Micromorphological Studies on *Gmelina arborea* and *Clerodendrum serratum*

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**Abstract**

The crude root drugs of *Gmelina arborea* Roxb. and *Clerodendrum serratum* Moon are often adulterated with roots of *Gmelina asiatica* Linn. and *Premna herbacea* Roxb. respectively. The present paper provides certain anatomical standards for diagnosing the roots of the above mentioned original drugs from their adulterants.

**Keywords:** *Gmelina arborea*, *Gmelina asiatica*, *Clerodendrum serratum*, *Premna herbacea*, Micromorphology.

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**INTRODUCTION**

The hypogean organs of plants serve as the sink for many metabolites. The storage roots and rhizomes which are variously modified in to different exomorphic forms are primarily endowed with storage function. These storage products have proved to be of high economic value, especially in terms of medicinal properties (1-2). When the underground organ excavated from the ground, there are always chances for accidental mixing of roots of other growing in the population. Surface morphology of the roots, of course, may help largely to diagnose the roots in question. However, the external feature will be of limited reliability in certain cases where the original specimens and the adulterants simulate very closely. Under such predicament, analyses of internal structure of the root have to be of dependable resort.

In the present investigation some renowned root-drug used in indigenous formulations namely, *Gmelina arborea* Roxb. (Fig. 1-2), *Clerodendrum serratum* Moon, *G.asiatica* Linn. and *Premna herbacea* Roxb. (syn. *Pygmaeopremna herbacea* Moldenke) have been studied anatomically and the data are presented for standardizing the identity of the roots. It has been noted that the pioneer work has been conducted on the study of external features of the herb and their officinal part (*G.arborea* and *G.asiatica*) (3). Not much work has been done on the anatomical structure, especially on the root woods. The root woods of the plants have been given more accents in the present study, since the drugs available in the market include the wood as well as bark.

**MATERIALS AND METHODS**

Authentic root wood pieces of all four species were collected from the field after establishing their taxonomic identity. Thick root woods were cut in to small pieces and boiled in water till the specimens started sinking. The specimens were pickled in glycerin alcohol mixture for further softening. Sections of 15-20μm thickness in transverse and longitudinal planes were taken with sledge microtome. The lateral roots, less then 5mm thick, were embedded in paraffin wax after dehydration and wax infiltration and sectioned with rotary microtome to the thickness of 10μm (4). Sections were stained with toluidine blue (5) or safranin. For the study of individual wood elements, wood tissues were macerated employing Jeffrey’s fluid (6). Description of the wood structure is followed as per the terminology recommended by IAWA (7). Photomicrographs were taken with Nikon Alphaphot microscope unit.
**Observation**

Growth rings less distinct; diffuse porous; pores narrow, thick walled, circular or elliptic (Fig.2:2-3); 36.8-55μm in diameter; tyloses absent; pores of the central parts of secondary xylem are filled with amorphous gummy substance. Axial parenchyma apotracheal, diffuse or paratracheal and scanty; occurs in vertical strands. Xylem rays predominantly biseriate, the two ends have very long, uniseriate, vertical row of tails (Fig.2:4); height of the rays 230-690μm; breadth 27.6μm. Imperforate tracheary elements include thick walled, narrow lumened libriform fibres and fibre-tracheids. Libriform fibres with wide lumen are also frequent. In macerated preparations, the vessel elements present a high degree of variation. Some are cylindrical, narrow with very long tails at both or one end; very narrow, long pitted elements with sub-terminal perforations are very common; these elements simulate the fibres (fibriform-vessel elements) in general shapes and size (Fig.2:5-6).

Growth rings fairly distinct, diffuse porous, growth rings demarcated by a broad zone of tangentially oblong, thick walled, narrow lumened fibres (Fig.3:2); pores predominantly in tangential chains or less frequently solitary; circular in cross-sectional outline (Fig.3:2-3); diameter of the pores 50-145 (93)μm; Vessel elements cylindrical, with or without tails; lateral wall pits with angular borders and elliptical aperture; perforation plate simple, horizontal vessels filled with lignified tyloses forming pseudoparenchymatous structures within the vessel (Fig.3:3-4). Axial parenchyma paratracheal, vasicentric forming a thin, less conspicuous sheath around the vessels. Xylem rays 1-3 seriate, homo or heterocellular; rays 2-many cells in height, measuring 165-506 (400)μm high and 40-46μm in breadth; fibres libriform type, thick walled, lumen fairly wide, pits well developed on the radial walls.

Growth rings quite distinct, diffuse porous, growth rings demarcated by thick walled, narrow lumened fibres; pores circular, thin walled; diameter of the pores 37.4 – 188 (102) μm; pores mostly solitary, less frequently in radial multiples (Fig. 4:3-4); individual vessel elements cylindrical, short, with simple horizontal perforation plate; intervacular pits bordered, borders angular, aperture elliptic; scalariform pits are also frequent.
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especially in the long narrow vessel elements (Fig.5). Axial parenchyma not abundant; either apotracheal or paratracheal and scanty. Xylem rays 1-3 seriate, homo or heterocellular; height of the rays 276-1012 (546.6) μm, breadth 55.2-110 (88.4) μm, needle-like crystals are abundant in the ray cells. Imperforate tracheary elements include, thick walled, simple pitted libriform fibres (Fig.5).

