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PHARMACOGNOSY OF TORENIA CRUSTACEA (L.) CHAM. & SCHLTDL. -A LESSER-KNOWN TAXA FROM KARNATAKA

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ABSTRACT

The increasing global interest in plant-based medicines underscores the need to systematically document and standardize lesser-known medicinal plants to ensure their efficacy, safety, and sustainable utilization. *Torenia crustacea* (L.) Cham. & Schltdl is a traditionally used medicinal plant from Karnataka, India, that remains scientifically understudied. This study provides a comprehensive pharmacognostic evaluation of *T. crustacea*, Fresh aerial parts were collected from the Tataguni estate (Bangalore) and subjected to macroscopic, microscopic, physicochemical, phytochemical, and fluorescence analyses using standard methods. Macroscopic examination revealed a quadrangular stem with prominent sclerenchymatous patches and a starch-rich pith. Microscopic investigation documented unicellular trichomes, multilayered collenchyma, well-differentiated palisade and spongy mesophyll, and scattered anomocytic stomata on leaf surfaces. Physico-chemical profiling of the powdered drug showed low foreign matter (1.2 %), moisture content (3.5 %), ash value (6.12 %), bulk density (0.384 g cm^{-3}), specific gravity (0.6711 g cm^{-3}), pH 5.9, aqueous extractive value (1.2 %) and ethanol extractive value (3.98 %). Preliminary phytochemical screening identified alkaloids, phytosterols, carbohydrates, saponins (aqueous extract), flavonoids (ethanol extract) and tannins, while fixed oils were absent. Fluorescence analysis with various reagents produced characteristic colour changes, further aiding

authentication. The study establishes reliable pharmacognostic parameters for *T. crustacea*, supporting its reliable identification and future exploitation in herbal-medicine formulations.

KEYWORDS: *Torenia crustacea,* Microscopy, physico-chemical parameters.

INTRODUCTION

Nowadays, people are highly interested in natural medicines derived from botanical sources, as they offer a broad range of therapeutic actions with comparatively fewer adverse effects.[3,4] A novel approach to analyzing plants for validating traditional claims is being developed in the search for bioactive components present in natural flora.[5] Numerous ethnomedicinal plants have been documented from different regions of Karnataka. However, many medicinal plant species have yet to be adequately explored; among them, *Torenia crustacea* is one for which only limited scientific reports are available.

T. crustacea is a lesser-known medicinal plant from Karnataka State, belonging to the family Linderniaceae of flowering plants. It is an important ethnomedicinal herb used for centuries and is widely utilized in countries such as Indonesia and Malaysia. Traditionally, this plant is used in the treatment of earaches, bruises, fever, thrush, inflammatory conditions, and various skin disorders, including itching, boils, ulcers, dysentery, and ringworm, particularly in postpartum women.[6,7] It has also been reported that this herb is used by the Bodo tribe of Assam for the management of diabetes.[1]

Recent studies, including LC-MS analysis, have revealed that compounds present in *Torenia* species exhibit significant antitumor activity.[2] The plant may contain a variety of secondary metabolites responsible for its anticancer potential. Chloroform extracts have shown promising in vitro anticancer activity in MTT assays.[8] Secondary metabolites such as flavonoids, phenolic acids and alkaloids are integral to both ecological functions and therapeutic application in the treatment of various ailments.[9] These compound are well known for their diverse biological activities, such as antioxidant, antimicrobial and anti-inflammatory effects, which help plants to adapt to environmental stress and also offer therapeutic potential for treating various human diseases.[10]

Despite their importance, species belonging to the family Linderniaceae, including *T. crustacea*, remain underexplored in herbal drug research, particularly with respect to their phytochemical diversity and pharmacological potential.[11] LC-MS studies have identified

phenolic acid-rich compounds such as 5-caffeoylquinic acid, squamatic acid, and rhodioloside, which are associated with neuroprotective, antidiabetic, and adaptogenic activities.[12] This plant possessess immense untapped potential for future pharmaceutical and biotechnological research addition to the stress tolerance through their antioxidant and antimicrobial properties.[13] Furthermore, the presence of arbutin, a well-known depigmenting agent, along with alkaloids such as protopine and rauwolscine, supports its traditional use in treating skin disorders and cognitive conditions.[14]

Traditionally, this plant has been used for wound healing, antipyretic purposes, and stress-related disorders. The presence of bioactive compounds such as flavonoids, phenolic glycosides, and coumarins provides scientific validation for these therapeutic uses.[15] However, many medicinal plants are on the verge of extinction without being properly identified and documented, despite their potential therapeutic value. Therefore, proper identification, standardization, and conservation of such plants are essential for their sustainable utilization in herbal medicine.

