

Pharmacognostic Profiling of *Cleome gynandra* L. - A Traditional Folk Medicine

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Abstract

The pharmacognostic features of *Cleome gynandra* L. a traditional anticancer drug for ascertaining its authenticity. Macroscopic, microscopic, histochemical localization studies and preliminary phytochemical screening along with HPTLC analysis were carried out for the aerial parts of the selected plant. The results of macro, microscopic, quantitative and histochemical localization studies revealed the presence of some unique microscopic features. Preliminary phytochemical screening data suggested the presence of alkaloids, phenols, tannins, flavonoids, terpenoids, glycosides, saponin and sterols. HPTLC profile was recorded for the chloroform extract. Totally 11 spots were observed and the Rf values were calculated and this profile can be used as a fingerprint for the authentication of the drug in dry condition. The above evolved characters can be used as pharmacognostic standards for the future identification and authentication for deciding the quality of this drug.

Keywords: Pharmaconostic profiling, *Cleome gynandra*, HPTLC, Macroscopy, Microscopy

INTRODUCTION

Medicinal plants are widely used in health care and as cosmetics in both developed and developing countries and play a major role in various traditional systems of medicine like *Ayurveda*, *Siddha*, Chinese, Tibetan, Homeopathy and Unani. Recently modern medicine is also increasingly dependent on plants, isolated molecules and their derivatives such as artemisinin, Taxol, Vincristine and Vinblastin¹. But the greatest lacuna existing in the herbal drug industry is the lack of quality control parameters for raw drugs. Quality control parameters must be determined following WHO protocols and sophisticated instrumental techniques².

Hence, the need of the hour is to provide properly identified and authenticated quality herbal drugs, which is possible only through pharmacognostic studies on herbal drugs employing standard WHO protocols and by determining their botanical, physicochemical and chemical profile³⁻⁶. Based on literature review and interviews with local herbal healers, an anticancer traditional herb *C.gynandra* L. was selected and studied from pharmacognostic point of view. *Cleome gynandra* belonging to the family Cleomaceae is a naturally occurring species. *Cleome gynandra* is a widely occurring herb in the southern part of Africa and various African countries. It is a globally distributed plant found mainly in tropical and subtropical regions. *Cleome* has yellow or white flowers. The leaves and seeds of this herb are used as medicine in several countries⁷. Sap from leaves possess curator properties and are used as an analgesic to treat headaches, earache, etc. Fresh leaves are squashed into the ears, nose, and eyes. It is also used to treat epileptic fits. An infusion of leaves or root is used in various conditions such as to facilitate childbirth to treat severe threadworm infection, stomachache and constipation, conjunctivitis and in reducing chest pains. Leaves are used to treat arthritis. They are also applied as a poultice or rubbed on the affected parts to cure rheumatism, neuralgia, and headache.



Figure 1: *Cleome gynandra* - Leaf

Cleome gynandra is widely used for the treatment of malaria, gonorrhoea, dysentery and rheumatoid arthritis. In India, it is used as anti-helminthic and rubefacient. In order to prevent sepsis, the leaves could be applied externally over the wounds. Further, the plant could be used to treat a condition such as piles, malaria, and cancer whereas the plant root is used to treat fever. Researchers have proved its properties such as analgesic, anti-inflammatory⁸, anticancer potentials⁹ and antipyretic activities scientifically⁹. These attributes of the plant make it an ideal target for anticancer screening since phylogenetically related plant species frequently display a considerable degree of similarity in the kinds of secondary metabolite and biological activities. (Figure 1).

MATERIALS & METHODS

Aerial parts of *Cleome gynandra* L. were collected from in and around Thanjavur and identified at the Centre for Advanced Research in Indian System of Medicine (CARISM), SASTRA University, Thanjavur, and the herbarium was submitted to CARISM. Identification was also further confirmed by comparing with specimens deposited at Rapinat Herbarium (RHT, 303), St. Joseph's College, Trichy, Tamil Nadu, India¹⁰.

