

Pharmacognostical, Physicochemical and Phytochemical Evaluation of *Strobilanthes kunthianus* (Acanthaceae)

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ABSTRACT

Objective: The present study aimed to evaluate pharmacognostical, physicochemical and phytochemical evaluation of various parts of *Strobilanthes kunthianus*. **Methods:** Macroscopical, microscopical, physico-chemical and phytochemical evaluations of leaves, stem, root and flowers of *S. kunthianus* were investigated. The paraffin embedded specimens were sectioned with the help of Rotary Microtome. The thickness of the sections was 10-12 µm and dewaxing was done by customary procedure. The sections were stained with toluidine blue for microscopical analysis. The preliminary phytochemical study was carried out for various extracts of *S. kunthianus* using standard procedure. **Results:** In the pharmacognostical, physicochemical and phytochemical studies, in an attempt to standardize the leaves, stem and root of *S. kunthianus* have been shown that will be definitely useful to the future researchers for the identification of the plant. **Conclusion:** These studies offer referential evidence for accurate identification and standardization of *S. kunthianus*.

Key words: *Strobilanthes kunthianus*, Pharmacognostic standardization, Physico-chemical evaluation, Phytochemical analysis.

INTRODUCTION

Medicinal plants and its isolated compounds have been the basis of treatment of many human ailments. The history of medicine dates back essentially to the survival of human civilization. The currently recognized modern medicines has been steadily established over the centuries by systematic and observational hard work of scientists. However, the basis of its development remains imbedded in traditional herbal medicine and therapies. The history of medicine includes many ridiculous therapies. Nevertheless, ancient knowledge has been the basis of modern medicines and will remain as one significant source of future medicine and therapeutics. However, difficulty behind the recognition of an alternative medicines in developed countries is the lack of documentation and strict quality control measures. So that the documentation and standardization of the raw materials used in herbal medicine is very essential for the worldwide acceptance of this system of medicine.

Pharmacognostical studies serve as an important tool in plant identification. Detailed microscopic evaluation will be of immense importance in the standardization of plant materials. Isolation of phytoconstituents from the active extracts helps in many ways in plant research. These constituents can serve as marker compounds for their standardization. The determination of the biological activities helps in developing these compounds into drugs or lead molecules for further drug development. Pharmacognostic standardization and physico-chemical analysis were globally accepted in identification and authentication of the genuine plant materials. Correct identification

and quality assurance of plant materials are indispensable to ensure reproducible outcome of herbal medicines, which will contribute to its safety and efficacy. Pharmacognostic standardisation of plant material include its morphological, anatomical and biochemical characteristics.¹

There are over 200 species of *Strobilanthes* nearly all in Asia and over 150 occurs in India, especially in Western Ghats and Nilgiris alone claims more than thirty species. Many of the species flower at longer intervals such as between six and twelve years, usually and in some even after 35 years. There exists a strong chemotaxonomical relationship among the genus. Species of *Strobilanthes* grow wild on the Nilgiri ranges between 6000 to 7000 feet. The genus *Strobilanthes* is known for its various biological activities.²⁻⁷

S. kunthianus (Neela kurinji) is a shrub in the grasslands of Western Ghats in India. The Nilgiris, which literally means the blue mountains got its name from the purplish blue flowers of Neela kurinji that blossoms gregariously once in twelve years. *S. kunthianus* is well known for its medicinal properties. It was reported to possess many biological activities including anti-inflammatory and anti-osteoarthritic, analgesic, antioxidant, antibiofilm, enzyme inhibitor, central nervous depressant, antiangiogenic, antifungal, antibacterial, antiseptic, antimicrobial, cytotoxicity and protect skin against UV.⁸⁻¹⁴

However, there is no scientific standards or pharmacognostic parameters are yet available to determine the quality of this crude drug. Thus, the present study was designed to evaluate the pharmacognostic, physicochemical and phytochemical parameters of various parts of *S. kunthianus*.

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MATERIALS AND METHODS

Plant material

The whole plant of *S. kunthianus* was collected from Thalaikuntha region, near Udthagamandalam, Nilgiris district, Tamilnadu, India. The plant was identified and authenticated at Botanical Survey of India, Coimbatore, Tamilnadu, India. Different parts of *S. kunthianus* was shown in Figure 1. The plant profile of *S. kunthianus* is shown in Table 1.

Pharmacognostical evaluation

Anatomical characterization

The different organs viz., root, stem, leaf and flowers of *S. kunthianus* were cut and removed from fresh healthy plants and fixed in FAA (5 ml of formalin + 5 ml of acetic acid + 90 ml of 70% ethanol). After 24 h of fixing, the specimens were dehydrated with graded series of tertiary-butyl alcohol as per the schedule.¹⁵ Infiltration of the specimens was



Figure 1: Different parts of *S. kunthianus*.

Table 1: Plant Profile of *S. kunthianus*.

