



Anatomical features of *Gynura lycopersicifolia* DC.

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Abstract: The present paper deals with anatomical features of *Gynura lycopersicifolia*, a rare medicinal plant collected from Tirumala hills of Andhra Pradesh. Photographs of Habitat, live specimen, dried plant parts, stem and Transverse sections (T.S) and internal anatomy with cell measurements of Leaf, Stem and Root were provided for easy identification and authentication of the species were provided with note on diagnostic characters.

Keywords: *Gynura lycopersicifolia*; Anatomical features; Tirumala hills.

Introduction

In pursuance of Pharmacognostical and ethno-botanical studies on some important medicinal plants in Chittoor district of Andhra Pradesh in India, it was found that some important medicinal plants were under studied and misidentified (Pushpalatha and Sujathamma, 2019). *Gynura lycopersicifolia* (Asteraceae), a rare succulent erect herb, a medicinal valued plant species is one among misidentified and adulterated with diverse impediments. It was established that anatomical characters can impeded the identification when morphological features are indistinct (David *et al.*, 2008). Some researchers (Kavitha *et al.*, 2019; Jyothi *et al.*, 2015; Prathap *et al.*, 2012 & 2014; Ramesh and chetty *et al.*, 2014) studied anatomical studies on medicinal plants of Tirumala and revealed the taxonomic ambiguity with anatomical studies.

Gynura lycopersicifolia DC., Prodr. [A. P. de Candolle] 6: 300 (1838). (Figure.1.A - C)
Vernacular names are Adavitametaaku and Needa chamanthi and the flowering and fruiting occurs between December - March.

Perusal of literature revealed that, Pullaiah and Ramamurthy (2007) reported this species occurrence from Tirumala and Vishkapatanam associated areas. Chetty *et al.*, (2018) reported it from Ghat roads, Papavinasanam, Japali hanuman teertham areas in Tirumala of Andhra Pradesh.

In this present research, we intended to work on anatomical features of *Gynura lycopersicifolia* which should be considered as rare species. This investigation aims to improve the existing data for identification in the typical *Gynura* species and this forms the additional feature.

Materials and Methods

The specimens of *Gynura lycopersicifolia* were collected from the rocky crevices in foot path waysides from Akasaganga theertham to Papavinasanam in of Tirumala in Andhra Pradesh (Figure 1.A - D). The botanical identification of the taxa was carried out by using regional and local floras (Hooker, 1982; Gamble and Fischer, 1957; Pullaiah and Sri Ramamurthy., 2007 and Chetty *et al.*, 2018). The herbarium was prepared according to the method of Jain and Rao (1977) and deposited in the Herbarium of Department of Botany, Sri Venkateswara University, Tirupati, Andhra Pradesh for further use. The voucher specimens (SVUTY/AST/3174) were authenticated by comparing voucher herbarium specimens deposited at BSI, Southern circle, Coimbatore (MH), Tamil Nadu.

Anatomical study- Microtomy

Healthy whole plant (leaf, petiole, stem, root) in vegetative stage were chopped and fixed in the field immediately in FAA (Formalin - 5ml + Acetic acid - 5ml + 70% ethyl alcohol - 90 ml).

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Figure 1. *Gynura lycopersicifolia*
Fig.1.A. Habitat. **Fig.1B.** Specimen.
Fig.1C. Dried parts.

After 24 hours of fixing, the different organs were dehydrated with graded series of tertiary-butyl alcohol as per the procedures (Sass, 1940; Ramesh *et al.*, 2014). After dehydration, infiltration of the parts was carried out with gradual addition of paraffin wax until tertiary-butyl alcohol solution attained super saturation. The plant organs were casted into paraffin blocks. The paraffin embedded parts were sectioned with the help of rotary microtome. The thickness of the sections maintained to be between 10-12 μ m. The sections were stained with toluidine blue as per the method of O'Brien *et al.*, (1964).

