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Original Article

SCIENTIFIC VALIDATION AND STANDARDIZATION OF PARPATAKA AN AYURVEDIC DRUG WITH RESPECT TO *FUMARIA INDICA*

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ABSTRACT

Objective: *Fumaria indica* is an essential curative herb and asserted as a prevalent weed across the plains of India. The entire plant is popularly employed in conventional systems of medicine for its therapeutic activities like anthelmintic, diuretic, diaphoretic, laxative, purging and stomachic. The entire plant is regarded to have therapeutical purposes in Ayurvedic and Unani systems of medicine and is employed in the preparation of important Ayurvedic formulation Parpataka. In Unani systems of medicine, it is used as shahtara. This contemporary study is intended to authenticate and validate the species *Fumaria indica* with respect to Parpataka drug.

Methods: The chief objective of this contemporary research work is to assess the various pharmacognostic properties like Macroscopical, Microscopical, Physiochemical and Fluorescence studies. Microscopical studies include cell structure and their arrangement, Physicochemical parameter s include loss on drying, total ash value, acid insoluble ash, water-insoluble ash, various extractive values etc. Qualitative tests for various functional groups were also carried out.

Results: The microscopical characters of leaf, stem and roots, physicochemical, preliminary phytochemical profiles were established.

Conclusion: The pharmacognostical screening on *Fumaria indica* is significant data for the identification and to determine the quality and purity of the plant material in future reviews.

Keywords: Parpataka drug, *Fumaria indica,* Macro and microscopical studies

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INTRODUCTION

Fumaria indica is diuretic, diaphoretic, aperient, laxative and anthelmintic. It is used in low-grade fevers, to purify the blood and also in skin disorders. The plant is bitter, cooling, expectorant, relieves constipation, increases vata, removes indigestion, biliousness, burning of the body, tired feeling, intoxication, urinary discharges, vomiting, thirst, enriches the blood and good in leprosy. Leaves are bitter, cooling, constipating, easily digested, cure bilious fevers, blood diseases, alley thirst, stop wandering of mind [1-2].

The drug is sold in Indian bazars under the name SHAHTERAH or PITPAPRA and used in stomach disorders, liver complaints and skin affections. The dried aerial parts of the *F. vaillantii* Loisel, are used as a substitute for fumitory in North India [3]. It is used in Ayurveda against fevers in Punjab and North India [4]. It is prescribed in the Siddha system of medicine, diuretic, stomachic, purifies the blood in skin diseases, strengthens the teeth and gives luster to the eyes, stops vomiting, good in diseases of the spleen [5]. It is used in Europe as an alternative, aperient, and antifebrile drug in Spain; it is given in visceral obstructions, scorbutic affections and in various eruptive diseases [6].

According to *the Ayurvedic Formulary of India* [7], *Fumaria indica* is the accepted source of the parpataka drug. Some others equate it with *Rungia repens* of the family Acanthaceae [8]. This is the Parpataka of Gujarat and Saurashtra. Other plants equated with the drug are *Polycarpaea corymbosa* (Caryophyllaceae), *Rostellularia procumbens* (Acanthaceae), *Glossocardia linearifolia* (Asteraceae) and *Mollugo stricta* (Molluginaceae) [9].

In Kerala, however, none of these is accepted as a source of the drug. Instead, three closely similar species of *Hedyotis (Oldenlandia), Hedyotis brachypoda (O. brachypoda), H. corymbosa (O. corymbosa)* and *H. diffusa (O. diffusa)* are generally accepted [10]. It is evident that, a great controversy in the identification of parpataka drug is noticed. In this connection, the present study was planned to evaluate pharmacognostical profiles of whole plant, which includes macroscopical, microscopical, physicochemical, phytochemical and fluorescence studies. Physicochemical parameters are the important characteristic features of a drug and with the help of this; we can detect the extent of adulteration as well as establish the quality and purity of the drug. There is a considerable difference in the ash values and extract values of different drugs but mostly the difference varies within narrow limits in case of the same drug.