Micromorphological studies:

Stem and leaves were cleared with 10 % bleach and stained using toluidine blue O and mounted with phenolated glycerin (50%). Examination of the powder for calcium oxalate, lignin, crystals, and starch grains was carried out using standard methods¹¹. The stained sections were mounted in water and observed under the microscope (Carl Zeiss Ax 100R), and microphotographs were taken with ProgRes digital camera and software.

Determination of Stomatal Number & Stomatal Index¹².

Equipment and materials:

Microscope with 40x objective and 6x eyepiece and camera lucida, water bath, test tubes, drawing paper, slides and cover glasses, chloral hydrate solution (50gm of chloral hydrate/ 20 mL distilled water), glycerol ethanol solution (1:1:1 ratio of glycerol, water, and ethanol)

Method: 5x5 mm leaf fragments were kept in a test tube consisting of 5mL chloral hydrate solution was heated, until the leaf fragments turned transparent. Later, these leaf fragments were transferred to a slide to be mounted; through the side of the cover glass, a drop of glycerol ethanol solution was added. Then the slide was examined through a microscope, which is attached to camera lucida. The drawing sheet was fixed on a drawing board and stomata, and epidermal cells were marked the 'x' and 'o' for epidermal cells and stomata respectively. The following formula is used to calculate the Stomatal Index = (No. of stomata × 100) / (No. of Epidermal cells + No. of Stomata) Ten leaf samples were observed, and the average no. of a stomatal index was calculated.

Determination of Palisade Ratio¹².

Equipment and materials: Microscope with 40x objective and 6x eyepiece and camera lucida, water bath, test tubes, drawing paper, slides and cover glasses, chloral hydrate solution (20gm of chloral hydrate was dissolved in 5 mL water, and then 5mL of glycerin added), glycerol ethanol solution (33mL of glycerol was made up to 100mL with water and pinch of camphor). **Method:** 5x5 mm leaf fragments and 5mL of chloral hydrate solution was heated in a test tube, the leaf fragments became transparent. Leaf fragments were then transferred to a slide to be mounted, and a drop of glycerol ethanol solution was added through cover glass. The slide was studied closely under a microscope which is attached to camera lucida. The drawing sheet was fixed on a drawing board, and four adjacent epidermal cells were traced on a drawing sheet. Then, focused gently downward the palisade cells into view. Sufficient palisade cells were traced to cover four epidermal cells. The numbers of palisade cells were calculated under the four epidermal cells and where the cells intersect were also included if it is more than half of the epidermal cells. The calculation of average palisade cell number under one epidermal cell is done by dividing the count by 4. Ten samples were selected and determined.

Determination of Vein Islet and Vein termination Number¹².

Equipments and materials:

Microscope with 40x objective and 6x eyepiece and camera lucida, water bath, test tubes, drawing paper, slides and cover glasses, chloral hydrate solution (20gm of chloral hydrate was dissolved in 5 mL water, and then 5mL of glycerin added), glycerol ethanol solution (33mL of glycerol was made up to 100mL with water and pinch of camphor)¹³. **Method:** 4mm² fragments lamina (central portion of the lamina, midrib, and margin of the leaf were excluded) were kept in test tube consisting of 5mL chloral hydrate solution was heated, then the leaf fragments became transparent. Later, leaf fragments were transferred to a slide and to be mounted in chloral hydrate solution. A drop of glycerol ethanol solution was poured through cover glass and examined with the help of stage micrometer which is attached to camera lucida. The drawing sheet was fixed on drawing board, and a line representing 2mm was drawn, and a square is drawn representing 4mm². The drawing sheet was moved so that the square brought to the center field of an eyepiece. The slide with leaf piece was placed on the microscope stage, vein islets and vein included within the square were drawn. The number of vein islets and vein terminations were counted. For each sample, three observations were made for per mm² the average no of vein terminators, and vein islets were calculated.

Powder microscopic analysis:

To study powder microscopic features, the powder was treated using phloroglucinol, HCl, chloral hydrate and potassium iodide¹³.

Quantitative microscopic studies¹⁴

5x5 mm quadrangle leaf in size was sliced and treated overnight with chromic acid (75%). The fragments became obvious and were wiping with distilled water and allowed for the quantitative microscopic studies.