For studying stomatal morphology, venation pattern (vein-islet, vein-termination) and trichome distribution were performed according to the modified protocol of Rao *et al.*, (2014). Paraffin embedded lamina were used for paradermal sections. From these sections, the epidermal layers as well as vein-islets and vein-terminations were studied. The alternative method was clearing the leaf fragments by immersing the material in alcohol (chlorophyll content will be expelled) followed by treating with 5-10% of sodium hydroxide (NaOH)

(Sivaja *et al.*, 2012 & Ramesh *et al.*, 2013). The cleaned materials were washed thoroughly, stained with safranin for further studies. Microscopic descriptions of all necessary cells and tissues are supplemented with photomicrographs and measurements are given. The mounted histological sections were then analyzed and imaged using Nikon E220 LED microscope (Nikon Inc., Japan). Descriptive terms of the anatomical features were used as per the terminology found in standard literature (Ewart, 2007; Fahn, 1982)

Results & Discussion

Anatomy with micromorphology

In this investigation, observations on *Gynura lycopersicifolia* anatomical sections of Leaf, petiole, stem and root were summarized below for micromorphological standardization.

Macroscopic features of vegetative parts of *Gynura lycopersicifolia*

It was observed that the Root is fibrous, Stem scabrous. Leaves rhomboid lyrate to pinnate partite, lower pinnae smaller than upper, terminal pinnae ovate to lanceolate, base auricled.

Anatomical features of the Leaf (2.A- 2.I)

Midrib

The midrib is circular in sectional view, projecting hemispherical body on both upper and lower sides. It is almost 550 μ m thick and 1.3 mm wide. It consists of a thin well defined epidermal layer of small squarish cells. The ground tissues is homogeneous consisting, fairly wide thin walled compact parenchyma cells. The vascular strands are four, two placed on the adaxial side and other two on the abaxial side have a few short rows of small xylem elements and small mass of phloem. (Fig.2A)

Lamina

The lamina is fairly thick and soft dorsiventral different is not distinct. It consists of a thin spindle shaped adaxial epidermal cells. The abaxial epidermis is also thin. The lamina is amphistomatic and occurred on both upper and lower epidermal layers. The mesophyll includes 6 or 7 layers of lobed loosely arranged cells; palisade zone not distinct. The lamina is 400 μ m thick non-glandular, uniseriate multicellular unbranched epidermal trichomes are often seen in the

