



## Research Article

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# Anatomical atlas of Panchavalkala – effective healing five bark drugs in gynaecological disorders

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## ABSTRACT

**About:** *Panchavalkala* is a combination of five bark drugs indicated in wide range of therapeutics in Ayurveda. These are the barks of five trees ie. *Nyagrodha* (*Ficus benghalensis* L.), *Udumbara* (*Ficus racemosa* L.), *Ashwatha* (*Ficus religiosa* L.), *Plaksha* (*Ficus lacor* Buch. Ham.), *Parisha* (*Thespesia populnea* (L.) Sol.ex Correa). Barks of these trees are dried in shade and are used for different formulations, in different pathological conditions, especially as wound healing and gynaecological disorders. Because of similar appearance of these five barks usually said to be adulterated with other barks of same species. Macro-microscopic works done under scientific guidelines are easy evident sources to prevent such problems. **Materials and Methods:** Bark samples of PVK were collected from their natural habitat, authenticated using floras and botanist's opinion. Macro-microscopic features of these samples were taken as per standard protocol. **Results:** Bark samples of PVK were thick and fibrous except *T. populnea* which was thick with transverse crack and fissure, whereas bark of *F. racemosa* was mucilaginous and *F. lacor* had transversely arranged lip shaped lenticels on outer surface. Wide secondary phloem and masses of stone cells; thick lignified cortical cells, secondary phloem with sieve tubes and laticiferous cells in the region of phloem were marked histological features of *F. religiosa* and *F. racemosa* respectively. *F. benghalensis* shows a wide secondary cortex with groups of stone cells, pitted cells while a wide secondary phloem is the feature of *F. lacor*. Starch grain, crystals of calcium oxalate, stone cells were common among powder characters of each sample of PVK.

**Keywords:** *Panchavalkala*, Macro-microscopy, mucilaginous cells, stone cells.

## INTRODUCTION

Categorisation of drugs having similar activity under a common heading and using that particular combination is a popular practice in Indian system of medicine<sup>[1]</sup>. *Panchavalkala* (Five bark drugs) a group of five drugs which includes *Nyagrodha* (*Ficus benghalensis* L.), *Udumbara* (*Ficus racemosa* L.), *Ashwatha* (*Ficus religiosa* L.), *Plaksha* (*Ficus lacor* Buch. Ham.), *Parisha* (*Thespesia populnea*). These are also familiar as *Panchakhiri Vrikshas* (five latex yielding trees)<sup>[2]</sup>. Barks of these trees are dried in shade and are used for different formulations (*Pancha Kashaya Kalpanas*)<sup>[3]</sup>.

Therapeutic utility of these drugs have been highlighted in classical texts of Ayurveda and all these have been said to be wound healing, styptic, best in gynaecological disorders<sup>[4]</sup>. Tannin, flavanoids, beta sitosterol and stegmasterol are some common phytochemical constituents found to be present in all these drugs<sup>[5]</sup> (Table No. 2) and *Kashaya* (Astringent) is main taste found commonly in all these barks<sup>[6]</sup> (Table No. 1). Though having certain similarity each drug is having its own specificity related to their medicinal property.

Pharmacognosy is a special branch related natural products, which can be defined as the study of macroscopic, microscopic, photochemical features of crude drug along with their history of availability, procurement, preservation etc.<sup>[7]</sup>. *Materia medica* are the results of such works. With advent of increased demand towards natural products, simultaneous non-availability of such drugs, led to a grave problem ie adulteration (admixture with spurious drug)<sup>[8]</sup>. Quality of a drug is an important factor in therapeutics. Hence pharmacognotic study and published materials on these natural products may help in reducing such problems, thus help in accuracy of treatment and their efficacy.

*Panchavalkala* barks though available popularly, because of their similar appearance, deliberately adulterated with available samples. *Plaksha* (*F. lacor* syn. *F. infectoria*) is a plant which said to be found rarely, and *F. tsjela* is commonly used in place of this<sup>[9]</sup>.

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Above discussed all factors necessitated to carry out a detailed pharmacognostic study of these five barks, which may decrease such admixture and may provide quality drug in the therapeutics. Hence,

macro-microscopic study of PVK has been carried out with proper scientific guidelines and details have been attempted in this paper.

