

Original Article

**PHARMACOGNOSTIC STANDARDISATION OF *CAYRATIA PEDATA* (LAM.) GAGNEP. VAR. *GLABRA* GAMBLE—AN ENDEMIC AND ENDANGERED MEDICINAL CLIMBER IN THIASHOLA, NILGIRIS**

SHARMILA S. \*, KALAICHELVI K., DHIVYA S. M.

<sup>1</sup>PG and Research Department of Botany, Vellalar College for Women (Autonomous), Thindal, Erode 638012, Tamil Nadu, India  
Email: drsharmilas@yahoo.com

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ABSTRACT

**Objective:** The main objective was to develop a detailed pharmacognostic profile of aerial plant parts of *Cayratia pedata* (Lam.) Gagnep. var. *glabra* Gamble (Vitaceae) an endemic and endangered medicinal taxon distributed in Thiashola, Manjoor, Nilgiris South Division, Western Ghats.

**Methods:** All pharmacognostic and phytochemical evaluation of *Cayratia pedata* var. *glabra* was carried out by different evaluation methods like macroscopic, microscopic, physicochemical, minerals, vitamins, heavy metal analysis, phytochemical studies and GC/MS analysis.

**Results:** The macroscopical investigation revealed that the stem is hirsute and grows up to a height of 12 m. The leaves are alternate, oblong and acuminate with smooth surface and texture (3 to 6 cm). Tendril, leaf-opposed, branched, wiry and coiled. Flowers yellow and fruits bilobed. The anatomical study in tendril and old stem provides a set of characters specific for *C. pedata* var. *glabra* with which one can establish the identity of the plant in fragmentary form. The availability of macro and micro elements were studied in plant powder (ash). The macro elements, calcium (34.50 mg/100 g) and potassium (11.45 mg/100 g) were present in high amount likewise in microelements manganese (4.56 mg/100 g) was significantly higher. The fat-soluble vitamin A-retinol (156.8 iu) was present in higher amount when compared to other vitamins. Results of the heavy metal analysis revealed that the concentration of Lead was less than 1 ppm and chromium occurred in traces. The other heavy metals like mercury, cadmium and arsenic were totally absent. The percent yield was maximum in methanol extract (11%) followed by water extract (10%). The preliminary phytochemical screening revealed the presence of alkaloids, flavonoids, glycosides, phenols and tannins, steroids and sterols, triterpenoids and volatile oil. GC-MS analysis showed the presence of 15 compounds such as Heptadecane (17.36%), Silane, trichlorooctadecyl (17.29%), Eicosane (15.44%), Heptane, 2,2,3,3,5,6,6-heptamethyl (14.71%), n-Tetradecyltrichlorosilane (13.64%), Pentadecane (10.55%), Iron, tricarbonyl [N-(phenyl-2-pyridinylmethylene) benzenamine-N, N'] (10.91%) and Octadecane (8.93%) were the other major compounds present.

**Conclusion:** The above parameters, which are being testimony for the first time, are momentous towards establishing the pharmacognostic profile for future identification and authentication of genuine plant material. This approach is important for this time since this species is listed in Red data book as per the IUCN red list categories and criteria due to their lower germination percentage and also due to its enriched medicinal value.

**Keywords:** *Cayratia pedata* var. *glabra*, Thiashola, Pharmacognosy, Physicochemical

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INTRODUCTION

In modern days a renewed interest is developed in drugs of natural origin simply because they are considered as green medication and this is always supposed to be safe. Another feature which emphasizes this attention is the incidences of harmful nature of synthetic drugs which are regarded as harmful to human beings and environment. The advantage of natural drugs is their easy availability, economic and less or no side effects but the disadvantage is that they are the victims of adulteration. Standardization of herbal medicines and quality control of the plant raw materials are very important aspects of manufacture and supply of herbal drugs. The importance of herbals is realized and efforts are being made to satisfy the regulatory requirements.

India is perhaps one of the largest producers of medicinal herb and is rightly called the "Botanical garden of the world". It is one of the leading countries enjoying a major global market share in medicinal plants. Herein, Tamilnadu is rich in medicinal plants, especially in the hilly tract of the Western Ghats, which is the storehouse of numerous high-value medicinal plants. The tribal community used 1,214 plant species to cure 121 diseases. To this date, as per the IUCN red list categories and criteria, there are about 200 plant species are red-listed, of which most of the medicinal plants are hitherto used by common people.