MATERIALS AND METHODS

The plant specimens, constrained to the present study, were solicited from Hill ranges of Dehradun, Uttarakhand state. It was examined with Herbarium specimen: K. M. Matthew, 166985 (MH) Maximum care was taken in collecting healthy plants. From a healthy sample, different organs were separated meant for the study. Then the separated samples were fixed in FAA. The collected samples were allowed to dehydrate with a graded series of tertiary butyl alcohol only after 24 h of fixation [11]. Then infiltration of samples was carried out by the progressive addition of paraffin wax (m. p. 58-60OC) until TBA solution attained supersaturation. The specimens were permitted to make into paraffin blocks.

Sectioning [11-18]

The selected samples, which are inserted in the paraffin wax, was sectioned with Rotary Microtome. The section with the thickness of 10-14 µm was de-waxed and stained with Toluidine blue. Lignified cells generate blue color, cellulose wall become pink color, suberin becomes dark green, mucilage becomes violet, protein bodies produce blue color etc. and also the necessary sections were stained

with safranin, fast green and IKI (for starch). Since Toluidine blue is a polychromatic stain, the staining results were exceptionally good, and some cytochemical reactions were also obtained. Photomicrographs Microscopic Pictures of different tissues at multiple magnifications were taken with help of Nikon photomicroscopic unit. Polarized light was utilized for the study of crystals, starch grains, lignified cells, and the bright field was used for normal observations. Scale bars in pictures indicated the microscopic magnification [8].

Physico-chemical studies

Physical constants like ash values were calculated according to the standard methods [19-23].

Fluorescence studies

It is one of the essential studies for quality control of drugs and valuable in preparing the standards of the quality of the powdered drug. The fluorescence study of powdered drugs as a method of identification seems to possess distinct probabilities of practical application.

Preliminary phytochemical studies

The whole plant was thoroughly washed and a sufficient quantity of the sample was collected and chopped off into small pieces and shade dried. The dried parts were pounded to make a coarse powder and stored in polythene containers for further analysis.

Alkaloids

The methanol extracts were evaporated to dryness and the residue obtained was digested with 1% hydrochloric acid. The resulting acidic solution was divided into two parts. To one part was added Mayer's reagent and to the second part Dragendorff's reagent. Appearance of precipitate or turbidity indicates the presence of alkaline preparation of reagents.

a. **Mayer's reagent:** 1.3 g of mercuric chloride and 5g of potassium iodide were dissolved separately in 60 ml and 10 ml of double distilled water and both the solutions were mixed and diluted to 100 ml.

b. **Dragendorff's reagent:** 8 g of the bismuth nitrate was dissolved in 20 ml of con. nitric acid and 27.2 g of potassium iodide in 50 ml of double distilled water. Both the solutions were allowed to stand till KIO_3 crystallized out. Supernatant was decanted and the final volume was adjusted to 100 ml.

Flavonoids (Shinoda's test)

a. The plant extract was tested for flavonoids by Shinoda's reaction. To a few ml of methanolic extract, con. hydrochloric acid, magnesium powder and a few fragments of magnesium metal were added. The presence of flavonoids was identified by the development of pink or magenta or red coloured flame.

b. To a few ml of methanolic extract, 10% sodium hydroxide solution and ammonia were added. Dark yellow colour indicates the presence of flavonoids.

Terpenoids (Noller's test)

To 1 ml of the methanolic extract with tin (one bit) and thionyl chloride was added. Appearance of pink colour indicates the presence of terpenoids.

Liebermann-Burchard's test

The Liebermann Burchard's reaction was carried out by adding 0.5 ml of H_2SO_4 along the side of the test tube containing a mixture of methanolic HCl and acetic anhydride (0.5 ml each). Formation of colour from green to bluish-green (sometimes via red or blue) indicates the presence of terpenoids.

Detection of steroids (Liebermann–Burchard's test)

To 1 ml of extract 0.5 ml of chloroform, 5 ml of acetic anhydride and 5 ml of acetic acid added, followed by a few drops of con. H_2SO_4. Development of blue-green colour indicates the presence of steroids.

Detection of saponins

To 1 ml of the extract, 5 ml of tap water was added and shaken vigorously. Formation of honeycomb, like froth, indicates the presence of saponins.

