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# Morphoanatomical evaluation of *Terminalia arjuna* roxb. Bark

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**Abstract**
*Terminalia arjuna* Roxb. (Combretaceae) is commonly known as Arjun tree and valued for its medicinal uses. In the present investigation, the detailed pharmacogenetic study of *T. arjuna* stem bark (TASB) is carried out to lay down the standards which could be useful in forthcoming experimental studies.

**Keywords:** *terminalia arjuna* roxb, macroscopy, microscopy, powder microscopy

## Introduction
*Terminalia arjuna* is a large, evergreen tree, with a spreading crown and dropping branches. It has been grown in most parts of India and used in Ayurvedic formulations since ancient times. Besides its wide range of medicinal uses, *T. arjuna* is planted for shade and ornamental purposes. Terminalia's active constituents include tannins, cardenolide, triterpenoid, saponins, flavonoids, gallic acid, ellagic acid, oligomeric proanthocyanidins (OPCs), phytosterols, calcium, magnesium, zinc, and copper [1, 2]. Improvement of cardiac muscle function and subsequent improvement in the pumping activity of the heart seems to be the primary benefit of Terminalia. It is thought that the saponin glycosides might be responsible for the inotropic effect of Terminalia, while the flavonoids and OPCs provide free radical antioxidant activity and vascular strengthening [3-4]. Therefore, in the present study an attempt has been made to study the pharmacogenetic standards of the bark of *T. Arjun.* But also in the detection of adulterants in marketed drugs as well as in Forensic detection.

## Materials and methods
### Chemicals and reagents used
Phloroglucinol (Chemie labs, Mumbai), Hydrochloric acid (SD fine chemicals, Bangalore) and Iodine (Chemie labs, Mumbai). The other solvents and water are laboratory grade.

### Authentication and process plant materials
The plant species was authenticated by S.M. Khasim, professor, Department of botany and microbiology, Acharya Nagarjuna University, Guntur. The specimen was deposited in the department for future reference. The drug material was subjected to ground and sifted in 60# mesh for further experimentation.

### Microscopic evaluation
### Preparation of sections
Microscopic studies had been done by preparing thin hand section of the root with the help of sharp cutting edge of the blade, then cleared with chloral hydrate solution, stained with phloroglucinol-hydrochloric acid (1:1) and mounted in glycerin.

### Powdered microscopy
The powder microscopy was carried out in accordance with the procedure described in Khandelwal [5].

## Results and discussion
### Macroscopic study
Bark available in pieces, flat, curved, recurved, channelled to half quilled, 0.2-1.5 cm thick, market samples upto 10 cm in length and upto 7 cm in width, outer surface somewhat smooth and grey, inner surface somewhat fibrous and pinkish, transversely cut smoothened bark shows pinkish surface, fracture, short in inner and laminated in outer part; taste, bitter and astringent.

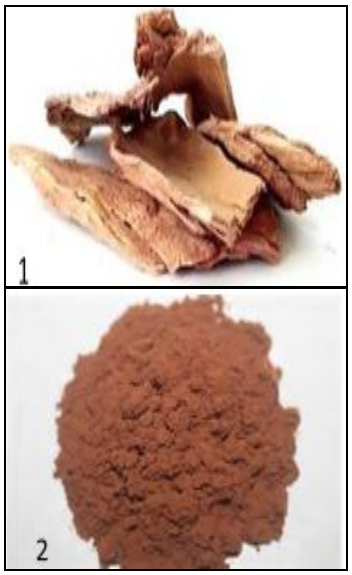


**Fig 1&2:** Crude form of Arjuna bark and powder

The bark is greyish and smooth externally, internally brown or red coloured and smooth. The shape of bark was flat and curved (Fig. 1). The transversely cut bark showed brownish surface, fracture, short in inner and laminated in outer part. The powder of TASB was light brown (Fig. 2) with astringent taste and no odour [6-7].

**Microscopic study**

Stem Bark -Mature bark shows cork consisting of 9-10 layers of tangentially elongated cells, a few outer layers filled with brown colouring matter; cork cambium and secondary cortex not distinct and medullary rays observed traversing almost upto outer bark; secondary phloem occupies a wide zone, consisting of sieve tubes, companion cells, phloem parenchyma and phloem fibres, traversed by phloem rays, usually uniseriate but biseriate rays also occasionally seen; in the middle and outer phloem region, sieve tubes get collapsed and form sclerenchyma; phloem fibres distributed in rows and present in groups of 2-10; rosette crystals of calcium oxalate measuring 80-180µ in dia., present in most of the phloem parenchyma, alternating with fibres; idioblasts consisting of large cells having aggregates of prismatic and rhomboidal crystals of calcium oxalate in row throughout the zone, measuring 260-600 µ in dia., starch grains, mostly simple, compound of 2-3 components, sometimes upto 5 components, round to oval, elliptical, measuring 5-13 µ in dia., distributed throughout the tissue (absent in T. alata); in a tangential section the uniseriate phloem rays 2-10 cells high and biseriate, 4-12 cells high; in longitudinal section rosette crystals of calcium oxalate found in the form of strands in phloem parenchyma.

