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Micromorphological studies of *Cleome felina* L. f.

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ABSTRACT

The study was to determine the micromorphological characters of *Cleome felina* L. f. The results revealed the presence of anomocytic stomata, multicellular and glandular trichomes in the leaves. The transverse section of stem shows the myrosin cell and idioblast sac in the pith region. The vessels are solitary, increases in diameter from centre to periphery noted in transverse section of root. The powder microscopy reveals the epidermal trichome, sclereids and vessel elements. The pharmacognostical standards of *C. felina* could be useful for the completion of a suitable monograph for its proper identification, determination of its quality, purity and detection of nature of adulteration.

Introduction

The medicinal effects of plants have made a superlative contribution in the origin and evolution of many traditional herbal therapies. These conventional understanding of the systems have begin to vanish with the passage of time due to shortage of written records. Medicinal plants have strong acceptance in religious activities, who worship the plants in the form of various gods (Silori and Badola, 2000; Dhyani, 2000).

Many high value medicinal plant species have resulted in decline over the years due to nonstop exploitation of medicinal plants from the wild

(Kala, 2004) and considerable loss of their habitats during past 15 years (FAO, 2003). An estimated 4,000 to 10,000 species of medicinal plants face potential local, national, regional or global extinction, with subsequent serious consequences for livelihoods, economies and health care systems (Anonymous, 2003).

The Capparidaceae family includes the genus *Cleome* which is the largest genus, comprising 180 to 200 species of herbaceous annual or perennial plants and shrubs widely distributed in tropical and subtropical regions. Mostly the *Cleome* is restricted to tropical regions, where approximately 150 species have been recorded by (Raghavan,

1993). In India, the genus is represented by fifteen species (Londhe, 2000). *Cleome* is also known as spider flower and mountain bee plant. The indigenous knowledge of many traditional communities has been formulated, documented, and ultimately become organized by various systems of medicine. *Cleome felina* L. f. is widely distributed in Deccan districts of Madras Presidency. It is an annual erect herb, 30-60 cm height much branched, leaves trifoliolate, leaflets 10-25 mm. long, ovate, obtuse, equaling or shorter than the petioles. Flowers axillary, solitary on pedicles, 12-18 mm long, purple or pink. Stamens, about 30; filiform. Capsule 8 times long as broad, compressed, linear, annular, acute at both ends, striate, glabrous, seeds many, glabrous, tubercled. The fresh and dry plant are equally used pounded, together with a little milk and sugar, it is prescribed in epistaxis (Sir Whitelaw Ainslie, 1826; Woodville, 1810). The plant is used as an astringent (Nadkarni, 1954). The seeds are vesicant and given internally as vermifuge (Henri Baillon, 1874).

In view of its medicinal importance and the fact that no information on the anatomy of this study plant are little or no specific investigation has been conducted specifically. Similarly anatomical characters are mostly used in systematics for identification, placing and grouping of plants in a satisfactory position in classification and for indicating patterns of relationship that may have been observed by superficial convergence in morphological features (Kemka-evans Ci, 2000). The present study has been carried out to standardize the anatomical features of leaf, stem and root analysis to serve as available source for proper identification of *Cleome felina*.

Materials and methods

Plant collection

The aerial parts of *Cleome felina* L. f. were collected from Thindal, Erode District, Tamil Nadu. The plant material was identified taxonomically with the help of the local floras (Gamble and Fischer, 1956; Matthew, 1983) and Botanical survey of India, Southern region center, Coimbatore, Tamil Nadu. The herbarium number provided by BSI is "BSI/SRC/5/23/2016/Tech./1344". The voucher specimen is kept in the Herbarium of Vellalar

College for Women (Autonomous), Erode-638 012, Tamil Nadu, South India.

Macroscopical observations

Macroscopical observations were carried out by using organoleptic evaluation method. The shape, size, colour, odour, taste, texture, margin, apex of leaves and various plant parts of *Cleome felina* were observed (Trease and Evans, 1983; Wallis, 1985).

