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Micromorphological Characterisation of two simulating root drugs: *Gmelina arborea* Roxb. and *Gmelina asiatica* L. (Verbenanceae)

V. Krishnan[1], M. Gopi [2]

Department of Plant Biology & Plant Biotechnology, [1]Presidency College, Triplicane, Chennai - 600005, Tamil Nadu, India.
[2]Guru Nanak College, Velachery, Chennai -600042, India
[1]krish_vimal_2009@yahoo.in, [2]lmk_gopi@yahoo.com

Abstract

Background/ Objectives: The new millennium is witnessing a profound resurgence in the traditional system of clinical application of the native herbal drugs. This has eventually led to the discovery of hundreds of new plant drugs, which are believed to possess therapeutic potentials.
Methods/ Statistical Analysis: To detect the adulterants from the original ones by mere spotting at sight is unscientific and unreliable under such situation, the crude drugs are to be subjected to microscopic analysis and anatomical parameters.
Findings: The present paper deals with two root drugs, popularly used in Indian System of Medicine, namely *Gmelina arborea* Roxb. and *Gmelina asiatica* L. The result findings highlight the anatomical differences of these two taxa.
Application/ Improvements: *Gmelina arborea* Roxb. is an important ingredient of 'Dasamula' preparation, restricted availability of this drug leads to adulterate *Gmelina asiatica* L. with the previous drug. However microscopic characters of these two root drugs helpful for analyzing to separating each other.

***Key Words*:** Diagnostic value. *Gmelina arborea* Roxb., *Gmelina asiatica* L., Plant Anatomy, Root drugs.

1. Introduction

The roots of plants provide at least 30% of total raw-drugs used in the formulations of herbal drugs, mainly obtained from raw drug dealers or plant collectors. Both of these sources are highly vulnerable for adulteration either intentionally or ignorantly. Very few roots have characteristic organoleptic features of reliable identity. Others lacking specific taste or odour pose problems in botanical diagnosis. However, the internal organizations of the roots have evolved structure and organization uniformity at specific, generic or at family levels. Many of the anatomical features of the roots seem to have adaptive values. The plant anatomy is an essential component of plant morphology and an integral unit of taxonomy and morphogenesis. There are many standard text books on pharmacognosy [1][2][3] which have laid down protocol for microscope studies of crude plant drugs of popular uses. Many crude phytodrugs are prune for adulteration due to lack of standard parameters for their identity. The primary aim of the present study is to analyse and chose the most important structural features of some selected root drugs namely, *Gmelina arborea* Roxb. and *Gmelina asiatica* L. It is also aimed to bring out those microscopic features that are to be highlighted for root drug diagnosis.

2. Materials and Methods

The root drug samples for the present study were collected from Trichy, Tamil Nadu for *Gmelina arborea* Roxb. and Orakkadam, near Chennai for *Gmelina asiatica* L. The plants from which roots were studied were authentically identified with the help of Floras [4][5]. The identification was based on floral and leaf characters. The root sample or fragments were chiseled out from the plant and fixed in FAA (5 ml of Formalin, 5 ml of Acetic Acid and 90 ml of 70% Ethyl Alcohol). After two days of fixing, the specimens were passed through graded series of Tertiary Butyl Alcohol, wax infiltrated and cast into paraffin blocks [6]. Sections of 10 – 12 µm thickness were cut with the rotary microtome along T.S. and L.S. planes. The sections were stained with 0.05% aqueous solution of Toludine Blue [7]. The photomicrographs were taken with NIKON – Lab. Photo – 2 Unit. The descriptions of the root bark and secondary xylem are as per the recommendations of Standard References [8][9].

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3. Observations

3.1. *Gmelina arborea* Roxb. (Verbenaceae): The plant is commonly called as '*Gamari*', is charmed deciduous tree with handsome panicles of brownish – yellow flowers (Fig. 1). The plants distributed in Sri Lanka, India, Himalaya and Philippines. The roots are an ingredient of '*Dasamula*', an ayurvedic preparation (Fig.2). The plant is used for antituberculae treatment. The root system consists of adventitious secondary and tertiary roots. The root's soft, cylindrical smooth with minute fissures. The tertiary roots are thin and fibrous. The root is reddish brown, easily breakable with firm periderm. The root has no specific odour, however, it tastes slightly bitter.