Histochemical Localization

Alkaloids - Freehand thin sections were treated with Dragendorff's reagent¹⁵. The sections were mounted and observed under the microscope, and the formation of color was observed.

Tannin- Sections upon treatment with FeCl₃ solution then mounted in clove oil and identified under the microscope for finding of tannin.

Terpenoids- Freehand thin sections were treated with 2, 4-dinitrophenylhydrazine. The sections were mounted and observed under the microscope, and the formation of colors was observed.

Flavonoids- Freehand thin sections were treated with NEU's reagent, the sections were mounted with 30% glycerol and observed under the fluorescent microscope (365nm), and the formation of fluorescent colors was observed.

Lipids- Freehand thin sections were treated with oil red, after ten minutes the sections were washed with freshly diluted isopropanol then washed with distilled water and mounted with 30% glycerol and observed under the microscope. Microphotographs were taken with the help of Carl Zeiss AXIO (German) microscope and Prog Res digital camera.

Phytochemical Screening

After extracting using different solvents such as hexane, chloroform, ethyl acetate, and methanol via cold maceration method, the dried and coarsely powdered leaves were primarily screened for the qualitative detection of phytoconstituents. About 25g of dehydrated plant sample was mixed with 150 mL of different solvents and kept overnight at room temperature in a shaker. The extract was collected after filtering using Whatmann no: 1 filters paper and stored at 4°C. The obtained crude extracts were evaporated to dry and weighed. The crude extracts percentage was calculated, and the color of the extracts was noted. The extracts, thus obtained, were allowed to various qualitative phytochemical screening for the detection of major chemical components present in the plant material¹⁶.

RESULTS AND DISCUSSION

Description

Cleome gynandra is a herb and erect up to 600 mm tall. Palmately compound leaves consist of 3-5 leaflets that are 20-50 mm length and have glandular hairs in leaves stalk. The leaf consists 20-100 x 8-40 mm smooth glands and taper towards the base. The surfaces below are finely smooth glandular and have multicellular hairs dotted on the main nerves. It consists of a long primary root and few secondary roots with root hairs. Leaf petioles and stem are thick glandular. They show violet to purple or green to pink variable pigmentations. Bisexual, bracteate, white tinged with purple flowers. Capsular fruits with linear, sub-erect 30- 150 x 2.5-5 mm. It consists of 2 mm long, thin-textured valve and glandular hairs. They have brown color seeds, circular in outline, with a faintly net surface and 1.5 mm in diameter⁷.

Macromorphological Features

It is mostly branched and woody with sticky stem, consisting of glandular hairs with longitudinal parallel lines. 3-5 palmately compound leaves and 20-50 mm long. The leaves emerge from leaf stalk tip, size 20-100 x 8-40 mm smooth base. It is often found with scattered multicellular hairs, smooth to finely glandular nerves.

Microscopic characters

TS of stem

TS of stem showed single layered round epidermal cells with thick cuticle. In epidermis multi-seriate spiny non glandular trichomes, long stalked uniseriate, biseriate, triseriate and multi-seriate and short stalked capitate glandular trichomes were observed. Base of the trichomes were 3 celled to many celled in thickness. Epidermis was followed by 2-3 cell layered thick walled polygonal collenchymas cells.

Collenchyma was followed by several cell layered, compactly arranged, polygonal large thin walled cortical cells. In cortex, cortical fibers were seen as patches with thick lignified walls, pitted striated and the lumen was wide. Some of the cortical cells contained simple, round and oval starch grains. Vascular bundle was a concentric ring, oval shaped; several vascular strands were compactly arranged. Inter fascicular regions were found which was made up of 2-3 cell wide parenchymatous cells. 7-8 cell layered irregular phloem cells were found, some of the phloem cells contained simple round to oval starch grains. 3-4 cell layers of tangentially elongated rectangular thin walled cambial cells were also seen between

phloem and xylem. Xylem occurred in long radial multiples, xylem fibres narrow, tracheids and broad xylem vessel elements were also noticed. Centre portion of the stem showed pith, which was made up of small and large round, oval and polygonal compactly arranged parenchymatous cells. Some of the pith cells contained simple starch grains.