The documentation of ethnopharmacobotanical information of herbaceous plants was carried out in Thiashola, Manjoor, Nilgiris

South Division, Western Ghats with proper permission obtained from the Principal Chief Conservator of Forests, Chennai and the District Forest Officer, Ooty under Section 28 (i) of Wildlife Protection Act, 1972, during 2009 and 2010. With the assistance of experienced and elderly tribes, traditional knowledge of this region informal interviews were conceded and documented. From the conducted survey 106 species were enumerated of this 76 have been recognized as medicinally and economically important species. Among the foresaid species, an endangered fragile species, *Cayratia pedata* (Lam.) Gagnep. var. *glabra* Gamble has been selected for further study since this species is listed in Red data book as per the IUCN red list categories and criteria due to their lower germination percentage and also due to its enriched medicinal value. The aerial plant parts of this species are used by the rural folk similar to other *Cayratia* species in curing skin diseases, hemorrhage, refrigerant, hysteria, wound healing and ulcers but it is unexplored commercially. A perusal of the previous literature revealed that this medicinal plant is unexplored, so a detailed systematic pharmacognostic study was carried out [1-3].

MATERIALS AND METHODS

Chemicals and instruments

All the chemicals used for the study were of laboratory grade. Compound microscope, watch glass, glass slides, cover slips and other common glasswares were used in this experiment. Photographs were taken with using Nikon Labphot 2 Microscopic

Unit and Trinocular microscope. Acetone and methanol solvents and reagents used for staining different sections like Toluidine blue, Safranin and IKI-Lugol's iodine were procured from The Precision Scientific Co., Coimbatore, India.

#### Collection and authentication of study plant material

Aerial plant of *Cayratia pedata* var. *glabra* (fig. 1) were collected from Thiashola, Manjoor, Nilgiris South Division, Western Ghats and the voucher herbarium specimen was processed followed by standard methods Jain and Rao [4]. The collected plants were identified with the help of the existing Floras [5-7] and compared with type specimens available in the herbarium of Botanical Survey of India, Southern Circle, TNAU Campus, Coimbatore (No. BSI/SRC/5/23/2010-11/Tech. 1300), Tamil Nadu and the type specimens were deposited for further reference.

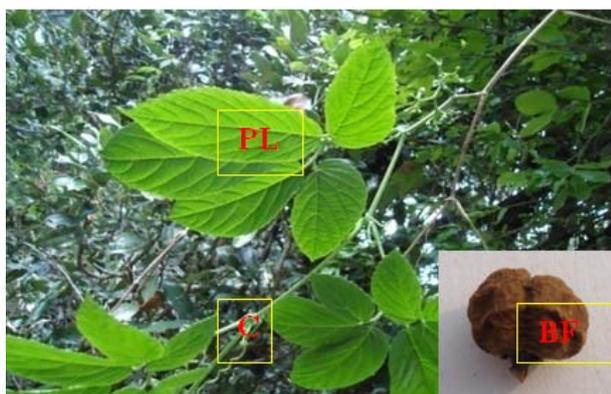


Fig. 1: Flowering twig of *Cayratia pedata* var. *glabra*, PL: Pedate Leaf; C: Climber; BF: bilobed fruit

#### Macroscopic and histological studies

The macroscopy and microscopic studies of this plant were carried out according to the method of [8-9]. Fresh and healthy stem and tendrils were separated from the plant and thoroughly washed with running water to remove the adherent impurities for anatomical studies. Some quantities of leaves and total aerial parts were air dried, powdered and stored in airtight containers for further studies. Fresh tendrils and stem were used for freehand section cutting and were fixed in FAA and dehydrated with TBA as per the schedule is given by Sass [10]. The paraffin-embedded specimens were sectioned with the help of Rotary Microtome. Dewaxing of the sections was done by customary procedure Johansen [8]. The sections were stained with Toluidine blue, Safranin and IKI-Lugol's iodine as per the method of O'Brien [11]. After clearing the T. S various microscopical studies were carried out in the study plant. Photographs of different magnifications were taken with NIKON ALPHA PHOTO-2 microscopic unit. Brightfield was used for normal observations whereas polarized light was employed for the detailed study of crystals and starch grains. Descriptive terms of the anatomical features are taken from the standard anatomy book [12].

