JPharmSci
Journal of Pharmaceutical Sciences
Open access peer-reviewed Journal
www.jpharmsci.com [ISSN: 1520-6017]
Scopus ELSEVIER

Pharmacognostical Characterization and Phytochemical Profiling of *Canna Indica* L. (Cannaceae)

Megavarthini R.[1*], Maheswari V.[2], Ravikkumar V. R.[3]

[1]PG Scholar, Department of pharmacognosy, The Erode College of pharmacy, Erode. The Tamil Nadu Dr. M. G. R. Medical University, Chennai.
[2]Assistant Professor, Department of pharmacognosy, The Erode College of pharmacy, Erode. The Tamil Nadu Dr. M. G. R. Medical University, Chennai.
[3]Professor and Head, Department of pharmacognosy, The Erode College of pharmacy, Erode. The Tamil Nadu Dr. M. G. R. Medical University, Chennai.

ABSTRACT

Adulteration or substitution of lower-quality herbal components frequently reduces their medicinal effectiveness and safety. Thus, establishing pharmacognostical and phytochemical criteria is critical for ensuring the legitimacy and reproducibility of herbal medications. The current work focusses on the pharmacognostic and phytochemical examination of Canna indica L. flower, a medicinal plant with antioxidant and anti-inflammatory characteristics. Diagnostic traits revealed by macroscopic and microscopic research include bright red zygomorphic flowers, dorsiventral sepals and petals, a bilobed, bissporangiate anther with two pollen sacs, and a trilocular ovary with ovules linked to the central axis. Powder microscopy revealed portions of the corolla epidermis with anomocytic stomata, pedicel epidermis with thick-walled cells, spiral vessels, calcium oxalate crystals, and pollen grains. Histochemical study revealed the presence of alkaloids and phenolic chemicals in the corolla. Physicochemical parameters were within pharmacopoeial limits, and heavy metals were below detectable levels, indicating safety. Ethanolic extraction via maceration produced a reddish-brown extract high in phytoconstituents. Preliminary and quantitative phytochemical investigations identified alkaloids, flavonoids, tannins, phenolics, terpenoids, steroids, and saponins, whereas TLC revealed unique Rf values, confirming several ingredients. These studies offer thorough quality requirements for Canna indica L. flower, which validate its authenticity and therapeutic efficacy.

Keywords: Canna indica L., Pharmacognostical, Phyto-Chemicals, Herbal Medicine, EECI.

INTRODUCTION

"Herbal medicine is a true gift from nature, providing safe and effective treatments for human health. Plants have long been used to treat illness and promote well-being, and even today, herbal remedies are essential for preserving overall health and illness prevention" [1].Herbal remedies have been used throughout history, dating back to ancient times. Herbs have been utilized in ancient Chinese, Greek, Egyptian, and Indian medicine for a variety of ailments. As a result, in recent years, there has been a dramatic increase in the number of drugs being standardized before they are used. Proper identification and quality control of the raw material are critical preconditions for ensuring the consistent quality of herbal medication, which will improve its safety and effectiveness. Standardized techniques involving step-by-step pharmacognostical and phytochemical investigations can be used to accurately identify and verify plant material [2].

Canna indica L., also known as "Kal vazhai" in Tamil, is a member of the Cannaceae family and the Canna genus. Other names for it include African arrowroot, Canna lily, Canna Indian shot, and Wild canna [3].

Canna indica is native to most of South America, Central America, the West Indies, and Mexico. It has also naturalized in other regions, including the

Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

southeastern United States (Florida, Texas, Louisiana, and South Carolina), Europe, Sub-Saharan Africa, Southeast Asia, and Oceania [4]. For thousands of years, indigenous peoples in the Americas cultivated *Canna indica* as a minor food crop [5, 6]. The plant cannot thrive in shaded areas and requires a moist soil climate for optimal growth [7, 8].

Canna indica flowers are bright red, which is due to the presence of flavonoids, phenols, and anthocyanin's. They also include many carotenoids such as lutein, β-carotene, violaxanthin, zeaxanthin, and β-cryptoxanthin [9, 10]. These phytochemicals contribute to the plant's bright colors and therapeutic capabilities.

Canna indica flowers have traditionally been utilized for a variety of ethno medicinal applications. They are known to treat eye problems, wounds, and inflammation because of their calming effects. Decoctions made from the plant are used to treat fevers and mild ailments. The blossoms are also used to treat diarrhea and stomach pain and as a diuretic for urinary difficulties. Poultices produced from flowers are used to alleviate swelling and joint pain. Canna indica is also used in folk medicine to control menstrual cycles and relieve pains [9].



Figure 1: *Canna indica* L.

MATERIAL & METHODS:

Collection, Identification & Preparation of Plant Materials:

In May 2025, *Canna indica* flowers were collected from Thalavaipettai village in Erode district, Tamil Nadu. Dr. K. N. Sunil Kumar, Research Officer and Head of the Department of Pharmacognosy, Central Council for Research in Siddha, Chennai, Ministry of AYUSH, Government of India, identified and authenticated the botanical material (C07042501I). The *Canna indica* flowers were properly cleaned after collecting, shade-dried at room temperature to a consistent weight, then ground into a coarse powder. The powdered substance was stored in airtight containers for later use in pharmacognostic and phytochemical studies.

Chemicals, Reagents & Solvents:

All chemicals, solvents and reagents used were of analytical grade.

Pharmacognostical Studies:

Macroscopical Evaluation:

Organoleptic characters like colour, odour, taste and nature are studied. Morphological characters such as size, shape, surface, fracture and thickness were observed for the determination of safety, efficacy and purity of crude drugs. External feature of test sample was documented using Nikon D-5600 Digital camera [11].

Microscopical Evaluation:

The sample was kept in fixative FAA for longer than 48 hours. The preserved specimens were cut into thin transverse section using a sharp blade and the sections were stained with 0.8% Safranin and 0.5% Astra blue. Transverse sections were photographed using Axiolab5 trinocular microscope attached with Zeiss Axiocam208 colour digital camera under bright field light. Magnifications were indicated by scale bar.

Powder Microscopy:

For powder microscopy, the sample was dried completely in the shade and macerated. A small amount of the powdered sample was mounted on a microscopic slide with a drop of 50% glycerol after being cleared with a saturated solution of chloral hydrate. The diagnostic characters were observed

using a Nikon ECLIPSE E200 trinocular microscope attached to a Zeiss ERc5s digital camera under field light. Photomicrographs were captured and documented for reference.

Histochemical Evaluation:

In histochemical evaluation, reagents are added to plant samples to identify specific cell components by their color reactions. A drop of reagent is placed on one edge of the cover-glass, and a strip of filter paper on the opposite edge draws the reagent across the specimen for even staining. Lignified cell walls stain pink to cherry red with phloroglucinol and HCl, while suberized or cuticular walls appear orange-red with Sudan III. Aleurone grains turn brown with iodine reagents. Calcium carbonate dissolves with effervescence in acids, whereas calcium oxalate dissolves in HCl without effervescence. Fats and oils stain red with Sudan III, starch gives a blue color with iodine, tannins turn bluish-black with ferric chloride, mucilage stains red with ruthenium red, and polyphenols produce a bluish-green color with toluidine blue [12].

Physico-Chemical Studies:

The shade dried powdered flower of *Canna indica* was used for analysis parameters which is useful parameters in the determination of quality and purity of crude drugs. Total ash, extractive values, loss on drying, foaming index, swelling index and foreign organic matters determined as per the standard WHO guidelines.

Determination of Ash Values:

Total Ash:

Silica crucible was heated to red hot for 30 minutes and it was allowed to cool in desiccators. About 2g of powdered sample was weighted accurately and evenly distributed in the crucible. Dried at 100-105℃ for 1 hour and ignited to constant weight in a muffle furnace at 600±25℃. The crucible was allowed to cool in a desiccator. The percentage yield of ash with reference to the air-dried substance was calculated by the formula.

