IJBPAS, April, 2024, 13(4): 1675-1688

ISSN: 2277–4998

International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

MORPHOLOGICAL AND MACROSCOPICAL CHARACTERISTICS OF *XANTHIUM INDICUM* AERIAL PARTS

THIRUMAL M*, KUMAR P R, MONIKA S AND ROHIL S S

Department of Pharmacognosy, SRM College of Pharmacy, SRMIST, Kattankulathur, Chengalpet district, 603203.

***Corresponding Author: Dr. Thirumal M: E Mail: thirumam@srmist.edu.in**

Received 14th April 2023; Revised 15th May 2023; Accepted 8th Aug. 2023; Available online 1st April 2024

https://doi.org/10.31032/IJBPAS/2024/13.4.7926

ABSTRACT

Background

Plants have played an important role as a source of useful compounds to mankind. *Xanthium Indicum Koenig* of Asteraceae (compositae) family is known as Maruloomatham in south India.

Objective

The study's objective is to analyse the Pharmacognostical standards of the aerial parts of *Xanthium indicum.*

Methods and Materials

The plant was chosen and extracted by Maceration method. The extraction was processed using the following solvents such as Petroleum ether, Chloroform, ethyl acetate, and ethanol. Ash value, extractive value, loss on drying and phytochemical screening were performed for *xanthium indicum* plant.

Results

Leaves are long, broadly triangular-ovate or sub orbicular, hispid on both surfaces. Flower heads numerous, white or green, in terminal and axillary racemes; male heads are globes. The root is circular with minute fissures. Seeds are present in fruit with a hard and tenacious prickly cover.

Conclusion

The latest findings may be a valuable resource for knowledge and could offer appropriate standards for identifying this plant material in upcoming research and application.

Keywords: *Xanthium indicum*, Compositae, Maruloomatham, Pharmacognostical study, Microscropy

INTRODUCTION

Xanthium Indicum Koenig of Asteraceae (Compositae) family is known as Maruloomatham in south India. It is used traditionally as diaphoretic, emollient and diuretic with astringent and anti-syphilitic properties. Chinese medicine uses the dried seeds and leaves of this plant as a raw material. Additionally, yellow staphylococcus, dysentery bacillus, and typhoid bacillus are known to be resistant to it's antibacterial actions. The leaves are said to lower blood sugar levels, and the roots can be used to treat hypothyroidism, create robustness, and prevent tumour growth. It can be usually found along the city side, rice fields, fence {Formatting Citation}. Very naturally it called Chota gokhru because it looks like cow's toe. It is also called as adhasisi, due to its treatment in curing hemicrania. *Xanthium indicum* is widely cultivated as a greeny vegetable in China **[1-3]**. In Assam the lower leaf and floral tops are boiled in water and are used as edible plant. Generally, the fruit is suspected as a toxic and the herb is also poisonous, so they are washed thoroughly and used for cooking **[4]**. Some animals eat sufficient of those young plants and die. In western culture *Xanthium indicum* is defined as a toxic plant for animals **[5]**. It is also considered to watch cattle loss and loss of horses, goats, pigs and sheep. It also helps in diminishing weight gained in poultry **[6-9]**. The main aim of this research is to identify and evaluate the Pharmacognostical and phytochemical characters of *Xanthium indicum* aerial parts.

Figure 1: *Xanthium indicum* Plant

MATERIALS AND METHODS

Collection and identification

Aerial parts of the *Xanthium Indicum* (Asteraceae), were obtained from Tirunelveli, Tamilnadu, India. The sample was taxonomically identified by Prof. Chelladurai, Director, Botanical research Centre, Tirunelveli, Tamilnadu, India. The plant was collected from Thirukazhukundram, Chengalpet district and the T.S was performed under Prof. Jayaraman, Plant Anatomy Research Centre, Tambaram, Tamil Nadu.

Pharmacognostical study

Sectioning and mounting

Microtome is used to embed paraffin. 10-12µm will be its thickness. The primary procedure is Dewaxing. Toluidine blue is used as a staining agent. The sections will be stained with toluidine blue[10]. The obtained stain will be correct because it has a polychromatic stain. The following is the colour and parts stained.

Macroscopy

External features of the sample were photographed using NIKON COOLPIX 5400 digital camera.

Microscopy

Samples were left in fixative solution FAA (Formalin-5ml + Acetic acid-5ml + 70% Ethyl alcohol-90ml) for more than 48 hours. A sharp blade was used to slice the preserved specimens into thin transverse pieces, and the sections were then dyed with safranin **[11]**. Under bright field lighting, transverse slices were captured on camera using a Zeiss Axio Cam Erc5s digital camera and a Nikon ECLIPSE E200 trinocular microscope. The scale-bars show the growths of the figures.