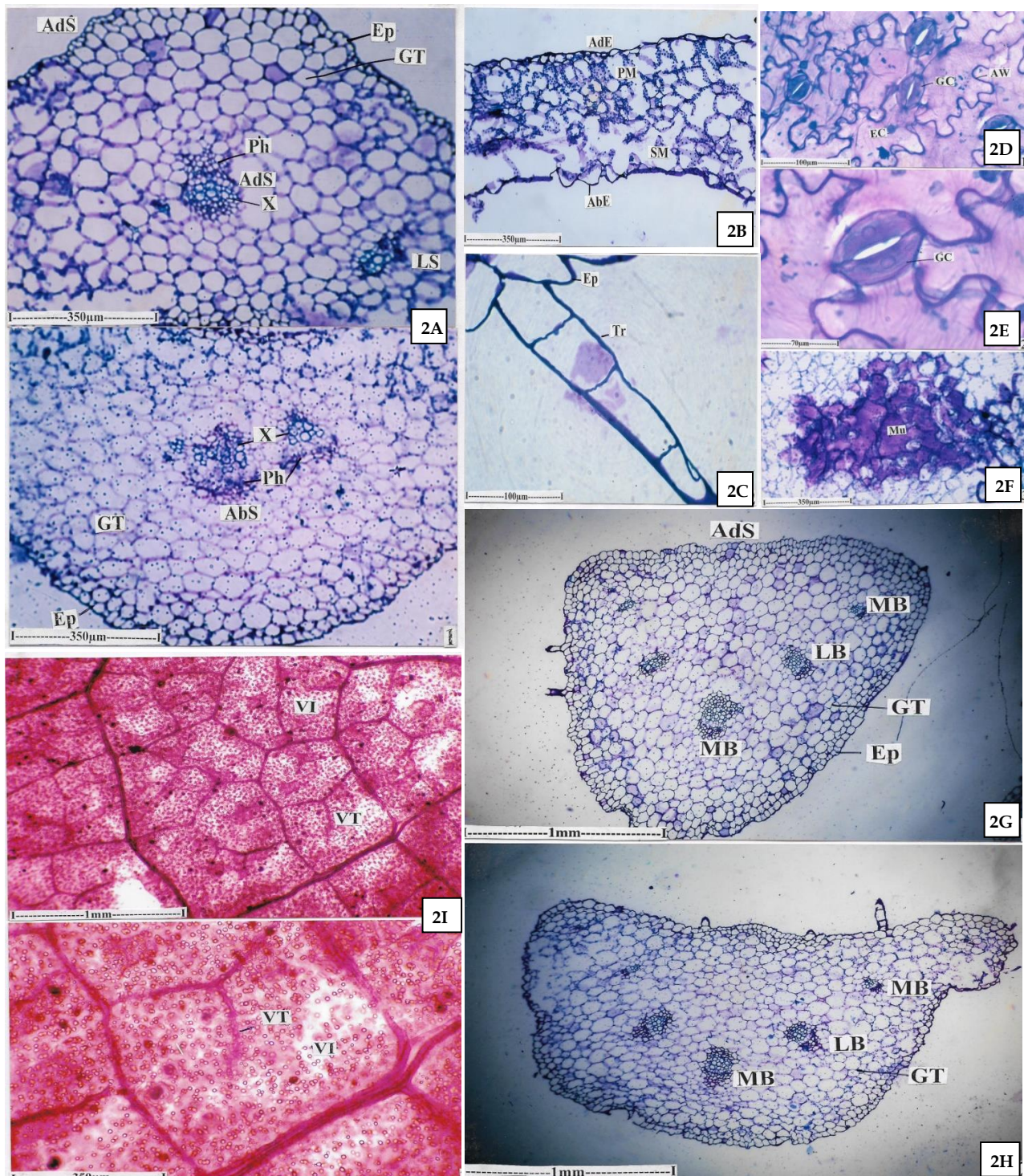


Figure 2. Leaf Micromorphology.

Fig. 2A. T.S. of Midrib of the leaf. **Fig.2B.** T.S. of Lamina **Fig.2C.** Non-glandular trichome. **Fig.2D.** Paradermal section of the lamina – abaxial side **Fig. 2E.** stomata – enlarged. **Fig.2F.** Mucilaginous mass in the mesophyll tissue. **Fig. 2G.** T.S. of Petiole – distal part (lower end) & **Fig. 2H.** T.S. of Petiole – Proximal part (Upper end). **Fig.2I.** Lamina cleared showing venation pattern. & Vein-islet – vein termination – enlarged.

Abbreviations in Figure. 2.A-I:

AbS : Abaxial side; **AdS :** Adaxial side; **Ep :** Epidermis; **GT :** Ground tissue; **LS :** Lateral side; **X :** Xylem; **Ph :** Phloem; *T.S. of Lamina:* **AbE:** Abaxial epidermis; **AdE :** Adaxial epidermis; **PM :** Paliside mesophyll; **Tr :** Trichome; **SM :** Spongy mesophyll; **AW :** Anticlinal cleavage; **GC :** Guard cell; **EC :** Epidermal cell; **Mu :** Mucilage; **VI :** Vein-islet; **VT :** Vein termination; **MB :** Median bundles; **LB :** Lateral bundles.

abaxial epidermis. The cells of the trichomes are vertically rectangular with thin walled and hyaline. The trichome is 300 μ m long and 50 μ m wide. (Fig.2.B,C)

Epidermal cells and stomata

In paradermal sections, the epidermal cells appear much wider, highly lobed with thin anticlinal walls. The stomata anomocytic type and no subsidiary cells are seen around the guard cells. The guard cells are prominent and elliptical measures 30 x 40 μ m in size. The mesophyll tissues possess thick accumulation of mucilage. The mucilage cells are normal cells and are not different from non-mucilaginous cells. (Fig.2D,E)

Venation pattern

The general pattern of venation is reticulate type. The major veins and veinlets are thin and straight. The vein islets are polygonal and well defined with distinct boundaries. The vein terminations are unbranched, long, thin and slender. Occasionally the vein-terminations are forked once. (Fig.2I)