Percentage of ash value = (weight of total ash/ weight of drug taken) x 100

Water Soluble Ash:

The total ash was boiled for 5 minutes with 25ml of water. The insoluble matter was then collected in an ash less filter paper. It was washed with hot water and ignited for 15 minutes at 450℃. The weight of the insoluble matter represented the water soluble was calculated with reference to the dried material.

Percentage of water-soluble ash = (weight of residue obtained/ weight of sample taken) x 100

Acid Insoluble Ash:

To the total ash add 25ml of dilute HCl was added, covered with a watch glass and boiled gently for 5 minutes. The watch glass was rinsed with 5ml of hot water and these washings were added to the crucible. The insoluble matter was collected on an ash less filter paper by filtration and the filter paper rinsed repeatedly with hot water until the filtrate is neutral and free from acid. Filter paper containing the insoluble matter was transferred to the crucible, dried on a hot plate and ignited to a constant weight in a muffle furnace at 400-500℃. The silica crucible was removed from the muffle furnace and allowed to cool in desiccators for 30 minutes and then weighed without delay. The content of acid insoluble ash was calculated.

Percentage of acid insoluble ash = (weight of residue obtained/ weight of sample taken) x 100

Sulphated Ash:

The determination of the sulphated ash value involves a systematic procedure. Initially, a known amount of the sample, typically ranging from 1 to 2 grams, is accurately weighed and placed into a crucible. To moisten the sample, a few drops of concentrated sulfuric acid are added. The crucible is then placed in a muffle furnace and incinerated at a temperature of approximately 600 ± 25 °C for around 30 minutes or until the sample becomes white or nearly white, indicating complete combustion. If necessary, the addition of sulfuric acid and subsequent ignition can be repeated to ensure full oxidation of the organic

matter. After incineration, the crucible is allowed to cool in a desiccator to avoid moisture absorption. Finally, the crucible is weighed again to determine the amount of sulphated ash residue remaining.

Determination of Extractive Values

Water-Soluble Extractive Value:

About 5gm of powder was weighed and macerated with 100ml of chloroform water (95ml distilled water and 5ml chloroform) in a closed flask for 24 hours. It was shaken frequently for 6 hours and allowed to stand for 18 hours. It was then filtered rapidly, taking precautions against loss of solvent and 25ml of the filtrate was evaporated to dryness in a tarred flat bottom shallow dish. 2ml of alcohol was added to the residue and it was dried at 105℃ for 1 hour in hot air oven and cooled in a desiccator for 30 minutes and weighted. Until a consistent weight was reached, the procedure was repeated. The percentage of water-soluble extractive value with reference to the dried drug was calculated.

Percentage of water-soluble extractive value = (weight of the dried extract/ weight of sample taken) x 100

Alcohol Soluble Extractive Value:

About 5gm of powder was weighed and macerated with 100ml 90% ethanol in a close flask for 24 hours. It was shaken frequently for 6 hours and allowed to stand for 18 hours. It was then filtered rapidly, taking precautions against loss of solvent and 25ml of the filtrate was evaporated to dryness in a tarred flat bottom shallow dish. It was dried at 105℃ for 1 hour in hot air oven and cooled in a desiccator for 30 minutes and weighted. Until a consistent weight was reached, the procedure was repeated. The percentage of alcohol soluble extractive value with reference to the dried drug was calculated.

Percentage of alcohol soluble extractive value = (weight of the dried extract/ weight of sample taken) x 100

Loss on Drying:

Accurately weighed quantity of the substances was taken in a previously ignited and cooled silica crucible and the substance was evenly distributed by gentle side wise shaking. The crucible with the constants was weighed. The loaded crucible and the lid were placed in the drying chamber at 105℃. The substance was heated for a specified period of time to a constant weight. The crucible was covered with the lid and allowed to cool in a desiccator at room temperature before weighing. In order to determine the drying loss in relation to the air-dried material, the crucible was lastly weighed.

Determination of Foaming Index:

About 1gm of the coarsely powdered drug weighed and transferred to 500ml conical flask containing 100ml boiling water. The flask was maintained at temperature 80-90℃ for 30 minutes. It was then cooled and filtered into a volumetric flask and sufficient water was added through the filtrate to make up the volume to 100ml. The decoction was poured into 10 stopper test tube in successive proportion of 1ml, 2ml, 3ml, 4ml up to 10ml and the volume of the liquid in each tube was adjusted with water to 10ml. The tubes were stoppered and Shaked in a length wise motion for 15 seconds, 2 shakes per second. Allowed to stand for 15 minutes and the height of the foam were measured.

Foaming Index = 1000/ a

Where, a = volume in ml of the decoction used for preparing the dilution in the tube where foaming to a height of 1cm is observed.

Determination of Swelling Index:

A specified quantity of the flower was accurately weighed and transferred into a 25ml glass stoppered measuring cylinder. The internal diameter of the cylinder should be about 16mm, the length of the graduated portion about 125mm, marked in 0.2ml division from 0 to 25ml in upward direction. Unless otherwise indicated in the test procedure, add 25ml of water and shake the mixture thoroughly every 10 minutes for 1 hour, allowed to stand for 3 hours at room temperature. The volume in ml occupied by the corms was measured including any sticky mucilage.

Calculate the mean value of the individual determination, related to 1gm of corm material [13-15].

Heavy Metal Analysis:

Heavy metals such as arsenic, lead, mercury, and cadmium cause toxic effects leading to intoxication. Their determination is performed using Inductively Coupled Plasma–Optical Emission Spectroscopy (ICP-OES). About 20 mg of the sample is digested with 1 mL of ultrapure nitric acid in a Teflon microwave digestion vessel for 45 minutes. The digested sample is then diluted to 50 mL. Calibration standards (2–10 µg/mL) and blanks are prepared using nitric acid. Analysis is carried out using an Agilent ICP-OES 5100 VDV with operating conditions of RF power 1.2 kW, plasma gas flow rate 12 L/min, and nebulizer gas flow rate 0.70 L/min. The digested samples are introduced into the plasma via a nebulizer and spray chamber for detection [16].

Phyto-Chemical Studies:

Extraction:

The flower of *Canna indica* were dried completely and pulverized into a coarse powder. The 100 gm of powdered material was then subjected to maceration extraction using 1000 mL of ethanol as a solvent. After the extraction process, the EECI was concentrated. The concentrated extract was stored under appropriate conditions for further phytochemical analysis. This extraction method helps in obtaining a wide range of bioactive compounds, which are essential for assessing the plant's medicinal potential. [17]





Figure 2&3: Shade-Drying & Extraction of *Canna indica* flower

Preliminary Qualitative Phytochemical Screening: [18-19]

The flower extract (EECI) were subjected to qualitative chemical analysis for the identification of active constituents in EECI.

Table 1: Preliminary phytochemical screening

Phytochemical	Test Procedure	Positive Indication
Tannins / Polyphenols	Add 3-4 drops of 10% FeCl3 to diluted extract	Blue color (gallic tannins), green (catechol tannins)
Carbohydrates (Molisch's test)	Add 5 mL Molisch's reagent and conc. H2SO4 to Extract	Violet color
Flavonoids a) Alkaline reagent test:	Treat extract with 10% NaOH; intense yellow color appears	Intense yellow color
b) Dilute NH3 test	Add dilute NH3 solution, then conc. H2SO4; yellow precipitate forms	Yellow precipitate

Terpenoids	Mix 0.2 g sample with 2 mL chloroform and 3 mL conc. H2SO4	Reddish-brown color
Alkaloids (Dragendorff's test)	Warm 2 mL extract with 2% H2SO4, add Dragendorff's reagent	Orange-red precipitate
Saponins	Boil 2 g powder in 20 mL water, shake 10 mL filtrate with 5 mL water	Frothing
Volatile Oils	Shake 2 mL extract with 0.1 mL NaOH and dilute HCl	White precipitate
Cardiac Glycosides	Treat 5 mL extract with 2 mL glacial acetic acid & one drop FeCl3	Violet or greenish ring near interface
Steroids	Dissolve 1 g extract in acetic acid, add conc. H2SO4	Green color
Protein & Amino acids	Few drops of Millon's reagent were added to the sample.	Red colour.
Gum and Mucilage	Add 10 mL extract slowly to 25 mL absolute alcohol with stirring	Precipitation
Fixed Oils and Fats	Press drop of extract between filter paper	Oil stain on paper

Quantitative Estimation: [20-21]

Total Phenolic Content (Folin-Ciocalteu's Assay):

Total phenolic content was determined using the Folin–Ciocalteu method. One ml of sample aliquot or gallic acid standard (0.007–1 mg/mL) was mixed with 5 mL of distilled water and 0.5 mL of Folin–Ciocalteu reagent. After 5 minutes, 1.5 mL of 20% sodium carbonate was added, and the volume was made up to 10 mL with distilled water. The mixture was incubated for 2 hours at room temperature, developing an intense blue color. Absorbance was measured at 750 nm using a UV–visible spectrophotometer. All samples were analyzed in triplicate with a reagent blank as control. Gallic acid was used as the standard, and results were expressed as milligrams of gallic acid equivalents (GAE) per 100 g of dry mass.

