World Journal of Pharmaceutical Science & Technology

Journal homepage: www.wjpst.com

Review Article

SCIENTIFIC METHODOLOGY FOR DESCRIPTION OF ROOT AND STEM RAW DRUG'S MACROMORPHOLOGY AND CYTOANATOMY

Switu Jani*[1], Gautam Fichadiya[2] and Harisha CR[3]

*[1]SRF, dravyaguna department, I.P.G.T. & R.A., Gujarat Ayurved University, Jamnagar, India

[2]Ph.D. scholar, pharmacognosy laboratory, I.P.G.T. & R.A., Gujarat Ayurved University, Jamnagar, India

[3]Head, pharmacognosy laboratory, I.P.G.T. & R.A., Gujarat Ayurved University, Jamnagar, India

Address for correspondence:

Switu Jani, SRF, dravyaguna department, I.P.G.T. & R.A., Gujarat Ayurved University, Jamnagar, India janiswitu@gmail.com

Received: 10-11-2017, Revised: 15-12-2017,Accepted: 01-03-2018

ABSTRACT

Pharmacognosy is a field in pharmaceutical sciences which has recently been gaining huge importance owing to provide help in correct identity of plants used as medicines. Recent increase in demand of medicinal plants has caused an urgent need to develop a systematic methodology for identification of correct botanical source macroscopically as well as microscopically. Organized drugs comprise of plant organs such as fruits, seeds, leaves, flowers, Root and stem. For systemic description of plant sample as macroscopically consists botanical source, family, habitat, use etc. Root and stem morphology includes their types, shape, size etc. The general cytoanatomy of root can be distinguished in to epidermis, cortex and vascular system while stem can be distinguished in to dermal system, ground tissue system and vascular system. Staining process can help to identify and differentiate the arrangement of various tissues and also the presence of secondary metabolites in the transverse section. Organoleptic evaluation of uniformed particle sized dried powder and its microscopic evaluation used for identification with reference to the same plant organ. The scientific pattern of describing the macromorphology and cytoanatomy can be helpful for initial standardization of the raw drugs.

Keywords: Cytoanatomy, Morphology, Scientific Evaluation, Standardization

INTRODUCTION

The utilization of plants for the treatment of diseases is well represented by their applications in almost all of the major alternative systems of medicine underlying in any philosophical premises such as *Unani, Sidhha, Ayurveda* and many other.[1]

Recent increase in demand of medicinal plants has caused an urgent need to develop a systematic methodology for identification of correct botanical source. Hence there is need for government bodies to prescribe the essentials for selectivity of medicinal plants. Many pharmacopoeias have been established i.e. British pharmacopoeia, Indian pharmacopoeia to establish and ascertain the criteria for medicinal plants import, export and consumption as medicines.

Pharmacognosy is a field in pharmaceutical sciences which has recently been gaining huge importance owing to provide help in correct identity of plants used as medicines. Pharmacognosy is derived from two Greek words *Pharmakon* means a drug and *Gignosco* means to acquire knowledge of.[2] To ascertain correct identification, quality, purity and efficacy of plant samples or raw materials provided either in research or pharmacy, it is important to set forth rules which are not only useful for identification but also vital for description of the plant or part of plant.

The scheme for Pharmacognostical study of plant material or crude drugs is as follows:

Official title, synonyms, vernacular name/s followed by botanical source, family, geographical source or habitat, history of the drug, cultivation, collection, processing for marketed crude drugs, morphological or macroscopical characters, microscopical characters, chemical constituents qualitative tests, pharmacological actions, therapeutic uses, preparations or formulations, commercial varieties, substitutes and adulterants and quality control of crude drug and phytopharmaceutical derived from them.[2] This review articles aims to provide information on scientific method for description of plant sample's or crude drug's macromorphology and cytoanatomy including powder microscopy and histochemical analysis of crude drug.

MACROMORPHOLOGY OF PLANT SAMPLE OR CRUDE DRUGS

The crude drugs are divided into two major divisions i.e. organized drugs and unorganized drugs. Organized drugs comprise of plant organs such as fruits, seeds, leaves, flowers, wherein the organs are made up of cells or definite structure. Unorganized drugs are derivatives from parts of plants such as exudates, resins, gums, latex. Macromorphology is applicable for organized drugs as one can easily describe the part of plant if well versed in botany.[2]

Root

Root is an organ of plant that develops initially from radicle, grows down into the soil, functions for absorption and anchorage.

Types: Tap root the main, persistent primary root of plant which shows apical dominance and adventitious root - the root arising from any part of plant body apart from radicle.[3] Modified roots: aerial roots, assimilatory roots, annulated roots, climbing roots, haustorial roots, mycorrhizal roots, prop roots and aerating roots

Size and shape: conical, fasciculated, fleshy, fibrous, napiform, fusiform, nodulose, and tuberous or tubercular.