Detection of tannins

The methanolic extract was concentrated and the residue was dissolved in water and tested with 1% gelatin solution and 1% of gelatin salt solution (1 g gelatin dissolved in 10 g NaCl w/w) to separate volumes. The appearance of white precipitate indicates the presence of tannins.

Proteins (Biuret test)

A small quantity of extract dissolved in few ml of water, equal column of 5% sodium hydroxide and 1% copper sulphate solution was added. Formation of violet purple colour indicates the presence of proteins.

Carbohydrates

a. The extract was mixed with Fehling's solution I and II and examined for the appearance of red coloration for the presence of sugars.

b. **Molish Test**: To the methanolic extract, α-naphthol solution was added. Then conc. H_2SO_4 was added gently along the walls of the inclined test tube. Formation of a red to violet colour indicate the presence of carbohydrates.

Phenolic compounds

To 1 ml of the extract, 2 ml of distilled water was added followed by 1-4 drops of 1% aqueous ferric chloride. Appearance of blue or green colour indicates the presence of phenols.

Anthocyanidins

The formation of red or purple colour in the plant extract, on adding an equal volume of methanolic HCl was taken as a positive reaction for anthocyanidins.

Anthraquinones

Twenty ml of benzene was added to 5 g of plant powder and filtered. To the filtrate 5 ml of 10% ammonium hydroxide solution was added and shaken well. The formation of pink, red, violet colour in the ammonical phase indicate the presence of anthraquinones.

Lignans

a. The plant extract was tested for the presence of lignans by adding con. HCl and 2% formaldehyde. Development of red colour indicates the presence of lignans.

b. The development of violet colour in the methanolic extract on adding Enrilich reagent is considered as a positive reaction test.

Indoles

The development of violet colour in the methanolic extract on adding Enrilich reagent is considered as a positive reaction test.

Quinones

To 1 ml of extract 1 ml of con. H_2SO_4 was added. Formation of red colour shows the presence of quinones.

Glycosides

The extract was mixed with a little anthrone on a watch glass. One drop of con. H_2SO_4 was added and made into a paste, warmed gently over the water bath. The presence of glycosides was identified by dark green colour.

Test for gums

The extract mixed with water gives the thickening of the substances, indicates the presence of gum.

Test for fixed oil

A small quantity of powder/extract pressed between the filter papers. Formation of grease spot indicates the presence of fixed oils and fats.

Test for reducing sugars

To 5 ml of extract, 5 ml of benedicts reagent was added. The tubes were incubated in boiling on a water bath for 10-30 min. The formation of an orange-red precipitate indicated the presence of reducing sugars.

RESULTS

Taxonomy: (Plate 1)

***Fumaria indica* (Hausskn.) pug**

Family: Fumariaceae

Regional names

Hin.: Pitpapra, Pitpapa, Pitpapda, Shahatra.

San.:Araka, Kalapanga, Charaka, Nakra,

Katupatra, Kavachanamaka, Krishnashakha, Ksheparpata, Panshu, Panshu Paryaya, Parpata, Parpataka, Pragandha, Pittari, Renu, Shita, Shitavallabha, Sutikta, Tikta, Trishnari, Triyashti, Varatikta, Varmakantaka.

Arab: Baglatul mulk, Bulslatul mulik, Sahatraja, shahtara

Ben.:Bansulpha

Bom.:Pitpatra

Chin.:Tuyshatuchain

Dec.:Pitpara, Shatra

Eng.:Fine-leaved fumitory

Ger.:Erdrauch

Guj.:Pattapapdo

Kan.:Parpataka

Kash.:Shahterah

Mar.:Pitpada

Nepa.:Kairuwa

Per.:Shahatra, Shatra

Sinh.:Pathapadagam

Tam.:Thura

Tel.:Chatharasi

Urd.: Shahtara

Abbreviations

Ara.: Arabic; Ben.: Bengali, Bom.: Bombay Presidency; Chin.: Chinese; Eng.: English; Cey.: Ceylon; Ger.: German; Fre.: French; Guj.: Gujarati; Hin.:Hindi; Kan.:Kannada, Kash.: Kashmiri; Mal.:Malayalam; Mar.: Marati; Nepa.: Nepali, Ori.: Oriya; Per.: Persian; San.: Sanskrit; Sinh.: Sinhalese, Tam.: Tamil, Tel.: Telugu, Urd.:Urdu

Part used: Whole plant.