Total Alkaloid Content:

One mg of the EECI extract was dissolved in dimethyl sulfoxide, mixed with 1 mL of 2N HCl, and filtered. The filtrate was transferred to a separating funnel, followed by the addition of 5 mL bromocresol green solution and 5 mL phosphate buffer. The mixture was extracted with 1–4 mL portions of chloroform by vigorous shaking, and the combined chloroform layer was diluted to 10 mL. Reference standard solutions of atropine (5 to 0.039 mg/mL) were prepared similarly. Absorbance of both standard and test solutions was measured at 470 nm using a UV–visible spectrophotometer against a reagent blank. The alkaloid content was expressed as mg of EECI extract.

Total steroid content:

1mL of test sample was added with 2mL of 4N sulphuric acid, 2mL of 0.5% iron (III) chloride and 0.5mL of potassium hexacyanoferrate (III) solution. The solution was heated at 72°C in water bath for 30 minutes and the volume was made up to 10mL with distilled water. The absorbance was read at 780nm.

Chromatography

Chromatography methods are important analytical tool in the separation, identification and estimation of components present in the plant.

Thin Layer Chromatography

Principle

The principle of separation is adsorption. It is reliable technique in which solute undergoes distribution between 2 phase, stationary phase and mobile phase. The mobile phase flows through because of capillary action. The compounds having higher affinity towards the stationary phase eluted slower were as the compounds having lesser affinity towards stationary phase eluted faster.

TLC Plate Preparation

The plates were prepared using Stahl TLC spreader. 40gm silica gel G was mixed with 85ml of water to prepare homogenous suspension and poured in the spreader. 0.25mm thickness of plates was prepared, air-dried until the transparency of the layer disappeared. Then dried at 110°C for 30 minutes and kept in desiccators.

Selection of Mobile Phase

Solvent mixture was selected on the phytoconstituents present in each extract. Factors such as nature of components, stationary phase, polarity, influence the rate of separation of constituents was considered. From the vast analysis, best solvents were selected which showed good separation with maximum number of components [22].

R_f value = Distance travelled by the solute/ Distance travelled by the solvent

RESULTS & DISCUSSION:

Pharmacognostical Studies:

Collection & Authentication:

The flower of *Canna indica* was collected in May 2025 from Thalavaipettai village, Erode district, Tamil Nadu. The plant material was botanically identified and authenticated (C07042501I) by Dr. K. N. Sunil Kumar, Research Officer and Head of the Department of Pharmacognosy, Central Council for Research in Siddha, Chennai, Ministry of AYUSH, Government of India. After collection, the *Canna indica* flowers were thoroughly washed, shade-dried at room temperature to a constant weight, and then processed into coarse powder. The powdered material was stored in air-tight containers for further use in pharmacognostical and phytochemical studies.

Macroscopic Standardization:

The organoleptic characters including color, odor, taste and external features of *Canna indica* L. were observed and the results were recorded in Table 2.

Table 2: Organoleptic characters of the Canna indica L.

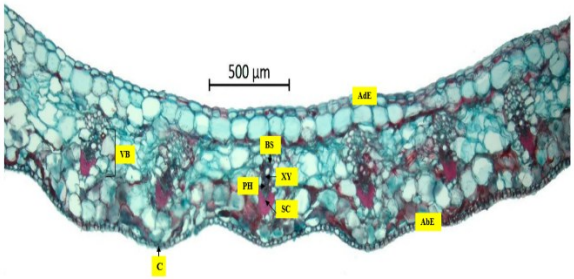
Organoleptic Characters	Observations
	FLOWER
Color	Outer surface – Bright red; Inner surface – Slightly lighter red with occasional yellow streaks at the petal base.
Odor	Mild, characteristic floral odour.
Taste	Characteristic.
Size	Flowers measure about 6–12 cm in length, petals 3–5 cm wide.
Shape	Irregular, asymmetrical with broad petals and narrow, tapering bases.

Microscopic Standardization:

A) Transverse Section:

a) Sepal:

The transverse section of the sepal is externally covered by a layer of cutin (C). Beneath it lies a single-layered adaxial epidermis (AdE) and abaxial epidermis (AbE), both composed of compactly arranged rectangular cells. The ground tissue consists mainly of large, thin-walled parenchymatous cells with distinct intercellular spaces, giving a loose spongy texture. Scattered in the mesophyll are several collateral vascular bundles (VB), each enclosed by a distinct bundle sheath (BS). Within each vascular bundle, xylem (XY) is oriented towards the adaxial side and phloem (PH) towards the abaxial side. Sclerenchymatous cells (SC) are associated with the vascular bundles, providing strength and mechanical support. Overall, the section shows a dorsiventral arrangement with cutinized epidermal layers, ground tissue, and embedded vascular bundles, reflecting the protective and supportive functions of the sepal.



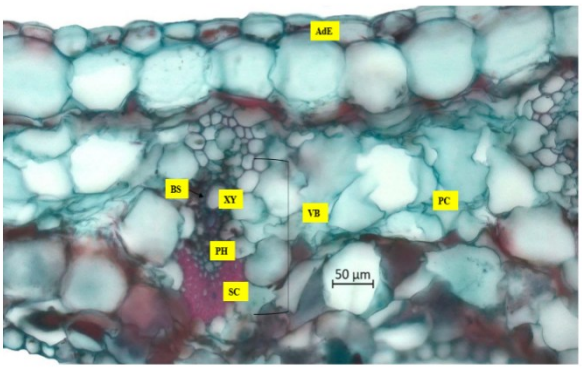
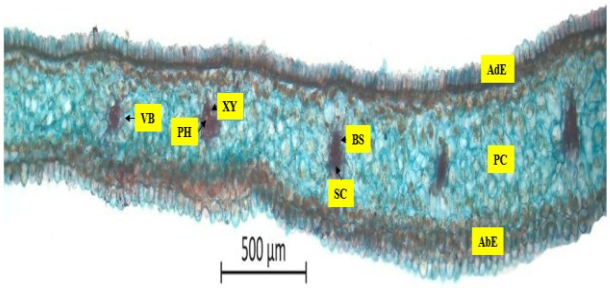


Figure 4: TS of *Canna indica* sepal **Figure 5: Enlarged view of TS of sepal**

AdE- Adaxial epidermis, **AbE**- Abaxial epidermis, **VB**- Vascular bundle, **XY**-Xylem, **PH**-Phloem, **SC**-Sclerenchyma cells, **PC**- Parenchyma cells, **BS**-Bundle sheath.

b) Petal:

The transverse section of the petal is bounded externally by a single-layered adaxial epidermis (AdE) and abaxial epidermis (AbE), both composed of compact, rectangular cells covered with a thin cuticle. Beneath the epidermal layers lies a broad ground tissue made up of thin-walled parenchymatous cells (PC), which are loosely arranged with distinct intercellular spaces. Scattered within the mesophyll region occur vascular bundles (VB), each enclosed by a bundle sheath (BS). The vascular bundles are collateral in nature, consisting of xylem (XY) towards the upper (adaxial) side and phloem (PH) towards the lower (abaxial) side. A few sclerenchymatous cells (SC) are present, providing mechanical support to the vascular tissue. The general ground tissue is mainly parenchymatous, serving in storage and flexibility, which maintains the delicate texture of the petal.