Petiole

The petiole is triangular at the distal and the planoconvex at the proximal end. The distal petiole is flat at the adaxial side and conical at the abaxial side. It consists of a thin well defined epidermal layer of squarish thin walled cells and homogeneous parenchymatous ground tissue. There are 5 vascular strands, which are arranged in a line of arc; of the 5 bundles, the lower median bundle is the largest; the two lateral bundles are smaller and two marginal bundles are the smallest. The petiole is 1.4 x 1.5 mm in size. The proximal end of the petiole is 1.2 x 1.8 mm in size. The structure is basically similar to the distal petiole; the epidermal and ground tissues are as in the distal petiole. The vascular strands are five arranged in a line. The vascular bundles are found to be collateral and wedge shaped. (Fig.2.G,H)

Anatomical features of stem (Fig. 3.A- 3.E)

(A) Young stem (Fig. 3A-3C)

The young stem is 2 x 2.6 mm thick. It consists of prominent, thin walled cubical epidermal cells followed by 4 layers of cells similar both epidermis. Inner cortex fairly wider comparing large compact cells. (Fig.3.A, B).

The vascular system is eustele comprising several discrete collateral wedge shaped vascular bundles arranged in a ring and the bundles are separated from each other by wide parenchymatous medullary rays. The vascular bundles have small cluster of narrow, angular thick-walled xylem elements and 3 or 4 layers of short rows of sieve elements and a prominent sclerenchyma cap. (Fig.3.C).