Powder microscopy

A drop of 50% glycerol in water was used to mount a pinch of the powdered sample on a microscopic slide. Characters were examined under bright field light with a Nikon ECLIPSE E200 trinocular microscope attached to a Zeiss ERc5s digital camera. Diagnostic characteristics were photographed and recorded as photomicrographs. The scale-bars serve as an indicator of the figures' magnifications.

Physico-chemial analysis

Ash value

Ash values are important parameters for evaluating the efficacy and purity of herbal medications. Total ash values were calculated by gradually heating the powdered sample between 100°C and 200°C until it turned white. The resulting powder was then dried and weighed **[12]**. Acid insoluble ash values was calculated by dissolving a part of the total ash in Conc. HCL, collecting the solution, washing it on filter paper, cooling it in a desiccator, and weighing it. Water soluble ash was also determined similarly.

Extractive values

5g of sample were macerated with various polarity solvents and agitated on an orbital shaker for 8 hours to obtain the extractive values. Filter, dried-off, and weighed extracts were used **[13]**.

Loss of drying

The values were determined by drying the material (10 g) in a moisture content balance and set temperature between 85–100°C. Drying was maintained till there was no difference between the two subsequent weight readings of more than 5 mg **[14]**.

Preliminary phytochemical screening

The five different extracts were subjected to a preliminary phytochemical study **[15]**. The leaf extracts are Petroleum ether, Chloroform, Ethyl acetate, and ethanol of *Xanthium indicum* were performed for the presence of different chemical components per the standard procedure.

RESULTS AND DISCUSSION

Morphological characters

An erect, unarmed annual herb is *Xanthium indicum*. Leaves are long, broadly triangular-ovate or sub orbicular, hispid on both surfaces. Apex acute irregularly serrate, base is cordate or cuneate. Flower heads numerous, white or green, in terminal and axillary racemes; male heads are globes; female heads are ovoid, covered with hooked bristles. The root is circular with minute fissures. • Seeds are present in fruit with a hard and tenacious prickly cover.

Macroscopy (Figure 2)

Fruit: Obovoid dark brown achenes measure about 1.3 to 3.5 mm long, green, turning yellow and then brown, enclosed in the hardened involucre, with two hooked beaks and entire surface covered by hooked bristles with characteristic taste and odour

Root: Rootstock shows a long taproot with many secondary roots arising from the crown, dark brown with characteristic odour and taste.

Stem: Stem stout, round or slightly ribbed, terete and rough with short, spiny hairs; often speckled; greenish- brown in colour with characteristic odour and taste.

Fruit Root Stem

Figure 2: Macroscopy of fruit, root and stem

Microscopical characters

Anatomy of leaf

The leaf consists of thick midrib and dorsiventral lamina. The midrib has a dorsal hump and thick lobed abaxial midrib. The vascular system of the midrib includes four independent bundles that are placed with the abaxial part, lateral parts and adaxial parts. The inner xylem and outer phloem of the vascular bundles are thick and collateral. The xylem components are lignified, circular tubes with thick walls. The proto xylem components

are pointed in the centre. The 40µm broad Meta xylem elements. On the outside of the xylem strand are the phloem components.

Lamina

The lamina has slightly undulated surfaces due to shallow ridges and furrows. The abaxial epidermis has small angular thin-walled cells. The mesophyll tissue includes an adaxial layer of simple, thick simple palisade cells. The spongy parenchyma cells are four layered; the cells are wide, circular and less compact. The lamina is 250µm thick

Leaf margin

The lamina's margins are slightly conical and thin. The epidermal cells have an angular shape and slightly thick wall. Differentiation between palisade and mesophyll is not clear.

Crystal distribution

The mesophyll tissue of the lamina frequently contains calcium oxalate crystals. Druses, round bodies with a spiky surface that make up the crystals, are present. The druses are lone and widely separated **(Figure 3)**.

Root

There are layers of cork made up of 3 to 4 layers of thick-walled cells followed by cortex composed of 10 to15 layers of parenchyma cells forming cortex; secondary growth normal; vessels either solitary or in rows of 2 to 3; rays mostly multiseriate, bi or uniseriate; xylem composed of vessels, parenchyma and bulk of fibre **(Figure 4)**.

Stem

TS of stem is roughly circular in outline; epidermis is single- layered made of isodiametric parenchymatous cells; covered with cuticle; covering trichomes present; hypodermis collenchymatous made up of 4 to 5 layers of cells; cortex is formed of 5 to 6 layers of parenchymatous cells; endodermis not distinct; pericycle sclerenchymatous, opposite to the vascular bundles; vascular bundles conjoint, collateral, open, arranged in a ring, widely separated from each other or closely placed; series of ray cells are seen between vessels; xylem consists of vessels, tracheids, parenchyma, and fibers; pith large, parenchymatous with numerous small rosette crystals **(Figure 5)**.

