared with 1–10 mL of this decoction, each adjusted to 10 mL with distilled water. Each tube was shaken vigorously for 15 seconds and allowed to stand for 15 minutes. The height of the foam in each tube was measured.

If the foam height in every tube is less than 1 cm, the foaming index is considered to be less than 100, indicating a low saponin content in the plant material.

Swelling Index

One gram of coarsely powdered *Adenium arabicum* leaves was placed in a 25 mL stoppered measuring cylinder with 25 mL of distilled water. The mixture was shaken intermittently for 1 hour and then allowed to stand for 3 hours at room temperature. The

final volume occupied by the plant material, including the swollen mucilage, was measured. The swelling index was calculated as the volume in milliliters occupied by 1 g of plant material.

Extractive Values

Extractive values were determined to estimate the amount of active constituents soluble in various solvents, which helps in assessing the quality and purity of the crude drug.

1. Alcohol-Soluble Extractive Value (Ethanol)

About 5 g of accurately weighed, coarsely powdered *Adenium arabicum* leaves were macerated with 100 mL of ethanol in a closed flask for 24 hours, with frequent shaking during the first 6 hours, and allowed to stand for the remaining 18 hours. The mixture was filtered, and 25 mL of the filtrate was evaporated to dryness in a tarred flat-bottomed dish and dried at 105 °C to constant weight. The percentage of alcohol-soluble extractive value was calculated with reference to the air-dried drug.

2. Water-Soluble Extractive Value

The same procedure was followed as above, replacing ethanol with distilled water. The extract was filtered, evaporated, and dried at 105 °C to constant weight. The percentage of water-soluble extractive value was calculated with reference to the air-dried drug.

3. Chloroform-Soluble Extractive Value

Five grams of powdered leaf material were macerated with 100 mL of chloroform in a closed flask for 24 hours, with occasional shaking. The extract was filtered, 25 mL of the filtrate evaporated to dryness, and the residue dried at 105 °C to constant weight. The percentage yield was calculated relative to the air-dried drug.

4. Petroleum Ether-Soluble Extractive Value

Similarly, 5 g of powdered material was macerated with 100 mL of petroleum ether. After filtration, 25 mL of the filtrate was evaporated to dryness, and the residue was dried at 105 °C to constant weight. The percentage of petroleum ether extractive value was calculated with reference to the air-dried drug.

2.6 Preparation of Extracts

Powdered leaves (10 g) were extracted with 200 mL of solvent (ethanol and water) using three methods:

- **Cold maceration:** Macerated for 24h at room temperature, filtered, and evaporated.
- **Ultrasound-assisted extraction (UAE):** Treated at 40 kHz for 4h, filtered, and concentrated.
- **Soxhlet extraction:** Extracted at 65-100°C until siphoning was clear, filtered, and concentrated. Filtrates were used fresh or evaporated to obtain dry extracts.

2.7 Preliminary Phytochemical Screening

Standard qualitative tests were performed on ethanol and aqueous extracts prepared by the three methods to detect major phytochemical groups (alkaloids, carbohydrates, glycosides, cardiac glycosides, proteins, flavonoids, phenolics, tannins, phytosterols, quinones, resins).

3. Results

3.1 Macroscopic Characteristics

The leaves of *Adenium arabicum* were evaluated for organoleptic and morphological characteristics such as size, shape, color, texture, Odor, and taste.

The organoleptic features are presented in **Table No. 1**

Table No. 1 Organoleptic Features of *Adenium arabicum* Leaves

Parameter	Observation
Shape	Oblong to elliptic
Size	5–12 cm long, 3–7 cm wide

Color	Dark green (upper surface), pale green (lower surface)
Odor	Characteristic, faint
Taste	Bitter
Base	Rounded to slightly tapering
Texture	Smooth, leathery
Margin	Entire
Apex	Rounded to obtuse
Venation Arrangement	Pinnate, reticulate

The dorsal and ventral leaf surfaces are shown in **Figure 2**.



Figure 2. Dorsal (Adaxial) and Ventral (Abaxial) Surfaces of *Adenium arabicum* Leaf showing its shape, venation pattern, and surface texture.

The leaves were oblong to elliptic, measuring 5–12 cm in length and 3–7 cm in width. The upper surface was dark green, and the lower surface pale green. They exhibited a smooth and leathery texture, with an entire margin, rounded base, and obtuse apex. Venation was pinnate and reticulate. Leaves had a faint characteristic odor and a bitter taste (**Figure 2**).

While macroscopic analysis provided an overview of the external morphology, detailed microscopic studies were performed to reveal the internal tissue organization and diagnostic anatomical characteristics of the leaves.

3.2 Microscopic Characteristics

Microscopic examination of leaf transverse sections revealed diagnostic features, including epidermis, mesophyll, stomata, and vascular bundles.

