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Research

Seed to Standard: A Pharmacognostical Insight into *Abutilon indicum* (L.) Sweet for Herbal Quality Control

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Abstract

Abutilon indicum (L.) Sweet, commonly known as Indian mallow or Atibala, holds significant value in traditional medicine systems such as Ayurveda for its therapeutic properties. Despite its historical use, particularly of the seeds, comprehensive pharmacognostical documentation remains limited. This study presents a detailed pharmacognostic evaluation of *A. indicum* seeds, including macroscopic, microscopic, and powder analyses. Macroscopic observation identified the seeds as reniform, hairy, brownish-black, with a characteristic odor and bitter taste. Microscopic examinations revealed diagnostic features such as multicellular hooked trichomes, a lignified palisade layer in the testa, starch-rich cotyledons with cluster crystals, and developing vascular tissue in the radicle. Powder microscopy confirmed the presence of oil globules, cluster crystals, starch grains, and trichomes. These diagnostic characteristics aid in the accurate identification, authentication, and standardization of the seeds, supporting their safe inclusion in herbal preparations and contributing to pharmacopeial quality standards.

Keywords: Abutilon indicum, Indian mallow, seed microscopy, trichomes, cotyledon, testa, cluster crystals.

INTRODUCTION

For thousands of years, medicinal plants have served as the foundation of traditional treatment systems in each civilization and continent. Communities used plant-based treatments to treat a variety of conditions, from minor infections to chronic illnesses, long before modern drugs became widely available.[1] Knowledge concerning plant-based remedies is deeply embedded in systems such as Ayurveda, Siddha, Unani, and Traditional Chinese Medicine, and it has been passed down through the generations. Today, the significance of

traditional medicinal plants is receiving increased scientific and international attention due to growing interest in natural, sustainable, and culturally integrated healthcare approaches.[2]

In addition to their therapeutic effectiveness, traditional medicinal herbs are beneficial because they are affordable, environmentally friendly, and frequently linked to less side effects than modern medications. Plants are the direct or indirect source of many therapeutic compounds used in modern treatment. The pharmacological characteristics of these plants are still being confirmed by ongoing research, which emphasizes their potential for drug development, particularly in the areas of immunology, hepatology, cancer, and endocrinology.[3,4]

Abutilon indicum (L.) Sweet, sometimes referred to as Indian mallow or Atibala in Ayurveda, is a significant member of this traditional plant species. It is a soft, hairy shrub that is extensively distributed in tropical and subtropical areas and belongs to the family Malvaceae. Traditional medicine has made considerable use of a variety of plant parts, including the roots, leaves, flowers, and most importantly, the seeds.

The seeds of *Abutilon indicum* have been employed for decades as coolants, demulcents, and mild laxatives because of their rich mucilaginous qualities. They are recommended by Ayurveda for ailments like inflammation, fever, gonorrhea, and urinary tract infections. The seeds' antibacterial, anti-inflammatory, antioxidant, and diuretic properties have been attributed to the presence of flavonoids, sterols, essential oils, fatty acids, and polysaccharides, according to phytochemical research.

Because of its wide range of ethnomedical applications and phyto-pharmacological potential, *Abutilon indicum* is a highly valuable plant that needs careful pharmacognostical and phytochemical research, especially for its seeds, which are not as frequently investigated as the aerial parts. Such traditional knowledge can be scientifically validated to help standardize, formulate, and appropriately use *A. indicum* in modern herbal therapies.[5-10]

MATERIALS & METHODS

Pharmacognostical Studies

1. Macroscopy (SOP No. PCOG-004-SOP): A Nikon D-5600 digital camera was used to record the test sample's external features.

2. Microscopy (PCOG-005-SOP): For more than 48 hours, the sample had been preserved in fixative FAA. A sharp blade was used to cut the preserved specimens into thin transverse sections, which were then stained with 0.8% Safranin and 0.5% Astra blue. Under bright field light, transverse sections were captured on camera with a Zeiss Axiocam208 color digital camera combined with an Axiolab5 trinocular microscope. A scale bar was used to show magnifications.

3. Powder microscopy (PCOG-006-SOP): After being cleared with a saturated solution of chloral hydrate, a pinch of the powdered material was placed on a microscopic slide with a drop of 50% glycerol. To confirm the presence of starch grains, the sample was treated with an iodine solution. Under bright field light, characters were observed with a Nikon ECLIPSE E200 trinocular microscope that was connected to a Zeiss ERc5s digital camera. Diagnostic character photomicrographs were taken and recorded.[11-14]

RESULTS

1. Macroscopy

Seeds reniform, hairy, dotted, minutely scrobiculate, brownish-black, and 3 to 5 mm in diameter, with characteristic odour and bitter taste.