**Table 1:** Rasa-panchaka of Panchavalkala

Drug	Rasa	Guna	Veerya	Vipaka
<i>Aswatha(F. religiosa)</i>	Kashaya Madhura	Guru Ruksha	Sheeta	Katu
<i>Udumbara(F. racemosa)</i>	Kashaya	Laghu Ruksha	Sheeta	Katu
<i>Vata(F. benghalensis)</i>	Kashaya	Guru Ruksha	Sheeta	Katu
<i>Plaksha(F. lacor)</i>	Kashaya	Guru Ruksha	Sheeta	Katu
<i>Parisha(T. populnea)</i>	Kashaya	Laghu Ruksha	Sheeta	Katu

**Table 2:** Phytochemical constituents and useful parts of Panchavalkala

Drug	Phytochemical constituents	Useful parts
<i>Aswatha(F. religiosa)</i>	Tannin, flavanoids	Bark, latex, leaf, aerial roots, fruit, seed
<i>Udumbara(F. racemosa)</i>	Tannin, lupeol, beta sitosterol	Bark, latex, root, aerial root, fruit
<i>Vata(F. benghalensis)</i>	Tannin, beta sitosterol, stigmasterol	Bark, latex, fruit, leaf, seed
<i>Plaksha(F. lacor)</i>	Tannin, beta sitosterol, lanosterol, lupeol	Bark, fruit, leaf
<i>Parisha(T. populnea)</i>	Tannin, gossypol, populneol	Bark, root, fruit, leaf

## MATERIALS AND METHODS

Bark samples of PVK were collected during the month of November and December from their natural habitat, cleaned properly from extraneous matter, photographs were taken, authenticated using floras and botanist's opinion. Samples cleaned from extraneous matter and deposited at SDM centre for research in Ayurveda and Allied Sciences. (Table No). Bark samples preserved in fixative solution for further macro-microscopic study. The materials were left in FAA (Formalin- 5ml+acetic acid 5ml+ 70% ethyl alcohol -90 ml) more than 48 hours. Few samples shade dried and powdered used for powder microscopic study<sup>[10]</sup>.

### Macroscopy

External features of these five bark samples were documented using Canon IXUS digital camera. Organoleptic features like colour, taste, appearance, smell were recorded and tabulated according to standard guidelines <sup>[11]</sup>.

### Microscopy

These preserved samples were cut into thin transverse section using a sharp blade and the sections were stained with saffranine. Transverse sections were stained properly and pictures were taken using Zeiss AXIO trinocular microscope attached with Ziess Axio Cam camera under bright field light. Proper magnifications of the figures are indicated by the measuring bars<sup>[12]</sup>.

### Powder microscopy:

Pinch of bark powder sample was warmed with drops of chloral hydrate on a microscopic slide and mounted in glycerine. Microscopic characters of the powder were observed under the microscope, diagnostic characters marked and photographic records were maintained <sup>[13]</sup>.

## RESULTS

Macroscopic features recorded scientifically along with their voucher numbers have been displayed at Table 3 and Figure 1. Transverse section of five barks taken and studied microscopically and features explained at Table 4 and Figure 2-6. Powder microscopic features of individual bark sample displayed at Table4 and Figure 2-6.

**Table 3.** Macroscopic features of ingredients of Panchavalkala

Drug	Voucher No	Macroscopy
<i>Aswatha(F. religiosa)</i>	771/16051703	Flat or slightly curved pieces, varying in thickness, outer surface brown or ash coloured, surface uneven due to exfoliation of cork, inner surface smooth and somewhat brownish, fracture, fibrous, astringent.
<i>Udumbara(F. racemosa)</i>	771/16051704	Greyish-green, soft and uneven, on rubbing white papery flakes come out, inner surface light brown, fracture fibrous, mucilaginous without any odour
<i>Vata(F. benghalensis)</i>	771/16051705	Grey, ashy white, light bluish-green or grey patches, bark or slightly curved, externally rough due to horizontal furrows and prominent lenticels, fracture short in outer two thirds, inner portion fibrous, astringent.
<i>Plaksha(F. lacor)</i>	862/17011902	Rough, flat to curved; external surface ash or whitish-grey; transversely arranged lenticels common, lip-shaped and exfoliating; internal surface rough, fibrous, longitudinally striated, reddish-brown; fracture, fibrous, astringent.
<i>Parisha(T. populnea)</i>	862/17011901	Outer surfaces were dull brown or grey in color, rough due to longitudinal and transverse crack and fissure due to exfoliation of the outer bark was seen, inner surface were striated and pale yellowish in color; fractures short and fibrous; odour and taste characteristic and slightly bitter.