Microscopical studies

Collection of specimens

The required samples of different vegetative organs were collected and removed from the plant and fixed in FAA (Formalin-5ml+ Acetic acid-5ml + 70% Ethyl alcohol-90ml). After 24 hours of fixing, the specimens were dehydrated with graded series of tertiary -butyl alcohol as per the schedule given by Sass (1940). Infiltration of the specimens was carried out.

Sectioning

The free hand sections were taken in leaf, stem and root. The thickness of the sections was according to Johansen (1940). The sections were stained with safranin as per the method of O'Brien et al. (1964). For studying the stomatal morphology and trichome distribution, paradermal sections (sections 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 (Sass, 1940). Glycerin mounted temporary preparations were made for macerated cleared materials. Powdered materials of different parts were cleared with NaOH and mounted in glycerin medium after staining. Different cell component were studied and measured.

Photomicrographs

Anatomical features of tissues are given wherever necessary. Photographs were taken with different magnification in Nikon lab photo 2 microscopic unit. Magnifications were indicated by the scale-bars in the micrographs. Anatomical features are given in the descriptive terms (Esau, 1964).

Results

The morphology of the plant *Cleome felina* L. f. is given in Fig. 1 (a-d). The organoleptic and macroscopical characters of leaf, stem, root, flower, fruit and seeds were observed and the results are presented in Table 1.

Leaflet

The leaflet consists of a dorsiventral to centric.

Abaxial epidermis is papillose. The epidermis of the adaxial portion of the midrib are wide, thin walled and rectangular in shape. The epidermal cells of the abaxial portion of the midrib is circular and thick walled (Fig. 2-a). The vascular bundle of the midrib is three, semicircular in outline and collateral. The bundles has long, parallel compact vertical lines of narrow, thick walled circular xylary elements and small units of discrete phloem elements (Fig. 2-b). Stomata are anomocytic that occurs on both surfaces of the lamina (Fig. 2-c).

Table 1. Macroscopical characters of *Cleome felina* L. f.

Part of the plant	Characters noted	Observation
Leaf	Colour	Green
	Odour	Characteristic
	Taste	Agreeable
	Size	Middle 15-16 mm, lateral 5-12 mm
	Shape	Obovate
	Texture	Rough with rigid scale like hairs
	Fracture	Fibrous
	Apex	Cuneate
	Margin	Ciliate
	Phyllotaxy	Alternate, trifoliate
	Appearance	Strigose
	Petiole	Long
Stem	Colour	Dark green
	Odour	Characteristic
	Taste	Agreeable
	Size	Up to 50 cm high
	Shape	Cylindrical
	Texture	Very rough with strigose
	Fracture	Neither soft nor hard
Flower	Colour	Pink or purple
	Inflorescence	Axillary, solitary
	Size	5-8mm
	Pedicel	3-15 mm long elongated to even 22 mm while fruiting
	Stamens	25-40
	Filaments	3-4 mm long
	Ovary	Sessile, 5-6 mm long
Fruit	Colour	Green
	Type	Dehiscent, siliqua
	Apex	Beaked
	Size	2-3 cm long
Seed	Colour	Yellowish brown
	Shape	Reniform
	Surface	Crested
	Size	1.5-2.5 mm
	Number	Many



Fig. 1: Macroscopic features of *Cleome felina*. (a) Habit, (b) Closure view of flower, (c) Closure view of fruit, and (d) Closure view of seed.

Petiole

The outline of the petiole was triangular with 'V' shaped adaxial groove. It was 1 mm in vertical plane and 900 µm in horizontal plane. The petiole has three larger and two smaller vascular bundles; of these bundles, two lateral abaxial bundles were larger and two wing bundles were smaller. The epidermis has the many multicellular and glandular hairs (Fig. 3a and b).

Stem

The transverse section of the stem was externally

bounded by the epidermis. There was presence of more prominent multicellular glandular hair on the stem (Fig. 4-a). The cortex region was of three layers of parenchyma cells, which were thin walled and mostly hexagonal in shape, and contain intercellular air spaces (Fig. 4-b) which was followed by four layers of collenchyma cells. Vascular bundle is oval in shape, concentric with phloem in the centre and surrounded by xylem (Fig. 4c, d and e). Interfascicular rays appeared homogeneously. The pith region was occupied by myrosin (Fig. 4-f and g). The presence of stone cells was also reported in the cortical region (Fig. 4-h).