Surface characters: colour, cracks, wrinkle pattern and annulations.

Fracture and texture: smooth, hard, rough, granulated, short or fibrous type of fracture. [3]

For example: fresh and dried succulent roots of *Asparagus racemosus* Willd. belonging to family Liliaceae.

Syn. *A. volubilis* Ham., *A. acerosus* Wall., *A. fasiculatus* Br.

Famiy : Liliaceae

Sanskrit name: *Satavari*, *Satamuli*

Official part used: fresh and dry tuberous succulent roots.

Fig. 1: Dried *Shatavari*

Macromorphology: adventitious roots arising from short root stock, generally long varying in length from 25 cm to about a meter, gradually tapering towards the basal and distal ends. Cylindrical in shape with small depressions, creamish white or light cream yellow in colour with smooth surface except for presence of rootlets. The outer skin is quite soft and easily removable. The cut surface of fresh root shows narrow light yellow peripheral strip with silvery white fleshy soft middle region and slightly narrow central woody core. Dried roots have longitudinally wrinkled surface with short transverse fissures. The outer layer is light yellow colour which adheres firmly to dry roots and is not removed easily. The roots have no specific odour but possess slight sweet mucilaginous taste.[4] (Fig.1)

Stem

Organ of plant that develops initially from epicotyl, grows mostly above the ground functions for support and conduction. Modified stem: rhizome, root stock, stolon, tendril, prickle, bulb, bulbil, cladode, cladophyll, phylloclade.

Type, size and shape: angular, branched, climbing, creeping, cylindrical, laticiferous, procumbent, scandent, trailing, twinner, subterranean.

Surface characters: lenticels, woody, with papery bark,

Fracture and texture: texture may be smooth, rough, pubescent, hairy and fracture may be short, fibrous, splintery and granular.[3]

For example: fresh and dry whole plant of *Andrographis panniculata* Nees. belonging to family Acanthaceae.

Syn. *A. subpathulata* C.B. Clerke, *Justicia paniculata* Burm.

Famiy: Acanthaceae

Sanskrit name: *Bhunimba, mahatikta, Kalmegha*

Official part used: fresh and dried whole plant.

Macromorphology: stem is branched, predominantly four angled, glabrous, spreading, without hair, horizontal with proper nodes and inter nodes. Fresh stem is dark green in colour whereas as dry stem cut pieces are brownish in color with bitter taste.[5]

Fig. 2: Dried stem of *Kalmegha*

CYTOANATOMY OR MICROSCOPY OF PLANT SAMPLE OR CRUDE DRUGS

Methodology for sectioning of plant samples

For stem, root, stolon cut the cylindrical portion which is almost straight and cut off the edges to obtain smooth surface. Hold the sample vertically between the first, second finger and thumb and gently move the blade back and forth from one end to the other for obtaining thin slices. Take sufficient amounts of transverse sections, select the ones which are thin and uniform reject the sections which are thick and oblique. In case of leaf drug, cut the leaf passing through midrib by trimming rectangular piece and as the lamina is very soft, it is essential to embed the piece in block of pith like usage of carrot for stamping. [6]

Root

Microscopy of *Shatavari* root

T.S. of root is almost circular in shape. It shows outer exodermis which is light yellow in colour within which is wide cortex surrounding a circlet of vascular bundle with centrally located pith.

The outermost layer consists of 6-10 rows of compactly arranged polygonal thick walled cells, outer piliferous layer is present at certain regions, followed by 20-25 layers of cortical cells, cortical cells are thin walled and circular or oval with intercellular spaces. Scattered within the cortex are number of cells which contain raphide bundles. After cortical zone comes single row of endodermis. Endodermal cells are narrow rectangular and thin walled. Vascular bundle has typical monocotyledonous type structure. Vascular bundle consists of phloem alternating to xylem and, phloem parenchyma cells are polygonal thin walled. Meta xylem and protoxylem. The centre of root is occupied by the pith which composed of small rounded mostly thin walled cells with large interspaces. (Fig.3)

