

PHARMACOGNOSTIC STUDY OF THE STEM AND LEAF OF ANDROGRAPHIS PANICULATA NEES

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Introduction

Andrographis paniculata Nees (Bengali, Kalmegh; Hindi, Mahatita; English, Creat) belongs to the family *Acantheaceae*. It is an annual plant, 1-4 feet high, commonly found throughout the Indo-Pakistan subcontinent. In some parts of India it is also cultivated in the gardens. The herb is well known under the name of Kalmegh and forms the principal ingredient of a household medicine called 'alui' which is extensively used in Bengal,¹ especially in cases involving liver troubles in children.

The plant is much valued for its stomachic and tonic properties. The whole of the plant tastes bitter and is occasionally used in cholera and dysentery. It is also said to be alexipharmic, and has been found serviceable in cases of general debility and advanced stages of dysentery. The expressed juice of the leaves is a common native domestic remedy in bowel complaints of children. The tincture of Kalmegh is said to be tonic, stimulant and aperient and to prove valuable in several forms of dyspepsia. Roxburgh remarks that its Hindustani name Mahatita means "king of bitters" and that it is a very powerful and much esteemed remedy.²

Materials and Methods

Preserved samples of the stem and leaf of *Andrographis paniculata* Nees which are used in the preparation of medicines were procured from the East Regional Laboratories as also from the local drug markets. Fresh samples of leaves and stems were also collected from the laboratory campus for detailed studies. Microchemical tests for the cell contents were also undertaken.

Investigation

Macroscopic Structures.—It is a medium-sized annual herb attaining a height of 1-4 feet. The stem is quadrangular, ribbed and glabrous. The nodes are swollen (Plate I, Fig. 1). The branching is of the ascending order and the branches arise from the base of the swollen nodes. There is no crack on the surface skin of the stem. No

characteristic odour is exhibited but the taste is bitter. The leaves are opposite on short petioles lanceolate, entire (Plate I, Fig. 2; Plate II, Fig. 6) and leaves measure $2\frac{1}{2}$ " by $\frac{1}{2}$ "- $\frac{3}{4}$ ", narrow at both ends, ovate at the base, paler beneath, petiole $0\frac{1}{4}$ ", bitter in taste.

Microscopic Characters

Stem.—The transverse section of the stem (Plate I, Fig. 3) shows a single-layered epidermis covered externally with a thick striated cuticle. Some of the epidermal cells are bigger than the normal ones due to the presence of cystoliths. The epidermal cells measure $22\text{-}33\text{-}44\text{-}55 \times 11\text{-}22\text{-}33\text{-}44$. The stomata which are present on the stem (Plate I, Fig. 4) are more or less circular and measure $33\text{-}38\text{-}5\text{-}44$ in diameter. Beneath the epidermis there are collenchymatous tissues 2-3 layered which form discontinued patches. Collenchymatous cells are present fully in the corners of the stem and measure $55\text{-}66\text{-}77 \times 11\text{-}22\text{-}33$ (Plate I, Fig. 3).

The parenchymatous cells present in the cortex may be divided into two categories, viz., chlorenchymatous and cells without chloroplast. The cells are mostly oval to polygonal in shape and measure $11\text{-}22\text{-}33\text{-}44$ in diameter (Plate I, Fig. 3). The endodermis is distinct and clearly demarcates the stelar region from the cortical cells. The endodermal cells measure $33\text{-}44\text{-}55\text{-}66 \times 22\text{-}33\text{-}35\text{-}37$ (Plate I, Fig. 3).

Beneath the endodermis there is a single discontinued layer of pericyclic fibres. These are thick-walled and lignified. This tissue is represented by strands of fibres. The fibres measure $330\text{-}418\text{-}517\text{-}561 \times 11\text{-}16\text{-}22\text{-}27$.

The stem possesses an amphiphloic siphonostele. A thin strip of cambium is present between the external phloem and the xylem. The centre is occupied by pith and composed of thin-walled parenchymatous cells (Plate I, Fig. 3).

The xylem consists as usual of vessels, tracheids, fibres and xylem parenchyma (Plate I, Fig. 5).