Root

TS of root composed of an outer piliferous layer, it includes thin superficial periderm which consists of broken epidermal layer. The cortex is composed of parenchyma cells with intercellular spaces; these cells are oval in shape and filled with myrosin. The vascular bundles lie at the center. In matured roots, secondary phloem is thin, continuous layer of sieve elements, parenchyma cells and phloem rays (Fig. 5-a). The phloem elements are small, squarish in shape and are arranged in vertical rows. Secondary xylem cylinder is circular in outline. It includes vessels, sclereids and fibres. The vessels of the secondary xylem are wide, circular and thick walled. The vessels are solitary (Fig. 5-b), the diameter of the vessels increases from centre towards periphery. It includes several straight, thin and one cell thick xylem rays (Fig. 5-c). The pith is well developed, thick walled and filled with myrosin (Fig. 5-d). Calcium oxalate crystals are distributed throughout the root. The crystals are solitary in each parenchyma cells (Fig. 5-d).

Powder microscopic observation

Epidermal trichome is long, glandular, multicellular and conical, which are attached to the epidermal cells by a group of cells measuring $40\mu\text{m}$ in diameter. The height of the trichome varies from $70\mu\text{m}$ to $170\mu\text{m}$ (Fig. 6-a). Fibre like sclereids are also seen in the powder, the sclereids is long, thick and tapering at the end (Fig. 6-b). The cell wall is thick in parenchyma cells (Fig. 6-c). The sclereids are long and thick. Narrow, cylindrical vessel elements are common in the powder (Fig. 6-d). The vessels surrounded by many minute, tracheid like vessels in the tip (Fig. 6-e).

Venation pattern

Densely reticulate and the major lateral veins give rise to uniformly thin minor lateral veins (Fig. 7-a). Vein islets with well-defined vein boundaries, polygonal with swelling boundaries, usually terminating with one vein; vein termination is either unbranched or branched.