#### Physico-chemical and extractive (%) analysis

The parameters like quantification of minerals, vitamins and heavy metals were studied according to the official method [13-15] and the WHO guidelines on quality control methods for medicinal plants material [16]. The air-dried, powdered plant material was extracted in Soxhlet apparatus successively with different solvents in the increasing order of polarity [Acetone (56.5 °C), Methanol (64.7 °C) and Water (99.98 °C)]. The extracts were evaporated using a rotary evaporator and water extract with a freeze dryer. The residues were weighed and it is used for the prediction of yield percentage (%).

#### Preliminary phytochemical screening

Phytochemical screening of different successive solvent extracts was carried out using the standard procedure described by Kokate et al. [17].

#### GC/MS analysis

##### Extraction of essential oil

The essential oil was extracted by hydrodistillation method. The fresh leaves of *C. pedata* var. *glabra* were collected (500 g) and placed in round bottom flask of the Clevenger type apparatus with water. The oil was hydrodistilled 3-4 h in this apparatus. The resulting oil was collected, preserved in a sealed sample tube and stored under refrigeration until analysis.

##### GC MS conditions

The essential oil was subjected to GC-MS analysis on the instrument-THERMO MS DSQ II-TR, 5-MS capillary standard non-polar column and the GC-MS trace ultra-version 5.0 software employing the following conditions: RT x 5 MS column (30x0.25 mmIDx1μM df, composed of 100% Dimethyl poly diloxane). Initially, oven temperature was maintained at 70 °C for 2 min, and the temperature was gradually increased up to 250 °C at 10 and 1μL of the sample was injected for analysis. Helium gas 99.995% of purity was used as a carrier gas as well as an eluent. The flow rate of helium gas was set to 1 ml/min. The sample injector temperature was maintained at 250 °C and the split ratio is 10 throughout the experiment periods. The ionization mass spectroscopic analysis was done with 70 eV. The mass spectrum was recorded for the mass range 40-1000 m/z for about 35 min. Identification of components was based on a comparison of their mass spectra. The identification of compounds was based on the comparisons of their mass spectra with NIST Library 2008 WILEY8, FAME. Total GC running time is 48.51 min [18].

#### RESULTS AND DISCUSSION

To ensure the quality of herbal products, proper control of starting material is utmost essential. Various techniques are used for the standardization of medicinal plants of therapeutic potential. But identification and evaluation of plant drugs by pharmacognostical studies is still more reliable, accurate and inexpensive.

##### Macroscopic characteristics

*C. pedata* var. *glabra* is a large, fragile liana. The leaves are alternate, pedately 5 foliolate (8-15 cm) long and grows up to a height of (8-12 m) with nodes and internodes. Leaflets are elliptic, oblong, serrate (7-12 leaflets; 3-6 cm long) and an acuminate apex. Leaves are dark green in colour with characteristic odour and bitter taste. Fruits are slightly green in colour, the fleshy and bilobed shape at its apex. Fruit shape is the important differentiable characterization among the other genus. Several earlier workers have adopted macroscopical features as one of the effective parameters for the pharmacognostical identification of several plant-derived crude drugs.

##### Anatomical description of tendril

The tendril superficially resembles a young stem. In transactional view, it is circular (1.75 mm thick) with a wavy outline (fig. 2A and 2B). It consists of a thin continuous epidermal layer of small semicircular cells with prominent cuticle. The cortex consists of outer wide patches of collenchyma alternating with the narrow bridge of parenchymatous cells in the furrows (fig. 2B). The inner cortex consists of two or three layers of parenchyma cells and prominent, discrete circular masses of fibres. The fibres are thickly walled and lignified. The vascular cylinder is thin (150 μm thick), wide and hollow enclosing wide parenchymatous pith. It comprises most thick walled lignified radial, parallel files of fibres; vessels restricted to a few elements situated along the inner border of the xylem cylinder (fig. 2B). Ploem occurs in a thin layer on the outer periphery of the xylem cylinder. Botanical identification of a phytodrug involves two steps. One is the identification of the plant by its floral characters and the other is a diagnosis of the plant with its microscopic characters. The latter procedure is useful for identification of fragmentary plant specimens. Certain microscopical characters are vulnerable for changes due to environmental stress. Yet, there are many anatomical features that are least modified by external factors and such features are specific at the species level or genus and family level. Early plant morphologist Robert Hook [19] clearly demonstrated that each kind of plant has its own distinctive structure by means of which it can be recognized.

