

Morpho-anatomical appraisal of *Gmelina asiatica* Linn: A pharmacobotanic approach for quality control of raw drug material

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Abstract

Gmelina asiatica Linn. of family Verbenaceae is one of the widely used medicinal plants whose various parts are employed in numerous traditional and folklore medicines. However, it still remains as an 'Anukta dravya' (undocumented drug) and needs immediate scientific consideration. The present study is focused on establishing the pharmacognostic parameters through assessment and documentation of the morphological and anatomical features of the plant root, stem and leaf. Thus, the results of the investigation would serve as a botanical data for the correct identification of the raw drug materials and enables easy detection and prevention of adulterations thereby, facilitating their better quality control in pharmaceutical industries.

Keywords: *Gmelina asiatica*, raw drug, botanical pharmacognosy

1. Introduction

Gmelina asiatica Linn, a straggling spinecent shrub is a native to Indian subcontinent. It is called as 'Gopabhadra' in Sanskrit, 'Badhara' in Hindi, 'Cherukumizh' in Malayalam and Asian Bushbeech in English. It belongs to the family Verbenaceae according to Bentham and Hooker's system of classification but Angiosperm phylogenetic system recognises it under the family Lamiaceae. The plant is of ethnomedicinal relevance owing to the numerous therapeutic uses of its various parts. Many survey reports reveals that the plant is used as a herbal remedy gonorrhoea, catarrh of the bladder and as a blood purifier [1]. The aerial parts including leaves are known to be used in the treatment of hepatic diseases such as jaundice by tribal communities in Tamil Nadu [2]. In Sri Lanka, the young shoots, leaves and roots of the plant are used in the preparation of traditional medicines [3]. Moreover, the roots and aerial parts are also employed for the treatment of rheumatism, fever, dysuria, syphilis, dandruff and diabetes [4]. Though the plant is widely employed in numerous folklore medicines, still they are not documented in any of the materia medica and hence remains as an 'Anukta dravya' [5]. Hence, the present study is focussed on the pharmacognostic assessment on various parts of the plant through morphological and anatomical evaluation.

2. Material and Methods

The studies were carried out in plant materials collected from Payattuville, Thiruvananthapuram district, Kerala, India. The authenticity of the plant was confirmed using the Flora of the Presidency of Madras [6] by the Herbarium curator, Botany department, Kerala University and the voucher specimen (KUBH 10132) was deposited. The root, stem and leaf were subjected to pharmacognostic analyses. The external morphology of plant parts, and other structural

Peculiarities were recorded and the microscopic characters of root, stem and leaf were studied as part of the anatomical investigation [7, 8, 9].

3. Results and Discussion

3.1 Morphological evaluation

The root has light brown colour, cylindrical shape, and fibrous fracture and is characterised by occasional lenticels (Fig.1). The stem is straggling with cylindrical shape. Stem bark is light brown coloured with white dots while the young branches have greenish colouration with numerous white spots (Fig.2). Both the main and sub-branches are characterised by small thick thorns. The petiole is greyish green with numerous hairs and about 1 cm in length. Leaves are simple, ovate with having a width of about 2-2.5 cm and laminal length of 2.5-3 cm range and are characterised by reticulate venation and entire margin. The leaves are light to dark green in colour with the abaxial side having comparatively lighter greenish to greyish colouration and have hairy smooth texture (Fig.3).



Fig 1: *Gmelina asiatica* root



Fig 2: *Gmelina asiatica* stem with thorns and leaves



Fig 3: *Gmelina asiatica* twig showing leaves and floral buds

3.2 Anatomical evaluation

3.2.1. Root

It consists of outer periderm, wide cortex, secondary phloem and central solid cylinder of secondary xylem. The periderm is superficial and it varies in thickness from 5 to 10 layers of phellem cells which are tangentially elongated and suberized. Inner to the phellem is a 2 to 3 layered clear cells forming phellogen which is followed by a wide cortex, which includes parenchymatous cells and characterised by numerous darkly stained highly thick walled stone cells which exist solitarily as well as in groups. Presence of stone cells in the secondary cortex has also been recorded in the roots of *G. arborea* [10]. Inner to the cortical zone lies secondary phloem without any clear cut border between cortex and secondary phloem. The secondary xylem includes diffusely distributed wide circular thick walled vessels and xylem fibres. The vessels may be solitary or paired. The xylem rays are in thin radial lines laden with starch grains. (Fig.4).