Fruit

TS of fruit shows thick pericarp differentiated into three regions – epicarp, mesocarp and endocarp; epicarp is made up of uniseriately compactly arranged, thick-walled, cells with numerous glandular, non-glandular and multicellular trichomes; inner to the epicarp mesocarp is present, divided into outer mesocarp made up of irregular, compactly arranged thick-walled sclerenchyma cells and inner mesocarp is made up of elongated thick-

walled sclerenchyma cells; endocarp is made up of 5 to 6 layers of cells **(Figure 6)**.

Powder microscopy

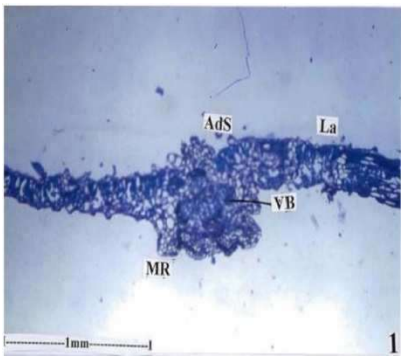
Powders are greenish-brown in color with a characteristic taste and odour. The powder microscopic characterization of the *X. indicum* stem showed the presence of thin-walled cortical parenchyma cells, fragment of vascular region showing xylem, cambium and phloem, longitudinally cut fragments of vessels with spiral and reticulate thickenings, bordered pitted vessels, pieces of thick-walled fibre from endocarp, thick and thin-walled fiber bundles, longitudinally cut phloem bundles with abundant rosette crystals **(Figure 7)**.

Physicochemical parameter

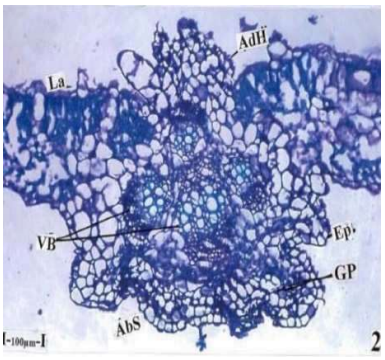
Physicochemical analysis of leaf powder was subjected to Loss on drying, ash value, and extractive value are presented in **Table 1**.

Preliminary phytochemical screening of various extracts of aerial parts of *xanthium indicum*

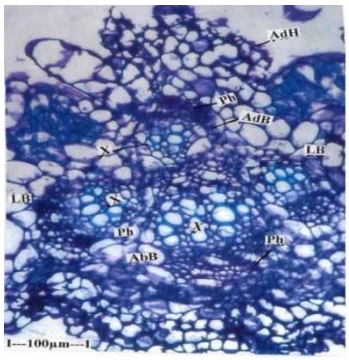
The extracts were subjected to qualitative analysis of the leaf of various extracts of aerial parts of *xanthium indicum* for the identification of phytochemical constituents such as Carbohydrate, Glycosides, Alkaloids, Proteins and amino acid, Phytosterols, Fixed oil and fats, Phenolic compounds, Tannins, Gums and mucilage and, Saponins **(Table 2)**.