Although *T. crustacea* possesses significant ethnomedicinal importance, it has not yet been thoroughly evaluated pharmacognostically with respect to its microscopic characteristics, powder microscopy, physicochemical parameters, and other standardization aspects. Hence, the present study aims to establish detailed pharmacognostic standards for this plant, which are essential for its proper identification, authentication, and future use in herbal drug development and documentation.

Figure 1: Aerial part of the plant and Flower.

MATERIALS AND METHODS

Fresh plant material was collected from the surrounding area of Tataguni Estate on Kanakapura Main Road, Bangalore, Karnataka. The specimen was identified by referring to botanical literature, and a voucher specimen was deposited in the Department of Postgraduate

Studies in Dravyaguna Vijnana, Sri Sri College of Ayurvedic Science and Research, Bangalore.

Fresh aerial parts were separated carefully and preserved in FAA preservative for microscopical studies. The sample was washed thoroughly under running tap water and spread over the working slab to remove the water, later on spread uniformly on blotting paper to absorb adhered moisture. Then plant material was shade-dried for about fifteen days, ensuring proper aeration and avoiding contamination. The dried sample was slightly warmed in a hot air oven before pulverization. The powder was sieved and stored in an airtight container.

Preserved plant material was used for free-hand sectioning of stem and leaf for microscopic studies, safranin and hematoxylin were used to stain the sections and mounted on a glass slides with glycerin as medium.[16,17] The microscopic slides were studied under a compound research microscope under different magnification such as 5X, 10X and 40X for microscopical features and photographs were taken. Organoleptic study was conducted for powdered sample for its texture, odour, colour and taste. Physico-chemical parameters for powdered herbal sample was assessed for foreign matter, ash value moisture, extractive values and specific gravity.[18] Bulk density of the powdered sample and P^H value for aqueous solution was determined by using digital P^H meter and was documented. Powder microscopy was carried out by following standard pharmacognostical procedures.[19] Preliminary phytochemical analysis was done by extracting 50 g of stored plant powder in the Soxlet apparatus by using distilled water and ethanol as a solvent. Extracts were filtered and filtrate was collected, volume of filtrate was reduced to 1/10 th by evaporation of solvent on a water bath. The dried extract was stored in a sterile airtight container and stored in 4^0 c in refrigerator and used for phytochemical analysis.[20] Fluorescence analysis of stored crude powder as such and was treated with different reagents of distilled water, Concentrated HCl, Concentrated H_2SO_4, Concentrated HNO_3, Acetone, 5% Iodine, 5% KOH, $FeCl_3$ and NaOH was observed the colour changes in visible light, short wave length and long wave length, the results are documented.[21]

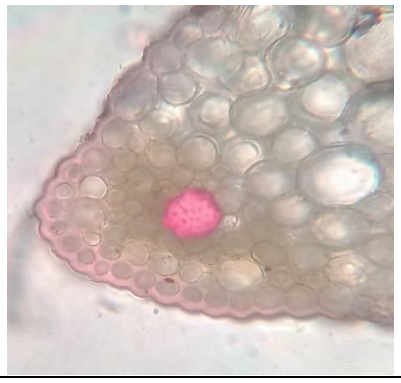
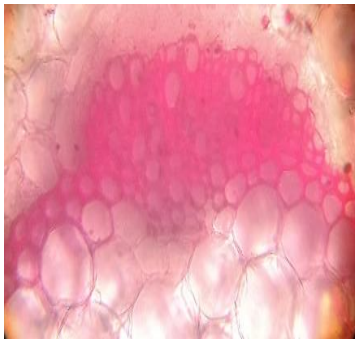
RESULT AND DISCUSSION