Fig 1: Macroscopy of *Abutilon indicum* seed

2. Microscopy

2. 1. Testa

The TS of seed shows outermost testa composed of epidermis with trichomes, a thick palisade layer, inner parenchyma, and compressed or lignified inner layers; epidermis is composed of single layer of cutinized and heavily lignified cells bearing elongated, thick-walled, multicellular trichomes which are curved or hooked; sub-epidermis composed of a layer of column cells through which a light line - linea lucida extends across; malpighian layer formed of a distinct row of columnar palisade cells which possess thick lignified walls; inner testa or tegmen composed of thin-walled parenchyma cells with tannin depositions; compressed layer represents the remnants of endosperm.

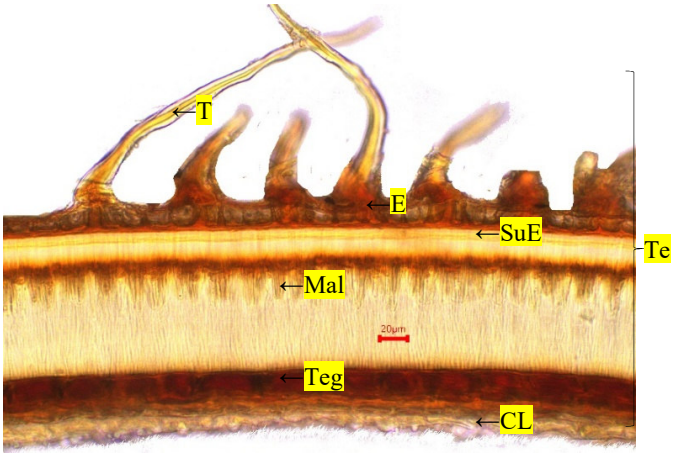

Fig 2: TS of Testa

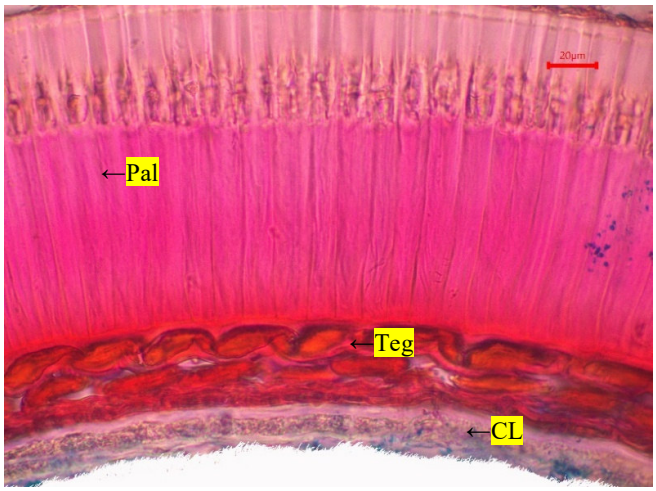

Fig 3: Enlarged view

CL - compressed layer; **E** - epidermis; **LE** - lower epidermis; **Mal -** malphigian layer; **Pa** - parenchyma; **Pal** - palisade cells; **OG** - oil globule; **SuE** – sub-epidermis; **Te** - testa; **Teg -** tegmen; **UE** - upper epidermis; **VB -** vascular bundle

2. 2. Cotyledon

The TS of the cotyledon shows outermost single layer of epidermis with compactly arranged cells covered with cuticle; the ground tissue is parenchymatous, occupying the majority of cotyledon and composed of outer 2 to 3 layers of isodiametric cells and inner single layer of palisade cells and are filled with starch and oil globules; primary vasculature is seen as a single, small vascular strand passing through each lobe of the cotyledon; numerous cluster crystals are observed in the cotyledon cells under polarizer.