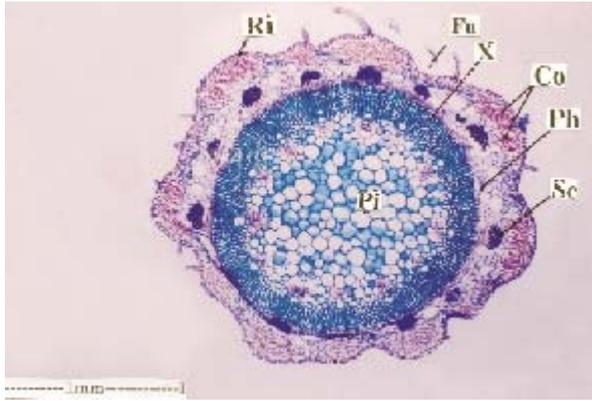


Fig. 2A: T. S of Ground plan view of Tendril

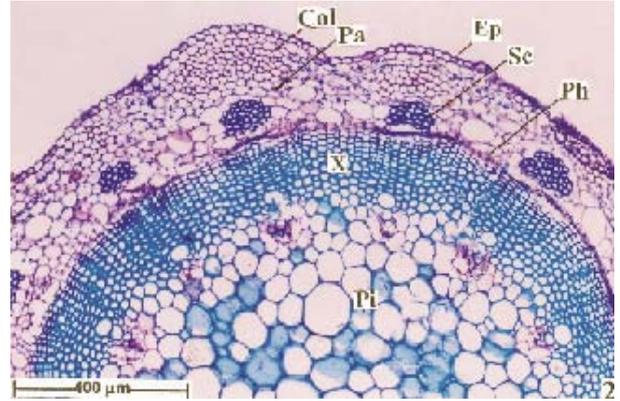


Fig. 2B: T. S of sector enlarged view of Tendril

Co: Cortex; Col: Collenchyma; Ep: Epidermis; Fu: Furrow; Pa: Parenchyma; Ph: Phloem  
 Pi: Pith; Ri: Ridge; Sc: Sclerenchyma; X: Xylem

**Anatomical description of old stem**

The old stem is circular in outline (3.5 mm thick) with an even surface, ridges and furrows have disappeared due to growth in thickness. It has undergone considerable quantum of secondary growth. The epidermis is intact and has not broken at any part of the stem. The cortex has outer, stretch masses of fibres and narrow parenchyma tissue lying in between the sclerenchyma masses. Semicircular discrete masses of fibres are located in a regular circle around the vascular cylinder. The fibres have thick lignified walls (fig. 3A and 3B). This is in corroboration with the work of [20]. The

vascular cylinder consists of fairly wide phloem tissue which occurs all around the xylem cylinder. It is interrupted by slightly dilated phloem rays (fig. 3C). Xylem cylinder is thick and continuous short rows of primary xylem occur along the inner border of the xylem cylinder. The secondary xylem includes wide, circular, thin-walled, mostly solitary vessels and ground tissue of thin-walled, lignified fibres. The fibres occur in regular radial files (fig. 3C).

The diameter of the vessels ranges from 80 to 200 μm. Wheeler and LaPasha and Pragasam [21, 22] observed that anatomy of *Cissus* sp. supports the close relationship with *C. pedata* var. *glabra*.