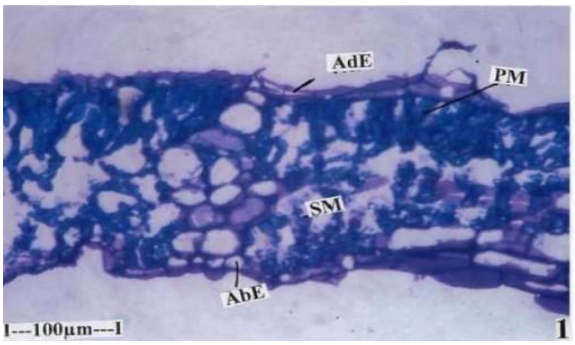
a) T. S of leaf through midrib



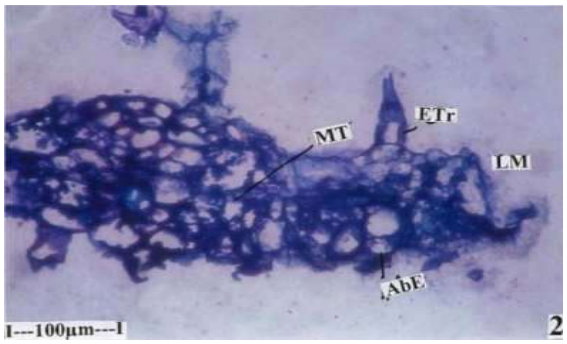
b) T. S of midrib enlarged



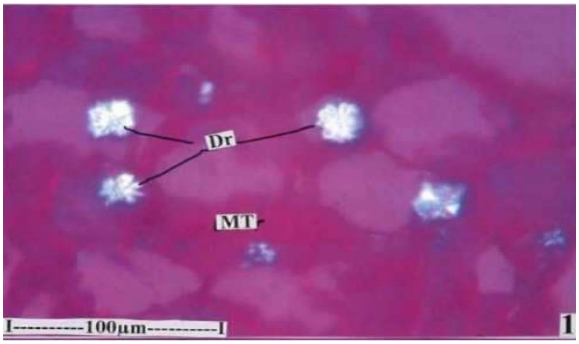
c) T. S of midrib-enlarged



d) T.S of lamina



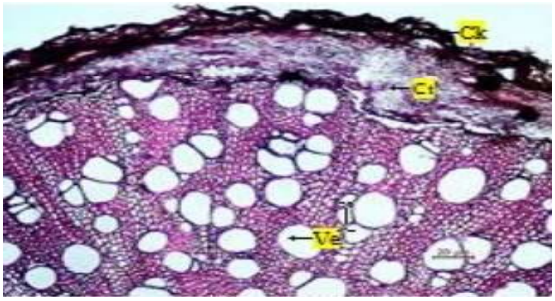
e) T. S of leaf margin



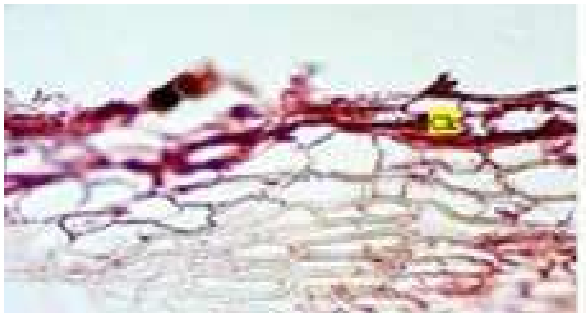
f) Crystal distribution in the leaf

AdS: Adaxial side La: Lamina VB: Vascular Bundles MR: Midrib; LA: Lamina AdH: Adaxial Hump VB: Vascular Bundles EP: Epidermis GP: Ground Parenchyma Abs: Abaxial side; AdH: Adaxial Hump AdB: Adaxial Bundle AbB: Abaxial Bundle LB: Lateral Bundle Ph: Phloem X: Xylem ; AdE: Adaxial Epidermis PM: Palisade Mesophyll SM: Spongy Mesophyll AbE: Abaxial Epidermis; MT: Mesophyll Tissue ETr: Epidermal Trichome LM: Leaf Margin AbE: Abaxial Epidermis; Druses Crystals in the Mesophyll Dr: Druses MT: Mesophyll Tissue; Single Druse – Enlarged Dr: Druses

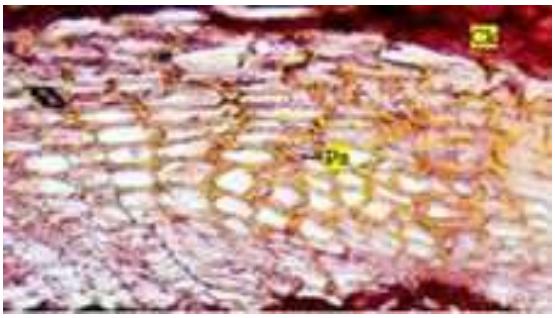
Figure 3: T.S of *Xanthium indicum* leaf