1	Botanical name	<i>Strobilanthes Kunthianus</i> Nees T Anders
2	Family	Acanthaceae
3	Synonyms	<i>Phlebophyllum Kunthianus</i> , <i>Strobilanthes Kunthianus</i> , <i>Strobilanthes Nilgirianthisis</i> , <i>Phlebophyllum Kunthianus</i>
4	Vernacular Names	Tamil – Neelakurinji, kurinji
5	Distribution	It is found in Western Ghats, The Nilgiris and the Palnis, and the hills of Kerala above 1800 m on grassy downs.
6	Description	Bushy shrub, 1- 2 m high, in stray clumps or gregarious; stems numerous, erect, quadrangular; nodes prominent. Leaves elliptic-ovate, ca 5 x 2.5 cm, acute at base, crenate-serrate at margin, acute at apex, coriaceous, scabrid above, white-villous between veins beneath; secondary veins 8 or 9 pairs, prominent; petioles ca 5 mm long. Inflorescences spikes, uninterrupted, sometimes branched, ca 8 cm long, supported by leafy bracts, white-villous; bracts elliptic-ovate, ca 1.2 cm long, acute at apex, white villous, floccose at margin and middle. Calyx ca 1.2 cm long, floccose-villous; segments linear-lanceolate, connate almost half way from base. Corolla tubular ventricose portion gradually expanding from base, hairy inside; lobes 5, orbicular, entire. Stamens 2, included, monodelphous; filaments ca 7 mm long, pilose; stamina sheath extending just above cylinder base. Ovary glabrous but hairy at tip; style ca 1.5 cm long, included, hairy. Capsules oblong, ca 1.2 cm long, 4-seeded; seeds orbitular; ca 1.5 mm, complanate, densely hairy and hairs spreading when wet except on basal circular areole. ²⁴
7	Parts used	Root, stem, leaves and flowers
8	Ethnomedical information	No ethnomedical information available
9	Chemical constituents and biological properties	No chemical constituents are reported. It was reported to possess biological activities including anti-inflammatory and anti-osteoarthritic, analgesic, antioxidant, antibiofilm, enzyme inhibitor, central nervous depressant, anti-giardial, antifungal, antibacterial, antiseptic, antimicrobial, cytotoxicity and protect skin against UV. ⁸⁻¹⁴
10	Other <i>Strobilanthes</i> species	<i>S. crispus</i> , <i>S. callosus</i> , <i>S. ixiocephala</i> , <i>S. auriculatus</i> , <i>S. discolor</i> , <i>S. cusia</i> , <i>S. cuspidatus</i> , <i>S. foliosus</i> , <i>S. consanguineus</i> , <i>S. gossypinus</i> , <i>S. pulneyensis</i> , <i>S. perrottetianus</i> , <i>S. papillous</i> , <i>S. neilgherrensis</i> , <i>S. wightianus</i> , <i>S. urceolaris</i> , <i>S. sessilis</i> , <i>S. asper</i> , <i>S. zenkerianus</i> , <i>S. mincranthus</i> , <i>S. luridus</i> , <i>S. homotropus</i> , <i>S. violaceus</i> and <i>S. amabilis</i> . ²⁵⁻²⁶
11	Reported chemical constituents from other <i>Strobilanthes</i> species	Lupeol was isolated from <i>S. callosus</i> and <i>S. ixiocephala</i> . Trypanthrin, indigo and indirubin were found in <i>S. cusia</i> . Caffeic acid, p-hydroxy benzoic acid, p-voumeric acid, vanilic acid, gentinic acid, ferulic acid, syringic acid, β -sitosterol and stigmasterol were isolated from <i>S. crispus</i> . ^{6, 27-30}
12	Reported biological activities of other <i>Strobilanthes</i> species	The plant <i>S. cusia</i> commonly known as banlangen was reported to possess antipyretic, antiviral, anti-inflammatory and anti-influenza activities. ³¹ <i>S. crispus</i> has been used as antidiabetic, antilytic, laxative, anti AIDS, antileukemic and hepatitis. ^{2-5, 32}

carried out by gradual addition of paraffin wax (m.p. 58-60 °C) until TBA solution attained super saturation. The specimens were cast into paraffin blocks.

Sectioning

The paraffin embedded specimens were sectioned with the help of Rotary microtome. The thickness of the sections was 10-12 µm. Dewaxing of the sections was done by customary procedure. The sections were stained with toluidine blue.¹⁶ Since toluidine blue is a polychromatic stain, the staining results were remarkably good and some cytochemical reactions were also obtained. The dye rendered pink color to the cellulose walls, blue to the lignified cells, dark green to suberin, violet to the mucilage, blue to the protein bodies etc., wherever necessary sections were also stained with safranin, fast green and IKI (for starch).

For studying the stomatal morphology, venation pattern and trichome distribution, paradermal sections (section taken parallel to the surface of leaf) as well as clearing of leaf with 5% sodium hydroxide or epidermal peeling by partial maceration employing Jeffrey's maceration fluid were prepared.¹⁵ Glycerin mounted temporary preparations were made for macerated/cleared materials. Powdered materials of different parts were cleared with sodium hydroxide and mounted in glycerin medium after staining. Different cell components were studied and measured.

Photomicrographs

Microscopic descriptions of tissues are supplemented with micrographs wherever necessary. Photographs of different magnifications were taken with Nikon labphoto 2 microscopic units. For normal observations bright field was used. For the study of crystals, starch grains lignified cells, and polarized light was employed. Since these structures have birefringent property, under polarized light they appear bright against dark back ground. Magnifications of the figures are indicated by the scale-bars. Descriptive terms of the anatomical features are as given in the standard anatomy textbooks.¹⁷⁻¹⁸

Powder microscopy

A few drops of chloral hydrate solution was added to a sample of powdered plant material on a slide, covered with a glass slip and heated gently over a microbunsen. Vigorous boiling was avoided. The slide was examined under the microscope. When the clearing process is completed a drop of glycerol solution was added which will prevent crystallization of the mounting agent on cooling.¹⁹

Physicochemical parameters

Physicochemical analysis i.e., alcohol (90% ethanol) and water soluble extractive values, total ash, acid-insoluble ash, water soluble ash and sulphated ash of the powdered drug were determined.²⁰⁻²¹

Extraction

Pre-extraction

The whole plant was washed thoroughly with water and separated into different parts viz stem, leaves, flowers and roots. These were shade dried and powdered separately using a mechanical blender before extraction.

Successive extraction

The powdered root and stem of *S. kunthianus* (500 g) were extracted successively with 2.5 l each of petroleum ether, chloroform, ethyl acetate and methanol in a Soxhlet apparatus separately for 18-20 h. The extracts were concentrated in a rotary evaporator under reduced pressure at 35-40 °C and stored at 4 °C in a refrigerator till further use.

Cold maceration

The powdered leaves and flowers (250 g) were extracted with 1.5 l of methanol by cold maceration separately by agitation for 7 days and filtered. The mass was squeezed out and again subjected for re-maceration for 7 days and filtered off. The combined filtrate was concentrated as above.

Crude extraction

The powdered root, stem, leaves and flowers of *S. kunthianus* (500 g) were extracted separately with 2.5 l of methanol in a Soxhlet apparatus for 18-20 h. The extracts were concentrated as above.

Phytochemical screening of *S. kunthianus* extracts

A systematic and complete study of crude drugs should include a complete investigation of both primary and secondary metabolites derived from plant metabolism. The different qualitative chemical tests are to be performed for establishing profiles of given extracts for their nature of chemical composition. All the extracts obtained as above were tested for the following qualitative chemical tests for the identification of various phytoconstituents.²²⁻²³

RESULTS

Macroscopic features

The plant is profusely branched, compared to shrub. Young stem is angular with four ridges, the leaves are elliptic-lanceolate to obovate, 5 cm long and 3 cm wide; lamina is thick and coriaceous, dark green and scelerid above, reticulate and white villous on aescles below; leaf margin are crenate-serrate; petiole is 1 cm long. Inflorescence is terminal or axillary, branched, unbranched spike. Bract and bracteoles are prominent, leafy; calyx has 5 sepals, gamosepalous, lobes are linear and lanceolate. Corolla is pale-blue to manne with 5 petals, gamopetalous, bilobed. Stamens: two, epipetalous, anthers dithecous, lobes parallel. Ovary is superior, bicarpellary, syncarpous, two ovules in each carpel. Seeds are densely hairy.