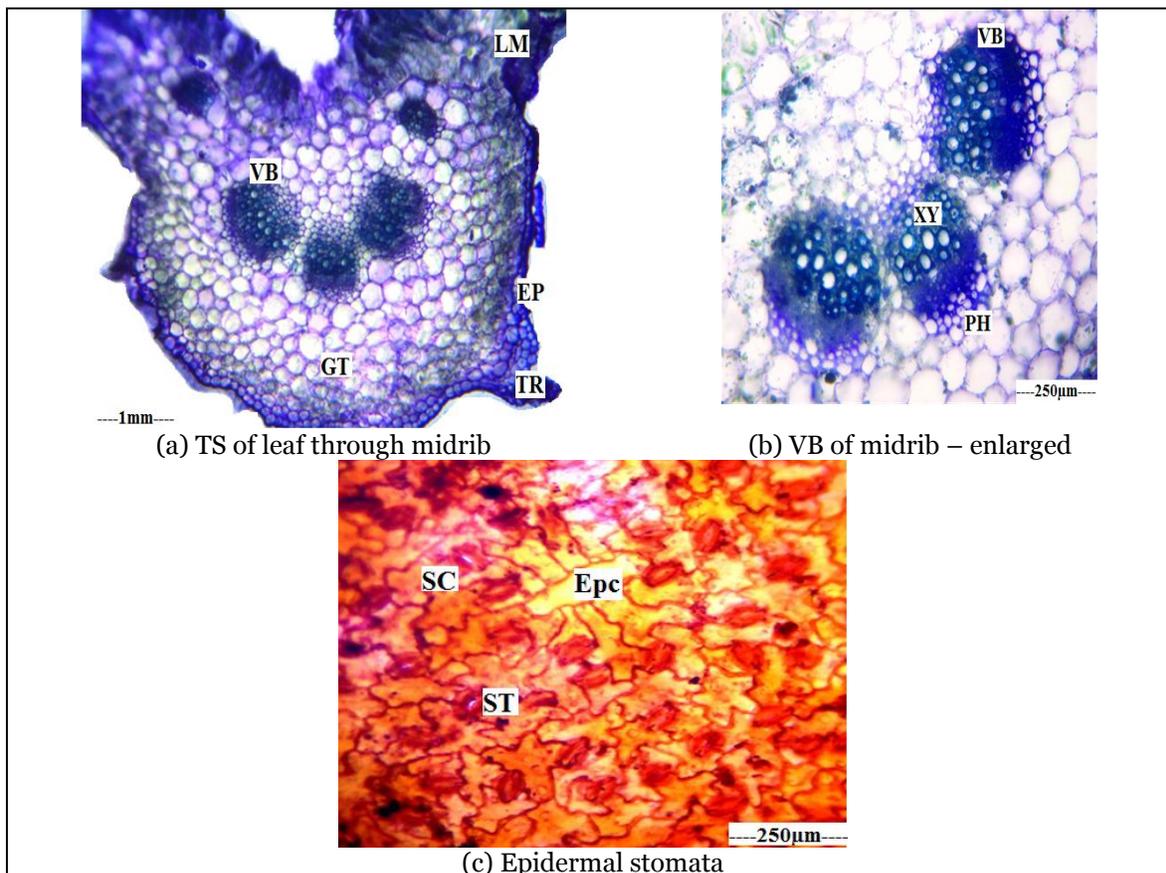


Fig. 2: Anatomy of midrib and stomata of *Cleome felina*. GT- Ground Tissue; LM- Lamina; VB- Vascular Bundle; XY- Xylem; TR- Trichome; PH- Phloem; ST- Stomata; SC- Subsidiary cells; Epc- Epidermal cell; EP- Epidermis.

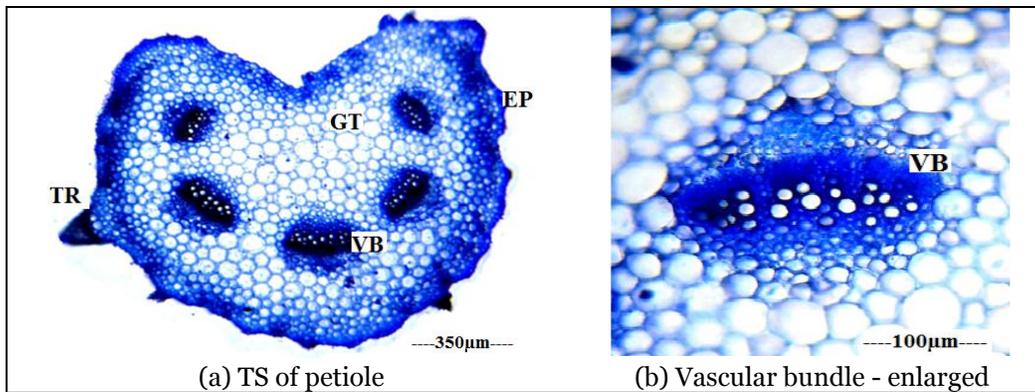


Fig. 3: Anatomy of *Cleome felina* petiole. GT- Ground Tissue; EP- Epidermis; VB- Vascular Bundle; TR- Trichome.