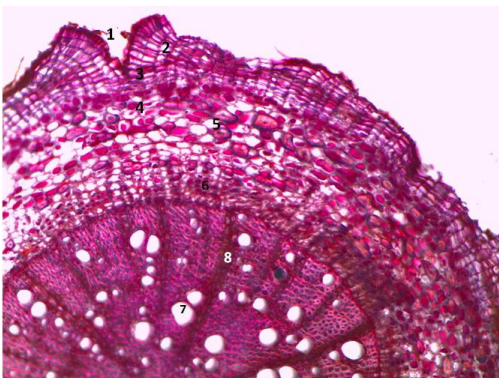


Fig 4: T.S. of root - a portion enlarged 1-lenticel, 2-phellem, 3-phellogen, 4-phelloderm, 5- stone cells, 6-phloem, 7-xylem vessel, 8- medullary ray

3.2.2. Stem

The stem is circular in outline. It consists of a developing cork, hollow cylinder of vascular segments and wide pith. A broken thin dark layer of epidermis could be seen as the outermost layer. Cork consist of 3 to 4 layers of closely packed parenchymatous cells. Underneath the cork cambium is 5 to 6 rows chlorenchymatous cortex. The pericycle is characterised by prominent sclerenchymatous patches of bundle cap and the vascular tissue is represented by rectangular mass of phloem and radial xylem tissue. Xylem has radial chain of wide, circular, vessels and thick walled fibers. Medullary rays are thin and uniseriate and the central pith is wide and parenchymatous (Fig.5). An earlier study on the stem anatomy of *G. asiatica* has reported the occurrence of calcium oxalate crystals in the pith cells [11]. However, the presence of such crystals could depend on environmental factors as seasonal variations has been reported in *Gmelina arborea* [12] and *Citharexylum myrianthum* [13] of family Verbenaceae.

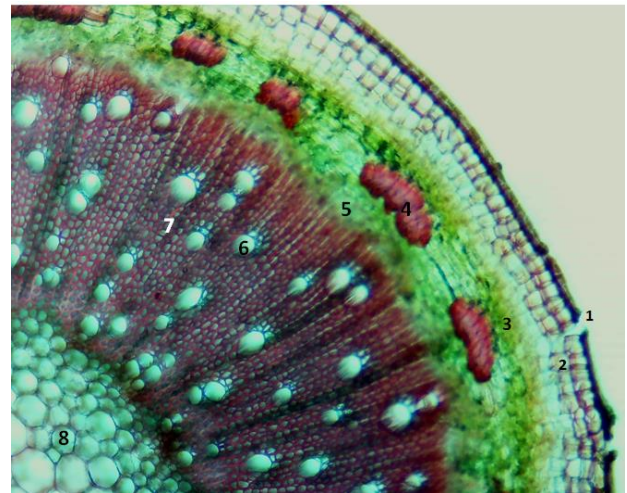


Fig 5: T.S. of stem - a portion enlarged 1- broken epidermis, 2- cork, 3-chlorenchyma, 4-bundle cap, 5-phloem, 6-xylem vessel, 7-vascular ray, 8-pith

3.2.3. Leaf lamina

The leaf has thin lamina and small midrib. The midrib has a nearly flat adaxial side and semicircular on the abaxial side. The abaxial epidermis is fairly thick with prominent cuticle. The adaxial epidermis is with rectangular cells and thick cuticle. The epidermis also have characteristic numerous indumenta. The trichomatous indumentations particularly on the abaxial surface is largely for protection and control against transpirational loss of water [14, 15]. The collenchymatous hypodermis is comparatively wider in the abaxial side than in the adaxial region and are narrower at the sides.

The central vascular elements are collateral with the phloem being adjacent to the radial side of the xylem elements which is endarch in nature. Sclerenchymatous patches form a broken ring around the vascular elements. The ground tissue is parenchymatous with small, circular and compact cells.

The green mesophyll tissue is differentiated into upper single layer of longitudinally elongated, compact palisade cells and irregular lower spongy mesophyll tissue. (Fig. 6).

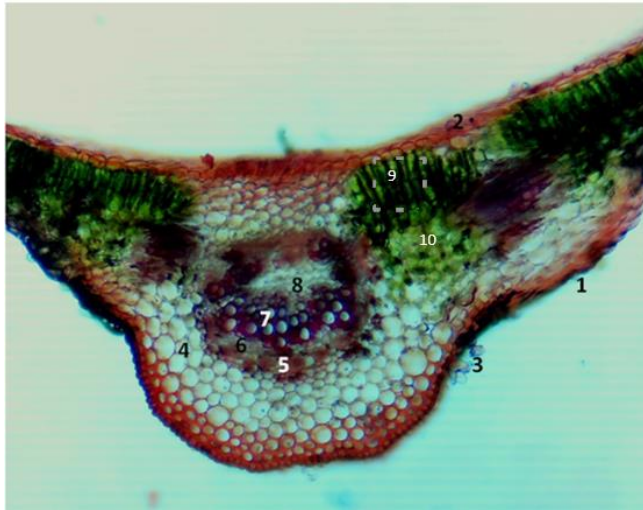


Fig 6: T.S. of leaf showing midrib 1-stomata, 2-epidermis, 3-indumentum, 4-hypodermis, 4-xylem, 5-sclerenchymatous patch, 6-phloem, 7-xylem, 8-ground tissue, 9-palisade mesophyll, 10-spongy mesophyll