Microscopic features

Leaf

The leaf has thick, prominently projecting midrib and lateral veins. The mid rib is 750 µm in vertical plane and 800 µm in horizontal plane. The mid rib has shallow median depression on the adaxial region; this part of the midrib has collenchymatous cells. The abaxial part has uneven and undulate outline; the epidermal layer is thin and continuous comprising of small squarish, thick walled cells. The ground tissue is parenchymatous; the cells are wide, angular, thin walled and compact. The vascular strand is small, single and consist of about eight parallel uniseriate rows of narrow xylem elements and wide thin phloem elements.

The lateral veins is bulbous and prominently protrudes on the abaxial side of the lamina. It is 650 µm vertically and 500µm horizontally. It has narrow, small celled epidermal layer and wide, angular copact parenchymatous ground tissue. The vascular strand is small, single and arc-shaped; it has four five short, thin rows of xylem elements and deep bowl-shaped line of phloem elements (Figure 2).

Lamina

The lamina is glabrous and smooth on the adaxial side and densely hairy on the abaxial side. The adaxial epidermis is quite wide; the cells are vertically oblong with thin anticlinal walls and thick cuticle on the outer tangential walls. The epidermis is 40 µm thick. Some of the epidermal cells are further dilated into wide circular or horizontally

elongated lithocysts possessing single, narrowly cylindrical rod like calcium carbonate cystolith. They are 170 μm long and 120 μm thick.

The abaxial epidermis is narrow with cylindrical cells. It bears dense covering type epidermal trichomes and less frequently glandular trichomes. The glandular trichomes have small epidermal basal cell, short, narrow stalk cell and capitate type secretory body cells. They have four or eight cells and possess dense cytoplasm and prominent nuclei. The glandular trichomes are 30-40 μm in height and 20-30 μm wide. They occur both on the adaxial and abaxial side of the lamina. The mesophyll consists of cylindrical compact, narrow pillars of palisade cells which are 50 μm in height. The spongy parenchyma zone is narrow comprising of three or four spherical or lobed cells (Figure 3).

Petiole

The petiole is wide pot-shaped in sectional view with flat adaxial side, short thick lateral wings on the adaxial part. The epidermal cell layer is thin with small cubical cells. Linear to the epidermal layer are two or three layer of collenchyma at the adaxial side and six or seven layers of

collenchyma at the abaxial side. The ground tissue is parenchymatous, homogeneous and the cells are circular to angular, thin walled and compact.

These is a single, wide, bowl-shaped vascular strand which consists of numerous, thin parallel files of angular, thick walled xylem elements lying on the outer part of the xylem. The petiole is 1.2 mm in vertical and 2.3 mm in horizontal planes. The vascular strand is 150 μm thick (Figure 4).

Stem

The young stem is somewhat four angled measuring about 3 mm thick. It has thin epidermal layer of small squarish cells bearing dense trichomes. The cortex is 250 μm wide and is differentiated into outer zone of parenchymatous cells. A thin median layer of cells in the cortex is chloenchymatous.

The vascular cylinder is thin, hollow and four-angled. It consists of short, narrow, circular radial files of xylem elements and xylem fibres.

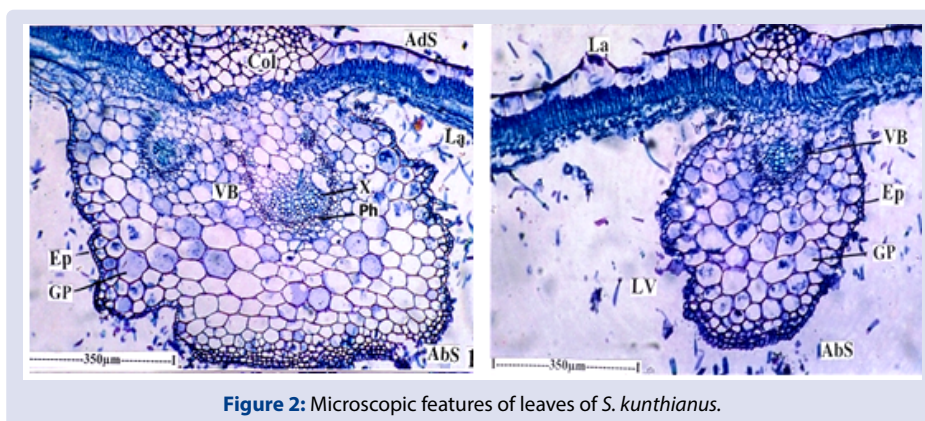


Figure 2: Microscopic features of leaves of *S. kunthianus*.