**Table 4:** Microscopic and powder microscopic features of ingredients of *Panchavalkala*

Panchavalkala	Microscopy	Powder microscopy
<i>Aswatha</i> ( <i>F. religiosa</i> )	Transverse section of bark shows compressed rectangular to cubical, thick-walled cork cells and dead elements of secondary cortex, consisting of masses of stone cells in large groups, rarely isolated, parenchymatous cells contain numerous starch grains and few prismatic crystals of calcium oxalate, secondary phloem a wide zone, phloem fibres in singles or in groups of 2 to many and non-lignified, numerous crystal fibres also present, in outer region sieve elements collapsed, inner region intact, phloem parenchyma thick-walled, a number of ray-cells and phloem parenchyma filled with brown pigments, medullary rays uni to multiseriate.	Lignified cork found in surface view, with rows of stone cells, sclerides. Fibres are of pitted, with abundant prismatic crystals, simple starch grains. Cut pieces of medullary rays embedded with dark brown content and cells filled with latex is found.
<i>Udumbara</i> ( <i>F. racemosa</i> )	3-6 layers of thin-walled cork cells with brownish content, secondary cortex 6-12 layered, composed of thin-walled rectangular cells with simple and compound starch grains and rhomboidal crystals of calcium oxalate, outer cells filled with chloroplast, cortex wide circular to oblong, thin-walled cells, with orange-brown content, some cortical cells get lignified with pitted walls, secondary phloem wide with patches of sieve tubes, companion cells separated by medullary rays, phloem fibres much elongated, lignified, very heavily thickened and possess narrow lumen: medullary rays uni to pentaseriate, a number of ray cells get lignified, laticiferous cells found in phloem region.	Powder exhibits the presence of non lignified septate fibres, with wide mouth stone cells, laticiferous canal, simple and compound starch grains, pieces of fibres and phloem elements.
<i>Vata</i> ( <i>F. benghalensis</i> )	Compressed cork tissue and dead elements of secondary cortex having stone cells, cortex and cork cells containing brownish content, secondary cortex wide, composed of large groups of stone cells and parenchyma with prismatic crystals of calcium oxalate, starch grains and tannin, secondary phloem composed of a few sieve elements parenchyma, fibres, stone cells and latex tube alternating with medullary rays, some phloem cells contain prismatic calcium oxalate crystals forming crystal fibres, medullary rays 2-5 seriate, few cells also converted into pitted stone cells, mostly rounded, rarely oval or semi-lunar in shape, simple as well as compound starch grains observed in parenchyma.	Pieces of rhytidome found along with thick walled hexagonal to pentagonal lignified cork cells embedded with dark brown tannin cells and crystals of calcium oxalate. Isolated or groups of circular to oval pitted stone cells, beaded with rectangular sclerides found abundantly. Longitudinally cut septate fibres associated with lactiferous tubes, tangentially and radially cut medullary rays found embedded along with crystals of calcium oxalate, starch grains.
<i>Plaksha</i> ( <i>F. lacor</i> )	5-8 layered cork consisting of thin-walled, rectangular cells, a few external layers exfoliating; secondary cortex very wide consisting of compactly arranged, rectangular, thick-walled, pitted cells, patches of circular to elongated, lignified, elliptical stone cells with striations; a few prismatic crystals of calcium oxalate and reddish-brown contents found scattered throughout the secondary cortex; secondary phloem very wide consisting of mostly stratified layers of collapsed cells forming ceratenchyma, groups of fibres, phloem parenchyma, laticiferous cells, traversed by 2-5 seriate phloem rays.	Fragments of rhytidome with sclerides, stone cells and tannin cells. Fragments of cork cells, abundant prismatic crystals of calcium oxalate seen embedded in parenchymatous cells.
<i>Parisha</i> ( <i>T. populnea</i> )	TS shows cork cells and three or four layers of thin walled phelloderm cells; fissures of various shapes and wide lenticels were seen in the periderm. Cortex is formed by several layers of tangential oblong compact parenchyma cells; phloem consists of wide phloem elements alternating with tangential blocks of phloem fibers; funnel shaped dilating rays in between the radial cones of phloem; differentiated into the outer collapsed and inner intact phloem with dilating rays alternating with radially extended, conical phloem fibers and crushed sieve elements.	Tannin filled cork cells can be viewed. Powder shows the presence of regular and irregular cork cells. Fibre bundles, rosette crystals and starch grains found abundantly when powder studied under microscopically.