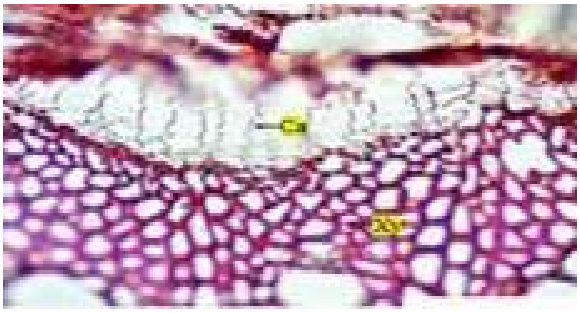
a) T.S of bark



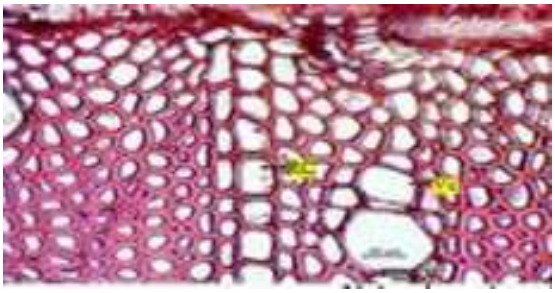
b) Outer bark region



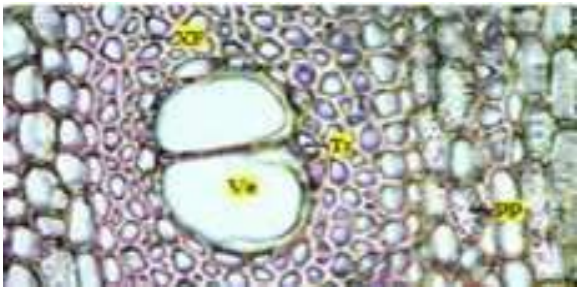
c) Cortex



d) Outer bark region cortex



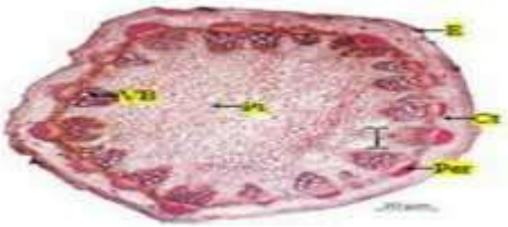
e) Xylem vesels



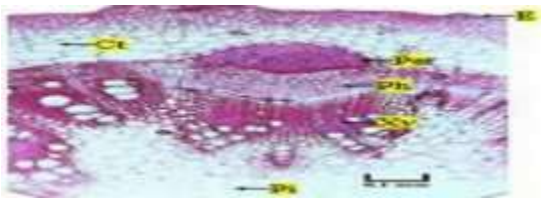
f) Xylem parenchyma

Ca- cambium, Ck- cork, Ct- cortex, Pa- parenchyma, PP- Pitted parenchyma, RC- Ray cells SG- Starch grains, Tr- Tracheid, VB- Vascular bundle, Ve- vessel, XF- Xylem fibre, XP- Xylem parenchyma

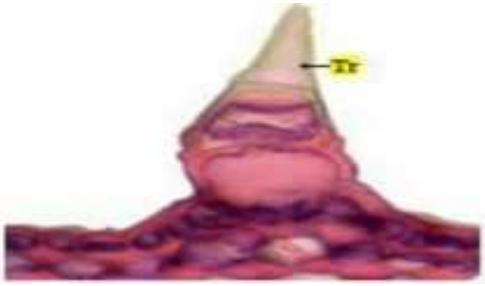
Figure 4: T.S of *Xanthium indicum* root