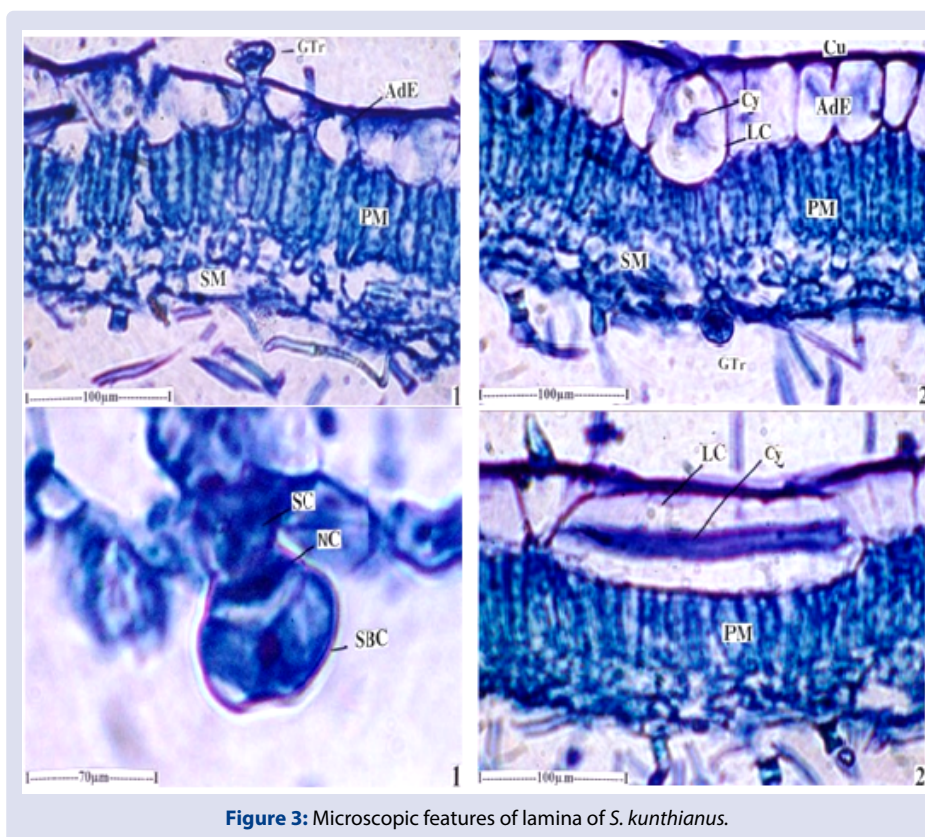


Figure 3: Microscopic features of lamina of *S. kunthianus*.

All along the outer part of the xylem cylinder occurs the phloem zone which has sieve elements and parenchyma cells. The vascular cylinder is 250µm thick. The pith is homogeneous and parenchymatous with thin walled compact angular parenchyma tissue (Figure 5).

Thick stem

The old and thick stem becomes circular in cross-sectional outline. It has cortex of 250µm wide, narrow continuous zone of phloem of 50 µm

wide and thick and dense secondary xylem (350µm wide) enclosing a wide central pith.

The cortex is homogeneous having elliptical tangentially stretched parenchyma cells. Secondary phloem has wide angular sieve elements and phloem parenchyma. Secondary xylem has narrow, circular thick walled vessels; they are solitary and diffusely distributed. The vessels are up to 20 µm wide. Xylem fibers are angular in sectional view, thick

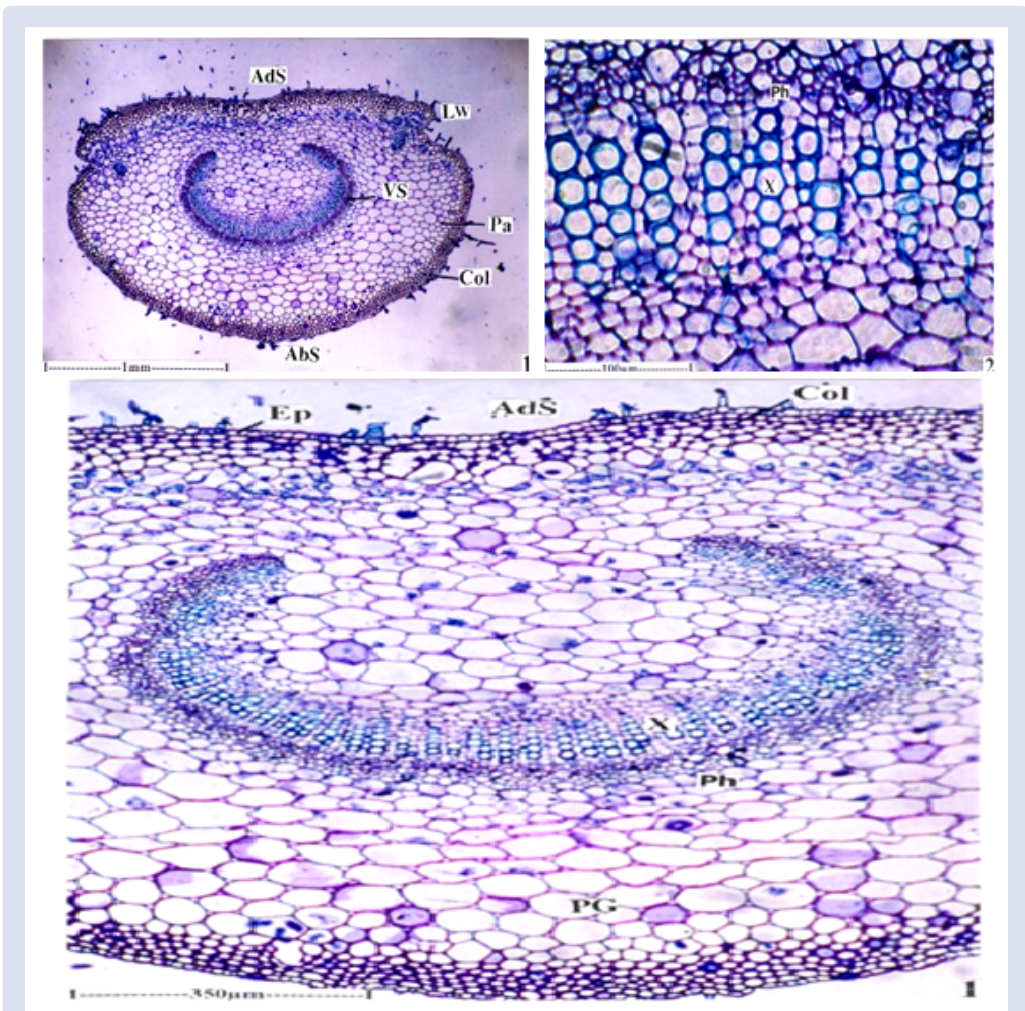


Figure 4: Microscopic features of petiole of *S. kunthianus*.

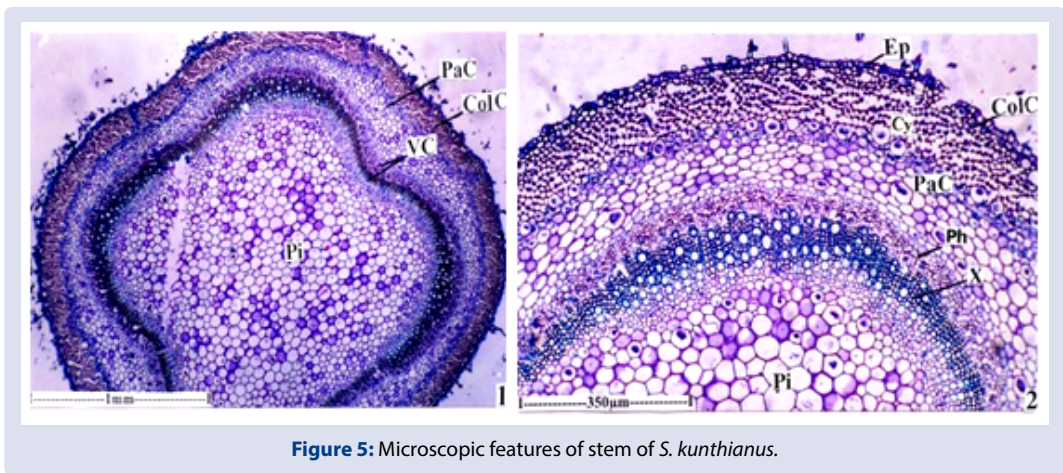


Figure 5: Microscopic features of stem of *S. kunthianus*.

walled and lignified; they occur in regular radial rows. Xylem rays are one cell thick and are straight. The rays cell are also thick walled and lignified (Figure 6).