The drug consists of nodulated root / rhizome. The structure of thin and nodulated part is basically similar. The narrow part of the root system has well developed periderm with deep irregular fissures. The first periderm is superficial in origin comprising 5-10 layers of homogenous phellem cells. The subsequent periderm originates deeper in the cortical zone or from the outer zone of the secondary phloem. These two periderm layers constitute what is known as rhytidome (Fig.6; 2, 6). The rhytidome is followed by a broad zone of secondary phloem where small nest of sclerenchyma elements are embedded. The secondary xylem forms a broad, dense cylinder with wide pith in the case of underground stem or without pith if it is root. Secondary xylem has distinct one or two growth zones. The elements of secondary xylem include narrow regular thin walled solitary vessels and thick walled libriform fibres. The pith when present is parenchymatous and compact.

The nodulated part of the organ may be either underground stem (rhizome) or root. In the case of rhizome there is distinct wide parenchymatous pith surrounded by several primary xylem strands (Fig. 6:3). The bulk of the organ consists of radial fibres of cells reaching up to the periphery. This zone has mostly radially oblong thin walled parenchymatous cells. However there are several circular narrow bands of tangentially oblong thick walled cells and isolated narrow indistinct vessels. These circular zones resemble somewhat the growth ring pattern of mature wood (Fig. 6: 4-5). All the cells of the radial fibres heavily loaded with starch grains (Fig. 6:7). The surface of the rhizome has broad secondary phloem with nests of sclerenchyma elements as in the non-nodulated bark. The rhytidome with two or three wavy periderm zones are well developed with fissures. This rhytidome portion is similar to that seen in the non-nodulated thin portion.

In the case of root organ, the central part is occupied by primary xylem elements without distinct pith.
zone. The other features of the organ are similar to the rhizome. However, the outer zone of the tuberous root, the vascular elements exhibit twisting and curling in the form of irregular nodules. The structures are probably brought about by imbalanced proliferation of xylem parenchyma.

**DISCUSSION**

The root of *G. arborea* is used in the indigenous formulations as one of the important constituents, specifically as an ingredient of Dasamula. Because its restricted availability this drug is often adulterated with or substituted by easily available root drugs such as *G. asiatica*. In fragmentary form of small pieces of wood sold in the market it is difficult to distinguish *G. arborea* from its adulterants. However, the histological features of *G. arborea* root wood are specific. These features can be employed for distinguishing *G. arborea* from *G. asiatica*.

The growth rings in *G. asiatica* are fairly distinct with diffuse porous distribution of vessels (Fig. 3). In *G. arborea*, the growth rings are not evident. The pore diameter seems to be strikingly different in these two species (Fig. 1). In *G. asiatica* the mean pore diameter is 93 μm, whereas in *G. arborea* it is only 45 μm. The xylem rays are very unique in *G. arborea*. The rays are predominantly biseriate with very long tails. In *G. asiatica*, the rays are 1 to 3 seriate without tails. The vessels are often filled with abundant tyloses in the root wood of *G. asiatica*, whereas in *G. arborea* tyloses are not evident. Another striking difference may be noted in the macerated vessel elements of the two species. In *G. arborea*, fibriform – vessel elements are quite...
abundant. These elements are narrow and fibre-like and possess well developed pits and sub-terminal perforations. In *G. asiatica*, the vessels are typically in a tangential line which is a rare or unique feature. In *G. arborea* the distribution of vessels is random and diffuse.

Two different drugs are sold in the market in the name of Bharangi. One is equated to *Clerodendrum serratum*. The other one is *Premna herbacea* (8). *Premna herbacea* has characteristic external morphology (Fig. 6) the roots are generally nodular with thin and spindle shaped thick portions along the length of the root. The thin portion of the root has dense secondary xylem cylinder with one or two growth rings. The periderm is composed of two or three zones of phellem alternating with non periderm tissues. It is typically of rhytidome type. The swollen nodular portion has somewhat anomalous structure. The secondary xylem is usually centric in growth and consists of mostly thin walled parenchyma cells arranged in radiating rows of cells. There are several growth ring-like narrow zones of thick walled cells and few narrow vessels. The nodular organ is primarily storage in function.

The roots of *Clerodendrum serratum* have typical dicotyledonous root structure (Fig. 4, 5). The root wood has distinct growth rings. The individual vessel elements bear either circular or scalariform bordered pits. The xylem rays are quite broad and possess needle like calcium crystals. The above mentioned characters may be largely aid in distinguishing the root drugs in fragmentary form.

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**REFERENCES:**