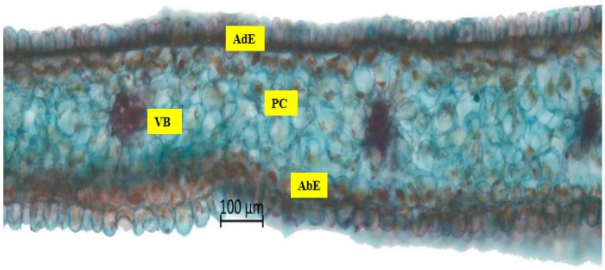


Figure 6: TS of *Canna indica* petal **Figure 7: Enlarged view of TS of petal**

AdE- Adaxial epidermis, **AbE**- Abaxial epidermis, **VB**- Vascular bundle, **XY**-Xylem, **PH**-Phloem, **SC**-Sclerenchyma cells, **PC**- Parenchyma cells, **BS**-Bundle sheath.

c) Anther:

The transverse section of the anther shows a **bilobed, bissporangiate** structure, with each lobe containing two pollen sacs (PS). The outermost layer is the epidermis (E), made up of a single layer of protective cells. Beneath it lies the endothecium (Et), consisting of radially elongated cells with characteristic fibrous thickenings that help in anther dehiscence. Towards the inner side, the pollen sacs are lined by the tapetum (T), a nutritive layer of dense cells that supply nourishment to the developing pollen grains (PG). The central region is occupied by connective tissue (C), containing vascular elements and calcium oxalate crystals (druses, D). The two lobes are separated by connective tissue, and the line of dehiscence is marked by the stomium (S), which ruptures at

maturity to release pollen. Overall, the section represents a typical **dithecous, bissporangiate anther** with well-differentiated protective, mechanical, nutritive, and reproductive tissues.

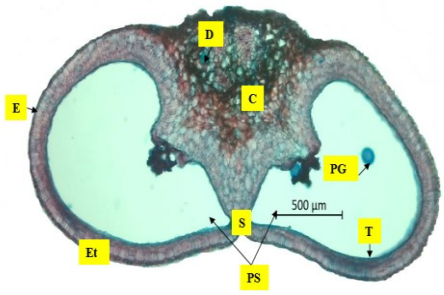


Figure 8: TS of *Canna indica* anther

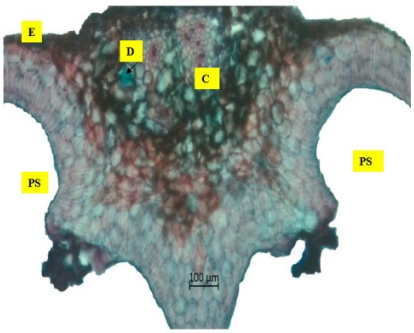
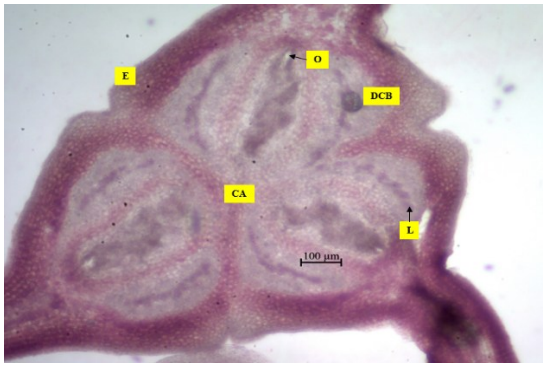


Figure 9: Enlarged view of TS of anther

E – Epidermis, Et – Endothecium, D – Druses, C – Connective, S – Stomium, PS – Pollen sac, PG – Pollen grain, T – Tapetum.

d) Ovary:

The transverse section of the flower ovary is **trilocular**, with three distinct locules (L), each containing a single **ovule (O)** attached to the **central axis (CA),** which serves as the placental tissue. The **epidermis (E)** forms the outer protective layer of the ovary. A **dorsal capellary bundle (DCB)** is present in the ovary wall, providing vascular support and nutrients. This ovary is from a **hermaphrodite, zygomorphic flower,** indicating the presence of both male and female reproductive structures with bilateral symmetry.



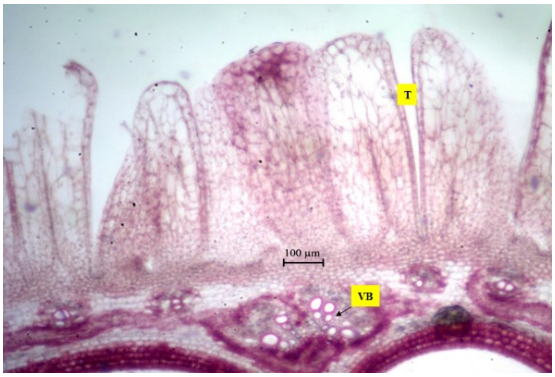


Figure 10: TS of *Canna indica* ovary

E-Epidermis, **O**- Ovule, **DCB**- Dorsal capellary bundle, **L**- Locule, **CA-** Central axis, **T**-Trichrome, **VB**- Vascular bundle.

B) Powder Microscopy:

The powder is brown in colour with a mild characteristic odour and a characteristic taste. Under microscopic examination, it shows the following diagnostic characters: fragments of **corolla epidermis,** consisting of rectangular to polygonal cells with a distinct cuticle; portions of **corolla epidermis bearing stomata**, generally of the anomocytic type; and pieces of **pedicel epidermis** with elongated, thick-walled cells. Elements of the vascular tissue are represented by **spiral vessels**, which appear elongated and lignified with characteristic secondary thickening. Numerous **prismatic crystals of calcium oxalate** are scattered throughout, while **pollen grains** are also observed,

mostly spherical with a distinct exine wall. These collective features serve as important diagnostic markers for the identification of the powdered drug.