1.1 *Nyagrodha*(*F. benghalensis*)1.2 *Udumbara*(*F. racemosa*)1.3 *Aswatha*(*F. religiosa*)



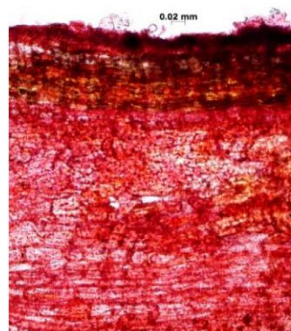


1.4 Parisa(*T. populnea*)

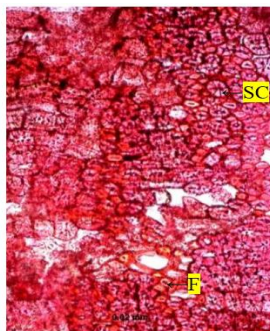


1.5 Plaksha(*F. lacor*)

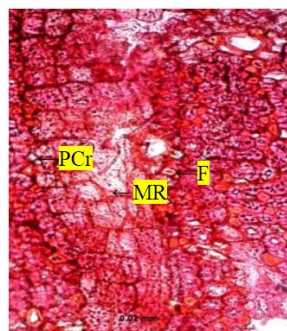
**Figure 1: Macroscopy of ingredients of Panchavalka**



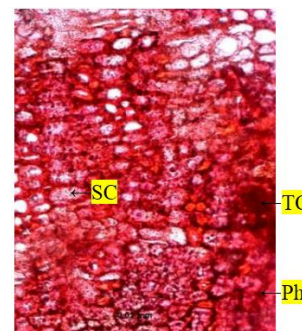
2.1 Cork and Cortex



2.2 Sclereids and fibres



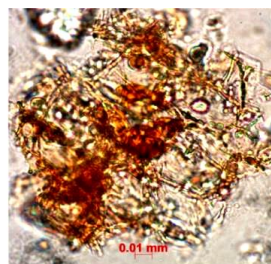
2.3 Medullary Ray



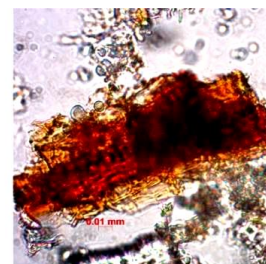
2.4 Phloem



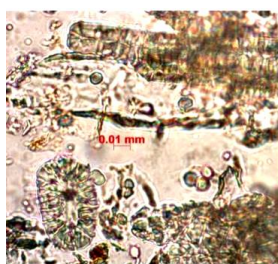
2.5 Cork in surface view



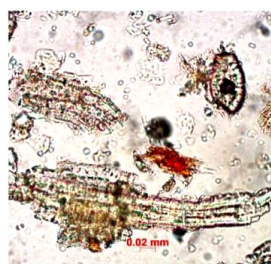
2.6 Cells with tannin and starch



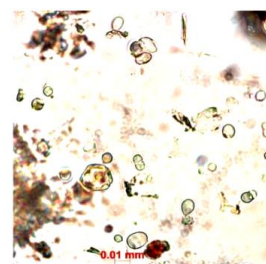
2.7 Cells with tannin



2.8 Stone cells and starch grains



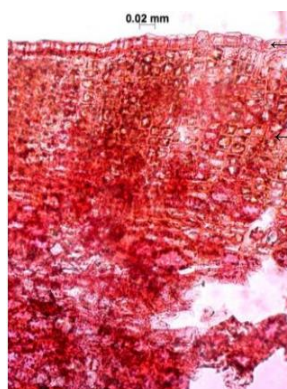
2.9 Fibre bundle



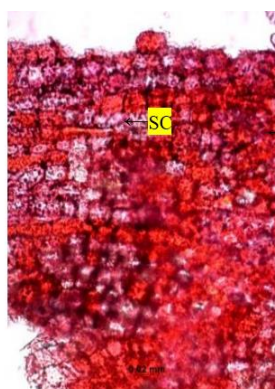
2.10 Starch grains

Ck - Cork, Ct - Cortex, F - Fibre, MR - Medullary rays, PCr - Prismatic crystal, Ph - Phloem, SC - Stone cells, TC - Tannin cell.