3.2.4. Petiole

Petiole is near circular in cross section with a slight bulge at the adaxial side. It consists of a thin epidermal layer of compactly arranged tangentially elongated cells and embedded in the ground tissue is the crescent shaped vascular tissue. The epidermis is characterised by the presence of a thick cuticle and numerous short trichomes and indumenta. The epidermis is followed by 5-6 layers of chollenchymatous cells. The ground tissue is characterised by small parenchymatous cells. The vascular strand forms a crescent arc structure with the adaxial concave and abaxial convex end with a subtending sclerenchymatous patch. It is collateral with endarch xylem adjoining a small phloem patch towards the outer side. Two small vascular elements are present on the adaxial portion, one on each side of the central crescent arc shaped element. (Fig. 7). Such a crescent arc shaped vascular feature has been reported in the petiole of several Verbenaceae members [16].

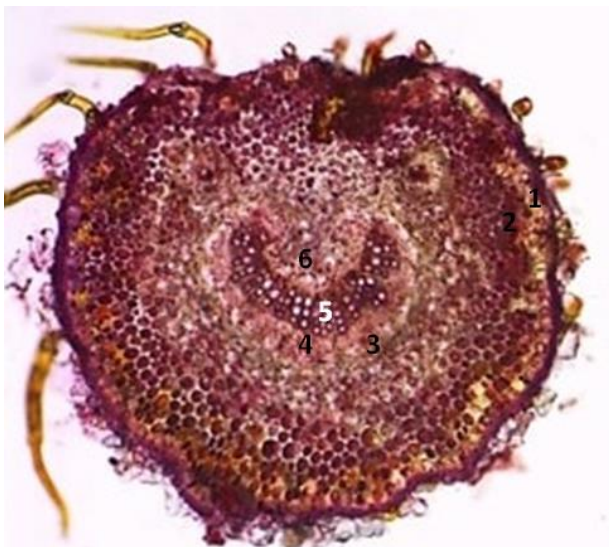


Fig 7: T.S. of Petiole 1-epidermis, 2-chollenchyma, 3-sclerenchymatous patch, 4-phloem, 5-xylem, 6- ground tissue

3.2.5. Leaf epidermal study

The epidermal analyses revealed prominent butterfly-shaped indumenta on the lamina which were comparatively in greater number on the abaxial side rather than on the adaxial surface (Fig 8). The abaxial epidermis further revealed the presence of anomocytic stoma which were scattered along with the indumenta (Fig 8). Presence of hypostomatous anomocytic condition in the plant has been earlier reported [14]. Petiolar epidermal analyses showed numerous multicellular uniseriate trichomes (about 2-4 cells long), in addition to the butterfly-shaped indumenta (Fig 9). Presence of numerous indumenta and trichomes reveal the xerophytic nature of *G. asiatica* [9]. It also ensures protection against the attack of phytophagous insects. Moreover, epidermal hairs have been considered as a specific anatomical feature of diagnostic importance in many plants [17].

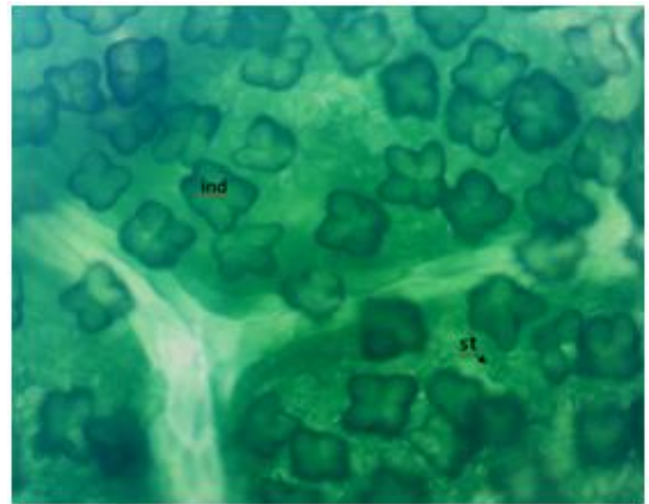


Fig 8: Abaxial epidermis showing indumenta (ind) and stoma (st)



Fig 9: Trichome

4. Conclusion

The accurate documentation of morphological and anatomical features of medicinal plants enable their easy identification and thereby prevent unintentional adulterations in the raw drug industry. The present study has made an attempt to assess the morpho-anatomical features of root, stem and leaf of *Gmelina asiatica* which would serve as a valuable botanical pharmacognostic data to be included in the pharmacopoeia of traditional complementary and alternative medical systems.

5. Acknowledgement

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6. Conflict of interests

The authors have declared that no competing interest exist.

7. References

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