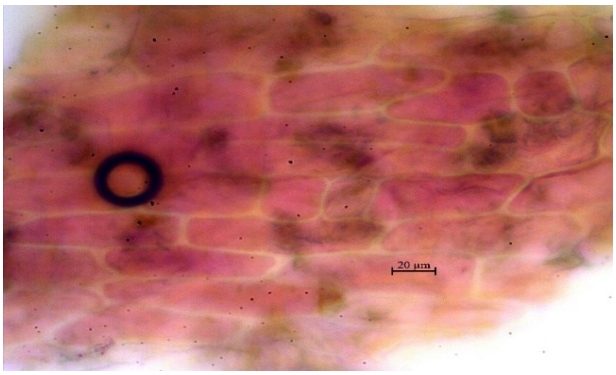


Figure 11.1: Corolla epidermis

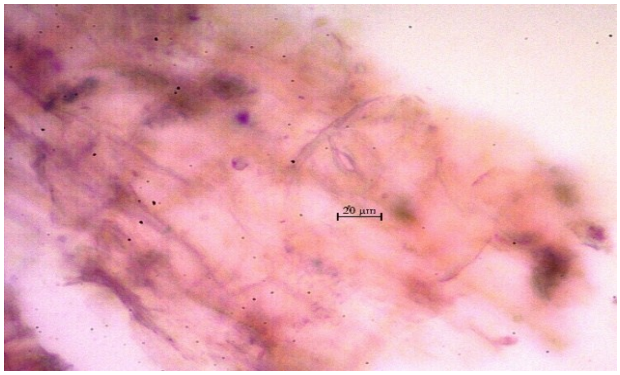


Figure 11.2: Corolla epidermis with stomata

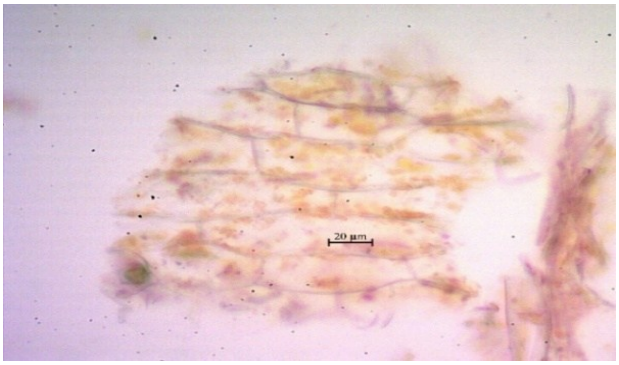


Figure 11.3: Pedical epidermis

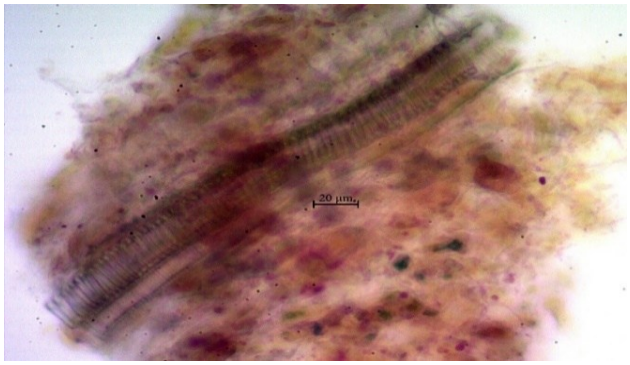


Figure 11.4: Spiral vessel



Figure 11.5: Prismatic crystal

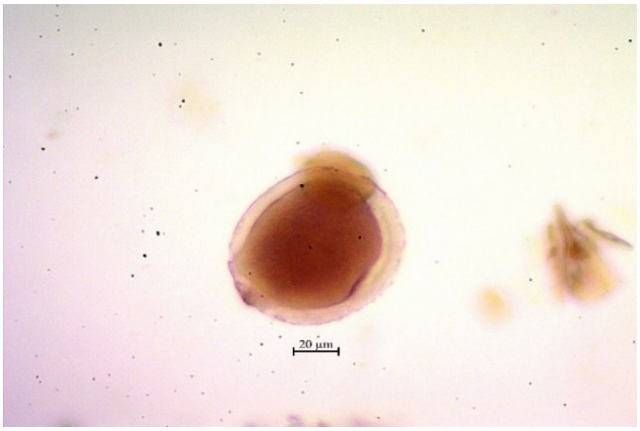


Figure 11.6: Pollen grains

Figure 11: Powder microscopy of *canna indica* flower

Histochemical Studies:

Histochemical evaluation of the flower revealed the presence of **alkaloids and phenolic compounds** localized in the corolla region. Reactions for **lignin, mucilage, oil globules, and resins** were found to be negative, indicating their absence in the floral tissues. These results suggest that the corolla serves as the major site for accumulation of secondary metabolites such as alkaloids and phenolic, while other

metabolites like mucilage, resinous matter, and lipid inclusions are not characteristic of the flower.

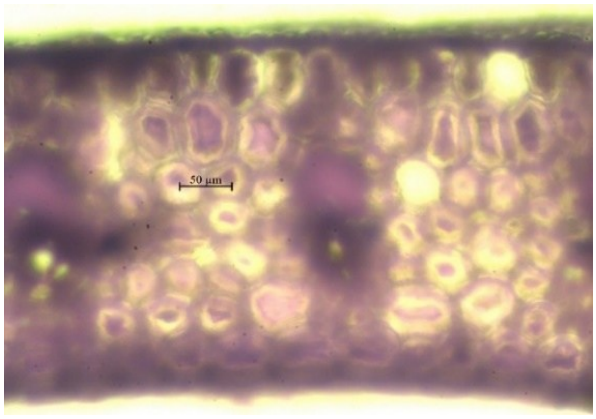


Figure 12.1: Alkaloid in corolla

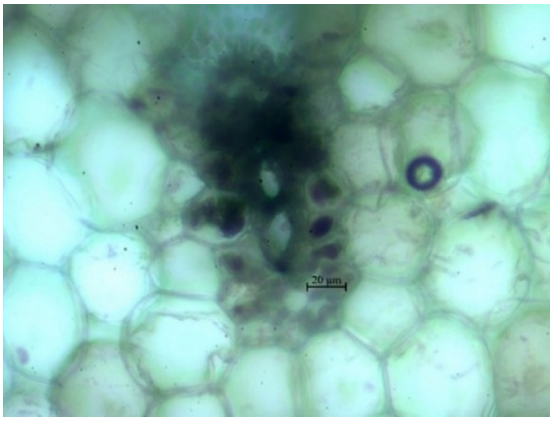


Figure 12.2: Phenolic compound in phloem

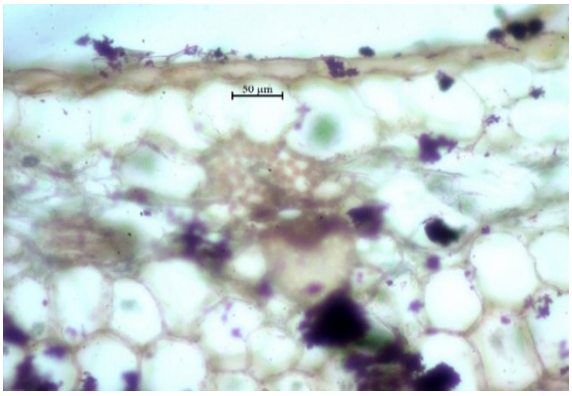


Figure 12.3: Thin cutin are present

Figure 12: Histochemical analysis of *canna indica* flower

Physico-Chemical Studies:

The physicochemical evaluation of *Canna indica* L. flower revealed important quality parameters. These values support the plant's quality, safety, and potential use in traditional and pharmacognostical applications.

Table 3: Physicochemical parameters of flower of *Canna indica* L.,

S.NO	PARAMETERS	RESULTS (%w/w)
I	**Ash value**	
1.	Total ash	13.07 ± 0.40
2.	Water soluble ash	7.23 ± 0.25
3.	Acid insoluble ash	2.47 ± 0.06
4	Sulphated ash	17.90 ± 0.10
II	**Extractive values**	
1.	Alcohol soluble extractive value	11.03 ± 0.06
2.	Water soluble extractive value	3.17 ± 0.15
III	**Loss on drying**	**6.90 ± 0.10**
IV	**Swelling Index**	3.20 ± 0.20 mL/g
V	**Foaming Index**	<100

Note: Each value represents Mean ± Standard deviation (n=3)

Quantitative Estimation of Heavy Metals:

The heavy metal analysis of *Canna indica* showed that arsenic, cadmium, mercury, and lead were below detectable limits (BDL). This indicates that the plant material is free from toxic heavy metal contamination.

Table 4: Quantitative estimation of heavy metals

Elements	*Canna Indica L.*
As	BDL
Cd	BDL
Hg	BDL
Pb	BDL

Note: BDL – Below Detection Limit.

Standard Linearity:

Table 5: Standard linearity for elements

S. No	Element	Wavelength	R^2 Value
1	Arsenic [As] (µg/ml)	188.980	0.9972
2	Cadmium [Cd] (µg/ml)	226.502	0.9964
3	Mercury [Hg] (µg/ml)	184.887	0.9985
4	Lead [Pb] (µg/ml)	220.353	0.9969