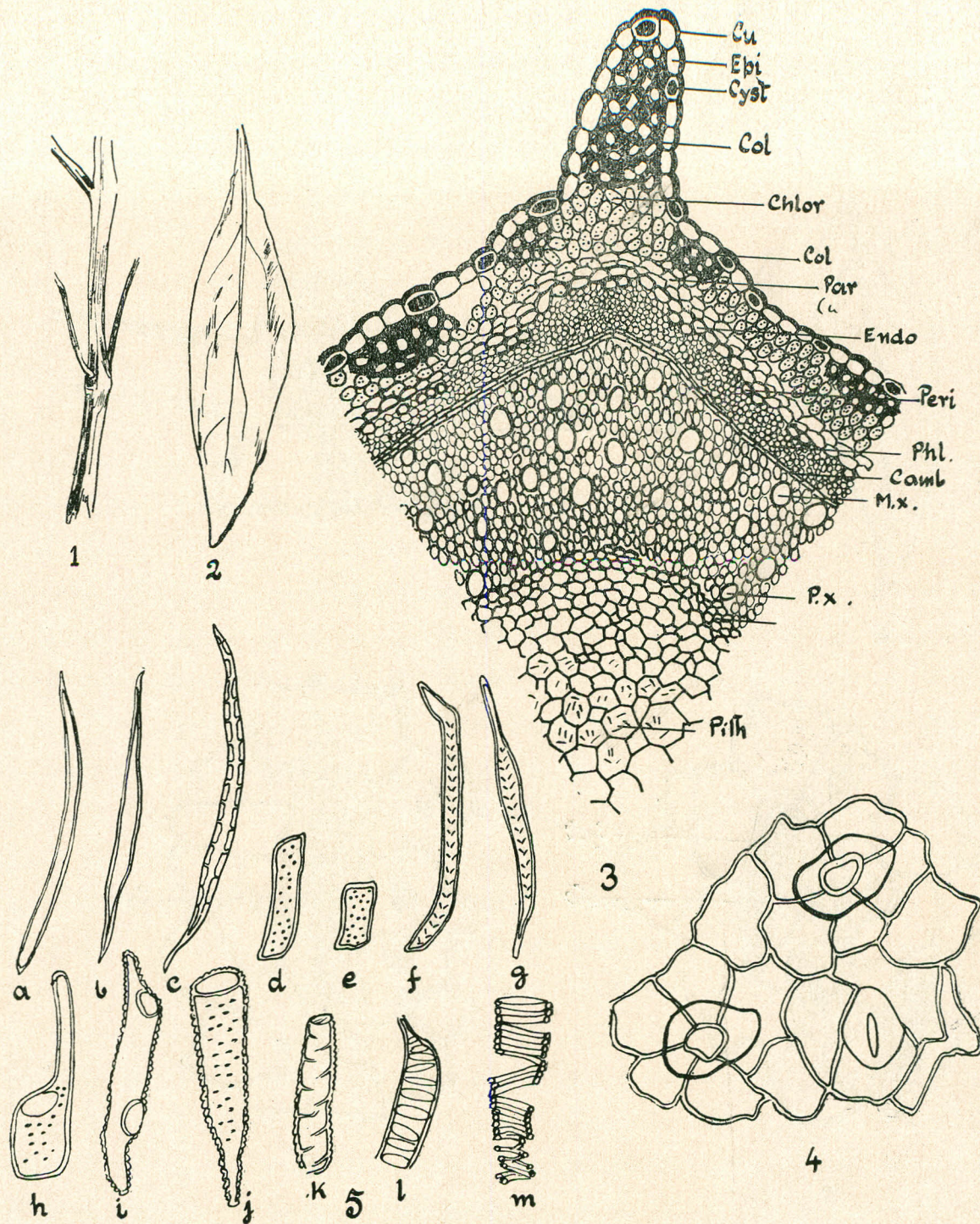


Plate I.—Macroscopical and microscopical characters of *A. paniculata*. Fig. 1: Stem. Fig. 2: Leaf. Fig. 3: Details of t. s. of mature stem. Fig. 4: Stomata on the stem. Fig. 5: a and b fibres, c xylem fibre, d and e, xylem parenchyma, f and g xylem tracheids, h, i, j, k, l and m xylem vessels. Cu, cuticle; Epi, epidermis; Cyst, Cystolith; Col., collenchyma; Chlor, chlorenchyma; Par, parenchyma (colourless); Endo, endodermis, Peri, pericycle; Phl, phloem; Camb, cambium; M.x, metaxylem; P.x., protoxylem.