Micromorphological Features

TS of Leaf

TS of the leaf revealed the presence of prominent midrib and thick lamina. The midrib is circular, wide and thick but the adaxial groove is narrow. The epidermis has thick round shaped cells covered with a thick cuticle. In some places, epidermis in the midrib shows the presence of large multiserial spine like and single cellular thin walled long non-glandular and short-stalked, biserial and triserial capitate glandular trichomes. The epidermis is followed by two layers of thick-walled collenchyma cells (Figure 2). Collenchyma cells are followed by ground tissue which consists of 6-8 cell layered compactly arranged parenchyma cells. Some of the parenchyma cells contained simple, oval and round starch grains with closely arranged striations and linear hilum (Figure 2). Druses type of calcium oxalate crystals is seen rarely.

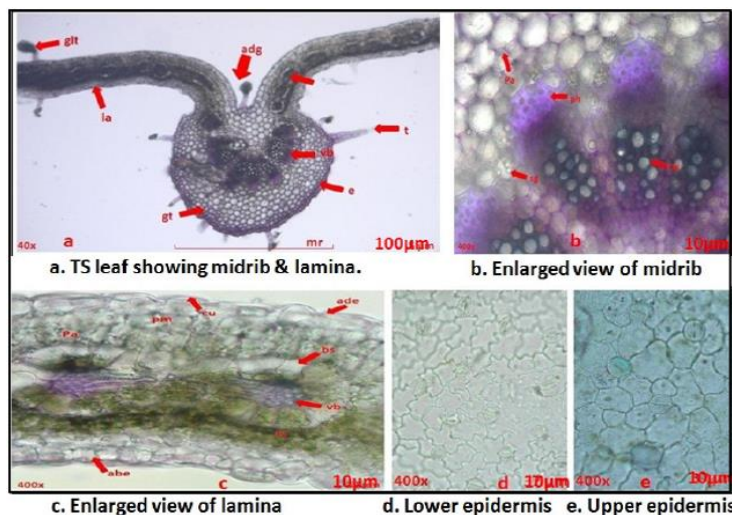


Figure 2: Micromorphological characters of *Cleome gynandra* – leaf

The vascular bundle is made up of three strands. Centre median strand is larger than other two lateral median strands. The vascular strands are collateral and made up of broad, thick-walled cells. The xylem regions are made up of vessel elements and xylem fiber. Phloem cells are present diffusely in the lower side of the vascular strand. Phloem cells contain simple round and oval shaped starch grains (Figure 2).

TS of Lamina

TS of lamina was uniform in both sides. Adaxial side epidermis consisted of thin walled cuticular barrel shaped cells with thick cuticle. In the abaxial side, the cells were cylindrical, thin walled cuticular and stomatiferous. Mesophyll tissue was not well differentiated into palisade and spongy tissue. 1-2 cell layered vertically elongated cells were in the adaxial side and the remaining cells were small, loosely arranged and lobed (Fig 2c). The anticlinal cell walls were undulate and epidermal cells were irregular in abaxial (Fig 2d) but in adaxial side the epidermal cells were polygonal (Fig 2e).

Lateral veins were dilated, circular and with collateral vascular strands, vascular strands were exsheathed and surrounded by single layer of wide bundle sheath cells. These type of bundle sheath cells are called Kranz-tissue. The vascular strand included a conical mass of xylem elements and a thick phloem cells (Fig 2c). Cleared leaf lamina showed dense reticulate venation pattern. The veins and the vein-lets were thick and the veins were straight. Vein-islets were distinct, vein terminations were simple or forked once or twice and the vein terminations were short and thick.

Leaf peelings showed thin walled epidermal cells were thin walled with many undulate anticlinal walls, the epidermal cells were wavy in outline in lower side (Fig. 2d) but straight outline in upper epidermis (Fig 2e). Stomata were abundant and anomocytic (Fig. 2d).