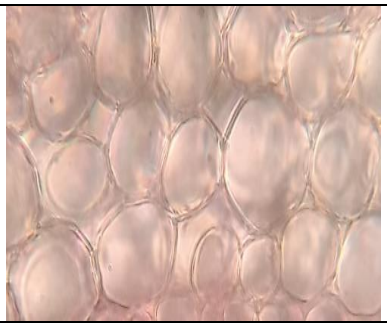
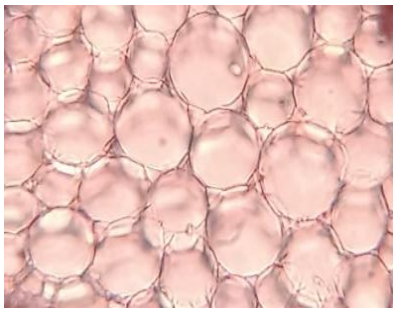
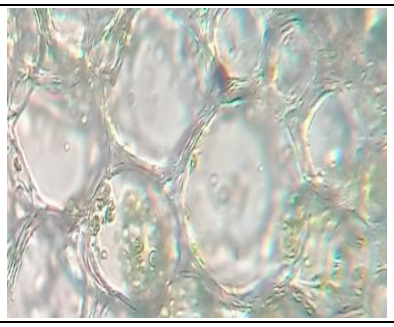
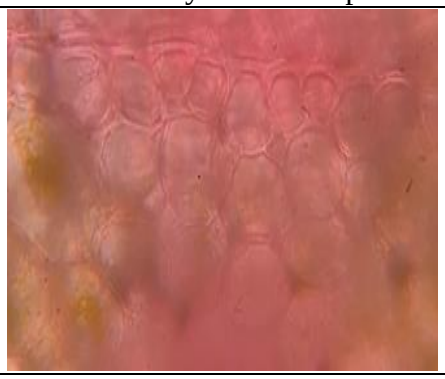
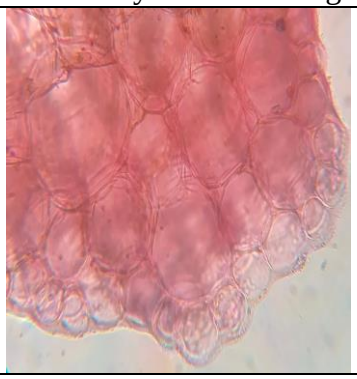
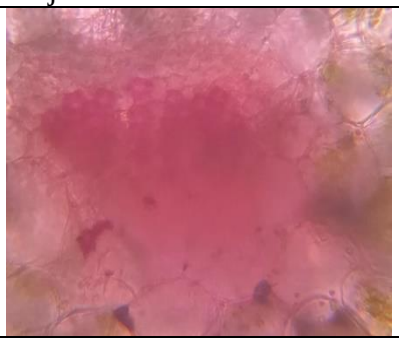
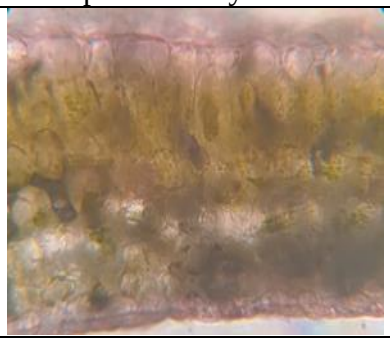
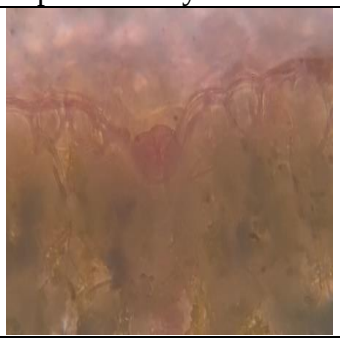
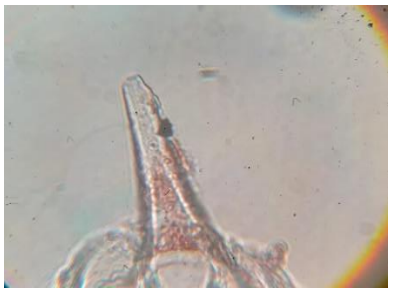
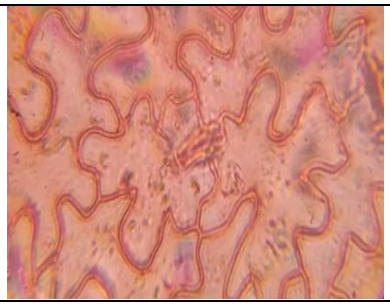
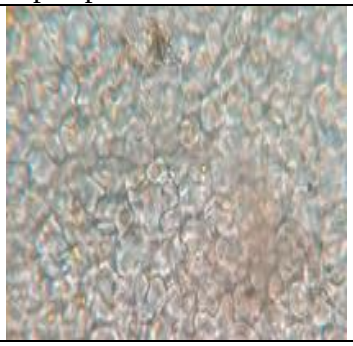
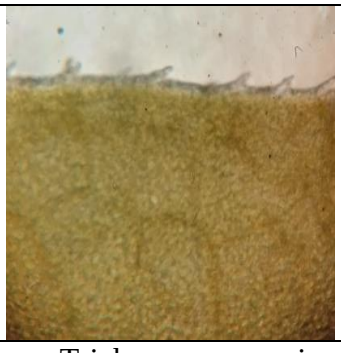
Microscopy

T S of stem: Transverse section [Figure-1.a] of stem is quadrangular in outline with light projection on two sides at centre region. Outer most layer is epidermis consists of single layer

made up of irregular sized cells covered by cuticle. On the edges of the angle there is a unicellular trichome with pointed tip. Below the epidermis at angular region there is a hypodermis made up of collenchyma cells with a prominent patch of sclerenchyma. Cortex is made of 4-5 layers of irregular sized but circular shaped parenchyma with intercellular space. Pericycle is circular in nature interspersed with 6 numbered vascular bundles. Pith is well devoloped with loosely arranged parenchyma with starch granules as cell inclusions.