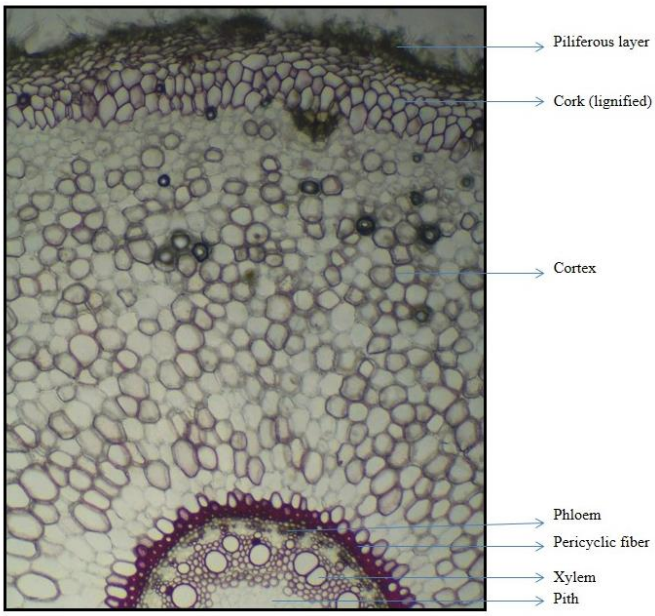


Fig. 3: T.S. of *Shatavari* Root (stained)

Stem

Microscopy of *Kalmegha* stem:

Predominant quadrangular stem consisting of single layered square shaped epidermis covered with thin layer of cuticle often intercepted by sessile glandular trichome and cystoliths. 3-4 layer of hypodermis made up of chlorenchymatous cells, followed by 5-6 layers of cortical cells, at all the four angles beneath the epidermis several layers of parenchyma apart from the cortex is found, single layered endodermis and unevenly distributed pericyclic fibres below which circular vascular bundle is located. Vascular bundle consists of xylem, xylem parenchyma and phloem. Centrally located pith covers up to ¼ th of the section, and often filled with microcrystals and oil globules. (Fig.4)

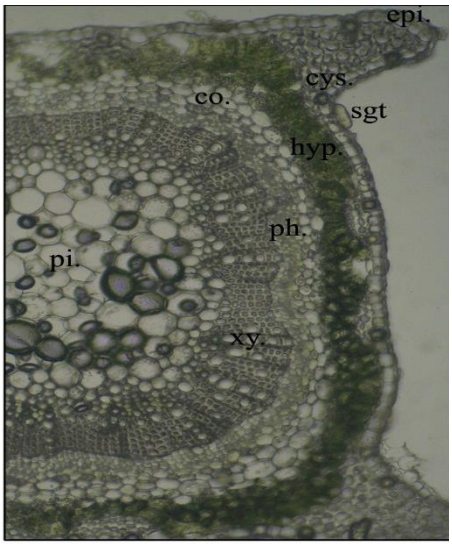


Fig. 4 : T.S. of *Kalmegha* Stem

POWDER MICROSCOPY

Methodology to obtain powder and slide preparation technique

Chop the shade dried stem, root or leaf samples separately into small pieces and grind them with help of mixer grinder. Sieve them through 60-80# sieve size to obtain uniform powder. This powder is further used for

powder microscopy. Organoleptic characters are to be noted and to observe microscopical characters Mount a small amount of powder on a clean dry slide add few drops of distill water with help of brush and cover it with cover slip. Mount small amount of powder on clean dry slide and various chemical reagents are used for detection of various chemical constituent. [6]

***Shatavari* root**

Organoleptic characters

Colour: creamish white **Odour:** faint characteristic

Taste: mucilaginous and bitter **Touch:** smooth.

Microscopic characters

Acicular crystal, fragment of border pitted vessel, cortical cells in surface view, simple starch grains and lignified cork cells in surface view. (Fig.5)

***Kalmegha* stem:**

Organoleptic characters

Colour: Green **Odour:** Faint bitter **Taste:** Bitter **Touch:** Fibrous.

Microscopic characters

Fragment of spiral vessel, covering trichome, blunt cystoliths, prismatic crystal, cystolith, warty multicellular trichome, fragment of annular and scalariform vessel of stem, sessile glandular trichome in surface view from stem and candalebra trichomes. (Fig.5)

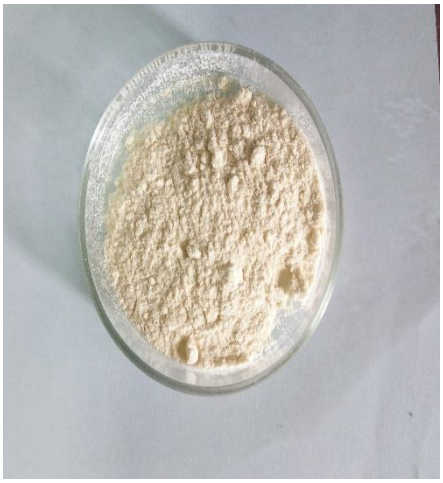
HISTOCHEMICAL TEST

For staining the transverse section, select thick sections and use chemical mentioned in Table no.1 for detecting various chemical constituents.[6]

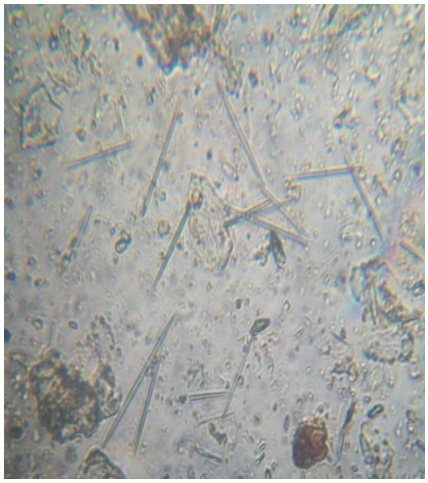
Table no. 1: List of chemical reagents used for presence of various ergastic substances.