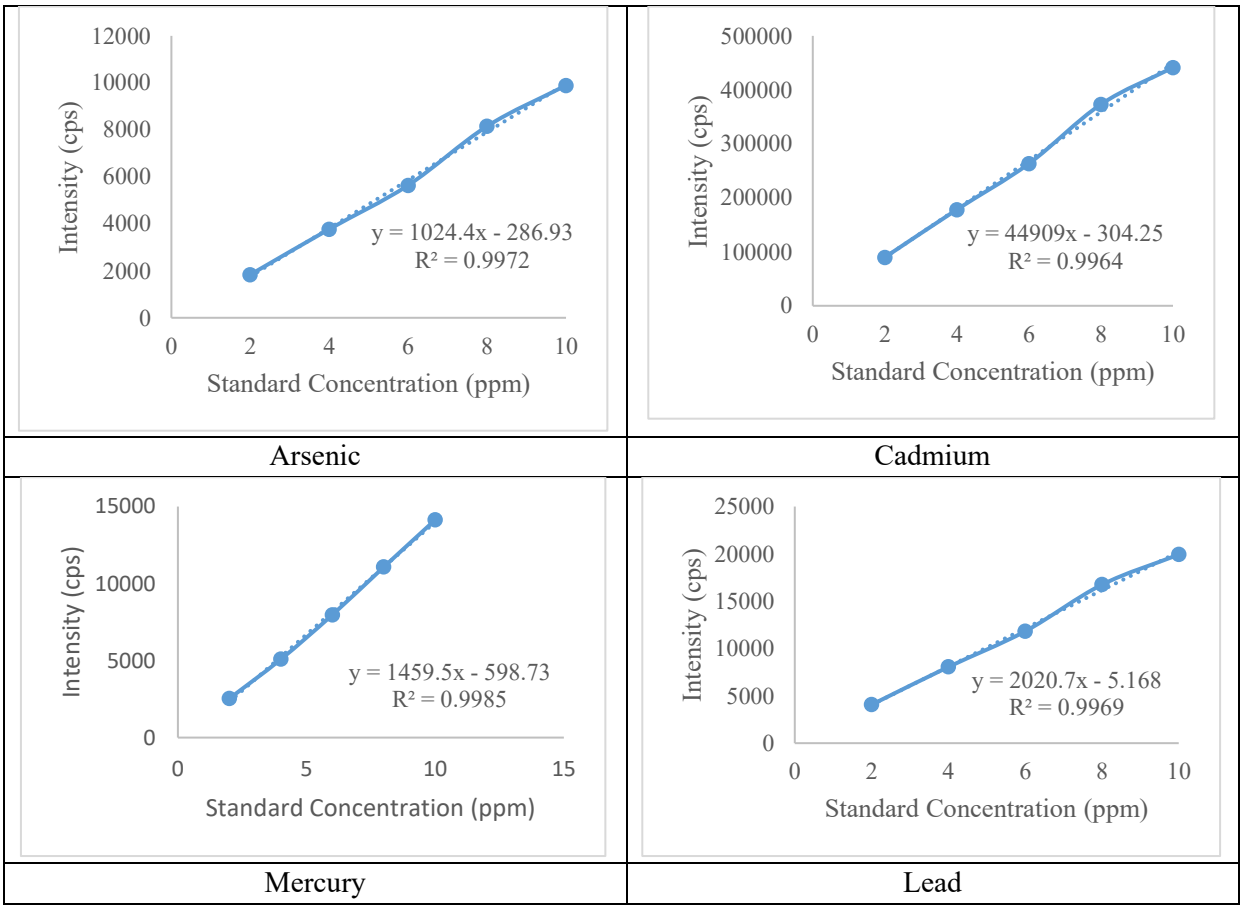


Figure 13: Linearity curve of elements Arsenic, Cadmium, Mercury & Lead

Standard Overlaid Graphs:

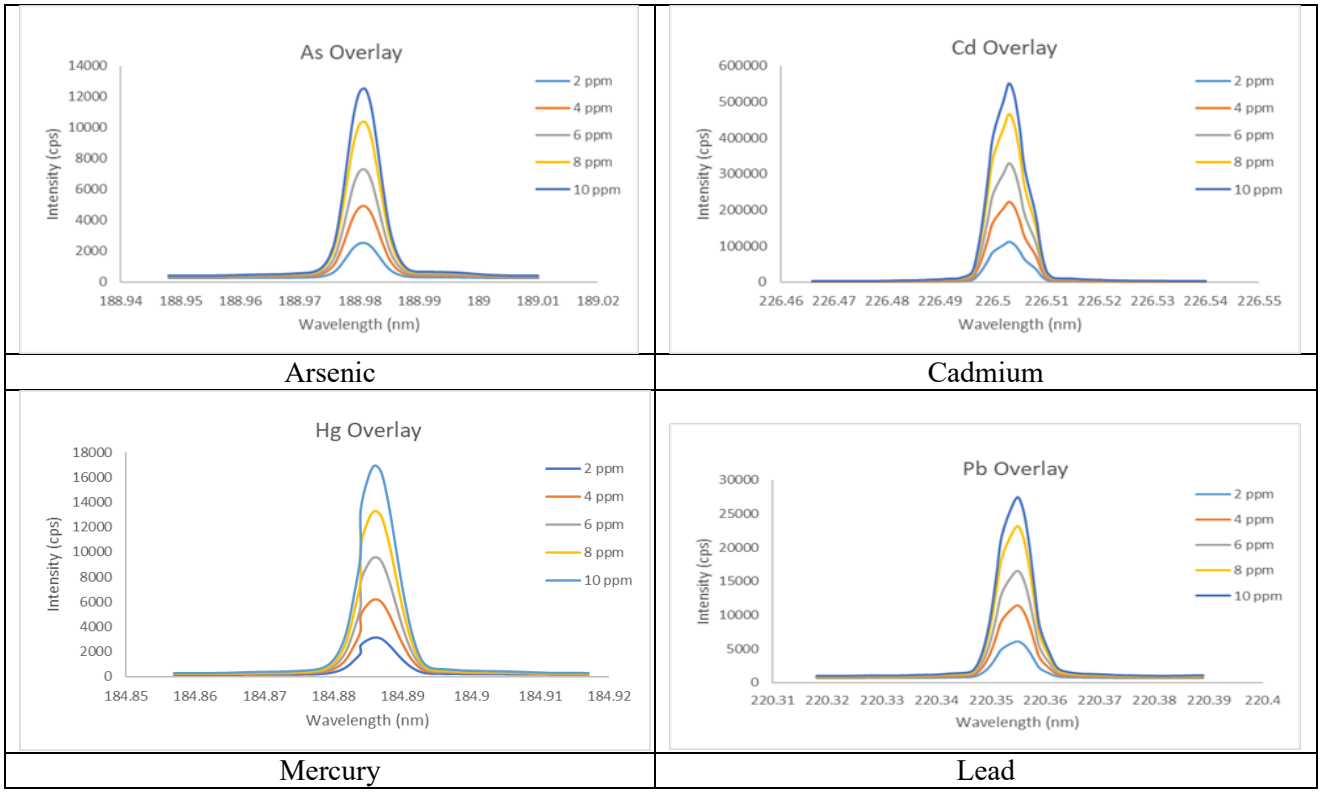


Figure 14: Overlaid Graph of Elements Arsenic, Cadmium, Mercury, Lead

***Canna Indica* Sample ICP-OES Graph:**

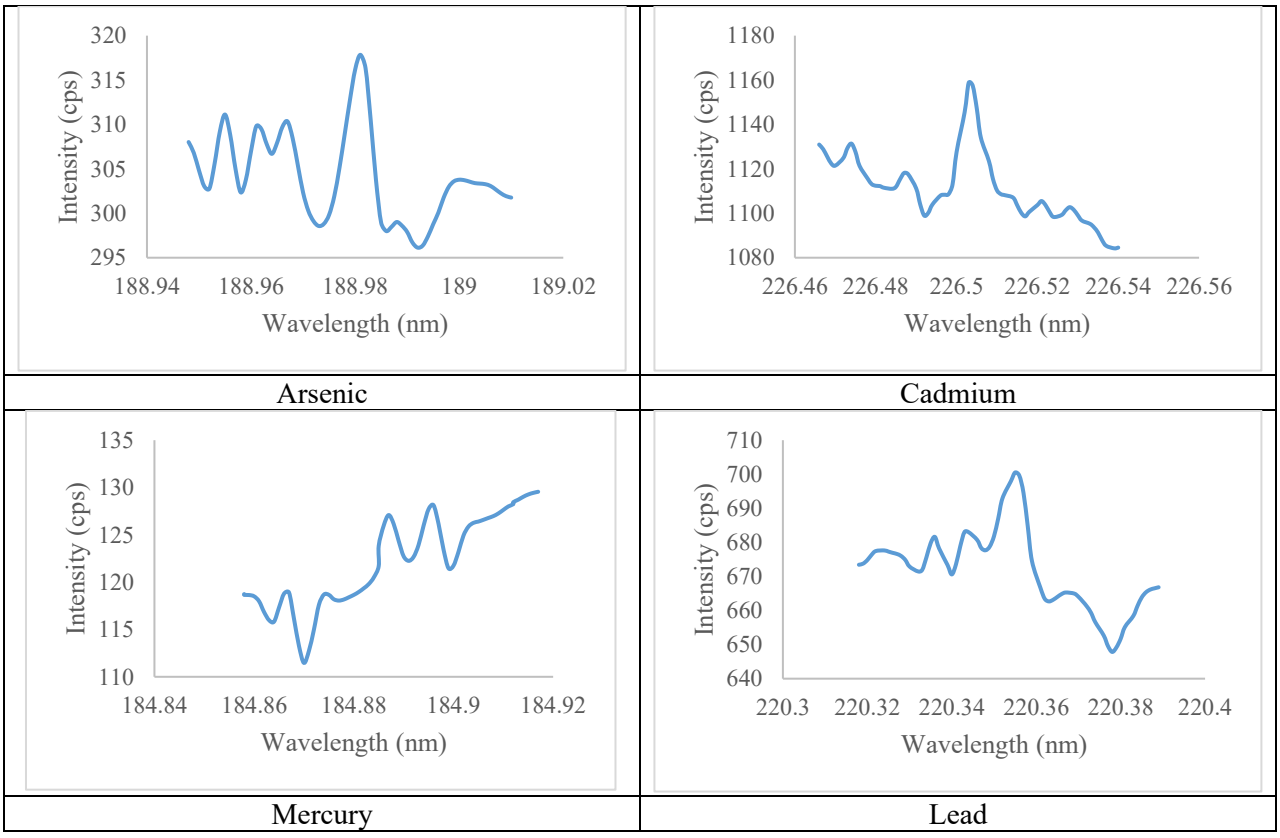


Figure 15: Linearity curve of element Arsenic, Cadmium, Mercury & Lead for *canna indica* samples

Phyto-Chemical Studies:

Extraction:

Table 6: Physical characters of the extract and its percentage yield

Plant Name	Solvent	Method Of Extraction	Physical Nature	Colour	Yield (%W/W)
Canna indica L.,	Ethanol	Maceration	Semi-solid	Reddish Brown	8.81



Figure 16: Extract of *Canna indica* L., flower

Qualitative Estimation of Phytoconstituents:

Preliminary Phytochemical Analysis:

Preliminary phytochemical screening reveals a rich chemical diversity, with flavonoids, tannins, phenols, carbohydrates, terpenoids, alkaloids, saponins, cardiac glycosides, and steroids distributed in ethanolic extracts.

Table 7: Preliminary phytochemical analysis of flower of *Canna indica* L.

S.NO	PHYTOCHEMICAL TESTS	ETHANOLIC EXTRACT
1	Alkaloids	+
2	Steroids and triterpenoids	+
3	Flavonoids	+
4	Tannins	+
5	Glycosides	+
6	Carbohydrates	+
7	Proteins	+
8	Free amino acids	_
9	Gums and mucilage	_
10	Phenolic compounds	+
11	Saponins	+
12	Waxes	_

(+ indicates present; - indicates absent)

Quantitative Estimation of Phytoconstituents:

The quantitative analysis of the EECI revealed the presence of significant amounts of key phytochemicals. The quantitative estimation confirms the importance of *Canna indica* as a valuable medicinal resource.

Table 8: Quantitative estimation of phytoconstituents

S.NO	PARAMETERS	CONCENTRATION (mg/ml)
1	Total Phenolic Content	1.68 ± 0.05
2	Total Alkaloid Content	2.47 ± 0.02
3	Total Steroid Content	4.64 ± 0.17

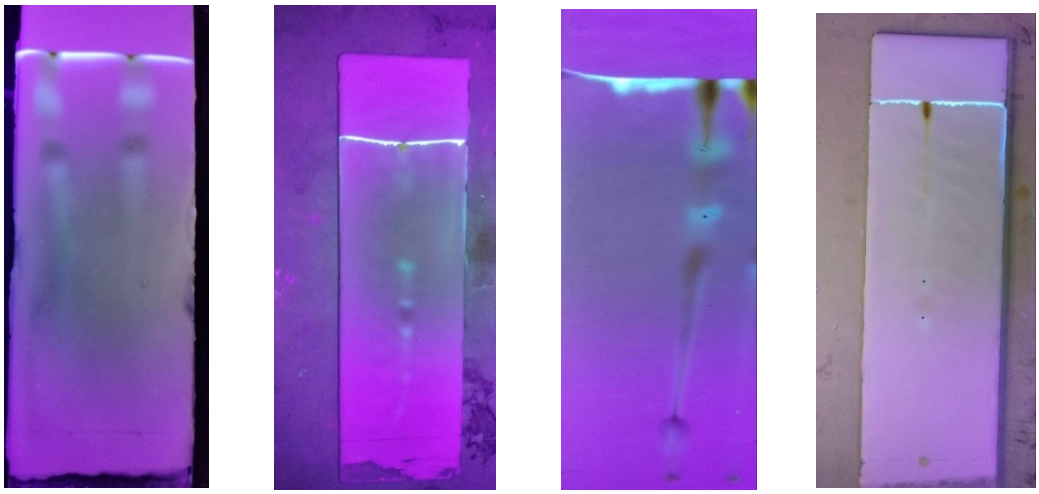
Note: All the values are expressed as mean ± SD (n=3)

TLC:

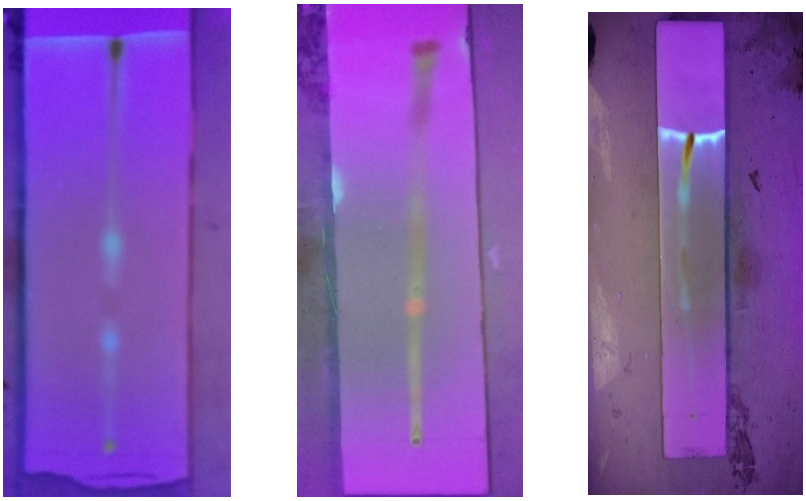
TLC studies of *Canna indica* L., was performed and shown in figure's analysis of EECI revealed distinct R_f values for various phytoconstituents. These results confirm the presence and separation of multiple phytochemicals in the extract.