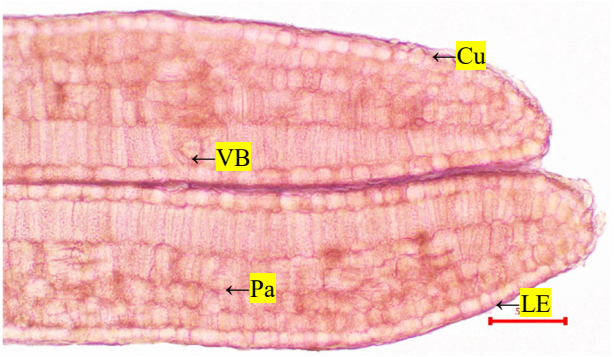

Fig 4: TS of Cotyledon

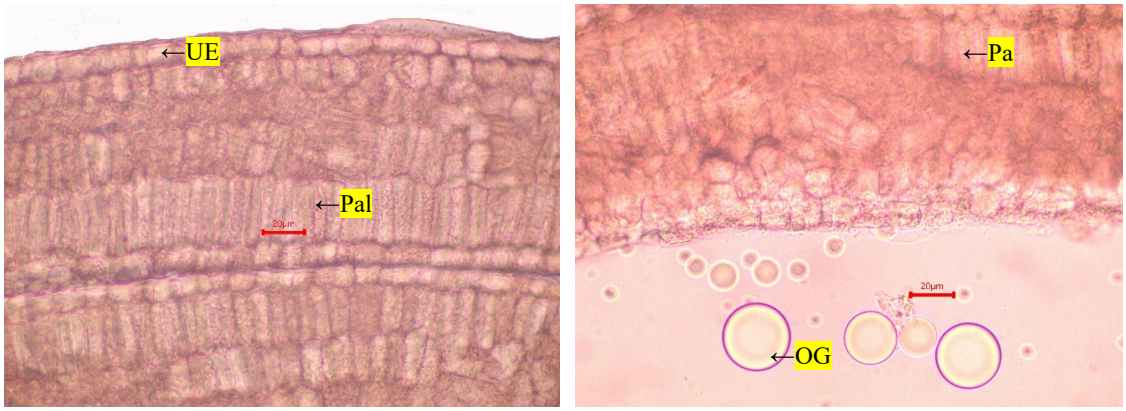

Fig 5,6: Enlarged view

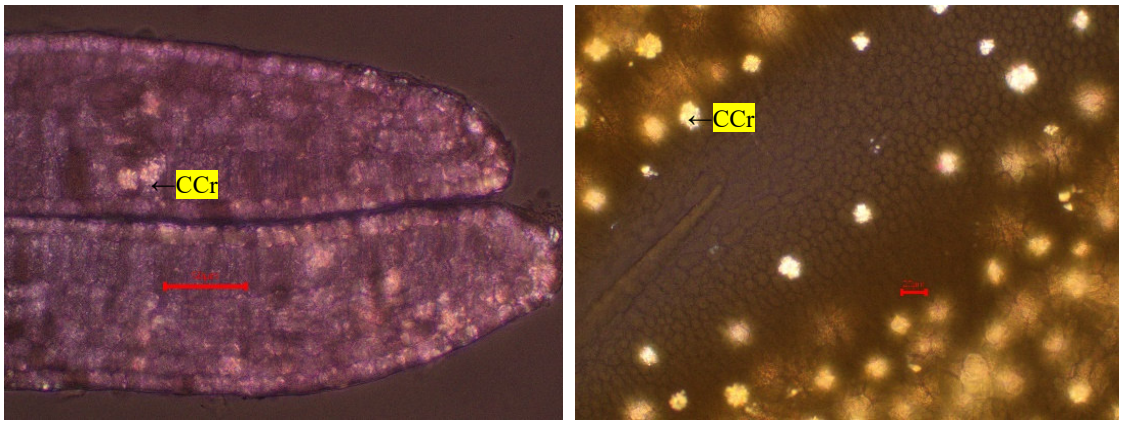

Fig 7,8: Under polarizer

CCr - cluster crystal; **Cu** - cuticle; **E** - epidermis; **LE** - lower epidermis; **Pa** - parenchyma; **Pal** - palisade cells; **OG** - oil globule; **UE** - upper epidermis; **VB -** vascular bundle

2.3. Radicle

TS of radicle is nearly circular in outline and shows outermost single-layered composed of small, compact cells; broad parenchymatous cortex made up of polygonal to rounded, thin-walled cells packed with dense starch grains and developing vascular bundles in the centre.