3.2. Anatomical features of the root: This root measuring about 2 mm in diameter has broad distinct periderm with shallow fissures (Fig. 3). The phellem tissue is homocellular with thin walled tubular cells and suberised walls. Phelloderm is not evident. The cortex is wide and distinct, consisting of compact circular parenchymatous cells. Two or three growth rings are solitary or in multiples of two. When viewed under polarized light, calcium oxalate crystals are seen in abundance in the phloem rays and phloem parenchyma. Starch grains are abundant in the xylem fibres. Thick root (Fig. 4) with a radius of more than 5 mm was studied. The old root has much broader, deeply fissured periderm. The phellem cells are compressed and collapsed. The cortex is narrow consisting of compact tangentially oblong parenchyma cells. The vessels are diffuse in distribution. The vessels are mostly solitary, circular or elliptical. The vessels become wider towards the periphery of xylem cylinder. Vessels are intervened with thick walled lignified fibres. When the section is viewed under polarized light, calcium oxalate druses are found abundant in the phloem parenchyma starch grains are also densely accumulated in the xylem fibres.

3.3. *Gmelina asiatica* L. (Verbenaceae): The plant is known as '*Small Casheri Tree*'. It is armed evergreen shrub, leaves elliptic – ovate and showy golden yellow flowers (Fig. 5). It is distributed in almost all districts of Tamil Nadu. It is abundant in the Picchavaram Scrub Jungle, Sri Lanka, Peninsula and Bangladesh. Root (Fig. 6) mucilaginous demulcent and astringent, used for treating rheumatism and catarrh of the bladder. The root is woody, thick, hard and brown. The surface is rough with shallow fissures. The root has no specific taste and odour.

3.4. Anatomical features of the root: Thick lateral root measuring about 5.5 mm thick, broad, fissured and superficial periderm (Fig. 7). In widest region the periderm is 500 µm thick. The phellem cells are thin walled, tubular in shape, suberised and homogeneous. The cortical zone is broad and consists of tangentially oblong, less compact parenchyma cells. The inner boundary of the cortex has small groups of sparse and isolated sclereids. The vessels are diffuse in distribution. The vessels are solitary, circular or angular and thick walled. The size of the vessels increases from centre towards the periphery. The narrow vessel is about 40 µm in diameter, while the wide vessels are 100 µm in diameter. When the phloem is viewed under polarized light prismatic crystals are seen sporadically in the phloem parenchyma. No starch grains are evident in the secondary xylem elements.