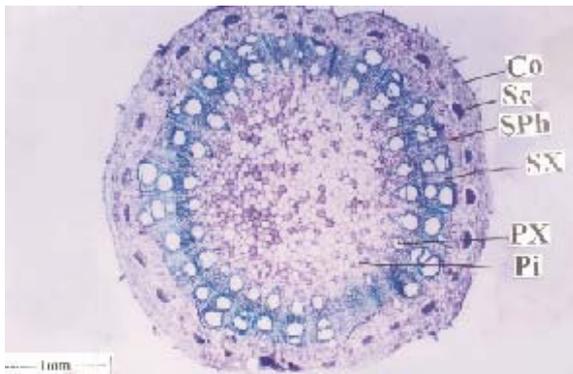


Fig. 3A: T. S of Ground plan view of old stem

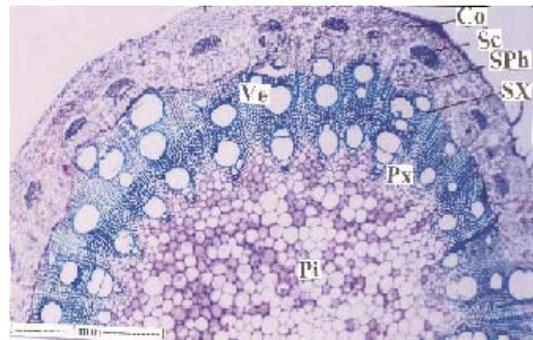


Fig. 3B: T. S of sector enlarged view of old stem

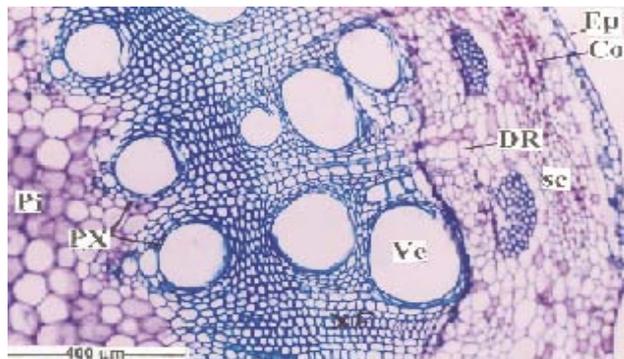


Fig. 3C: T. S of sector further enlarged view of old stem

Co: Cortex; Ep: Epidermis; DR: Dilated Ray; Pi: Pith; PX: Primary Xylem; Sc: Sclerenchyma  
 Ve: Vessel; XF: Xylem Fibres`

## Physico-chemical analysis

### Estimation of minerals

The availability of macro and micro elements were studied in plant powder (ash) of *C. pedata* var. *glabra* and the observed results are presented in table 1. The concentration of macro and micro elements was as follows. Calcium (34.50 mg/100 g), magnesium (1.24 mg/100 g), sodium (0.56 mg/100 g), potassium (11.45 mg/100 g), manganese (4.56 mg/100 g), zinc (0.11 mg/100 g), iron (2.67 mg/100 g) and copper (0.98 mg/100 g). Among the various macro elements, calcium and potassium were present in high amount. The microelement manganese (4.56 mg/100 g) was significantly higher in *C. pedata* var. *glabra* than the others. Likewise, the elements such as K, Ca, Zn, Na, Fe, Pb, Cd, Cu, Mg, Cr and Co in root powder of *C. quadrangularis* were analysed by [23].

Calcium is necessary for neuromuscular mechanism [24], dietary supplements of Mg have been reported to be effective in treating depression [25], sodium maintains the osmotic pressure, irritability of muscle, permeability of the cell and heartbeat, glucose absorption [25], potassium deficiency leads to stroke, diabetes and hypertension [26], Mn deficiency, results in young ones with ataxia, bone deformities and liver arginase activity in animals [25], Zn deficiency includes hepatic porphyria and proteinuria, wound healing, lesions of skin, dwarfism and hypogonadism [27], deficiency of iron results in hypochromic nutritional anemia and ulcerative lesion in the gastrointestinal tract [25] and deficiency of Cu may produce hepatolenticular degeneration of Wilson's disease [24]

**Table 1: Mineral values of *C. pedata* var. *glabra* powder**

Minerals	Values (mg/100 g) dry weight #
Macroelements	
Calcium	34.5±1.74
Magnesium	01.24±0.08
Sodium	00.56±0.00
Potassium	11.45±8.14
Microelements	
Manganese	04.56±1.54
Zinc	00.11±0.07
Iron	02.67±0.57
Copper	00.98±0.43

#Values are means of three independent analysis ±S tandard Deviation

### Estimation of vitamins

Vitamins are organic compounds required for growth and maintenance of life, functioning as regulatory substances by performing specific functions and are essential. The fat soluble and water soluble vitamins were found in *C. pedata* var. *glabra* plant powder. The results are presented in table 2. The fat-soluble vitamin A-retinol (156.8 iu) was higher than water-soluble vitamin B<sub>2</sub>-riboflavin (1.14 iu) followed by vitamin B<sub>3</sub>-niacin (0.67 iu), vitamin B<sub>1</sub>-thiamine (0.56 iu), niacinamide-(0.56 iu) and vitamin B<sub>12</sub>-cyanocobalamin (0.0013 iu) respectively. Vitamin E (tocopherol), vitamin B<sub>5</sub> (pantothenic acid) and vitamin B<sub>9</sub>. (folic acid) were occurred in traces.