Table 9: TLC studies of *canna indica* L.,

S.NO	PHYTOCONSTITUENTS	SOLVENT SYSTEM	NO. OF SPOTS	R_f VALUE
1	Alkaloids	n-butanol: acetic acid: water (40:10:30 v/v)	2	0.38, 0.66
2	Flavonoids	Ethyl acetate: acetic acid: formic acid: water (100:11:11:27 v/v)	3	0.37, 0.46, 0.59
3	Terpenoids	Hexane: ethyl acetate (80:20 v/v)	2	0.75, 0.98
4	Saponins	Chloroform: glacial acetic acid: methanol: water (64;32;12;8 v/v)	2	0.46, 0.59
5	Tannins	Toluene: ethyl acetate (93:7 v/v)	2	0.42, 0.54
6	Phytosterols	Chloroform: ethyl acetate: formic acid (50:40:10 v/v)	3	0.32, 0.78, 0.92
7	Steroids	Chloroform: methanol (90:10 v/v)	2	0.65, 0.75



ALKALOIDS **FLAVANOIDS** **TERPENOIDS** **SAPONINS**



TANNINS **PHYTOSTEROLS** **STERIODS**

Figure 17: TLC of ethanolic extract of *Canna indica* L.,

DISCUSSION

The current work established thorough pharmacognostic and phytochemical standards for *Canna indica* L. flower, ensuring authenticity and quality control for medicinal use. The macroscopic examination revealed bright red zygomorphic flowers with uneven petals and a moderate characteristic scent, which is consistent with previous botanical descriptions of Canna species and confirms accurate identification. Microscopic examination of the sepal, petal, anther, and ovary revealed dorsiventral organization, collateral vascular bundles, and supporting sclerenchymatous tissue. The anther was found to be bilobed and bissporangiate, while the ovary was trilocular with central placentation characteristics typical of Cannaceae. Powder microscopy revealed diagnostic components such as corolla epidermis with anomocytic stomata, spiral vessels, calcium oxalate crystals, and pollen grains, which are critical markers for identifying the powdered medication. Histochemical localization indicated the presence of alkaloids and phenolic compounds in the corolla, indicating that these areas could be potential bioactive component accumulation locations. The absence of mucilage, oil globules, and resins reinforces the dominance of polar phytochemicals, which is consistent with the polarity of the ethanolic extracts used.

Physicochemical constants, such as ash levels, extractive values, loss on drying, foaming, and swelling indices, were all within acceptable pharmacopoeial ranges, showing purity and minimum contamination. The absence of foreign organic matter and harmful heavy metal levels below detectable limits (BDL) (As, Cd, Hg, and Pb) demonstrate the raw material's safety and environmental acceptability for pharmaceutical application. Phytochemical analysis of the ethanolic extract revealed the presence of important secondary metabolites including alkaloids, flavonoids, tannins, phenolic compounds, steroids, saponins, and terpenoids. Quantitative examination revealed significant quantities of steroids (4.64 mg/mL), alkaloids (2.47 mg/mL), and phenolics (1.68 mg/mL), indicating the extract's high pharmacological potential. These bioactive chemicals are renowned for their antioxidant, anti-inflammatory, and cytoprotective properties, which support *Canna indica*'s historic usage in treating inflammation, wounds, and infections. TLC analysis confirmed the existence of unique phytoconstituents, allowing for the creation of an extract fingerprint profile.

Overall, the study presents accurate diagnostic, physicochemical, and phytochemical criteria that can be used as reference standards to assess the quality of *Canna indica* flowers. The findings not only back up its ethno medicinal claims, but also provide a solid framework for future formulation and pharmacological evaluation in natural medicine development.

CONCLUSION

The present study successfully developed the pharmacognostical, physicochemical, and phytochemical standards of *Canna indica* L. flower, giving critical parameters for authenticity and quality assurance. The macroscopic and microscopic traits proved the plant's identity, while histochemical tests pinpointed crucial secondary compounds like alkaloids and phenolics inside the floral tissues. Physicochemical constants and heavy metal analysis revealed that the raw material was pure, stable, and suitable for medical usage. Preliminary and quantitative phytochemical screening revealed the existence of therapeutically active compounds, specifically, alkaloids, flavonoids, tannins, phenolics, terpenoids, steroids, and saponins, which confirm the traditional medicinal claims. The TLC fingerprint confirmed chemical diversity, proving the extract's genuineness. Overall, *Canna indica* flower shows promise in terms of phytochemical richness and safety, making it an excellent candidate for further pharmacological research and formulation development in herbal medicine.

ACKNOWLEDGEMENT

The authors are grateful to The Erode College of Pharmacy for providing the necessary facilities and support to carry out this work.

REFERENCE

1. Megavarthini R, Mahalaksmi S, Gokulakrishnan S, Manokaran S, Ravikkumar VR. Anti-urolithiatic activity of hydro-alcoholic extract of

the whole plant Pennisetum purpureum (Cenchrus purpureus). Int J Pharmacogn Pharm Res. 2025; 7(2):131–136.
2. Handral HK, Jha PK, Shruthi SD. Pharmacognostic and phytochemical studies on the leaves of Murraya koenigii (L) Spreng. Pharmacophore. 2010; 1(3):231–238.
3. Mishra S, Yadav A, Singh SK. A review of Canna indica Linn: pharmacognostic and pharmacological profile. J Harmon Res Pharm. 2013; 2:131–44.
4. Glinos E, Cocucci AA. Pollination biology of Canna indica (Cannaceae) with particular reference to the functional morphology of the style. Plant Syst Evol. 2010.
5. Mishra T, Das A, Prasad A, Sen A. Phytochemical screening and in-vitro antioxidant profiling of solvent fraction of Canna edulis Ker Gawler. Free Radic Antioxid. 2012; 2(1):13–20.
6. United States Department of Agriculture, Agricultural Research Service (USDA ARS). Canna indica L. Germplasm Resources Information Network (GRIN) [Internet]. 2016
7. Flora of North America Editorial Committee. Magnoliophyta: Alismatidae, Arecidae, Commelinidae (in part), and Zingiberidae. Vol. 22. New York: Oxford University Press; 2000. p. I–xxiii, 1–352.
8. Hokche O, Berry PE, Huber O, editors. Nuevo Catálogo de la Flora Vascular de Venezuela. Caracas: Botanical Institute of Venezuela Foundation; 2008. p. 1–860.
9. Chate E. Le Canna, son histoire, sa culture. Paris: Librairie Centrale d'Agriculture ET de Jardinage; 1867.
10. Enrique J, Baran L, Gonzalez-Barol AC, Ciciarelli MM, Rolleri CH. Characterization of biominerals in species of Canna (Cannaceae). 2010.
11. Brindha S, Divya KG, Remya A, Kumar SKN, Rajeswaran PS. Foliar macro-micro-morphology of Capparis zeylanica L. J Ayu Med Sci. 2017;2(2):174–8.
12. Ahmad S, Hasan MM. Standardization of crude drugs: a precise review. World J Pharm Res. 2015; 4(10):155–174.
13. Sass JE. Elements of botanical micro technique. New York: McGraw Hill Book Co.; 1940. p. 222.
14. Kokate CK. Practical pharmacognosy. 4th Ed. New Delhi: Rajkamal Electric Press; 2005. p. 545–547.
15. United States Department of Agriculture. Dr. Duke's phytochemical and ethnobotanical https://phytochem.nal.usda.gov/phytochem/plants/show/1366
16. World Health Organization. Quality control methods for medicinal plant materials. Geneva: WHO; 1998. p. 128.
17. Megavarthini R, Ravikkumar VR, Loganayagi M, Nixson NN, Sanjaykumar M, Maheswari V. FT-IR and gas chromatography–mass spectroscopy analysis of Canna indica L. flowers: a green route to silver nanoparticle synthesis. YMER. 2025; 24(9):403–415.
18. Khandelwal KR. Practical pharmacognosy. 16th ed. Pune: Nirali Prakashan; 2006.
19. Ingle KP, Deshmukh AGDA, Dudhare MS, Moharil MP, Khelurkar VC. Phytochemicals, extraction methods, identification and detection of bioactive compounds from plant extracts. J Pharmacogn Phytochem. 2017; 6:32–6.
20. Kokate CK. Practical pharmacognosy. p. 138–139.
21. Bhalodia N, Nariya P, Acharya R, Shukla V. Evaluation of in vitro antioxidant activity of flowers of Cassia fistula Linn. Int J PharmTech Res. 2011; 3(1):589–599.
22. Patel A, Patel A, Patel A, Patel NM. Estimation of flavonoid, polyphenolic content and in vitro antioxidant capacity of leaves of Tephrosia purpurea Linn. (Leguminosae). Int J Pharm Sci Res. 2010; 1(1):66–77.

HOW TO CITE: Megavarthini R.*, Maheswari V., Ravikkumar V. R., Pharmacognostical Characterization and Phytochemical Profiling of Canna Indica L. (Cannaceae), J. Pharm. Sci., 2025, 1 (11), 985-1001. https://doi.org/10.5281/zenodo.17630552