TS of Seed

TS of seed showed the presence of epidermis, sub epidermis, parenchymatous cells, inner integuments and an endosperm (Fig. 3a) Epidermis was made up of vertically elongated thin walled round and elongated cells. In some places the epidermal cells are were longer but in some places it was shorter in some places it is 2-3 cell layered (Fig. 3b). Sub epidermis comprised of club shaped thin walled cells (Fig 3b). Sub epidermis was followed by 1-2 cell layered inner integuments which was made up of vertically elongated thick walled sclerenchyma cells with wide lumen and the lumens were filled with crystals (Fig 3b). Near the grooves, vertical elongated testa cells were followed by 2-4 cell layered small oval to round shaped sclerenchymatous testa cells with wide lumen (Fig. 3b). Next to the integuments the 3-4 cells layered, thin walled irregular parenchyma cells were arranged. These parenchymatous cells were followed by endosperm cells

which were made up of polygonal irregular and thin walled cells. Endosperm cells were filled with fatty oils and oil globules (Fig. 3c).

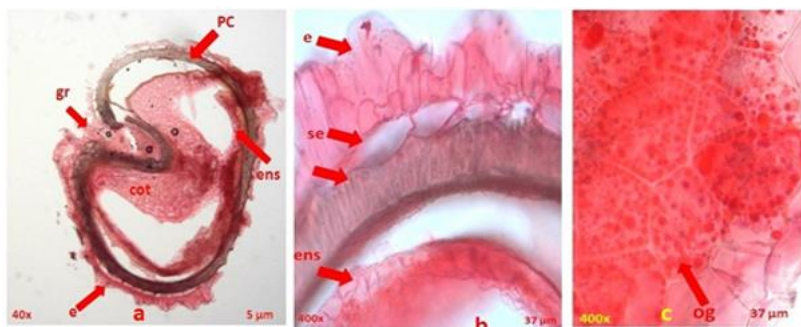


Figure 3: Micromorphological characters of *Cleome gynandra* – seed

Powder Microscopic studies

Powder microscopic studies (Figure 4a) revealed the presence of simple, round and oval starch grains with closely striated margins. Brown contents were found in some parenchyma cells.

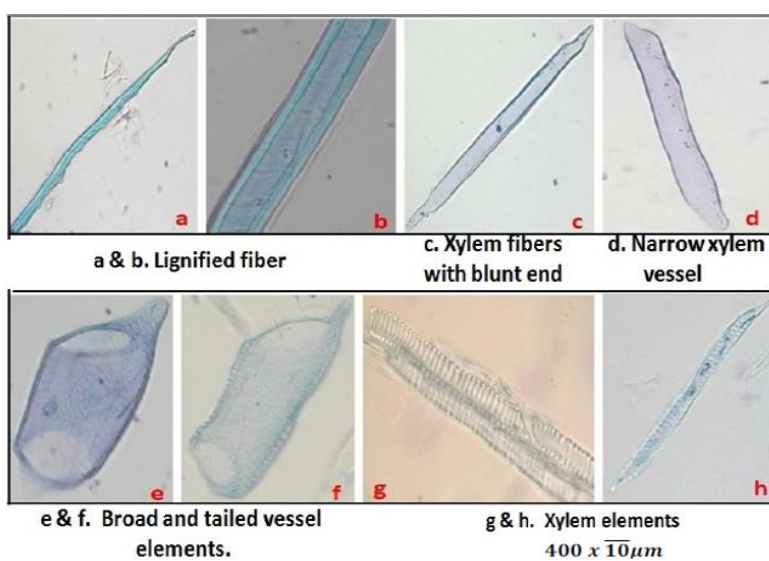


Figure 4a: Powder microscopic studies of *Cleome gynandra* leaf

Rarely druses of calcium oxalate crystals were observed in parenchyma cells, fats/fatty oil globules were also found in the fragments of endosperm cells and lipid layers of cell walls of parenchymatous cells. Powder microscopic studies further revealed the presence of long, broad cortical fibers with pitted thick cell walls. Xylem fiber ends are tapering blunt and bifurcated. Narrow and long tracheids with spiral and bordered pitted thickenings were also noticed. Pitted xylem vessel elements are also present. Trichomes unicellular, multi-seriate spiny. Non glandular trichomes, long-stalked uniseriate, bi-seriate, tri-seriate, multi-seriate and sessile. Capitate glandular trichomes were also observed. Some of the xylem vessel elements are with annular and spiral thickening (Figure 4b).