Figure 1. *Gmelina arborea* Roxb. flowering shoot

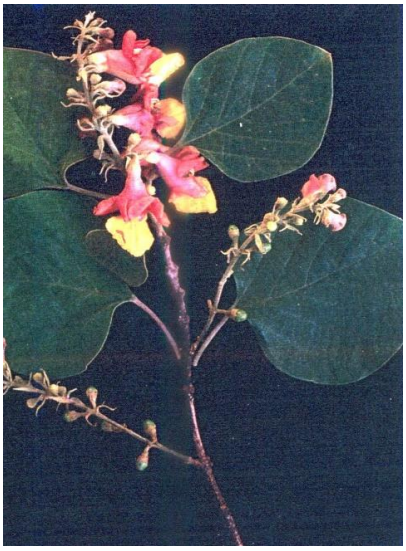

Figure 2. *Gmelina arborea* Roxb.
Root system showing tap root and lateral root

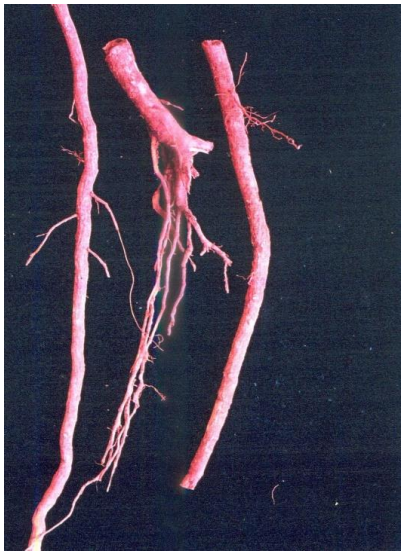

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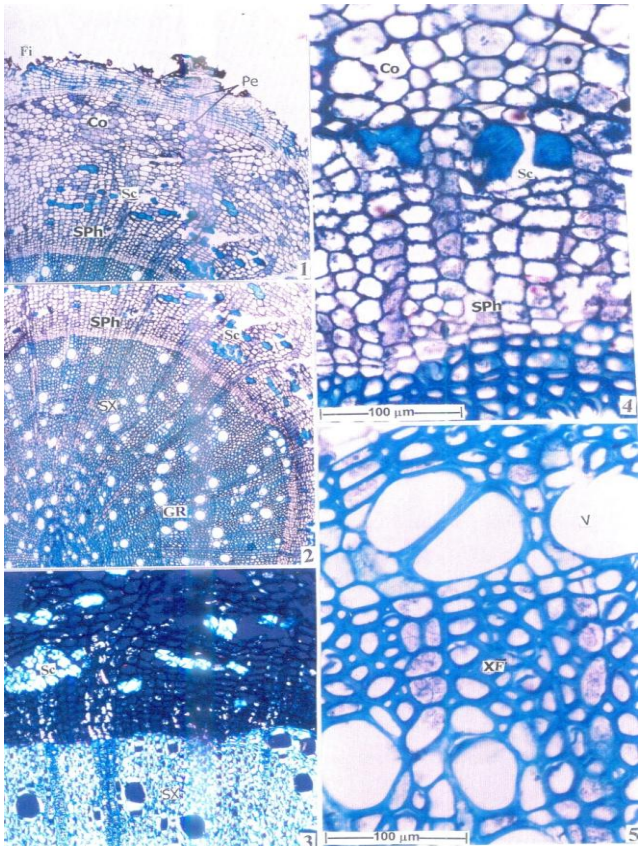
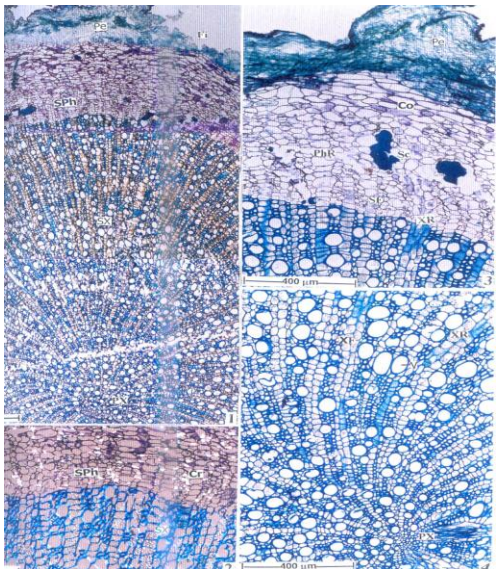
Figure 3. Anatomy of thin root of *Gmelina arborea* Roxb.



3.1. T.S. of Root through cortex and Periderm; 3.2. T.S. of secondary xylem cylinders; 3.3. Secondary xylem and secondary phloem under polarized light showing crystals in the phloem rays; 3.4. Secondary phloem enlarged; 3.5. Secondary xylem enlarged
(Co – Cortex; Cr – Crystals ; Fi – Fissures; GR – Growth Ring; Pe – Periderm; Sc – Sclerenchyma;
Sph – Secondary phloem; Sx – Secondary xylem; V – Vessel; XF – Xylem Fibre)

Figure 4. *Gmelina arborea* Roxb. Anatomy of thick root



4.1. T.S. of root – one sector enlarged; 4.2. Secondary xylem with starch grain and secondary phloem with crystals under polarized light; 4.3. Secondary phloem and Periderm; 4.4. Secondary xylem enlarged
(Co – Cortex; Cr – Crystals ; Fi – Fissures; GR – Growth Ring; Pe – Periderm; PhR – Phloem Ray; PX – Primary Xylem; SE – Sieve Elements; Sph – Secondary phloem; Sx – Secondary xylem; V – Vessel; XF – Xylem Fibre); XR – Xylem Ray)