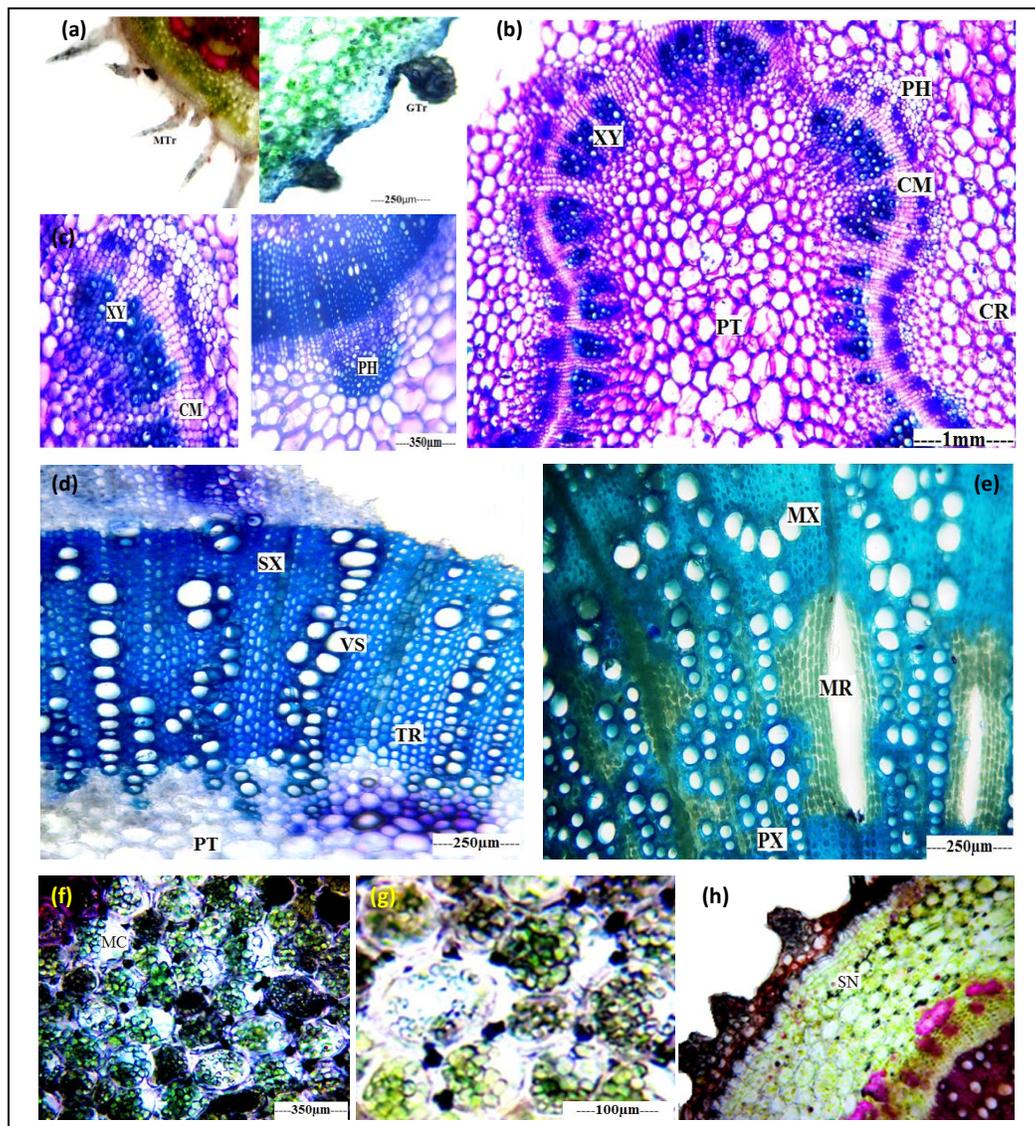


Fig. 4: Anatomy of *Cleome felina* stem. (a) Trichomes, (b) TS of stem, (c) Xylem and phloem elements, (d) Secondary xylem enlarged, (e) Medullary rays, (f) Myrosin cells, (g) Myrosin cells enlarged, and (h) Stone cells. CR– Cortex; PT– Pith; PH – Phloem; VS– Vessels; CM – Cambium; MX- Meta xylem; PX- Proto xylem; MR- Medullary ray; MTr- Multicellular strigose trichome; GTr- Glandular trichome; SN- Stone cells; MC- Myrosin cell; XY- Xylem; SX – Secondary Xylem; VS – Vessels; TR- Tracheids.