Root

The root has rough and uneven outer surface. Periderm is seen at discontinuous places and it is not continuous. The cortex has outer zone of circular, wide, less compact parenchyma cells; the liner zone of cortex has wide gaps of empty chambers and the cells further towards interior are nitaet, elliptical and compact. Secondary phloem is narrow and continuous. It has large, radial files of phloem elements (Figure 7).

Secondary xylem

Secondary xylem has dense, diffuse wide, circular vessels distributed among thick walled fibers. The diameter of the vessels increase gradually towards the periphery and it measures 40 μm wide. The pith is narrow and nitaet. It is parenchymatous, comprises of thin walled circular compact cells (Figure 8).

Venation

The secondary and tertiary veins are thin and less prominent. The venation system is obscured blue to dense outgrowth of the epidermal trichomes. The vein-islets are wide and polygonal in outline. Distinct vein-terminations are not evident (Figure 9).

Powder microscopy

The powder exhibits fibers and vessel elements. The vessel elements are long, narrowly cylindrical and have long or short tails. The elements are 600-650 μm long. They have simple, oblique perforations at the ends. The lateral walls have wide, circular, alternate pits.

The fibers are liberiforous type, having thick lignified walls. They are narrow with pointed ends and narrow lumens. The lumen is 10 μm in wide. These are also septate fibers, which have wide lumen and thin septa; cell inclusions are often seen in the septate fibers. The septate fibers are 20 μm wide.

Cystoliths are frequently seen in the powder. They are narrow, elongated, and blunt at one end and pointed at other. The surface is warty. The cystolith is 60 μm thick and 700 μm long (Figure 10).

Physicochemical constant

The percentage yield of different types of ash and extractive values of flowers, root, stem and leaves of *S. kunthianus* powdered material are given in the Table 2. The total ash, water soluble ash, sulphated ash and alcohol soluble extractive values of the leaves of *S. kunthianus* were found to be high when compared to the other plant materials. The acid insoluble ash was found to be high in root and water soluble extractive value in flowers.

Preliminary qualitative phytochemical studies

The preliminary phytochemical study results were shown in Tables 3 and 4. The successive petroleum ether and chloroform extracts of stem and root were found to contain phenolics, steroids and triterpenoids. The successive ethyl acetate and methanol extracts of stem were found to contain flavonoids, glycosides and phenolics. These two solvent extracts in root showed the presence of glycosides, phenolics and saponins. The macerated methanolic leaves extract showed the presence of glycosides, phenolics, steroids, triterpenoids and tannins. Along with these alkaloids, flavonoids, saponins and tannins were found to be present in macerated and crude methanol extracts of the flowers. The

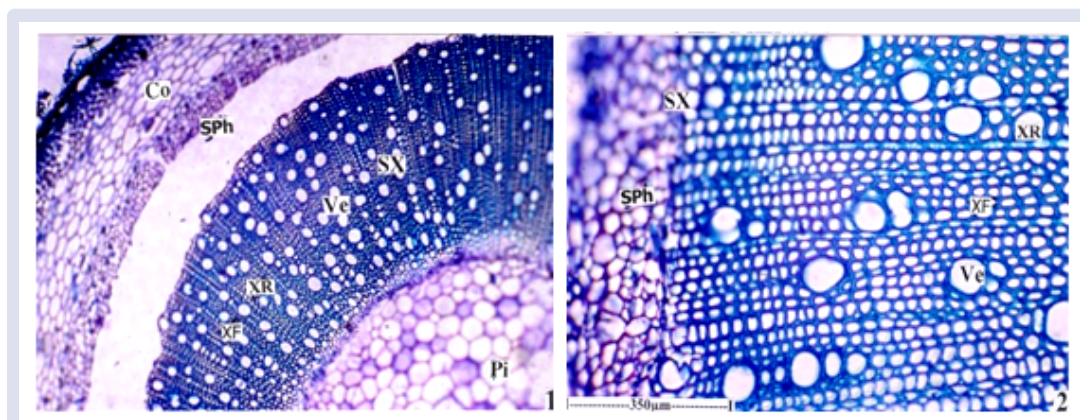


Figure 6: Microscopic features of thick stem of *S. kunthianus*.

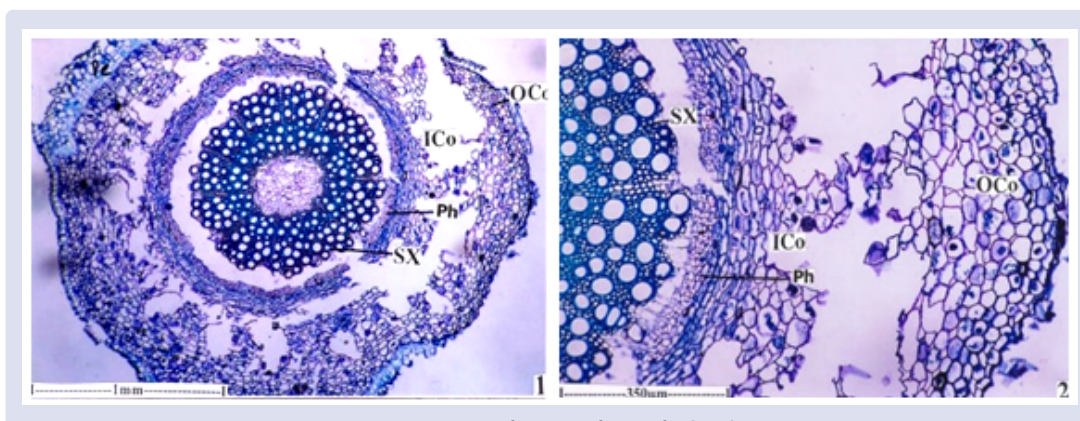


Figure 7: Microscopic features of root of *S. kunthianus*.