Photomicrographs are shown in **Figure 3**.

The microscopic characteristics are summarized in **Table No. 2**

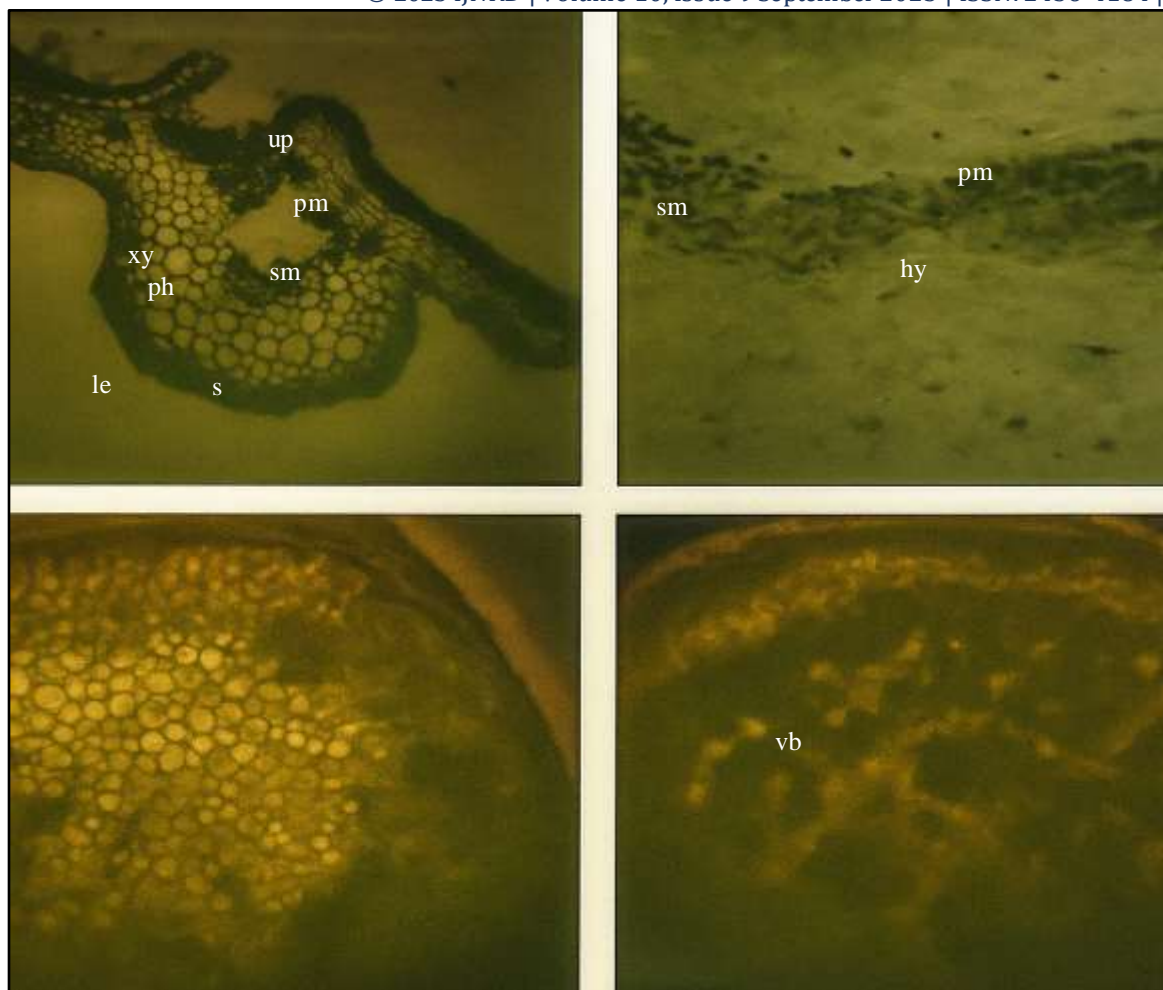


Figure 3. Transverse Section (TS) of *Adenium arabicum* dicotyledonous leaf showing up: upper epidermis, pm: palisade mesophyll, ph: phloem, xy: xylem, hy: hypodermis, le: lower epidermis, s: stomata, sm: spongy mesophyll, vb: vascular bundle using a compound light microscope at 400 \times ; scale bar = 10 μ m).

Table No. 2 Microscopic Features of *Adenium arabicum* Leaf

Feature	Observation
Epidermis	Single-layered; upper epidermis with thick cuticle, lower epidermis thinner
Mesophyll	Palisade parenchyma (1–2 layers, compact, elongated cells); Spongy parenchyma (4–6 layers, loosely arranged with air spaces)
Stomata	hypostomatic (more on lower epidermis)
Vascular Bundle	Collateral type, surrounded by parenchymatous sheath cells

3.3 Physicochemical Parameters

Physicochemical constants were determined according to WHO guidelines.