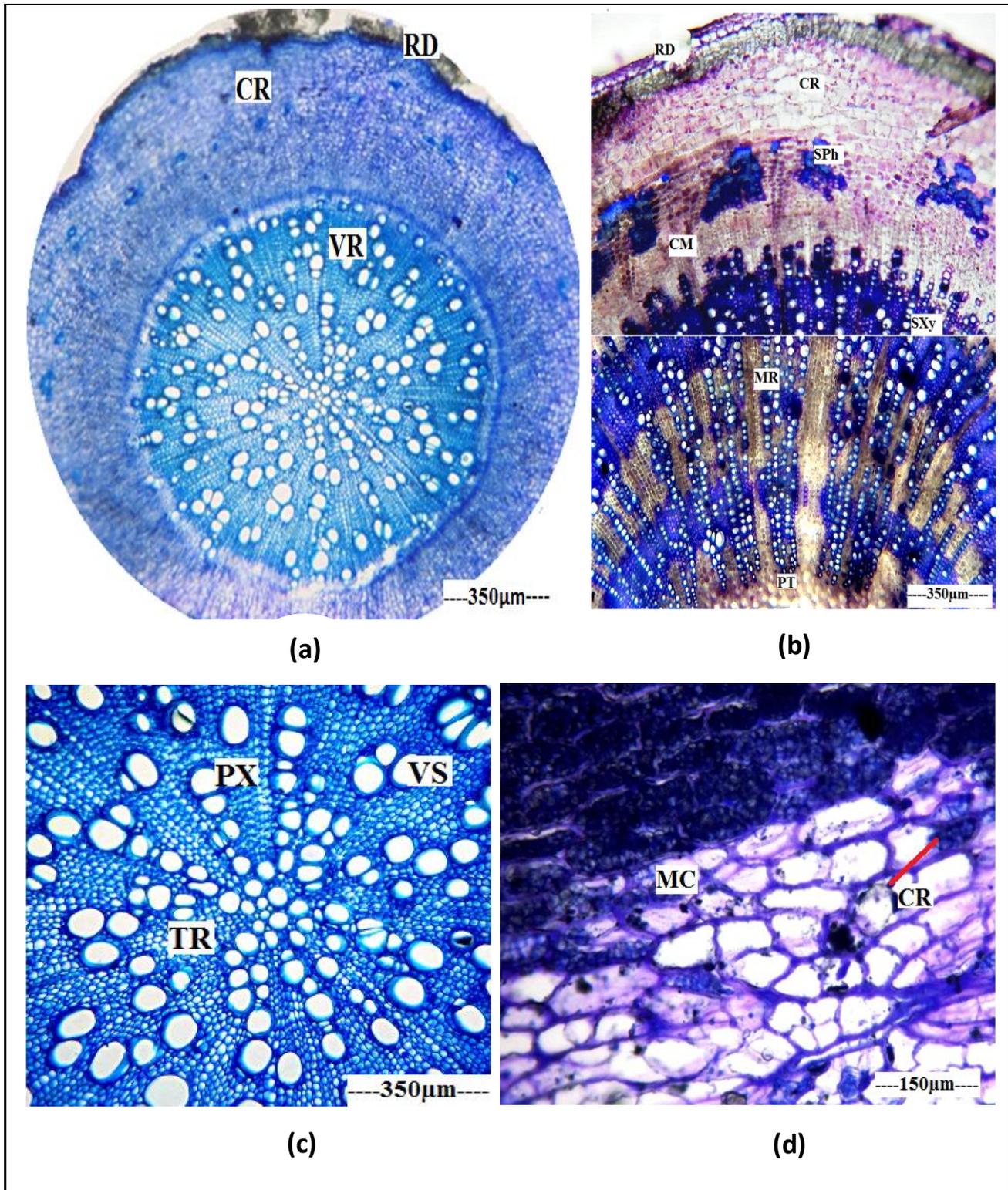


Fig. 5: Anatomy of *Cleome felina* root. (a) TS of Primary Root – Entire View, (b) TS of Primary Root- Enlarged, (c) TS of Secondary Root – Entire View, and (d) Myrosin cell and calcium oxalate crystals. CR – Cortex; CM- Cambium; RD- Rhizodermis VR- Vascular cylinder; PX- Primary xylem; VS- Vessels; TR- Tracheid; SPh- Secondary Phloem; SXy- Secondary Xylem; MR- Medullary ray; PT- Pith; CR- Calcium oxalate crystals; MC- Myrosin cells.