VTS of leaf: Vertical transverse sections [Figure-1.j] of leaf at midrib region showed a convex shaped irregular outline at the adaxial part. Epidermis at the midrib region is covered by thick cuticle than laminar epidermis. Below the upper and above the lower epidermis there is a multi-layered collenchyma. Vascular bundle is present at the center, covered by loosely arranged parenchyma cells. At the laminar region mesophyll tissue is differentiated into elongated palisade cells followed by the multilayered spongy parenchyma. There is a glandular trichomes on the upper epidermis between the midrib and edges, there is a unicellar trichomes on the laminar edges. Epidermal peel [Figure 1.q] shows a scattered anomocytic stomata.

<table>
<tr><td>  </td><td>  </td><td>  </td></tr>
<tr><td>a. T.S of Stem</td><td>b. T.S of Stem- Portion enlarged</td><td>c. Epidermis with cortex</td></tr>
<tr><td>  </td><td>  </td><td>  </td></tr>
<tr><td>d. Portion enlarged at stem angle</td><td>e. Pericycle band</td><td>f. Enlarged pericycle band</td></tr>
</table>

		
g. Parenchyma cells at cortex	h. Parenchyma cells at pith	i. Collenchyma at stem angle
		
j. VTS of leaf at midrib	k. Epidermal layer of leaf	l. Epidermal layer at midrib
		
m. Midrib vascular bundle	n. T.S of lamina	o. Glandular trichome
		
p. Epidermal trichome	q. Epidermal peel with stomata	r. Vein islets
		
l. Palisade cells	m. Trichomes on mid rib	m. Trichome on margin

Organoleptic study: [Table 1] The Plant powder was coarse in nature, colour was light green. There was a characteristic odour and it had no taste.

Table 1: Organoleptic study.

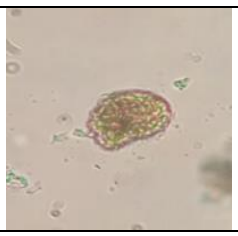
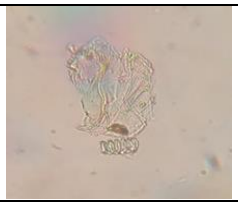
Sl. No	Parameters	Results
1	Nature	Coarse
2	Odour	Characteristic odour
3	Colour	Light green
4	Taste	Tasteless

Physico-chemical parameter:(Table-2) Foreign matter is 1.2 percent, moisture content is 3.5 percent, bulk density is 0.384 gram per cubic centimeter, ash value is 6.12 percent and specific gravity is 0.6711 gram per centimeter cube, pH is 5.9, aqueous extractive value is 1.2 percent and Ethanol extractive value is 3.98 percent.

Table 2: Physico-chemical characters.

Sl. No	Parameters	Results
1	Foreign matter	1.2%
2	Moisture	3.5%
3	Bulk density	0.384g/cc
4	Ash value	6.12%
5	Specific gravity	0.6711g/cm^3
6	P^H	5.9
7	Aqueous extraction value	1.2%
8	Ethanol extraction value	3.98%

Powder microscopy: The powder microscopy of the botanical shows vessels, epidermal cells, isolated palisade parenchyma, fragments of trichome, tracheids (Figure 2)

			
A. Vessel	B. Epidermal parenchyma	C. Chlorenchyma	D. Fibers
			
E. Trichome	F. Pitted vessel	G. Vessel	H. Tracheids

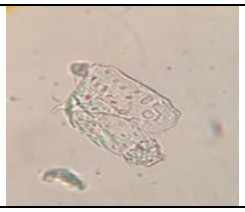
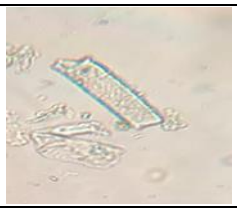
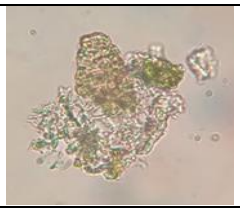
			
I. Parenchyma cell	J. Phloem	K. Fragment of vessel	L. Fragment of epidermal cell

Figure 2: Powder microscopy.