Most of these xylem elements show pitted type of thickening, the pits being simple. A few xylem vessels are also of the spiral and scalariform type. The xylem vessels (Plate I, Fig. 5: h, i, j, k, l, m) have broad, flat or oblique ends with simple side wall perforations and measure 110-308-418-561 in length.

The tracheids (Plate I, Fig. 5: f and g) are longer than the vessels and have tapering ends, measuring, 132-330-440-660 in length. The fibres (Plate I, Fig. 5: a and b) are longer than other xylem elements and measure 275-418-539-638 in length, having thick walls and tapering ends with simple pits on their walls. The xylem parenchyma

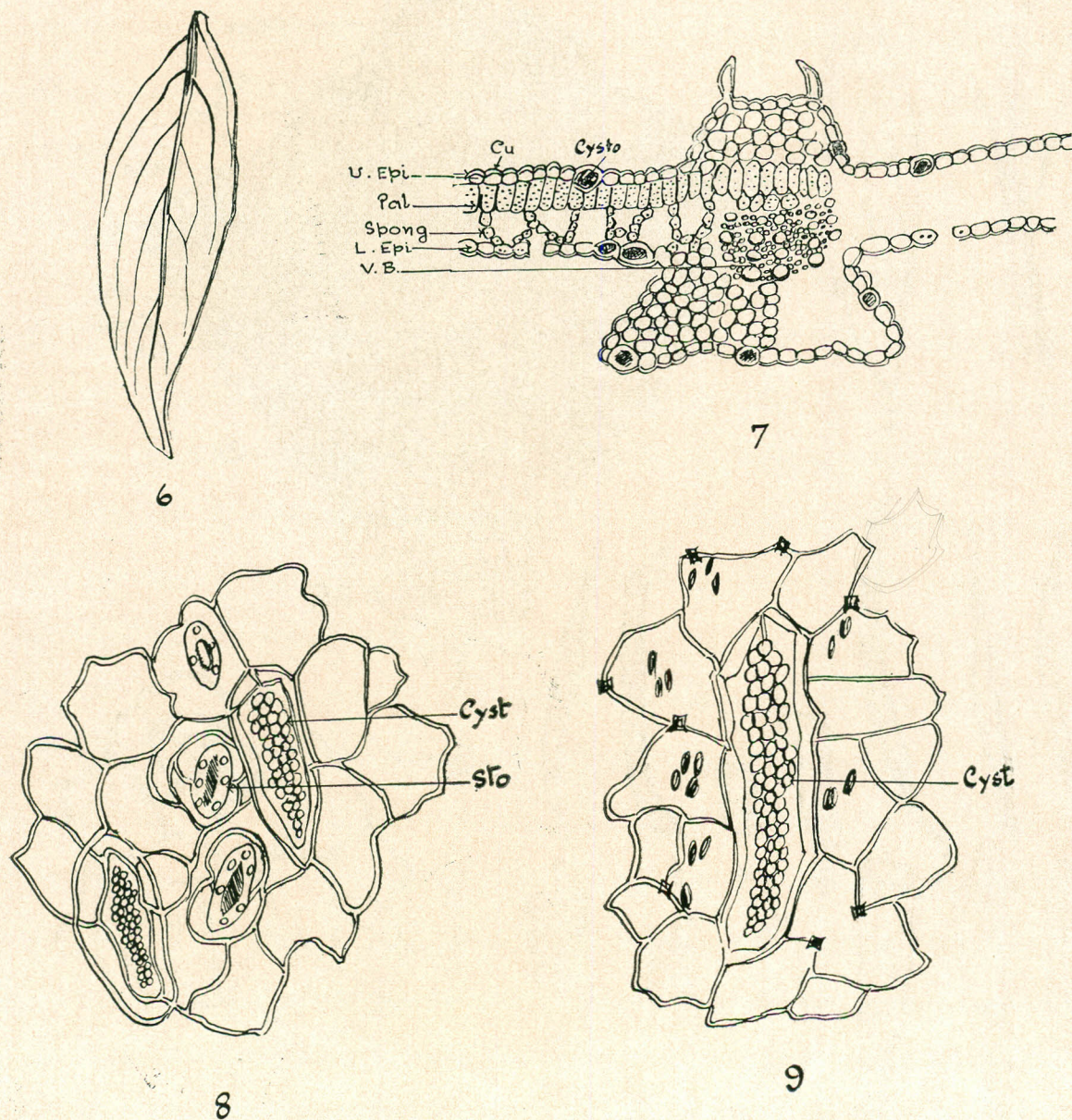


Plate II.—Microscopical characters of the leaf. Fig. 6: A ventral view of the leaf. Fig. 7: Details of t. s. of the leaf. Fig. 8: Thin peeling from the lower surface of the leaf showing cystoliths and stomata. Fig. 9: An enlarged cystolith. Cu, cuticle; U. Epi, upper epidermis; Pal, Palisade parenchyma; Spong, spongy parenchyma; L. epi, lower epidermis; V. B., vascular bundle; Cyst, cystolith; Sto, stomata.

consists of polygonal cells and measure 22-44-55-66 in diameter (Plate I, Fig. 5: d and e).

The pith is composed of thin-walled parenchymatous cells which are isodiametric and round in shape measuring 22-66-88-154 in diameter. The pith contains needle-shaped and rectangular to rhombic crystals. The needle-shaped crystals measure 5-11-27-33 in length and the rectangular crystals measure 11-22-27 × 5.5-11-22.

Leaf.—(Figs. 2 and 6). The leaf exhibits a dorsiventral structure and shows differentiation in the mesophyll tissue. The epidermis is single-layered and covered externally by a thick striated cuticle which is developed more strongly on the upper surface than on the lower one. The epidermal layers contain hair (Plate II, Fig. 7).

The epidermal cells are tangentially elongated and measure 11-22-33 × 5.5-11-22 both on the upper and lower sides. Cystoliths are present on the epidermal cells. A uniform type of stomata is distributed on the lower surface of the leaf and the stomata are accompanied by subsidiary cells which are placed transversely to the pore (Plate II, Fig. 8). The stomata on the leaf measure 22-33-44 × 11-22-33.

The palisade tissue consists of 1-2 layers of cells measuring 33-55-66 × 11-6-22. The spongy mesophyll consists of 2-3 layers of somewhat isodiametrically loosely arranged cells measuring 22-33-44 in diameter. At the margin of the leaf the palisade cells are replaced by isodiametric type of cells which become thick-walled^{3,4} (Plate II, Fig. 7).