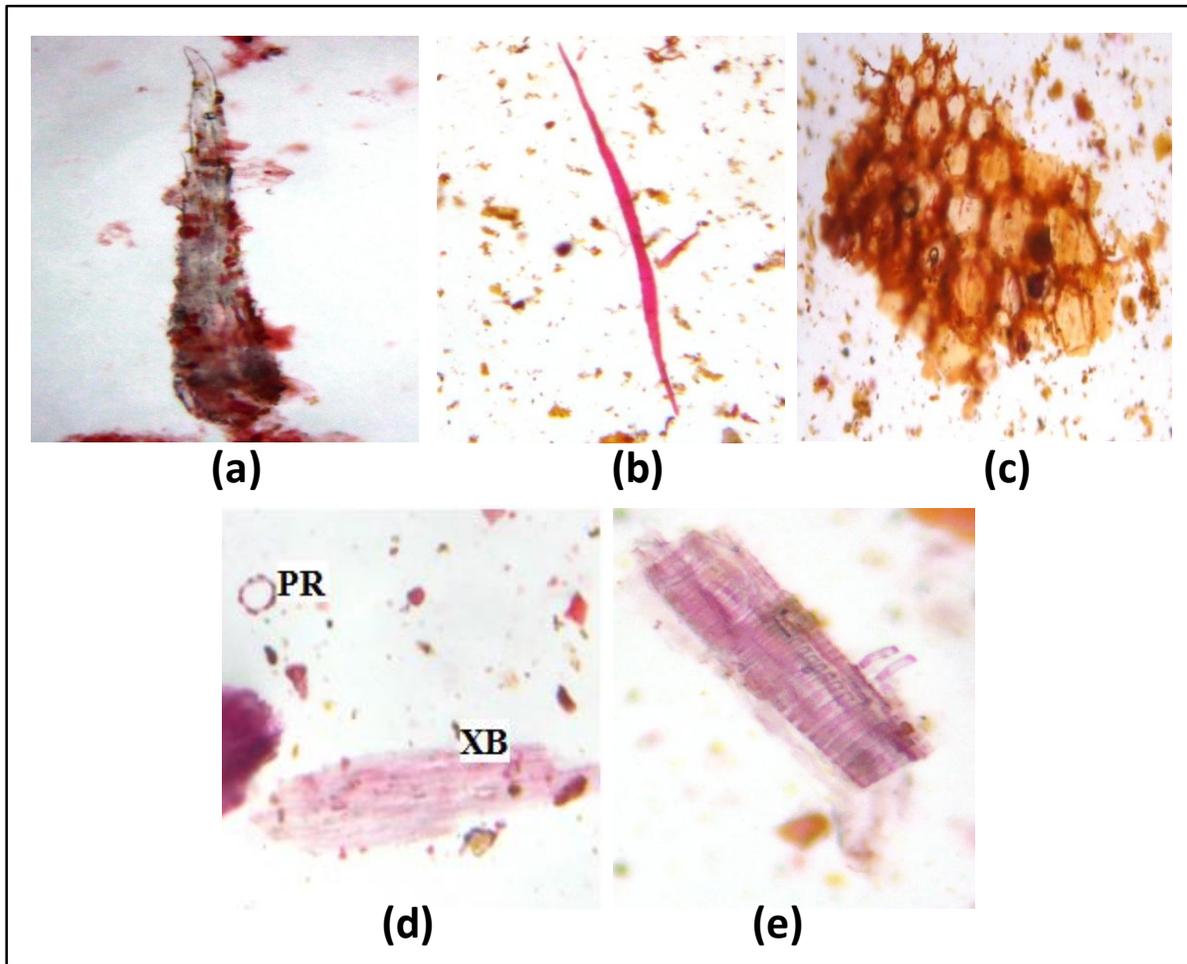


Fig. 6: Powder microscopic observation of *Cleome felina*. (a) A trichome, (b) A tailed fibre, (c) A bundle of elongated parenchyma cells, (d) Xylem bundle, and (e) Xylem vessels. PR- Parenchyma cell; XB – Xylem bundle, FR- Fibre, TR: Trichome.