Figure 4b: Powder microscopic studies of *Cleome gynandra* leaf

Quantitative microscopy

The stomatal index and stomatal frequency of *C. gynandra* were calculated for both adaxial and abaxial epidermis¹⁴. A number of vein islets and vein terminations were calculated, and the palisade ratio was also calculated in both upper and lower epidermis (Table 1 & 2).

Table 1: Quantitative Microscopic studies of *Cleome gynandra*

| S. No | Quantitative characters | Minimum | Maximum | Average |
|-------|----------------------------------|---------|---------|---------|
| 1. | Palisade Ratio | 4 | 6 | 6 |
| 2. | Stomatal index (Upper epidermis) | 33 | 49 | 39 |
| 3. | Stomatal index (Lower epidermis) | 44 | 51 | 46 |
| 4. | No of Stomata (Upper) | 23 | 26 | 24 |
| 5. | No of Stomata (Lower) | 15 | 22 | 18 |
| 6. | No of Vein islets | 65 | 98 | 81 |
| 7. | No of vein Termination | 51 | 81 | 64 |

Table 2: Size of the xylem elements of *C. gynandra*

| S. No | Characters | Minimum (µm) | Maximum (µm) | Average(µm) |
|-------|-----------------|--------------|--------------|-------------|
| 1. | Xylem fibers | 104 | 183 | 123 |
| 2. | Tracheids | 49 | 104 | 80 |
| 3. | Vessel elements | 49 x 24 | 92 x 24 | 92 x 35 |

Histochemical Localization studies

The histochemical localization of *Cleome gynandra* was represented in Figure 5. Some of the epidermal cells and cuticular cells revealed the presence of fatty materials. Besides cortical, phloem cells, trichomes, trichome basal cells all showed the presence the lipids and fats. The protein bodies were observed in some of the cortex, phloem and pith cells. Pectin was observed in sclerenchyma cells, xylem elements and in epidermal cells. Collenchyma cells are also revealed the presence of pectin. Starch grains were observed in cortical cells, phloem cells and pith cells. The starch grains are simple, round and oval shaped with closely arranged striations and linear hilum. Tannin was present in some of parenchyma cells, trichomes, epidermal and mesophyll cells. Alkaloid was localized in trichomes, and in some specialized epidermal and cortical cells. Presence of terpenoids was observed in trichomes, trichome basal cells and epidermal cells. Flavonoids were found to present in some trichomes. Trichome basal cells sclerenchyma, epidermal cells and xylem elements.

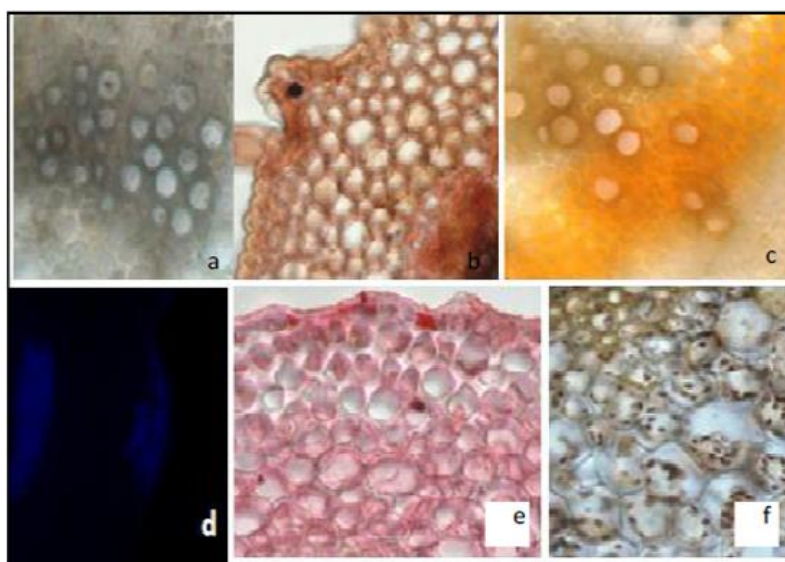


Figure 5: Histochemical localization of *Cleome gynandra*

- Black color indicates the presence of Tanins (treated with FeCl_3)
- Brown color indicates the presence of Alkaloids (treated with Wagner's reagent)
- Orange indicates the presence of Terpenoids (treated with DNPH)
- Blue fluorescence indicates the presence of Flavonoids (treated with NEU reagent)
- Red color indicates the presence of Lipids in cell membrane (treated with oil red)
- Black color indicates the presence of starch (treated with IKI)