Thin peelings from both the upper and lower surface of the leaf were taken and studied under the microscope. Large elongated cystoliths with blunt extremities are observed and the cystoliths measure 33-132-198 × 22-33-44 (Plate II, Figs. 8 and 9). Cystoliths are distributed and form a very important character of the family *Acanthaceae* to which the plant belongs.⁵

Microchemical Tests—The pith cells contain a large number of acicular to rhombic crystals which consist of calcium oxalate. Large cystoliths are present abundantly in the epidermal cells of the leaves and also in the epidermis of the stem (Plate II, Fig. 8 and 9). Chemical tests of the cystoliths show that each cystolith has a strong incrustation of calcium carbonate. The leaves contain traces of an essential oil. Tests for tannins, alkaloids and mucilages were made but were negative.

Discussion

It has already been mentioned that the species *A. paniculata* is being largely used for the preparation of different kinds of medicines in the local pharmacies under various trade names. As the source of the plants at present is the wild natural growths, sometimes other species of plants are collected without notice and sometimes with the purpose of adulteration. It is expected that with the present description of the macro- and microscopical characters of the species it would be quite easy to determine the purity of a sample of collection when compared with the description and figures given in the paper. It is reported that ordinarily leaves and twigs of young jute plants *Corchorus* species were sometimes mixed with the genuine.

It is needless to mention that such admixtures can be easily determined by careful examination. However, there is another species of *Andrographis* grown in Bengal, the name of which is *A. echoidis*. This species differs from *A. paniculata* by having capsule hairy and elliptic; leaves oblong sub-elliptic and hairy; racemes axillary and pedicels very short. The authors have not as yet come across with the species in East Pakistan. It is reported to be found in Chotanagpur, Bihar and West Bengal and is an annual herb like *A. paniculata*.

The authors hope to carry out the comparative botanical pharmacognostic study of the species *A. echoidis* as soon as they get the species of the plant.

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