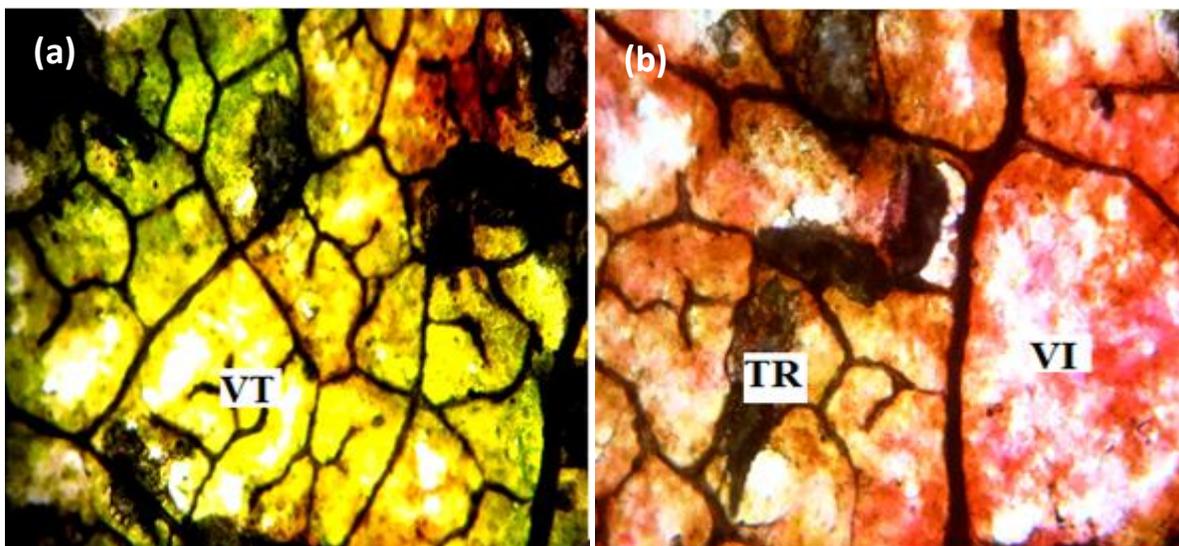


Fig. 7: Venation pattern in *Cleome felina*. VL: Vein lets; VI: Veins; TR: Trichome.

Discussion

The result of the present observation includes epidermal characteristics, trichome, stem, root inclusions can be used to distinguish *C. felina* from other members of the genus and are of taxonomic value and also supports the works of (Metcalf and Chalk, 1983; Jansen, 2004). Foliar epidermal cells, stomatal cells and trichome complexes in some Indian species of *Cleome* were reported (Jelani et al., 1990). This has also been done in other medicinal plant species (Edeoga and Okoli, 1997; Edeoga et al., 2007).

The results of the stomatal characteristics are in contrast with the findings of Edeoga et al. (2009), however supports the works of Metcalfe and Chalk (1983). Diacytic stomata are common in *C. gynandra*, *C. paradosea* and *C. brachycarpa*. On the basis of arrangement of the epidermal cells near the guard cell, more than 25 main types of stomata in dicots have been recognized (Metcalf and Chalk, 1983). In present observations, stomata are anamocytic which occur on both surfaces of the lamina (2-c).

An important observation in the stem and root anatomy of this species is the presence of calcium oxalate crystals in solitary. The crystals mostly occurred in the parenchyma cells. The localization of these substances could be involved in the synthesis of carbohydrate (Edeoga and Okoli, 1997). Idioblastic cells sacs have been recorded in *C. aspera*, *C. chelidonii*, *C. felina* and *C. tenellam* (Rajagopal and Ramayya, 1968; Saha et al., 1990). The general description of the micromorphological characters of the leaf, stem and roots of *C. felina* is helpful in identifying them correctly to avoid substitution and adulteration of this medicinally important plant.

Conflict of interest statement

Authors declare that they have no conflict of interest.

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