Vitamin A and β-carotene are unique radio-protective agents (Levenson et al., 1984). Vitamin A helps to maintain good sight and prevents eye diseases. Both the vitamins have antioxidant property [28]. Vitamin B<sub>12</sub> is the largest and the most complex of all the

vitamins. Cobalamin is the term used to refer to a group of cobalt-containing vitamins [29].

**Table 2: Estimation of vitamins in the plant powder of *C. pedata* var. *glabra***

Vitamins	Values (iu) #
Vitamin A	156.8±49.4
Vitamin E	In traces
Vitamin B <sub>1</sub>	0.56±0.46
Vitamin B <sub>2</sub>	1.14±0.09
Vitamin B <sub>3</sub>	0.67±0.57
Vitamin B <sub>5</sub>	In traces
Vitamin B <sub>12</sub>	0.13±0.01
Niacinamide	0.56±0.61
Folic acid	In traces

# Values are means of three independent analysis±Standard Deviation

### Estimation of heavy metals

Table 3 showed the concentration of heavy metals found in plant powder of *C. pedata* var. *glabra*. The concentration of Lead was less than 1 ppm and chromium occurred in traces. The other heavy metals like mercury, cadmium and arsenic were totally absent. Chromium deficiency leads to arteriosclerotic heart diseases [30], accelerating insulin utilization of glucose, maintains the normal cholesterol level in blood, incorporation of amino acids in heart muscle [25]. The less than 1 ppm of lead, nil amount of mercury, cadmium and arsenic and traces of chromium in the sample analysed indicating the water pollution free edaphic condition of Thiashola forest.

**Table 3: Estimation of heavy metals in the plant powder of *C. pedata* var. *glabra***

Heavy metals	Values (ppm)
Lead	<1
Mercury	Nil
Cadmium	Nil
Arsenic	Nil
Chromium	In traces

### Prediction of yield percentage

The air-dried, the powdered sample was extracted with different solvents for the phytochemical and pharmacological studies. The yield of different solvent extracts during successive solvent extraction was calculated and presented in table 4. The percent yield was maximum in methanol extract (11%) followed by water extract (10%). The acetone extract shows minimum yield (7.5%). The above findings indicated the concentration of secondary metabolites [20].

### Qualitative phytochemical screening

The preliminary phytochemical screening revealed the presence of alkaloids, flavonoids, glycosides, phenols and tannins, steroids and sterols, triterpenoids and volatile oil. The chloroform extract was more efficient than ethanol (table 5). All extracts showed the negative response to saponins. The preliminary data collected in the present study helped in the preparation of an authentic preliminary phytochemical profile.

**Table 4: Extractive values of *C. pedata* var. *glabra* powder in various solvents**

Method of extraction	Solvents used	Yield (%) #
Continuous hot percolation using Soxhlet apparatus	Acetone	7.50±1.21
Hot and cold maceration	Methanol	11.0±2.00
	Water	10.0±2.00

# Values are means of three independent analysis±Standard Deviation

## Screening of plant powder extracts

Chemical constituents	Chemical tests	Chloroform extract	Ethanol extract
Alkaloids	Dragendorff's reagent	-	-
	Mayer's reagent	+	-
	Wagner's reagent	+	-
Anthroquinones	Borntrager's test	-	-
	Alkaline reagent test	+	+
Flavonoids	Zinc hydrochloride test	+	+
	Borntrager's test	+	+
Glycosides	Ferric chloride test	+	+
	Foam test	-	-
Phenols and tannins	Salkowski test	+	-
	Sulfur test	-	-
Saponins	Libermann-Burchard test	+	+
	Sudan test	+	-
Steroids and sterols			
Triterpenoids			
Volatile oil			

Note: '+', '-' indicates the presence/absence of compounds

## Gas chromatography/Mass spectrometry (GC/MS) analysis

The components present in the essential oil of *C. pedata* var. *glabra* leaves were identified by the GC-MS analysis. The GC-MS Chromatogram of the number of peaks of the compounds detected was shown in fig. 4. This analysis reveals the presence of phytoconstituents belonging to the type-acids, esters, alcohols, ethers, hydrocarbons, alkane, fatty acids etc. The identified compounds of the essential oil their retention indices, percentage composition, chemical structure and activities are given in table 6 and 7. Fifteen compounds were detected from the essential oil of *C. pedata* var. *glabra*. The results showed the presence of Heptadecane