PREPARATION OF EXTRACTS

Chloroform extract

50g of dry, coarsely powdered drug of *Cleome gynandra* was taken and extract prepared using soxhlet apparatus and chloroform was used as solvent (250ml). The extract was collected and concentrated *in vacuo* and stored in refrigerator and used for preliminary phytochemical screening and HPTLC finger printing¹⁷.

Aqueous and Methanolic extract

50g of dry powdered drug of *Cleome gynandra* was weighed and added water (250 ml) and methanol (250ml) The extracts were obtained by cold maceration method and stirred intermittently. The extracts were filtered and concentrated *in vacuo* and the concentrated extracts were lyophilized and kept under sterile condition for further use in phytochemical screening¹⁸.

Preliminary phytochemical analysis

Chloroform, methanol and aqueous extracts of aerial parts of the *C. gynandra* were screened for the presence or absence of alkaloids, flavonoids, tannin, glycosides, phenol, saponins, terpenoids, carbohydrate, protein, phlobatannins, anthroquinone and cardiac glycosides by following -standard textual procedures¹⁹.

Preliminary phytochemical screening

Chloroform extract of the selected plant drug revealed the presence of Alkaloids, flavonoids, tannin, phenols, glycosides, saponins, terpenoids and cardiac glycosides. Methanol extract showed the presence of alkaloids, flavonoids, glycosides, tannins, phenols, carbohydrates, proteins, saponins and terpenoids, aqueous extracts indicated the presence of alkaloids, flavonoids, glycosides, tannins, phenols, carbohydrates, proteins, saponins, sterols and terpenoids (**Table 3**)

Table 3: Preliminary phytochemical screening of leaves of *C. gynandra*

| S. No | Plant Constituents | Identification Test | Methanol extract | Aqueous extract | Chloroform Extract |
|-------|-------------------------|----------------------------|------------------|-----------------|--------------------|
| 1. | Alkaloids | Mayer's Test | + | + | + |
| | | Dragendroff's test | + | + | + |
| | | Brontrager's test | + | + | + |
| 3. | Glycosides | Legal's test | + | + | + |
| | | FeCl ₃ test | + | + | + |
| 4. | Phenols | Lead acetate test | + | + | + |
| | | FeCl ₃ test | + | + | + |
| 5. | Tannins | Alkaline reagent test | + | + | + |
| | | Lead acetate test | + | + | + |
| | | Million's test | + | + | + |
| 6. | Protein and amino acids | Ninhydrin test | + | + | + |
| | | Biuret test | + | + | + |
| | | foam test | + | + | + |
| 7. | Saponins | foam test | + | + | + |
| 8. | Sterols | Liebermann's Burchard Test | - | + | - |
| 9. | Flavonoids | Shinoda's test | + | + | + |
| | | Alkaline reagent test | + | + | + |
| 10. | Terpenoids | | + | + | + |
| 11. | Carbohydrates | Molisch's Test | + | + | + |

HPTLC Profile of Chloroform Extract

5mg of *Cleome gynandra* chloroform extract was dissolved in chloroform and 2, 5, 10µl extract applied as bands at a height of 10 mm from the base of 5 x 10 cm on a pre-coated silica gel 60 F₂₅₄ HPTLC plate (E.Merck) of uniform thickness 0.2mm using Linomat5 sample applicator and developed up to 80 mm from the base of the plate in an automatic developing chamber (CAMAG ADC2) using the mobile phase [Methanol: Ethyl Acetate: Toluene: Formic acid (1:1:7.5:0.2) v/v]. The plate was dried in air and observed the plate under UV light at 254 nm and 366nm. Profile pictures were recorded using CAMAG REPROSTAR²⁰ (Figure 6).