The physicochemical parameters are listed in **Table No. 3**

Table No. 3 Physicochemical Parameters of *Adenium arabicum* Leaves

Parameter	Value (% w/w)
Total Ash	13.68 % w/w
Acid Insoluble Ash	4.40 % w/w
Water Soluble Ash	3.69 % w/w

Loss on Drying	3.33% w/w
Swelling Index	2–4 mL/g
Foaming Index	Below 100

3.4 Extractive Values

The extractive values of *Adenium arabicum* leaves in different solvents listed in **Table No. 3**

Table No. 4 Extractive values of *Adenium arabicum* leaves in different solvents

Method	Solvent	Extractive Value (% w/w)
Maceration	Ethanol	4.95 %
Maceration	Water	10.0 %
Maceration	Petroleum Ether	1.25 %
Maceration	Hexane	1.33 %

3.5 Preliminary Phytochemical Screening

The preliminary qualitative analysis of *Adenium arabicum* leaves was carried out using three extraction methods (Maceration, Sonication, Soxhlet) with ethanol and water as solvents. Various phytochemical groups were tested. “+” indicates the presence of a phytochemical, whereas “–” indicates its absence.

Phytochemical screening results are presented in **Table No. 5**

Table No. 5 Preliminary Phytochemical screening of *A. Arabicum* leaves

Phytoconstituent	Ethanol (Maceration)	Aqueous (Maceration)	Ethanol (UAE)	Aqueous (UAE)	Ethanol (Soxhlet)	Aqueous (Soxhlet)
Alkaloids	+	+	-	+	+	+
Carbohydrates	+	+	-	-	+	+
Reducing Sugars	-	+	-	-	+	+
Glycosides	+	+	+	+	+	+
Cardiac Glycosides	+	+	-	+	+	+
Proteins & Amino Acids	+	+	+	+	+	+
Flavonoids	+	+	+	+	+	+
Phenolic Compounds	+	+	+	+	+	+
Tannins	+	+	+	+	-	-
Phytosterols	+	+	+	+	+	+
Quinones	+	-	+	-	+	+
Resins	+	+	+	+	+	-

“+” indicates presence, “–” indicates absence of phytochemical.

Discussion

This study was conducted to establish a comprehensive pharmacognostic profile and perform preliminary phytochemical analysis of *Adenium arabicum* leaves, which is essential for their proper identification, authentication, and quality evaluation. Macroscopic examination revealed distinct morphological features such as thick, fleshy, obovate leaves with a smooth glossy surface, consistent with the xerophytic nature of the plant. Microscopic analysis showed a dorsiventral structure with well-organized palisade and spongy mesophyll layers, collateral vascular bundles, and numerous anomocytic stomata, all of which serve as diagnostic characteristics. Powder microscopy further confirmed identifying features including fragments of epidermal cells, palisade tissue, spiral xylem vessels, and unicellular trichomes, which are valuable markers for distinguishing the powdered drug.

The physicochemical parameters obtained, including total ash, acid-insoluble ash, water-soluble ash, loss on drying, swelling index, and foaming index, were found to be within acceptable ranges. These values provide important baseline data to ensure the purity, quality, and stability of the plant material and to detect possible adulteration or contamination during storage or processing.

Preliminary phytochemical screening revealed the presence of several bioactive groups such as alkaloids, flavonoids, tannins, phenolic compounds, glycosides, saponins, and carbohydrates. The detection of these secondary metabolites supports the traditional use of *Adenium* species and indicates that the plant may possess a broad range of biological activities. This also establishes a foundation for future detailed chemical and pharmacological investigations.

However, the current study is limited to pharmacognostic and qualitative phytochemical evaluations and does not include pharmacological, toxicological, or quantitative analyses. Further studies are needed to isolate and characterize the active constituents, assess their pharmacological potential, and determine their safety using advanced analytical and experimental approaches.

In summary, the findings of this study provide essential reference data for the authentication and standardization of *A. arabicum* leaves, which will aid in ensuring the quality and reliability of future herbal preparations derived from this plant.

Conclusion

The present study successfully established the pharmacognostic characteristics and conducted preliminary phytochemical screening of *Adenium arabicum* leaves. The macroscopic, microscopic, and powder features identified in this work can serve as reliable diagnostic markers for the proper identification and authentication of the plant material. The physicochemical parameters determined provide essential baseline data for quality control, while the detection of various secondary metabolites offers a scientific basis for its traditional use and future investigation.

Although the study focused mainly on pharmacognostic and qualitative phytochemical aspects, it highlights the need for further research to isolate and characterize the bioactive constituents and to evaluate their pharmacological efficacy and safety. Overall, these findings contribute valuable reference data that will support the standardization and quality assurance of *A. arabicum* as a potential source of herbal drugs.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this research work.

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