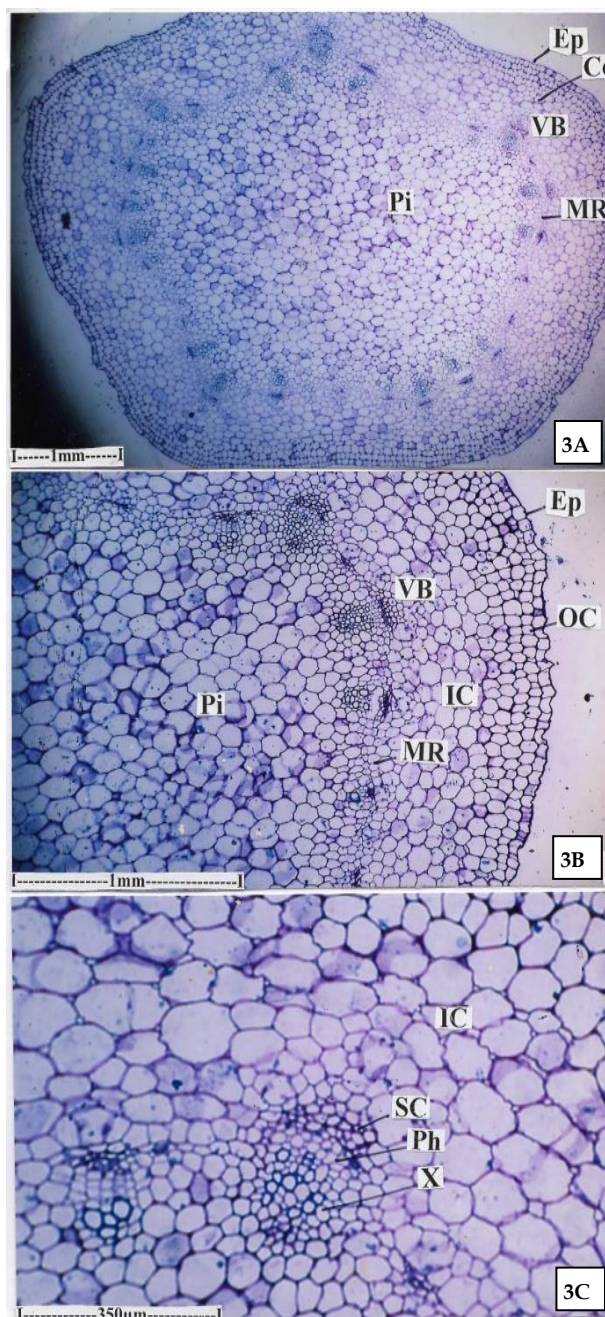


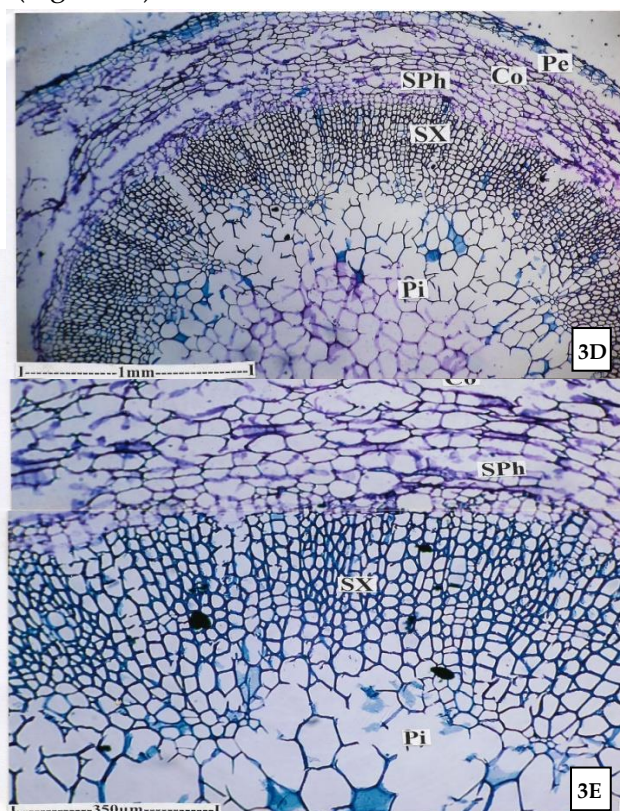
Figure. 3A. T.S. of Young stem – entire view.

Fig. 3B. T.S. of Young stem – sector.

Fig. 3C. Vascular bundles enlarged.

(b) Thick stem (Fig.3.D,E).

The thick stem is about 3 mm in diameter. It consists of thin periderm and thick cylinder of secondary xylem. Periderm includes three or four layers of narrow phellem cells. The cortex is 700 μm wide and includes large, compact polygonal parenchyma cells. Secondary xylem consists mostly of xylem fibres. vessels are scanty. The fibres are thin walled with wide lumen. The piths is wide and parenchymatous. (Fig.3.D,E).

**Figure 3D.** T.S of Old Stem**Fig. 3E.** A sector enlarged.

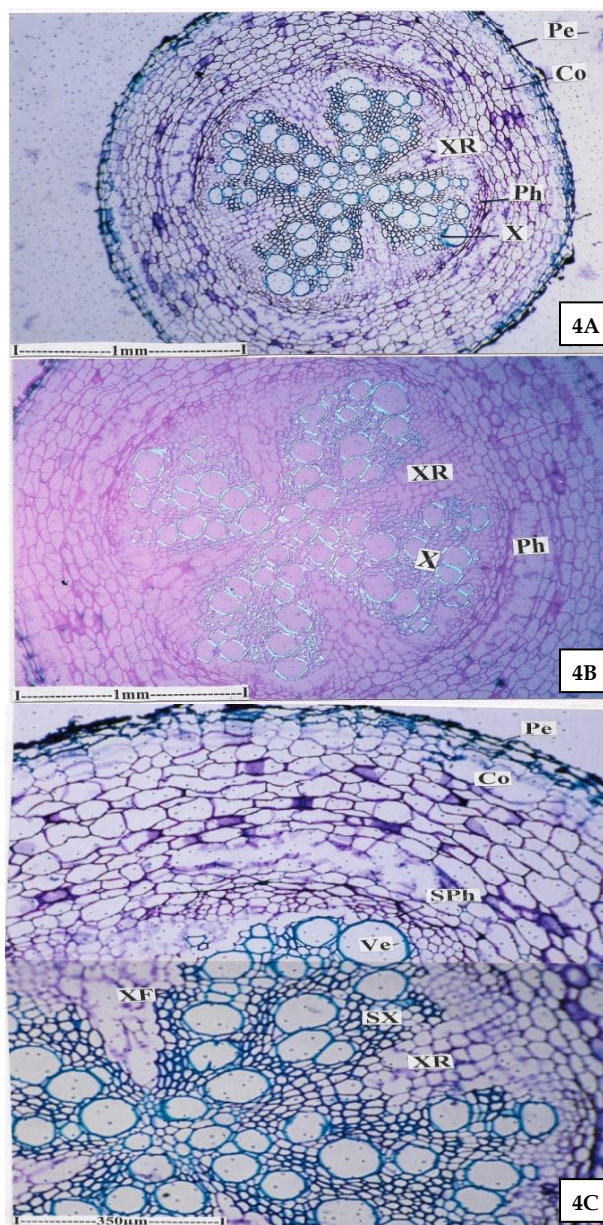
Abbreviations in Figure. 3.A-E:

Ep : Epidermis; Co : Cortex; IC : Inner cortex; SC : Sclerenchyma; MR : Medullary ray; Pi : Pith; VB : Vascular bundle; X : Xylem; Ph : Phloem; Co : Cortex; SPh : Secondary phloem; Pe : Periderm; SX : Secondary xylem.