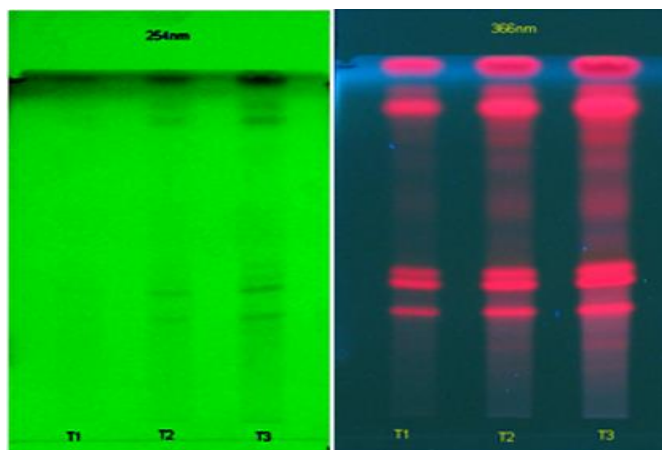


Figure. 6: HPTLC fingerprint of Chloroform extract of aerial parts of *C. gynandra*. a. 254nm; b. 366nm

HPTLC profile

Well resolved HPTLC finger prints (profiles) were observed at UV light (254 nm and 366 nm) and the results were recorded as a reference standard to authenticate the *C. gynandra* plant material in dry condition. HPTLC showed 9, 11 and 14 spots in 2, 5 and 10 µl of chloroform extract. 11 spots were observed distinctly and their Rf values, area percentage were calculated (Table 4). The HPTLC results are in accordance with the results of the histochemical localization of this plant revealing the presence of alkaloids, flavonoids and terpenoids.

Table 4: HPTLC fingerprint of Chloroform extract of aerial parts of *C. gynandra*

| Peak | Start Rf | Start Height | Max Rf | Max Height | Height % | End Rf | End Height | Area | Area % |
|------|----------|--------------|--------|------------|----------|--------|------------|--------|--------|
| 1 | 0.00 | 2.2 | 0.03 | 14.1 | 1.86 | 0.04 | 13.2 | 224.9 | 1.15 |
| 2 | 0.07 | 19.9 | 0.08 | 30.9 | 4.08 | 0.09 | 25.6 | 470.6 | 2.40 |
| 3 | 0.13 | 31.2 | 0.21 | 71.5 | 9.45 | 0.22 | 69.2 | 3132.9 | 15.99 |
| 4 | 0.22 | 70.0 | 0.24 | 144.2 | 19.06 | 0.29 | 39.0 | 4294.3 | 21.92 |
| 5 | 0.30 | 39.5 | 0.33 | 138.8 | 18.35 | 0.35 | 62.7 | 2610.3 | 13.32 |
| 6 | 0.35 | 63.7 | 0.36 | 81.4 | 10.76 | 0.39 | 35.6 | 1746.7 | 8.92 |
| 7 | 0.39 | 36.1 | 0.41 | 48.7 | 6.44 | 0.44 | 0.3 | 1023.3 | 5.22 |
| 8 | 0.45 | 0.6 | 0.50 | 45.1 | 5.96 | 0.58 | 7.8 | 2193.6 | 11.20 |
| 9 | 0.72 | 0.7 | 0.75 | 12.1 | 1.60 | 0.78 | 0.1 | 224.0 | 1.14 |
| 10 | 0.81 | 0.1 | 0.85 | 82.9 | 10.96 | 0.92 | 0.3 | 2261.8 | 11.55 |
| 11 | 0.94 | 0.5 | 0.98 | 86.8 | 11.47 | 0.98 | 56.2 | 1408.2 | 7.19 |

CONCLUSION

Pharmacognostic standardization is an important technique in the identification and authentication of medicinal plants and herbal products. It helps us to understand the identification, purity, safety and genuineness of the raw materials and thereby helping to ensure the safety and efficacy of herbal drugs. Chromatographic finger printing has gained global acceptance in establishing variability within the same herbal material. The present work is an investigative study on the pharmacognostic and HPTLC characterization of the medicinal plant *Cleome gynandra*.

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