Preliminary phytochemical analysis: (Table-3) Aqueous extract of crude drug powder showed the presence of alkaloid, phytosterol, carbohydrates, saponin, flavonoid and tannins. Fixed oils and proteins were absent. Fixed oil is absent in both the case of aqueous and ethanol extracts, saponin is present in aqueous extracts only, flavonoids were present in the ethanol extract.

Table 3: Phytochemical analysis study.

Sl. No	Components	Tests	Aqueous extracts	Ethanol extracts
1	Alkaloids	Mayer	-	+
		Wagners	-	+
2	Phyto-steroids	Salkowski	-	-
		Liberman and buchard	-	-
3	Carbohydrates	Benedicts	+	+
		Molisch	+	+
4	Proteins	Biuret	+	+
		Millons	+	+
5	Fixed oil	Stain test	-	-
6	Saponins	Froath	+	-

Fluorescence analysis: Fluorescence analysis of crude powder with different chemical reagents in visible, short and long wavelength was observed. Powder as such and treated with different reagents such as distilled water, concentrated HCl, concentrated H_2SO_4, HNO_3, acetone, 5 percent Iodine, 5 percent KOH, $FeCl_3$ and NaOH are documented in table (Table-4)

Table 4: Fluorescence study with different chemical reagents in Visible and UV light.

Sl. No	Drug powder with reagent	Visible	Short wavelength(254nm)	Long wavelength(366nm)
1	Powder as such	Light green	Light green	Light green
2	Powder +Distilled water	Green	Dark green	Light green
3	Powder + Concentrated HCl	Blackish green	Blackish green	Light green

4	Powder +Concentrated H_2SO_4	Blackish	Blackish	Green
5	Powder +Concentrated HNO_3	Brown	Green	Light green
6	Powder +Acetone	Green	Dark green	Red
7	Powder +5%Iodine	Light brown	Dark green	Very light green
8	Powder +5%KOH	Light brown	Dark green	Light green
9	Powder +$FeCl_3$	Dark brown	Dark green	Light green
10	Powder +NaOH	Light green	Dark green	Light green

DISCUSSION

Stem anatomy revealed its outline having four prominent angles with two narrow elevations on opposite sides and shallow on other two opposite sides. There is a prominent sclerenchymatous circular patches at the four angle. Number of vascular bundles corresponding the four angle and two elevations. These microscopic feature help identify the species as a part of pharmacognosy parameters. Leaf microscopy showed presence of unicellular sharp pointed trichome on the leaf margin as well as on the leaf surfaces and glandular tetrahedral trichomes on the upper epidermis. Leaf epidermal peel showed anomocytic stomata. The above microscopic characters help in identification of herbal drugs as an important parameter.

Organoleptic study is a sensory test to assess the parameters of herbal powder. Physicochemical parameter helps to authenticate the quality of herbal drugs. Ash values specific gravity, bulk density, extractive values and P^H values. Foreign matter and moisture content values help to storage of herbal drugs. Powder microscopy is used to check the quality of herbal drugs in powder form. It helps to study the specific characters, type of epidermal trichomes, vessel thickenings and fibers and so on. Fluorescence analysis of herbal drugs as such and treated with nine other reagents including distilled water under visible, short and long wave length. Powder as such showed no difference in colour under visible, short and long wave length. With distilled water under short wave length is dark green in colour. It is blackish when treated with Conc.HCl under visible and short wave length and light green under long wave length. Crude drug powder with Conc.H_2SO_4 is blackish under visible and short wavelength and green in Long wave length. With Conc.HNO_3 under visible light is brown, under short wavelength is green and under long wave length is light green. Herbal powder with acetone showed significant colour indication under visible light it is green, under short wavelength is dark green and under long wave length it is red. Powder with 5% Iodine and 5% KOH under visible light is light brown, under short wave length dark

green and under Long wave length light green but very light in case of 5% KOH. With FECL3 dark brown, dark green, light green respectively under visible and long wave length, with NaoH light green under Visible, dark green under short wave length.

CONCLUSION

The present study provides essential pharmacognostical data for *Torenia crustacea*, including microscopic characteristics, physicochemical parameters, and phytochemical profile. These parameters can serve as a reference for the identification, authentication, and quality control of this medicinal plant. The study also highlights the presence of bioactive constituents that support its traditional uses. Further advanced phytochemical and pharmacological studies are required to explore its full therapeutic potential.

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