Anatomical features of Root (Fig. 4A, 4B, 4C)

The root exhibits unusual structure due to deep cleavage of xylem cylinder into four fan shaped lobes. The root is 2 mm thick. There is uniformly thick superficial periderm consisting of three layers of narrow tabular phellem cells. Cortex is 400 μm thick; the cortical cells are large, thin walled and less compact. Secondary

phloem occurs in small nests all around the xylem. Secondary xylem is divided into four fan shaped segments by wide xylem rays. The segments are 650 μm thick and 400 μm wide at the wide outer part. It consists of wide, circular thin walled vessels and wide, thin walled lignified fibres. The vessels are upto 120 μm wide.

**Figure 4A.** T.S of Root –entire view.**Fig. 4B.** T.S. of Root under polarized light.**Fig. 4C.** T.S. of Root - A sector enlarged.

Abbreviations in Figure. 4A - 4C:

T.S. of Root as visualized under polarized light - Co : Cortex; Pe : Periderm, XR : Xylem ray; X : Xylem; Ph : Phloem; SX : Secondary xylem; SPh : Secondary phloem; Ve : Vessel; XF : Xylem fibre.

Previously, Bercu (2014) done on microanatomical studies in *Gynura aurantiaca*. Phytochemical investigation on *Gynura lycopersicifolia* was performed by Reddy et al., (2019) and Shankaraiah and Santosh (2017). Studies on the synthesis, characterization and antibacterial properties of green-synthesized silver nanoparticles from whole plant aqueous extracts of *G. lycopersicifolia* was investigated by Peer and yasodamma (2019). Reddy et al., (2019) worked on pharmacological activities *G. lycopersicifolia*. In-vitro antihelmintic activity of the leaves of *G. lycopersicifolia* was done by Shankaraiah and Santosh (2017). Hitherto no reports on anatomical studies on *Gynura lycopersicifolia* work has been published.

In the present study, Anatomical features of *Gynura lycopersicifolia*, a rare distinct species was studied in order to characterize the systematic utility and to comprehend the pharmacopoeial efficacy. For this, transverse section (T.S) taken from the top, middle and lower part of the leaf, stem and root was observed under microscope. For this investigation, toluidine blue (polychromatic stain), which resulted remarkably good and some cytochemical reactions (cell inclusions) was obtained. The dye rendered pink colour to the cellulose walls, blue to the lignified cells (lignin), dark green to suberein (cuticular cell wall), violet to the mucilage, blue to the protein bodies (Ashokan, 2006; Cutler et al., 2008; Saukel and Ginko, 2014). Wherever necessary sections were also stained with saffranin and fast-green and solution of Potassium iodide (KI) & iodine (I₂) for starch test changed to blue colour, 1% solution of ferric chloride (FeCl₃) exhibited light blue/ black colour to the tannins when applied to the sections. Some anatomical characters such as the number, measurement and shape of epidermal and inner tissue cells, internal microscopic characters like palisade and spongy parenchyma layers, abaxial and adaxial stomata, trichome types provide information of taxonomical significance.

These anatomical features in addition to existing macro characters of the genera and species level distinction would be useful in correct identification and authentication of plant species (Jyothi et al., 2015; Saukel and Ginko

(2014; Ramesh et al., 2014; Sonibare and Osiyemi, 2012).

Conclusion

In conclusion, this study form the first of its kind repot on anatomy and micromorphology of *Gynura lycopersicifolia* revealed a scientific authentication, proper identification and standardization of anatomical profile distinguishing other *Gynura* spp. and it is essential to undergo molecular studies for further validation which can resolve any taxonomic ambiguity within this genus.

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