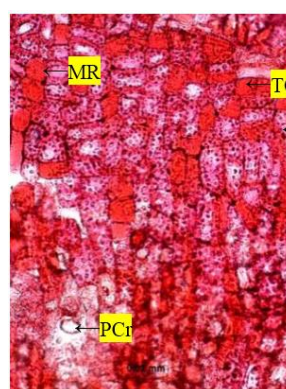
**Figure 2: Microscopy of ingredients of Panchavalka – Nyagrodha(*F. benghalensis*)**



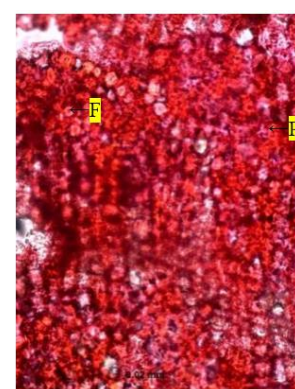
3.1 Cork



3.2 Cortex

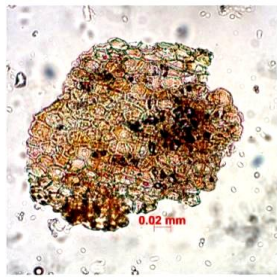


3.3 Sclereids

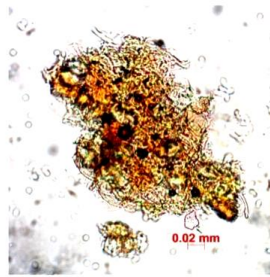


3.4 Phloem

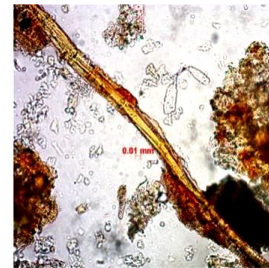
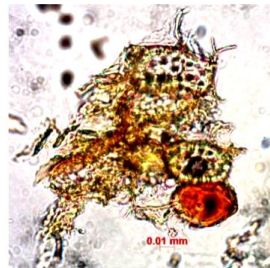
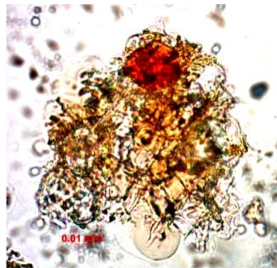
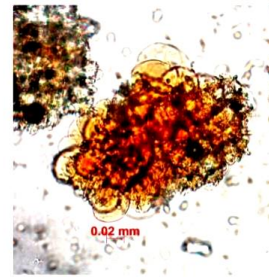




3.5 Cork in surface view



3.6 Cells with tannin



3.7 Parenchyma with sclereids and tannin cells

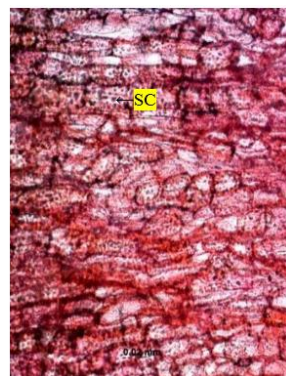
3.8 Fibre and starch grains

Ck - Cork, Ct - Cortex, E - Epidermis, F - Fibre, MR - Medullary rays, PCR - Prismatic crystal, Ph - Phloem, SC - Stone cells, TC - Tannin cell.

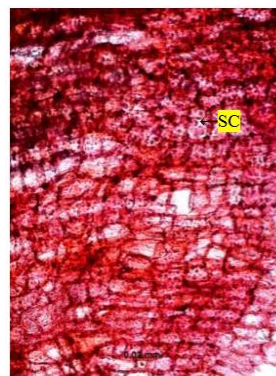
**Figure 3:** Microscopy of ingredients of Panchavalka – *Udumbara(F. racemosa)*