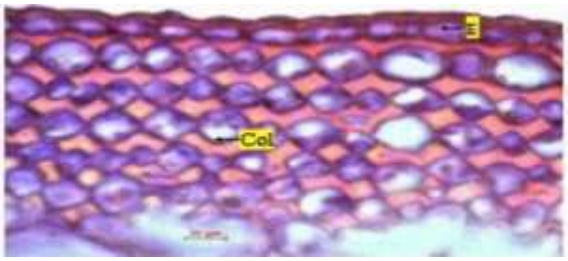
a) T S of stem



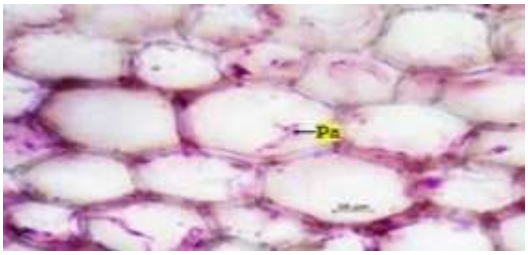
b) T S of stem enlarged



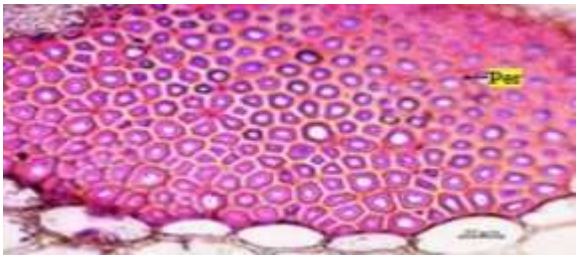
c) Trichome



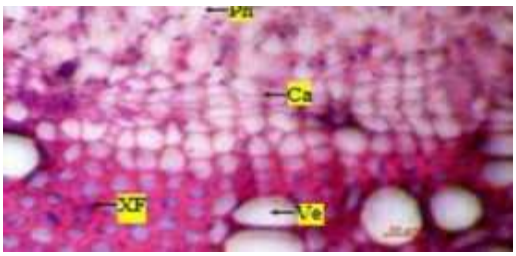
d) Upper portion



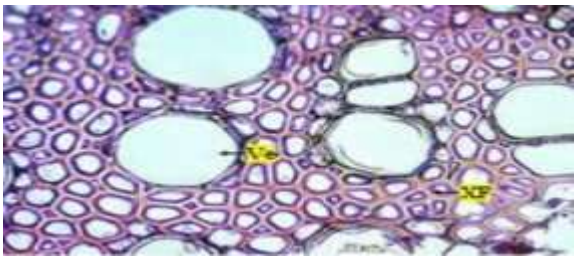
e) Cortex



f) Pericycle



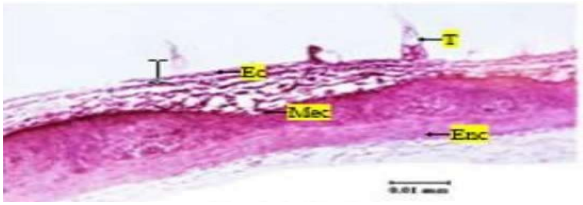
g) Vascular region



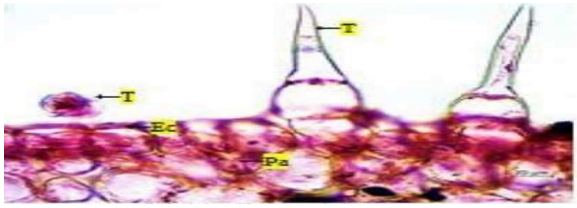
h)Vessels

Ck- Cork, Col- Collenchyma, Ct- Cortex, Pa- Parenchyma, Per- Pericycle, Ph-Phloem, Pi- Pith, RCr- Rosette crystals, T- Trichome, VB- Vascular bundle, Ve- vessel, XF-Xylem fibre

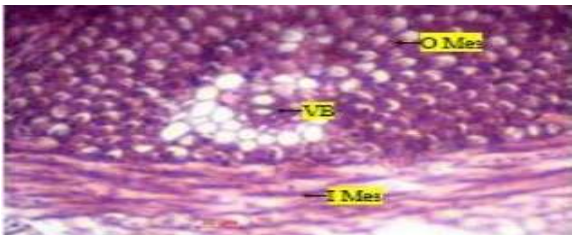
Figure 5: T.S of *Xanthium indicum* stem



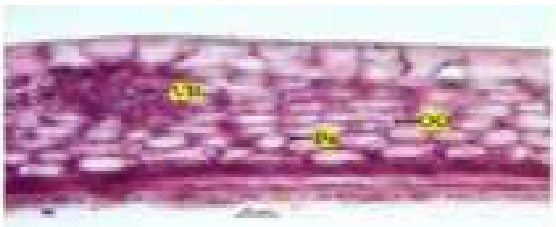
a) T S of fruit wall



b) Multicellular trichomes



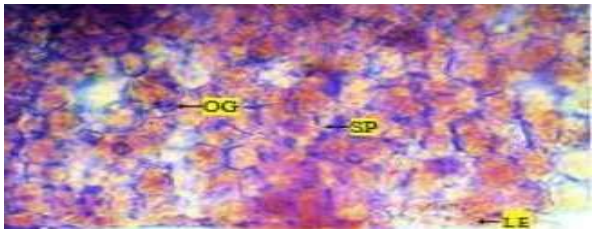
c) Mesocarp



d) Endocarp

e) Testa

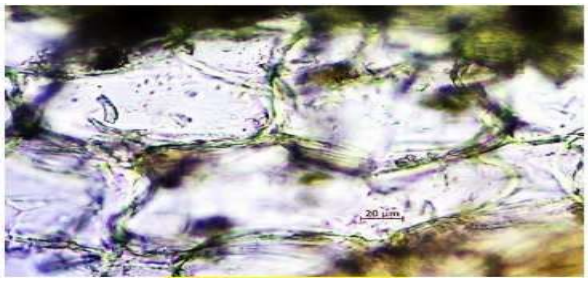
f) Cotyledon upper region palisade cells



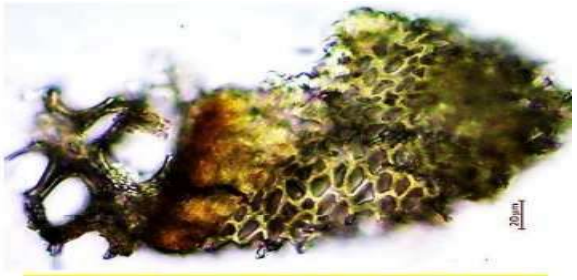
g) Cotyledon upper region spony cells

AG- aleurone grains, Enc- Endocarp, Ens- Endosperm, Ec- Epicarp, EEpidermis, I Mes- Inner mesocarp, LE- Lower epidermis, Me- Mesophyll, OG- Oil globule, O Mes- Outer Mesocarp, Pa- Parenchyma, Pal- Palisade, SP- Spongy parenchyma, SC- Stone cells, SG- Starch grains, UE- Upper Epidermis, VB- Vascular bundle, T- Trichome