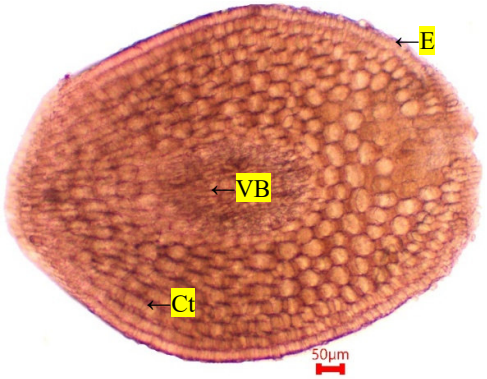

Fig 9: TS of radicle

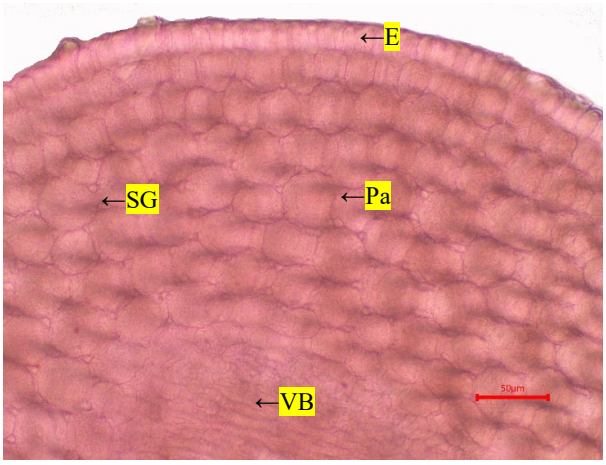

Fig 10: Enlarged view of radicle

Ct - cortex; **E** - epidermis; **LE** - lower epidermis; **Pa** - parenchyma; **SG -** starch grain; **VB -** vascular bundle

3. Powder Microscopy

The powder is brownish-black in colour, with a characteristic odour and bitter taste, and exhibits trichomes, fragments of testa, pigment layer of the tegmen, parenchyma cells, oil globules, cluster crystals, and starch grains.