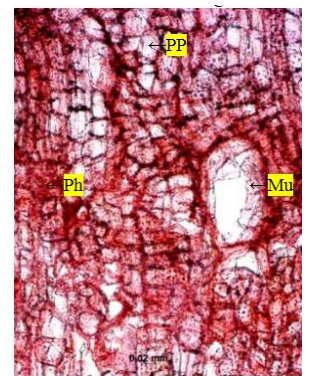
4.1 Cork and cortex



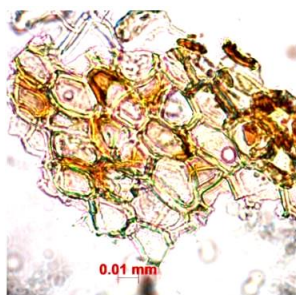
4.2 Cortex enlarged



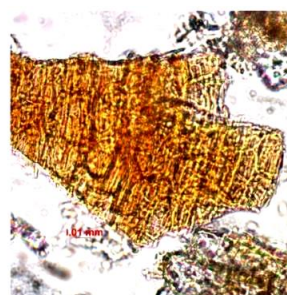
4.3 Sclereids



4.4 Mucilage cell in phloem region



4.5 Cork in surface view



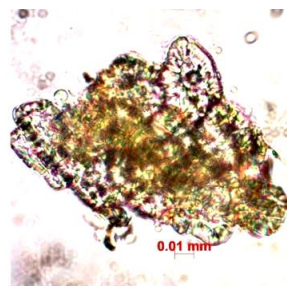
4.6 Sclerified cork



4.7 Parenchyma with content



4.8 Sclereids



4.9 Stone cells

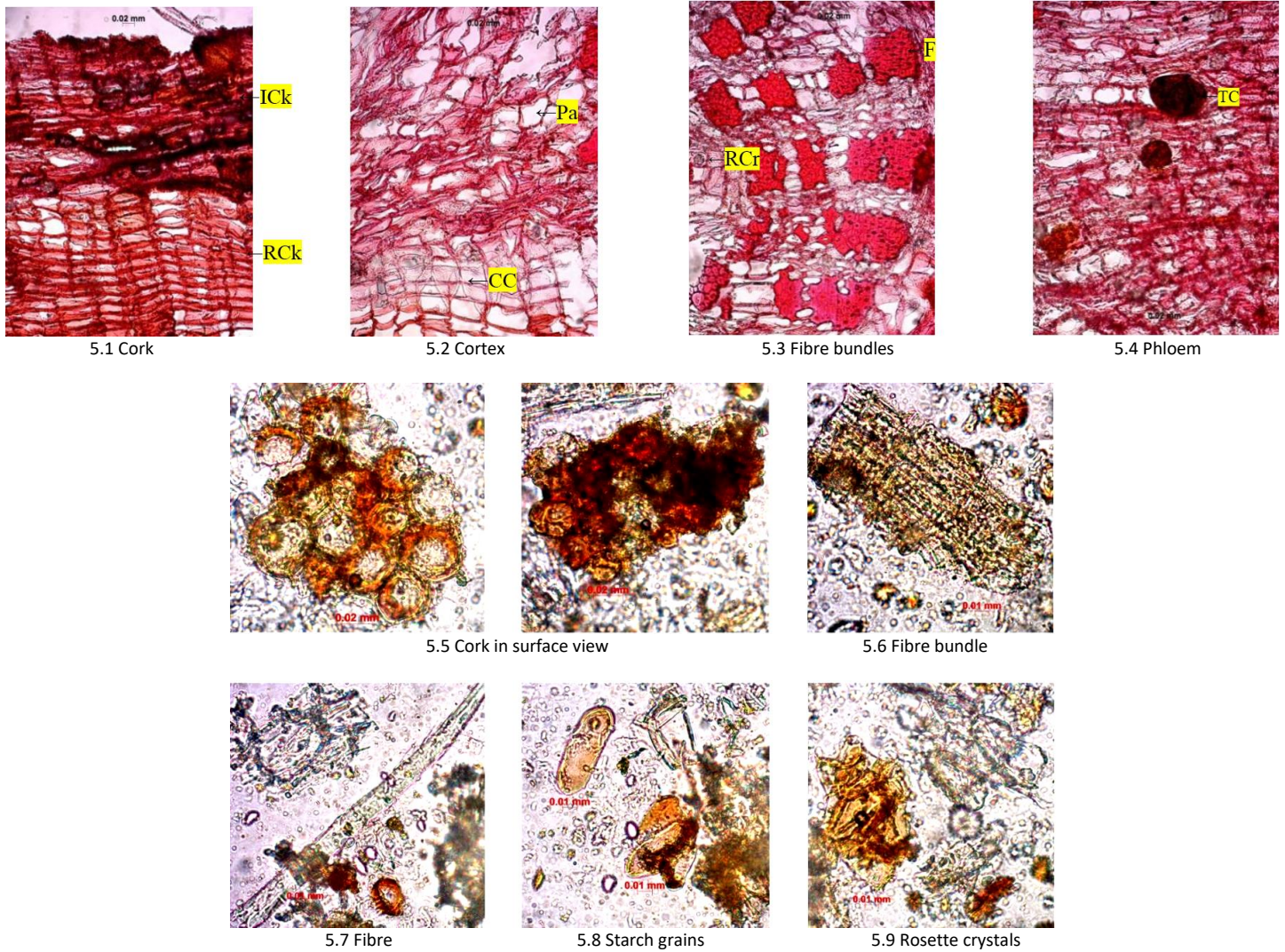


4.10 Pitted parenchyma

Ck - Cork, Ct - Cortex, Mu - Mucilage, Ph - Phloem, PP - Pitted parenchyma, SC - Stone cells, TC - Tannin cell.