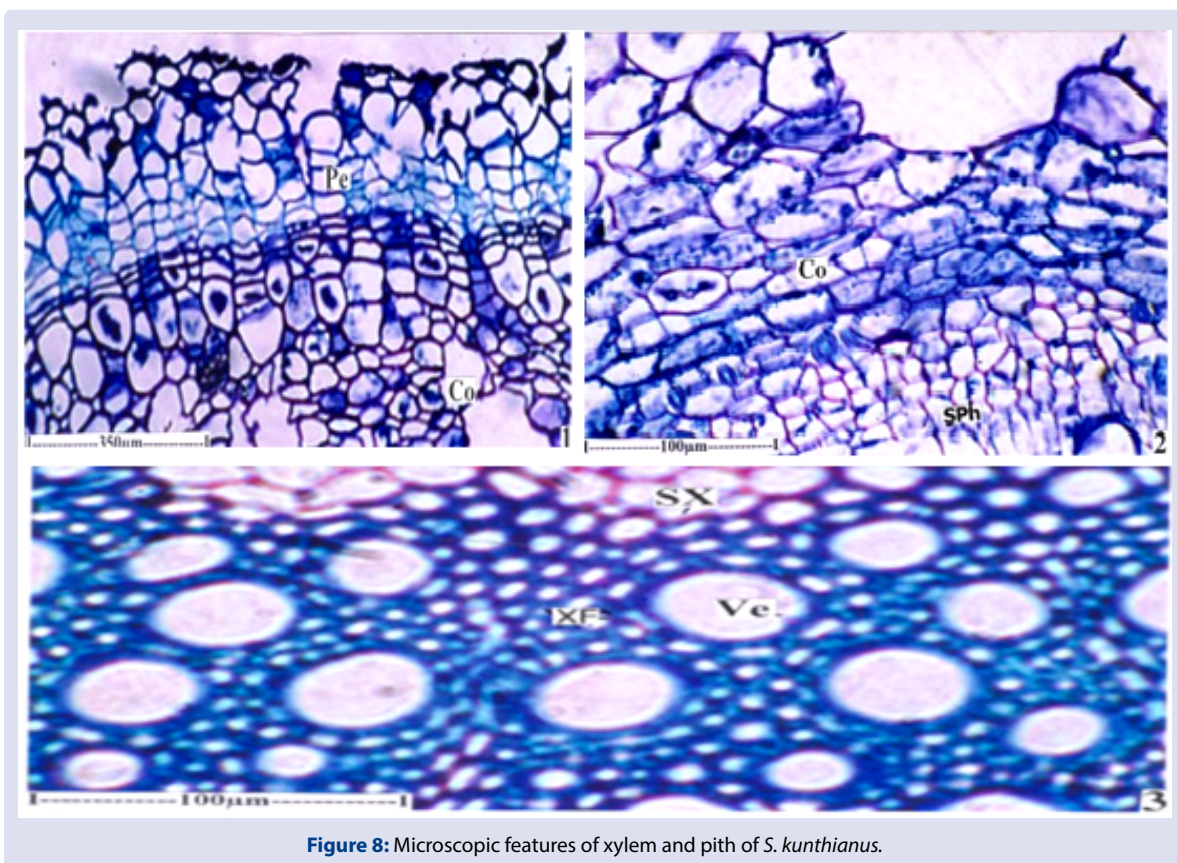


Figure 8: Microscopic features of xylem and pith of *S. kunthianus*.

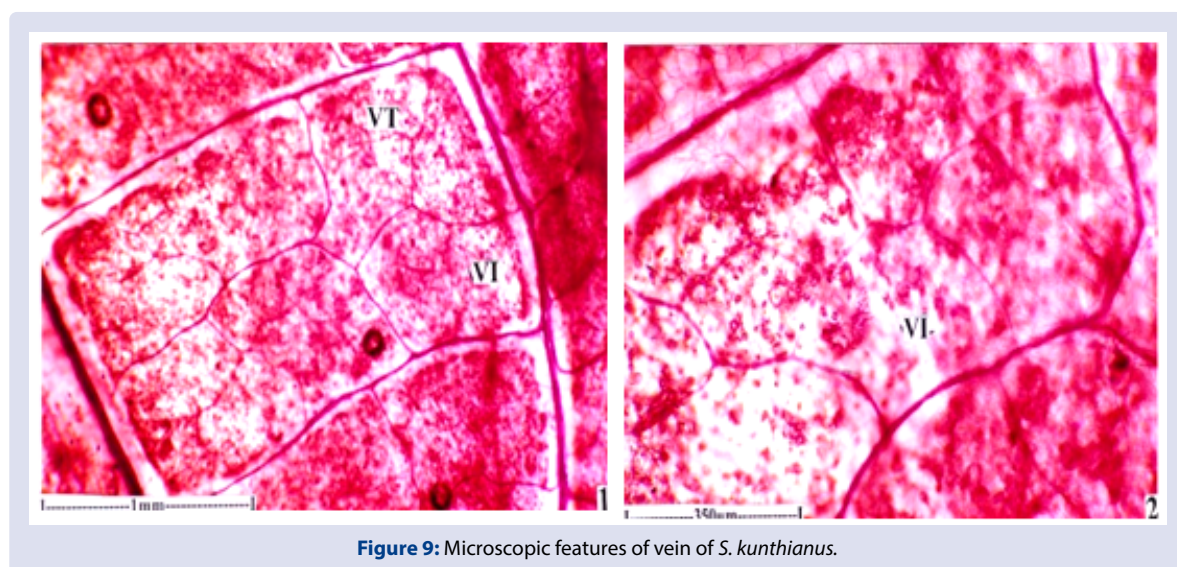


Figure 9: Microscopic features of vein of *S. kunthianus*.

Table 2: Physicochemical constants of *S. kunthianus*.