Fig 11: Trichome

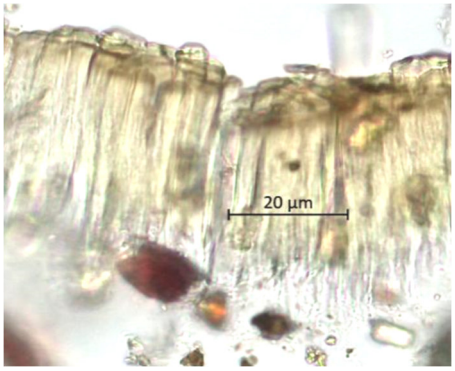

Fig 12: Testa

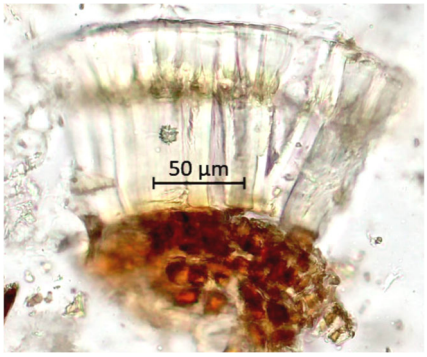

Fig 13: Sectional view

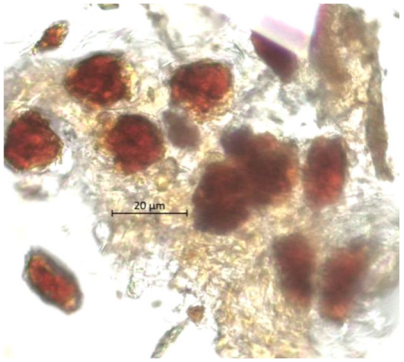

Fig 14: Pigment layer

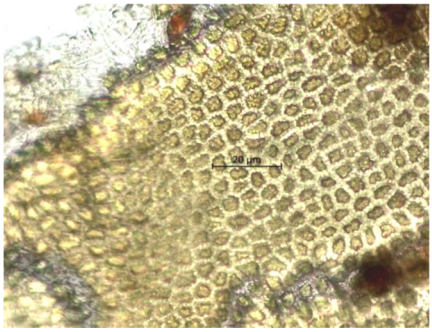

Fig 15: Surface view of testa

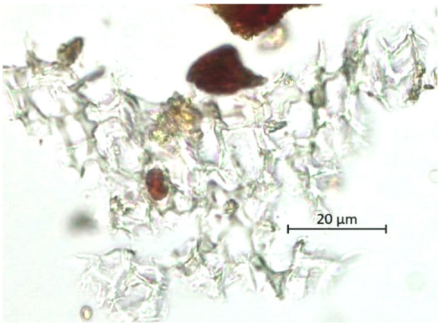

Fig 16: Parenchyma cells

Fig 17: Oil globules

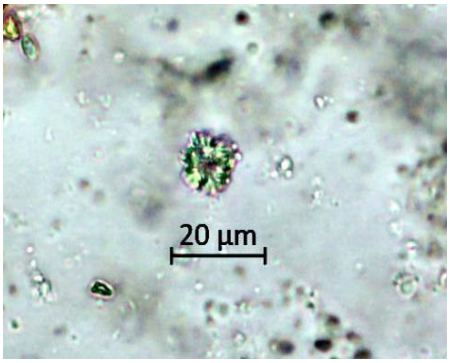

Fig 18: Cluster crystal

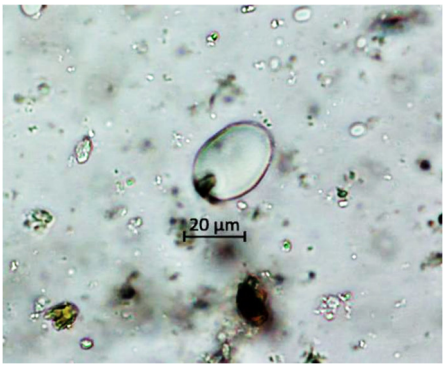

Fig 19: Starch

DISCUSSIONS

Abutilon indicum (L.) Sweet seeds are the subject of a recent pharmacognostical study aimed at documenting certain macroscopic, microscopic, and powder features to help with identification, authentication, and standardization for medicinal use. Its traditional use in herbal preparations was supported by the analysis, which found a number of diagnostic characteristics in line with the pharmacognostic standards of raw plant materials.

Macroscopic analysis

The seeds had a brownish-black color, a distinctive smell, and a bitter taste, according to macroscopic examination. They were also reniform, hairy, and minutely scrobiculate. These characteristics allow for rapid identification at the field level and are consistent with traditional Ayurvedic descriptions of Atibala seeds.

Microscopic evaluation

Examining the seed's transverse section under a microscope showed important characteristics of the radicle, cotyledon, and testa. Important distinguishing characteristics of the testa were discovered to include multicellular curving trichomes, a sub-epidermal light line (linea lucida), and a palisade layer (malpighian cells). Confirming the seed's nutritional and phytochemical storage architecture, the cotyledon section displayed parenchymatous ground tissue with a distinct palisade layer, starch grains, oil globules, and cluster crystals. Indicating active metabolic tissues, the radicle displayed a wide parenchymatous cortex along with growing vascular strands. The known therapeutic uses of *A. indicum* seeds as laxatives, anti-inflammatories, and demulcents are consistent with these structural characteristics.

Powder microscopy

Trichomes, testicular and tegmental fragments, oil globules, cluster crystals, and copious starch grains were among the important identifying features that powder microscopy demonstrated. In order to prevent adulteration and substitution, these tiny components are essential for guaranteeing the validity of powdered medicinal ingredients used in formulations.

The pharmacognostic identity of *Abutilon indicum* seeds is supported by these observations taken together, which also offer a strong foundation for their application in quality assurance, standardization, and additional phytopharmacological studies. The seed has been used traditionally as a nutritional tonic and to soothe mucous membranes because of its starch reserves and oil globules. In addition to suggesting possible stability in dried formulations, cluster crystals and lignified tissues also point to functions in defense and preservation.

Because seeds are frequently underrepresented in normal pharmacopeial documentation, the study highlights the necessity of routine microscopic and macroscopic profiling of crude herbal medications. These findings are important for regulatory bodies that focus on the efficacy, safety, and purity of plant-based medications, as well as for pharmaceutical companies and herbalists.

CONCLUSION

The pharmacognocal analysis of *Abutilon indicum* seeds reveals distinct macroscopic, microscopic, and powder-based diagnostic characteristics that confirm their authenticity and historic therapeutic application. Their pharmacological importance is supported by the presence of characteristic features such as oil globules, palisade layers, lignified trichomes, and starch-rich parenchyma. These findings offer a strong foundation for quality assurance, standardization, and additional phyto-pharmacological research, in addition to confirming conventional wisdom. In order to guarantee safety, effectiveness, and regulatory compliance in plant-based therapies, this study highlights the importance of including seeds in herbal pharmacopeial documentation, as they are frequently underdocumented in conventional references.

Acknowledgement

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