(17.36%), Silane, trichlorooctadecyl (17.29%), Eicosane (15.44%), Heptane, 2,2,3,3,5,6,6-heptamethyl (14.71%), n-Tetradecyltrichlorosilane (13.64%), Pentadecane (10.55%), Iron, tricarbonyl [N-(phenyl-2-pyridinylmethylene) benzenamine-N, N'] (10.91%) and Octadecane (8.93%) were the other major compounds present (table 6). Table 7 lists the major phytoconstituents and their chemical structure and biological activities obtained through the GC-MS studies. The predominant compounds have the property of antioxidant, antifungal, antibacterial, antiallergic, chemopreventive and anti-cancer activity. The biological activities listed are based on Dr. Duke's phytochemical and ethnobotanical databases by Dr. Jim Duke of the Agricultural Research Service/USDA.

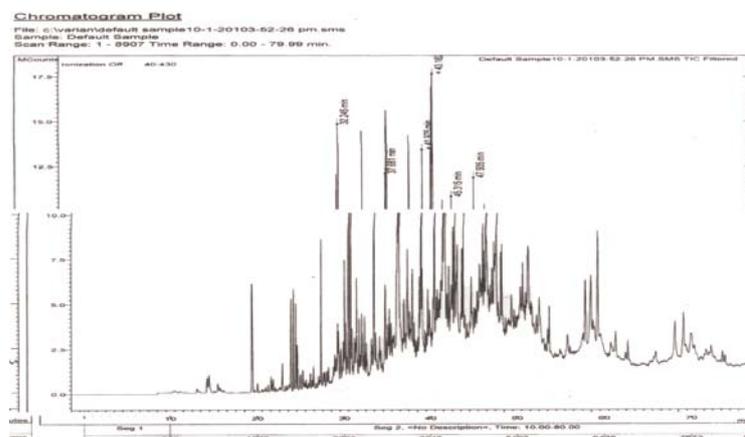
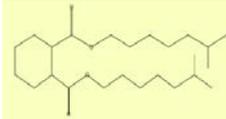
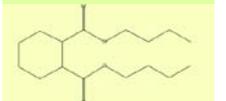
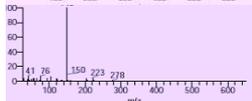
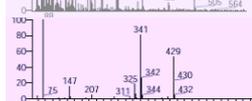
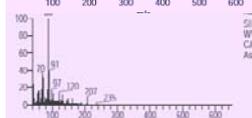
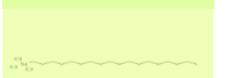
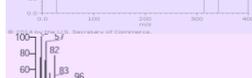
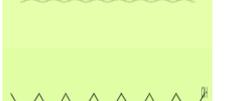
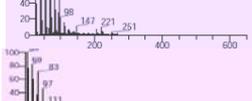
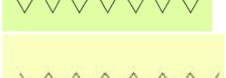
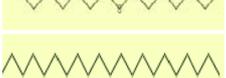
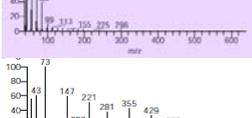
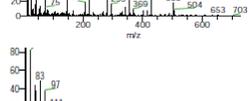
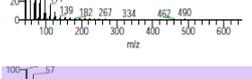
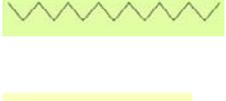
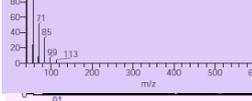