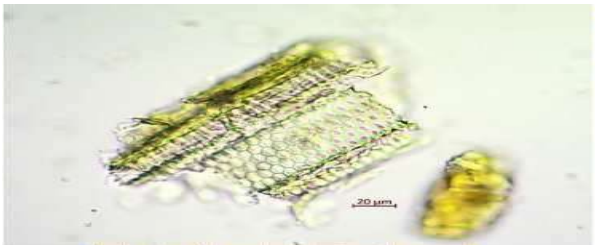
Figure 6: T.S of *Xanthium indicum* fruit



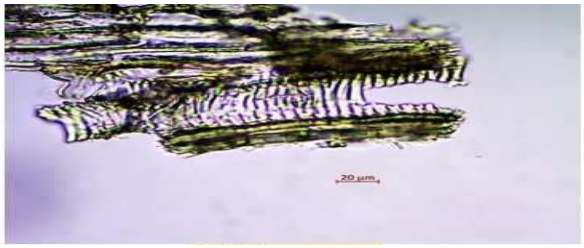
a) Cortical parenchyma



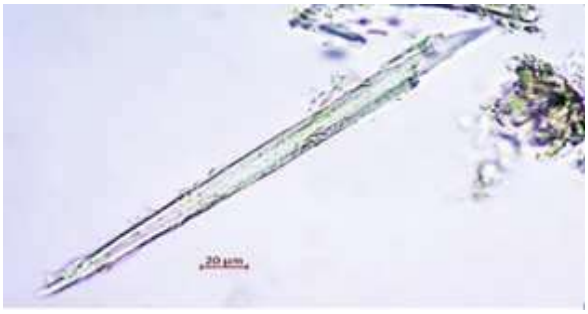
b) Vascular fragment with xylem, cambium and phloem



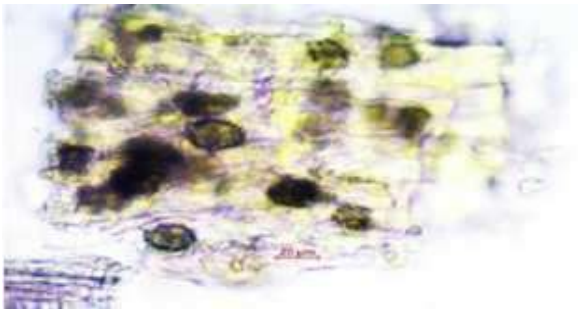
c) Spiral and bordered pitted vessels



d) Reticulate vessel

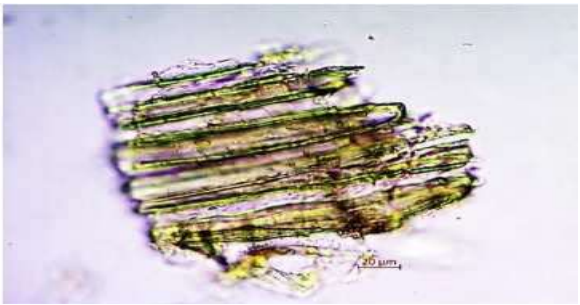


e) Fiber



f) Rosette crystals

g) Thick walled fibre bundles from endocarp



h) Thin walled fibre bundles

Figure 7: powder microscopy of *Xanthium indicum* fruit

Table 1: Physicochemical parameters of the leaf of *Xanthium indicum*

S. No.	Parameters	Values% w/w
1.	Ash values	
1.1	Total ash	7.43
1.2	Acid insoluble ash	3.67
1.3	Water soluble ash	7.24
2.	Extractive values	
2.1	Pet ether	1.55
2.2	Chloroform	1.09
2.3	Ethyl acetate	1.59
2.4	Ethanol	1.69
3.	Loss on drying	9.06

Table 2: Phytochemical screening of various extracts of aerial parts of *xanthium indicum*

S. No.	Test	Pet Ether	Chloroform	Ethyl acetate	Ethanol
1	Carbohydrate	-	+	-	+
2	Glycosides	-	+	-	-
3	Alkaloids	-	+	-	+
4	Proteins & amino acid	-	-	-	+
5	Phytosterols	+	-	+	-
6	Fixed oil and fats	+	-	+	+
7	Phenolic compounds	-	-	-	+
8	Tannins	-	-	+	-
9	Gums and Mucilage	-	-	-	-
10	Saponins	+	+	+	+

CONCLUSION

Xanthium Indicum, an Indian medicinal plant, was taken for this study. Though it has been already used for various types of diseases like urinary infection, parasitic infection and bacterial infection, it can be treated for cancer as well. In this study, the discussion is made about the pharmacognostical and phytochemical using the aerial parts of the plant. The Pharmacognostical part of the research can be widely used for the determination of the crude drug from the plant. The qualitative study or physiochemical analysis was performed and potentiality of the drug was noted. The latest findings may be a valuable resource for knowledge and could offer appropriate standards for identifying this plant material in upcoming research and application.