**Sclereids**

The abundant sclereids, which occur single or more frequently,in small groups;they show considerable variation in size and shape but are usually more or less isodiametric;the walls of most of the cells are moderately thickened and often the outer wall is less thickened that the others;occasional cells have very thick walls with a small lumen; pits are numerousand conspicuous, and striations are usually visible.

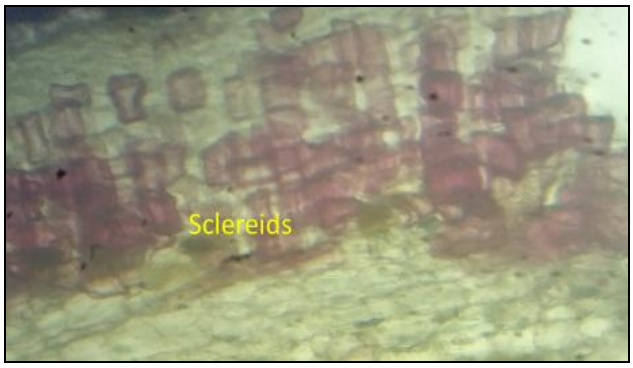


**Fig 3**

Parenchyma cells give rise to sclereid by secondary thickening and lignin deposition on their walls. They are usually isodiametric and may be of various shapes. According to shapes, they may be branchy-, macro-, astro-, trichosclereids etc. It has long numerous pits with rounded pit aperture. Ramiform pits are present on brachysclereids.

**Cork**

The fairly numerous fragments of cork composed of moderately thick-walled cells, polygonal in surface view, with dark red to brown contents.

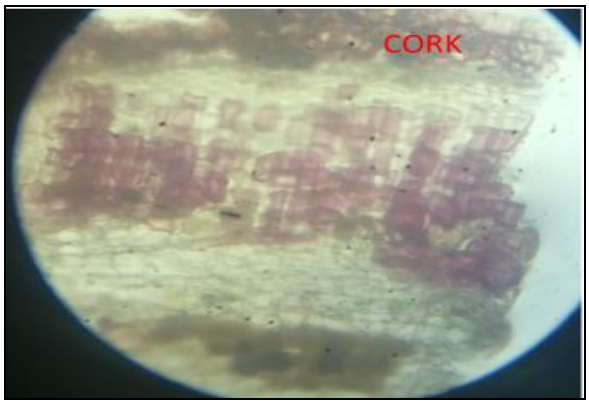


**Fig 4**

The very occasional fragments of cork. In surface view, the cells are thin-walled and polygonal; in sectional view, occasional fragments show the cell layers arranged in alternating bands of thin-walled cells and thicker-walled, rather indistinct, lignified cells.

**Fibres**

The abundant fibres, yellowish in colour, which are very large and usually found fragmented; they occur singly or occasionally, in groups of two or three cells.

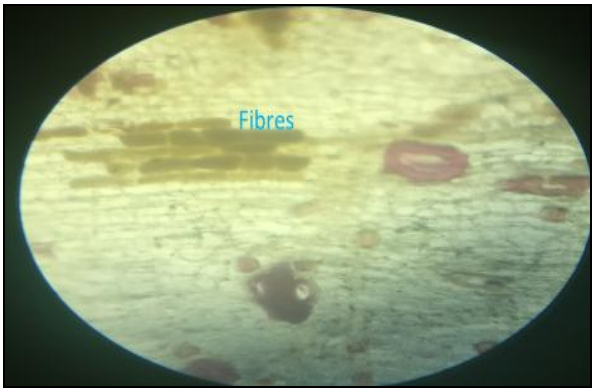


**Fig 5**

Individual fibres are fusiform with bluntly pointed ends which may be indistinctly forked; the walls are straight, heavily thickened and lignified and usually show conspicuous striations; the pits are numerous and distinctly funnel-shaped, opening into the lumen which is somewhat uneven; short, longitudinal fissures also often occur in the walls at intervals.

**Parenchyma**

The abundant parenchyma of the phloem, many of the cells of the PhloemParenchyma are fragmented and in addition to the colouring matter some of the cells containing starch granules and others contain microcrystals of calcium oxalate.