S. No	Plant materials	Ash values (% w/w)				Extractive values % w/w	
		Total ash	Acid Insoluble ash	Water Soluble ash	Sulphated ash	Alcohol soluble	Water soluble
1	Flower	6.61 ± 0.03	0.08 ± 0.01	1.52 ± 0.14	0.12 ± 0.01	1.02 ± 0.05	10.32 ± 0.08
2	Root	5.10 ± 0.13	2.06 ± 0.02	0.76 ± 0.05	0.23 ± 0.02	1.09 ± 0.04	2.30 ± 0.06
3	Stem	2.99 ± 0.02	1.40 ± 0.02	0.38 ± 0.04	1.11 ± 0.06	0.73 ± 0.05	5.14 ± 0.09
4	Leaf	20.49 ± 0.31	1.06 ± 0.03	4.05 ± 0.10	3.22 ± 0.09	1.64 ± 0.12	3.43 ± 0.03

Average of three determinations, mean ± SEM

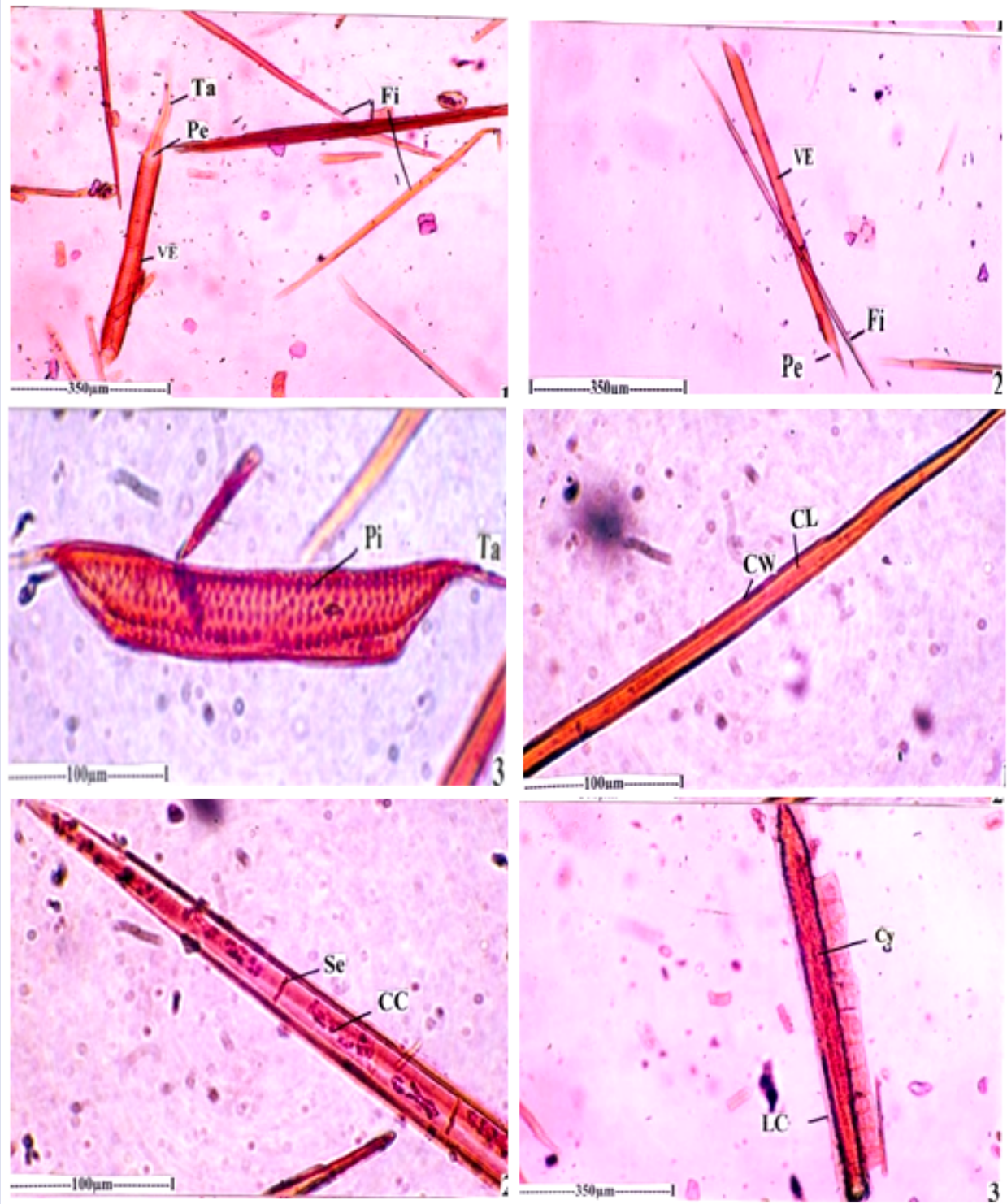


Figure 10: Powder microscopy of *S. kunthianus*.

Table 3: Percentage yield and qualitative phytochemical analysis of successive extracts of stem and root of *S. kunthianus*.

Extract	Nature	% Yield	Phytoconstituents							
			Alkaloids	Flavonoids	Glycosides	Phenolics	Saponins	Steroids	Triterpenoids	Tannins
Successive stem extracts										
Petroleum ether	Greenish yellow powder	3.00	-	-	-	+	-	+	+	-
Chloroform	Dark green sticky	0.95	-	-	-	+	-	+	+	-
Ethyl acetate	Dark green sticky	0.60	-	+	+	+	-	-	-	-
Methanol	Greenish black sticky	2.95	-	+	+	+	-	-	-	+
Successive root extracts										
Petroleum ether	Yellowish white powder	3.20	-	-	-	+	-	+	+	-
Chloroform	Pale brown sticky	1.10	-	-	-	+	+	+	+	-
Ethyl acetate	Reddish brown sticky	0.90	-	-	+	+	+	-	+	-
Methanol	Brown semi solid	2.42	-	-	+	+	+	-	-	-

+ Present, - Absent

Table 4: Percentage yield and qualitative phytochemical analysis of methanol extracts of *S. kunthianus*.

Extract	Nature	% Yield	Phytoconstituents							
			Alkaloids	Flavonoids	Glycosides	Phenolics	Saponins	Steroids	Triterpenoids	Tannins
Macerated leaves extract	Greenish black sticky	4.60	-	-	+	+	-	+	+	+
Macerated flower extract	Reddish brown sticky	3.05	+	+	+	+	+	+	-	+
Crude flower extract	Dark reddish brown sticky	19.60	+	+	+	+	+	+	+	+
Crude stem extract	Dark green sticky	9.85	-	-	+	+	-	+	+	-
Crude root extract	Pale brown semi solid	4.80	-	+	+	+	-	-	-	-
Crude leaves extract	Dark greenish black	12.80	-	-	+	+	-	+	+	+

+ Present, - Absent

crude methanol extracts of the stem and the leaves contain glycosides, phenolics, steroids and triterpenoids. The crude methanol extract of the root showed the presence of flavonoids, glycosides and phenolics.