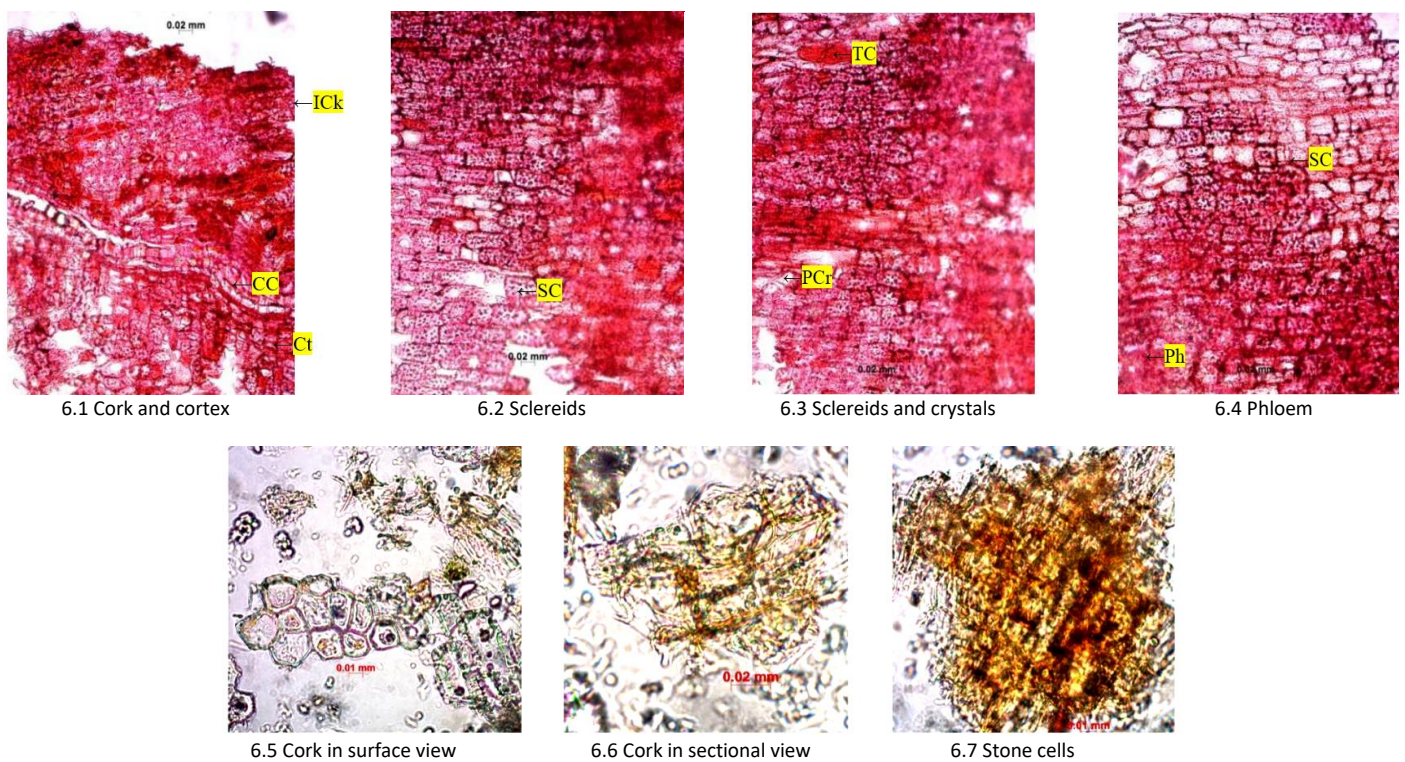
**Figure 4:** Microscopy of ingredients of Panchavalka -*Ashwatha(F. religiosa)*