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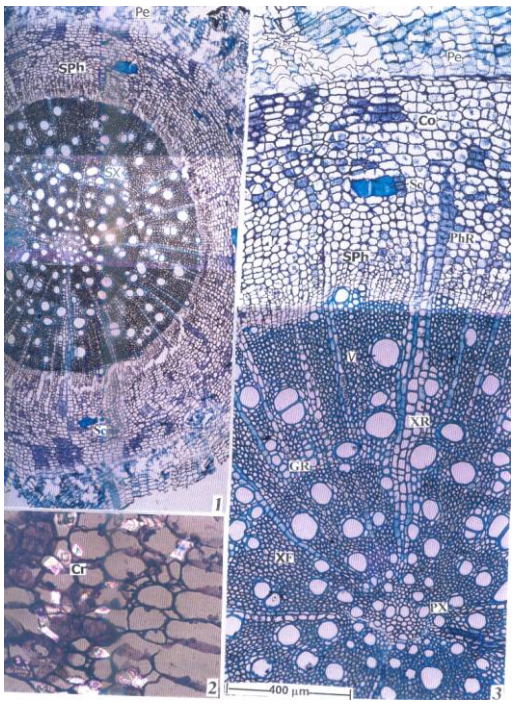
Figure 5. *Gmelina asiatica* L. Shoot bearing flower and fruit

Figure 6. *Gmelina asiatica* L. Woody root and a flowering shoot

Figure 7. *Gmelina asiatica* L. Anatomy of Lateral root



7.1. T.S. of root – entire view; 7.2. Crystals in the cortex; 7.3. Secondary xylem and secondary phloem enlarged
(Co – Cortex; Cr – Crystals ; Fi – Fissures; GR – Growth Ring; Pe – Periderm; PhR – Phloem Ray; PX – Primary Xylem; ; Sc – Sclerenchyma; Sph – Secondary phloem; Sx – Secondary xylem; V – Vessel; XF – Xylem Fibre); XR – Xylem Ray)

4. Discussion

Anatomy of the root varies in much the same way as that from the aerial part of a plant. The composition of phellem and the occurrence of phelloids in various proportions and various arrangements may be of diagnostic value [10]. Distribution pattern of vessels in the cross - sectional view of the roots of normal secondary growth imparts useful diagnostic feature which is easy to access. Among the different cell inclusions, calcium oxalate crystals exhibit fascinating morphological spectrum and great range of distribution patterns. Pharmacognosists have relied greatly on the crystal habits of the crude drug for identification [2][3]. Calcium oxalate crystals have been estimated to account for 1 – 20% of dry weight of a plant [3]. The size of the crystals and the morphology they adopt are believed to be related the size and shape of the cells in which they are found [11]. Starch grains are also equally abundant in the root cells. Their abundance and localization in the cells are of some diagnostic value. The detailed toxicology, analysis

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of agroforestry, phytochemical and pharmacological properties of *Gmelina arborea* was thoroughly studied and well documented by various workers [12][13][14]. The scientific literatures proves that the medicinal root of *Gmelina asiatica* possess anti-proliferative activity [15]. The detailed pharmacognosy for *Gmelina asiatica* stem were studied and added to the botanical information to medicinal pharmacobia [16]. The antimicrobial activities of Gmelina asiatica were studied along with other medicinal plants [17]. The gross anatomical features and detailed microscopic features of the roots and barks offer highly indelible clues for the botanical diagnosis of the fragmentary specimens [18] [19]. However, the detailed root pharmacognosy is lacuna in the medicinal pharmacobia. The present investigation deals with two species of *Gmelina* analysed by using microscopical profile helpful hand to identify these species authentically. The common features of these plants possess a broad periderm with deep fissured. The cortex is wide, parenchymatous with small nests of sclerenchyma elements. The growth rings are fairly distinct. The calcium oxalate druses are found abundant in the phloem parenchyma. Starch grains are also densely accumulated in the xylem fibres of *Gmelina arborea* root. The starch grains and crystals absent or poorly represented in the bark and xylem of *Gmelina asiatica* root. These roots though uniform in gross anatomical manifestation, exhibit strikingly great deal of variation in crystal distribution, starch grains prevalence in the vascular tissues.

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