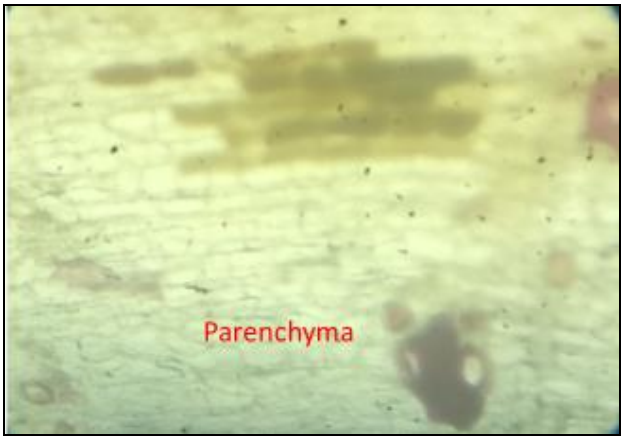


**Fig 6**

Most of the cells are thin-walled but occasional groups have thicker walls which are distinctly pitted.

**Medullary Ray**

The medullary ray is more usually seen in radial longitudinal view, frequently associated with fibres; the cells have moderately thickened walls.

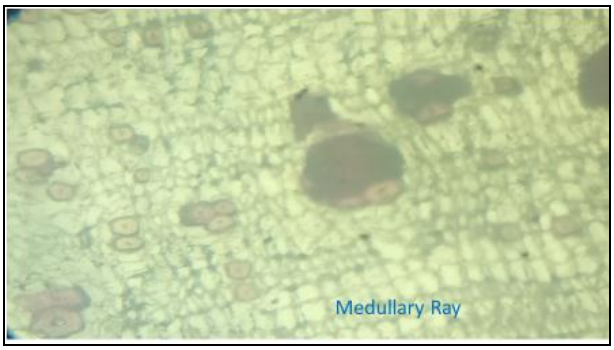


**Fig 7**

**Stone cells**

The medullary ray cells frequently contain numerous small, acircular crystals of calcium oxalate.

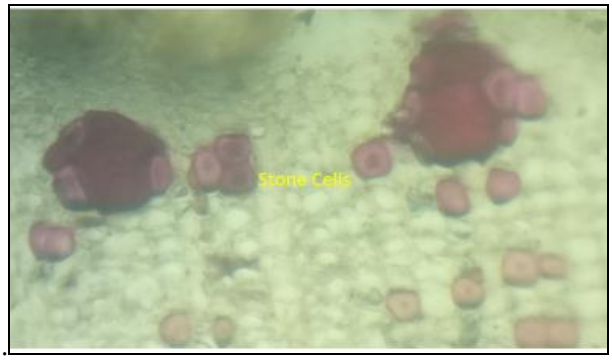


**Fig 8**

**Characteristics of powder microscopy**

**Starch Grains**

The occasional starch granules, which are found scattered and in some of the parenchymatous cells.

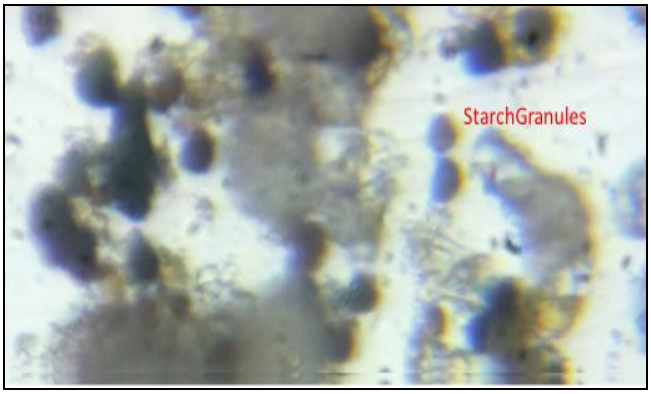


**Fig 9**

They are small, usually simple and spherical but occasional compound granules are found with two or three components.

**Calcium Oxalate Crystals**


**Fig 10**

Which occurs in masses in some of the parenchymatous cells; they rarely are found scattered.

Individual crystals are very small and are irregular in shapes.

**Conclusion**

Standardization of herbal drugs is very much crucial because they are produced from heterogeneous sources which could result in variations. These kinds of variations can cause spurious results in various pharmacological and phytochemical studies. *T. arjuna* bark was recognized for many therapeutical properties, therefore, the current study might be beneficial to supplement the information in respect to its identification, authentication, and standardization.

**Acknowledgement**

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