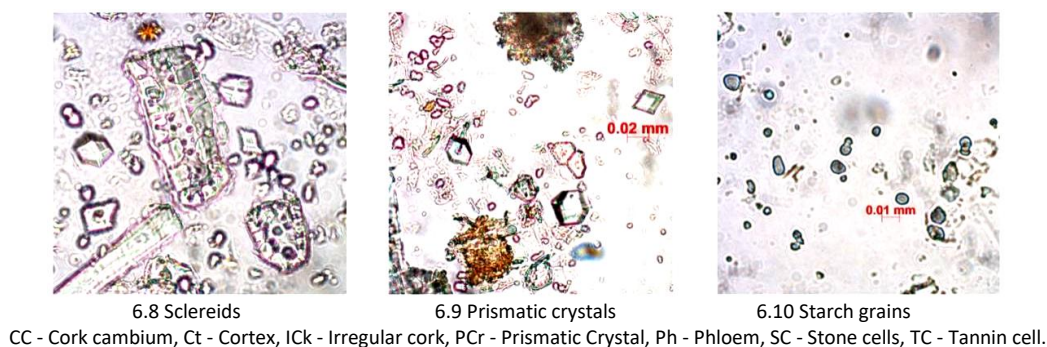


CC - Cork cambium, ICK - Irregular cork, F - Fibre, RCr - Rosette crystal, RCK - Regular cork, TC - Tannin cell.

**Figure 5:** Microscopy of ingredients of Panchavalka -*Parisa (T. populnea)*







**Figure 6:** Microscopy of ingredients of Panchavalkala – *Plaksha*(*F. lacor*)

## DISCUSSION

Indian system of medicine has its own theoretical policies, and the real expert in treatment is the one who designs an ideal drug (herb/mineral/animal product) at that particular pathological condition [14]. Increased demand on herbal medicine resulted in erroneous collection of plant products unlike the traditional method of drug design and use [15]. Quality ensured natural products are the common demand in the global market. Authenticity, safety, and purity are the three major aspects of quality [16]. Authenticity is the basic step in any research related to natural product and it involves many steps. Identification of crude drug through its vernacular names, marking organoleptic characters, describing morphologic features etc [17]. And these are a part of macroscopic study. Describing histological features by transverse section of the plant part is microscopic swot [18]. As different parts of natural products are used in treatment, authenticated source is very essential to give therapeutic integrity.

PVK are bark products of five plants commonly used in Indian system of medicine, since centuries, in various pathological conditions, either individually or in combinations. Barks are secondary external tissues lying outside the cambium in stem and also known as periderm [19]. Though barks of many trees look similar; because of growing pattern, harvesting, drying techniques these exhibit several morphological and microscopical characters. Apart from having high medicinal demand PVK barks as from similar plant species, not have much macroscopic differences. Self explanatory macro-microscopic atlas prepared help in rapid identification of particular sample, apart from preventing its admixture.

Bark samples of PVK were thick and fibrous except *T. populnea* which was thick with transverse crack and fissure. The bark of *F. racemosa* was mucilaginous with latex whereas *F. lacor* had transversely arranged lip shaped lenticels on outer surface.

Microscopic observation portrays cellular arrangements, histological characters etc. Wide secondary phloem and few stone cells, prismatic crystals, calcium oxalate at the region of secondary cortex were marked histological features of *F. religiosa*. *F. racemosa* exhibits thick lignified cortical cells, secondary phloem with sieve tubes and laticiferous cells in the region of phloem.

*F. benghalensis* shows a wide secondary cortex with groups of stone cells, pitted cells while a wide secondary phloem is the feature of *F. lacor*. Bark of *T. populnea* has shown the presence of thin walled phelloderm cells, tangential blocks of phloem fibres and crushed sieve elements.

Starch grain, crystals of calcium oxalate, stone cells were common among powder characters of each sample of PVK. Lignified cork cells were common in *F. religiosa*, where nonlignified septate fibres found among *F. racemosa*. Pieces of rhytidome along with thick walled cork cells were the features found in *F. benghalensis* and *F. lacor*.

## CONCLUSION

Quality assessment of a drug, include anatomical confirmation, chemical evaluation and purity index. Naming, marking macro-microscopic features along with organoleptic characters are the part of identification of drug which is also termed as pharmacognostic study [20]. Bark samples of PVK here provided in conjunction with pharmacognostic atlas help in quick identification of quality drug.

## Financial support and sponsorship

Part of the observations is made from findings of a major research project entitled "Development of Sequence Characterized Amplified Region (SCAR) markers for the identification of popularly used five bark drugs '*Panchavalkala*' ", RGU:R&D:Res.Wing:2014-15 dated 13 MAR 2015, sanctioned by Rajiv Gandhi University of Health Sciences, Bangalore.

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