Fig. 4: Chromatogram profile of essential oil of *C. pedata* var. *glabra*

Table 6: GC/MS analysis of essential oil of *C. pedata* var. *glabra*

RT (Min)	Chemical compounds	Molecular formula	Molecular weight	Peak area (%)
18.14	1,2-Benzenedicarboxylic acid, diisooctyl ester	C <sub>24</sub> H <sub>38</sub> O <sub>4</sub>	390	1.26
21.47	Neophytadiene	C <sub>20</sub> H <sub>38</sub>	278	3.67
26.71	Dibutyl phthalate	C <sub>16</sub> H <sub>22</sub> O <sub>4</sub>	278	6.27
32.24	Silane, trichlorooctadecyl	C <sub>18</sub> H <sub>37</sub> Cl <sub>3</sub> Si	386	17.29
33.17	Cyclohexasiloxane, dodecamethyl	C <sub>12</sub> H <sub>36</sub> O <sub>6</sub> Si <sub>6</sub>	444	1.89
35.63	5-Benzyloxymethyl-2,2-dimethyl-1,3-dioxolan-4-yl ester of (4R,5R)-p-Toluenesulfonic acid	C <sub>21</sub> H <sub>26</sub> O <sub>6</sub> S	406	1.90
36.12	n-Tetradecyltrichlorosilane	C <sub>14</sub> H <sub>29</sub> Cl <sub>3</sub> Si	683	13.64
37.68	Heptadecane	C <sub>17</sub> H <sub>36</sub>	240	17.36
39.44	1-Tetradecanol (CAS)	C <sub>14</sub> H <sub>30</sub> O	214	5.48
41.97	Heptane, 2,2,3,3,5,6,6-heptamethyl	C <sub>14</sub> H <sub>30</sub>	198	14.71
43.18	Eicosane	C <sub>20</sub> H <sub>42</sub>	282	15.44
45.31	Iron, tricarbonyl [N-(phenyl-2-pyridinylmethylene) benzenamine-N, N']	C <sub>21</sub> H <sub>14</sub> FeN <sub>2</sub> O <sub>3</sub>	398	10.91
46.91	Octadecane	C <sub>18</sub> H <sub>38</sub>	254	8.93
47.03	Pentadecane	C <sub>15</sub> H <sub>32</sub>	212	10.55
47.93	phenylmethyl ester	C <sub>23</sub> H <sub>38</sub> O <sub>2</sub>	346	9.97

Table 7: Mass spectrum and structure of phytochemicals identified by GC-MS analysis

Chemical compounds	Structure	Hit spectrum	Nature of compound	Activity
1,2-Benzenedicarboxylic acid, diisooctyl ester			Ester	Endocrine disruptors
Neophytadiene			Hydrocarbon	Antioxidants, antibacterial activity
Dibutyl phthalate			Plasticizer	Urinary infection, Antioxidants Antimicrobial, Antifouling
Silane, trichlorooctadecyl			Inorganic compound	Anticancer
Cyclohexasiloxane, dodecamethyl			Silicon compound	Increase the risk of neoplasms in humans
5-Benzyloxymethyl-2,2-dimethyl-1,3-dioxolan-4-yl ester of (4R,5R)-p-Toluenesulfonic acid			Ester	Intracellular calcium mobilization
n-Tetradecyltrichlorosilane			Amino Alcohols	Anticancer
Heptadecane			Alkane hydrocarbon	Antimicrobial activity, antioxidant activity
1-Tetradecanol (CAS)			Primary aliphatic alcohols	Reduction of myristic acid, antimicrobial activity
Heptane, 2,2,3,3,5,6,6-heptamethyl			Alkane	Antiallergic agents
Eicosane			Alkane	Antioxidant
Iron, tricarbonyl [N-(phenyl-2-pyridinylmethylene) benzenamine-N, N']			Derivative of aniline	Fungicidal activity
Octadecane			Hydrocarbon polymer	Antimicrobial, anticancer, anti-inflammatory, scavenging activity
Pentadecane			Organic compound	Antimicrobial activity, anticancer, antioxidant activity
Phenylmethyl ester			Fatty acid	Central nervous system stimulant, antioxidant, Hypocholesterolemic, Nematicide

The mass spectra are fingerprint of that compound which can be identified from the data library. The spectra of the compounds were matched with Wiley 9.0 and National Institute of Standards and Technology libraries.

This report is the first of its kind to analyze the chemical constituents of essential oil of *C. pedata* var. *glabra* using GC-MS analysis. Similar observations were made by Muhammad Athar Abbasi et al. [31, 32].

**CONCLUSION**

The pharmacognostic details obtained in the present study will facilitate in providing authentic scientific characterization and identification of *C. pedata* var. *glabra* used in indigenous medicines. Such parameters also help in establishing pharmacopeial standards which are urgently required not only for the survival of age-old traditional system of medicines but also in view of the fact that these systems are attaining global importance. This simple but reliable standardization will be useful to a layperson in using the drug as a home remedy and also in the pharmaceutical industry for testing the raw material. A pharmacognostical standard serves as a reference piece and helps in the further identification and authentication of this taxon. The presence of various bioactive compounds confirms the application of *C. pedata* var. *glabra* for various ailments by traditional practitioners. However, isolation of individual phytochemical constituents may proceed to find a novel drug.

**CONFLICT OF INTERESTS**

We declare that we have no conflict of interest

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