Sr. No.	Component	Characteristics	Test reagents	Observations
1	Starch	Simple or compound starch grains	Iodine solution	Blue or deep violet
2	Volatile oils	As droplets in cells	Sudan red III	Red colour

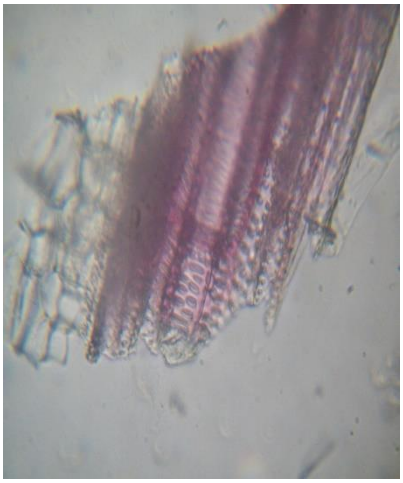
3	Tannins	Phenolic compounds in cells	Dil. Ferric chloride	Bluish black colour
4	Calcium oxalate	Excretory products of plant metabolism	Conc. Hydrochloric solution	Dissolves completely
5	Lignin	Lignified tissues to provide mechanical strength to plant cells	Phloroglucinol + conc. HCl	Red colour



Shatavari Powder

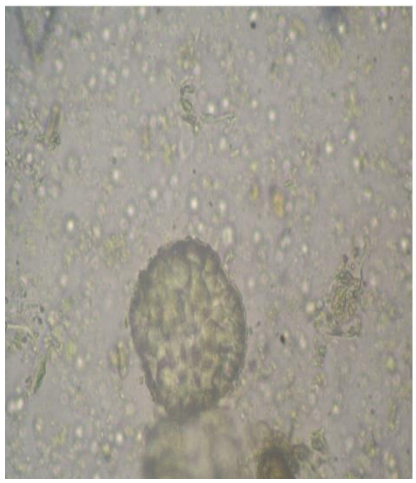


Acicular crystal

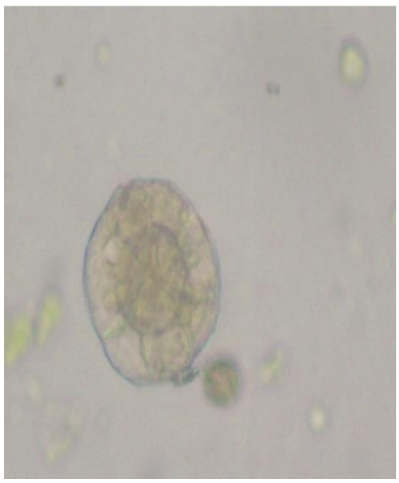


Pitted vessel lignified

Kalmegha Powder



Cystolith



Sessile glandular trichome

Fig. 5 : Diagnostic powder characters of illustrated plant samples.

CONCLUSION

This article will be helpful in scientific method for description of plant sample's or crude drug's macromorphology and cytoanatomy including powder microscopy and histochemical analysis. It is also helpful for new scholars to describe the plant samples under evaluation.

References

1. Trease and Evans. Pharmacognosy. 16 th ed. London: saunders Elsevier, 2009, pp. 3, 523-524.
2. Kokate CK, Purohit AP, Gokhale SB. Pharmacognosy. 42nd edi., Pune Nirali prakashan;2008, pp. 1.3, 1.14, 1.8
3. Sharma OP. Plant taxonomy, 2nd edi., New Delhi: Tata Mcgraw hill publication; 2009, pp. 176-191
4. Narayana K I,. Kolammal M. Pharmacognosy of Ayurvedic Drugs Kerala, Pharmacognosy unit, Ayurveda college, Thiruvananthapuram; series 1 number 6, 1994, pp. 49-52.
5. S jani, Charisha Bhupesh P. Detailed comparative micromorphological and micrometric evaluation of *Andrographis paniculata* and its adultarant (*a. Echioides*), ,2017 WJPR, 6(3): 825-837.
6. Khandelwal KR, Practical Pharmaconosy. 19 th ed. Pune: Nirali prakashan;2008, pp.13,14.