CONFLICT OF INTEREST

The authors have no conflict of interest.

ACKNOWLWDGEMENT

The authors would like to thsnk Prof. Jayaraman, Plant Anatomy Research Centre, for their kind support during macroscopical and microscopical studies.

REFERENCES

[1] S. V. Thite, B. A. Kore, M. Camacho-Tapia, and J. M. Tovar-Pedraza, “First report of Podosphaera xanthii causing powdery mildew on Xanthium

strumarium in India," *J. Plant Pathol.*, vol. 100, no. 1, pp. 129–129, Apr. 2018, doi: 10.1007/s42161-018-0019-9.

[2] A. Singh and I. Kaliappan, "Role of medicinal plants and their chemical constituents in ameliorating the cause for non-alcoholic fatty liver disorder—A review," *J. Appl. Pharm. Sci.*, pp. 43–55, Jun. 2022, doi: 10.7324/JAPS.2022.120605.

[3] S. S. Rohil and P. R. Kumar, "Xanthium indicum Koenig-A Review," *Res. J. Pharm. Technol.*, vol. 13, no. 5, p. 2475, 2020, doi: 10.5958/0974-360X.2020.00442.4.

[4] C. RN., "Glossary of Indian medicinal," 1956.

[5] D. S., "Safety issues affecting Chinese herbs: The case of Xanthium.," *ITM*, 2002.

[6] D. L. Martin T, Stair EL, "Cocklebur poisoning in cattle.," *J. Am. Vet. Med. Assoc.*, vol. 189, no. 5, pp. 562–3, 1986.

[7] O. F. Oelkers S, "Cocklebur poisoning in swine [Xanthium spinosum].," *Bov. Pract.*, vol. 3, no. 2, pp. 11–14, 1982.

[8] E. W. Burrows GE, Tyrl RJ, Rollins D, Thedford TR, Mcmurphy W, "Toxic plants of Oklahoma and the Southern Plains. Stillwater: Oklahoma State University;," *Circ. E - Oklahoma State Univ. Coop. Ext. Serv.*, 1991.

[9] N. Vyas and A. Argal, "Antiurolithiatic Activity of Extract and Oleanolic Acid Isolated from the Roots of Lantana camara on Zinc Disc Implantation Induced Urolithiasis," *ISRN Pharmacol.*, vol. 2013, pp. 1–5, May 2013, doi: 10.1155/2013/951795.

[10] D. B. McMillan and R. J. Harris, "Introduction," in *An Atlas of Comparative Vertebrate Histology*, Elsevier, 2018, pp. ix–xxix. doi: 10.1016/B978-0-12-410424-2.00018-4.

[11] T. M. Jasiem, "Isolation of terpene and pharmacognostical study of iraqi caper shrubs (Capparis spinosa) L.," *Res. J. Pharm. Technol.*, vol. 11, no. 6, p. 2388, 2018, doi: 10.5958/0974-360X.2018.00441.9.

[12] V. G. Vaidya, "The Seasonal Cycles of Ash, Carbohydrate and Nitrogenous Constituents in the Terminal Shoots of Apple Trees and the Effects of Five Vegetatively Propagated Rootstocks on Them I.

Total Ash and Ash Constituents," *J. Pomol. Hortic. Sci.*, vol. 16, no. 2, pp. 1–126, Jan. 1939, doi: 10.1080/03683621.1939.11513509.

[13] A. J. Arawande JO, Akinnusotu A, "Extractive value and phytochemical screening of ginger (Zingiber officinale) and turmeric (Curcuma longa) using different solvents.," *Int. J. Tradit. Nat. Med.*, vol. 8, no. 1, pp. 13–22, 2018.

[14] K. A. Razvi SZ, Kamm I, Nguyen T, Pellett JD, "Loss on Drying Using Halogen Moisture Analyzer: An Orthogonal Technique for Monitoring Volatile Content for In-Process Control Samples during Pharmaceutical Manufacturing.," *Org. Process Res. Dev.*, vol. 25, no. 2, pp. 300–7, 2021.

[15] S. Selvakumar, S. Gangatharan, and M. R. K. Rao, "Preliminary Phytochemical Screening of Root Extracts of Crossandra infundibuliformis .," *Res. J. Pharm. Technol.*, vol. 9, no. 2, p. 131, 2016, doi: 10.5958/0974-360X.2016.00021.4.