DISCUSSION

Quality and reproduction of the total spectrum of constituents of the herbal drugs are extremely important. The herbal raw material often show a natural variability due to many external influences such as climate, soil quality, harvesting and drying conditions, with the consequence that the qualitative and quantitative composition varies from batch to batch from harvest to harvest, in particular. Plant identity can be achieved by macro and microscopical examination. Microscopical evaluation is indispensable in the initial identification of herbs, as well as in identifying small fragments of crude or powdered herbs and detection of foreign matter and adulterants. Hence, pharmacognostical studies were carried out with a focus on bringing out diagnostic character will be of immense help in proper identification, which play an important role in the standardization of plant materials. A detailed study of microscopic characters of all the parts such as leaves, flower, stem and root along with the photographs of the special characters taken during the study serves in identifying the plant. The microscopic features of leaves, lamina, petiole, stem, root, xylem, pith and vein islet were studied. The powder microscopy was also studied.

Determination of physicochemical constants is important for the purpose of evaluation of crude drugs. The total ash, water soluble ash,

sulphated ash and alcohol soluble extractive values of the leaves of *S. kunthianus* were found to be high when compared to the other plant materials. The acid insoluble ash was found to be high in root and water soluble extractive value in flowers.

Preliminary phytochemical analysis is used for the purpose of evaluation of crude drugs. The four successive extracts of root and stem and six methanol extracts were tested for their phytoconstituents. Phenolics, steroids and triterpenoids were found in successive petroleum ether and chloroform extracts of stem and root. Glycosides and phenolics were found in ethyl acetate and methanol stem and root extracts and all the methanol extracts. The present results were well correlated with Singh et al., 2014,¹⁰ reported that the methanolic flower extract of *S. kunthianus* showed the presence of alkaloids, carbohydrates, phytosterols, tannins, proteins and flavonoids.

The microscopic evaluation of various parts of *S. kunthianus* and its extractive values, ash values of the powdered drug and preliminary physico-chemical and phytochemical screening that have been carried out which would be of considerable use in the identification of *S. kunthianus*. The percent extractives in different solvents indicate the quantity and nature of constituents in the extracts. The extractive values are also helpful in estimation of specific constituents soluble in particular solvent. This findings are useful to supplement the existing information with regard to identification and standardization of *S. kunthianus* even in the powdered form of the plant drug to distinguish it from drug and adulterant. These studies also suggest that the observed

pharmacognostic, physicochemical and phytochemical parameters are of great value in the quality control and formulation development.

CONCLUSION

Pharmacognostical evaluation of the various plant parts of *S. kunthianus* was carried out in order to establish the identity and to standardize the plant. Microscopical characters of leaves, flowers, stem and root were studied. Physicochemical parameters like total ash, acid insoluble ash, water soluble ash and sulphated ash values and extractive values like alcohol soluble and water soluble were determined. Preliminary phytochemical analysis was carried out. Glycosides and phenolics were found in successive ethyl acetate and methanol stem and root extracts and all the crude methanol extracts. The present study may be useful to supplement the information with regard to its standardization, identification, and in carrying out further research and its use in Ayurveda system of medicine.

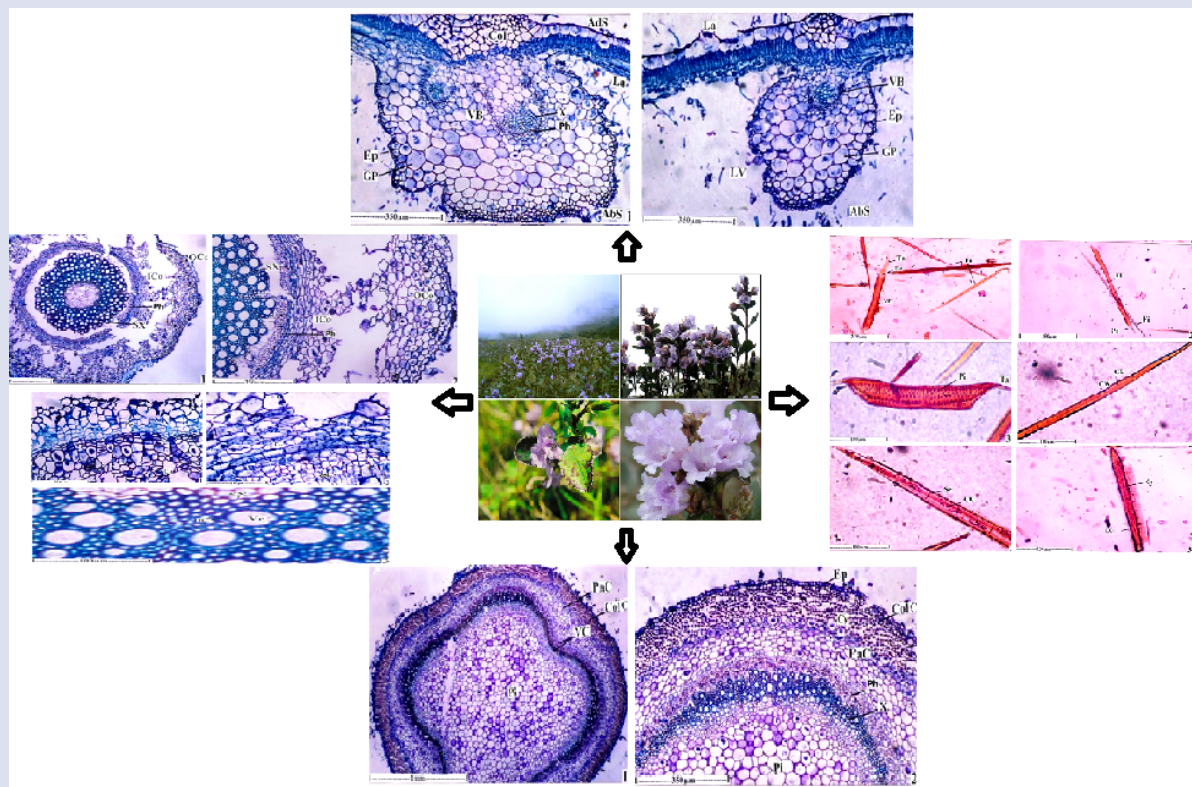
CONFLICTS OF INTEREST

None.

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GRAPHICAL ABSTRACT



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