Fumaria indica (Hausskn.) Pug. J. Linn. Soc. Bot. 44: 313. 1919. Jafri in Nasir and Ali, Fl. W. Pakistan 73: 39. 1974; Matthew, Ill. Fl. Tamil Nadu Carnatic t. 24. 1982. *F. vaillantii* Lois. J. Bot. (Desvaux) 2: 358. 1809, var. *indica* Hausskn. Flora 56: 443. 1873. *F. parviflora* ssp. *vaillantii* (Lois) Hook. f. Fl. Brit. India 1: 128. 1872. *F. parviflora* auct. non Lam: Wight and Arn. Prodr. fl. Ind. orient. 18. 1834; Wight, Ill. Ind. Bot. 5. 11 (bis) A: 1840; Gamble, Fl. Madras 1: 36(26), 1915: Fyson, Fl. s. Ind. hill stat. 19. 1932; Matthew, Mat. Fl. Tamil Nadu Carnatic 139. 1981.

Annual diffuse herb, branchlets grooved, puberulous. Leaves 2-3 pinnatisect, 5-7.5 cm, segments 0.5 to 1.5 cm, membranous, base obtuse, margin entire, apex acute, mucronulate, petiole 6 to 8 mm. Raceme terminal, leaf-opposed, to 2.5 cm, 10-16 flowered, peduncle to 4 cm, pedicel 2 mm. Flowers small, white or pink, with purple tips to the petals. Sepals 2, ovate to 2 mm. Petals 2+2 with purplish tips, oblong to 7 mm. Stamens diadelphous, 3+3, staminal sheath subulate above, to 4 mm. Ovary one-celled, ovoid, 1 mm, ovules 1 or 2, on parietal placentation, style filiform, to 4 mm, stigma 2-lobed. Fruits indehiscent, globose, to 2 mm, 1-seeded.

Fl. and Frt: October–March

Herbarium specimen examined: K. M. Matthew, 166985 (MH)

Distribution: India through to Central Asia. Lands in Telangana[23] and Vijayanagaram districts[24].

Macro and microscopical characters of root

Macroscopical characters

Roots are elongated, taproot thick, lateral roots are slender, root measures 0.2 cm in diameter, taste bitter.

Microscopical characters

Transverse section of the mature root is circular in outline and shows crushed cortex and secondary phloem measuring 100 μm in width. Surface is rough and shallow-fissured. Primary xylem is diarch and the secondary xylem occur in two broad triangular rings. Secondary xylem consists of vessels and xylem fibres. Vessels are wider, thick walled, angular and are mostly in radial multiples. Widest vessel is 100 μm in diameter and the narrow vessel is 30 μm in diameter. In between the two xylem wings and opposite to the protoxylem points, parenchymatous vascular rays are present (fig. 1).

Root-diagnostic characters

1. Presence of crushed cortex.
2. Diarch condition of xylem.
3. Secondary xylem occurs in two broad triangular wings.
4. Secondary xylem consists of thick radial bands of vessels and xylem fibres.

Macro and microscopical characters of stem

Macroscopical characters

Branches grooved, 0.3 cm in diameter, taste bitter and no specific odour.

Microscopical characters

Transverse section of the stem is uneven in its outline and shows epidermis, cortex and stelar region. There is a wide elliptical pith-canal surrounded by vascular bundles (fig. 2).

Epidermis is made up of narrowly oblong, thin-walled rectangular cells. Cortex is narrow less conspicuous. Around the circumference of the stem, three large fan-shaped vascular bundles and two smaller, radially elongated bundles lying in between larger ones. Larger bundles have wide band of radial rows of vessels and xylem fibres. Vessels are thin-walled, elliptical and in radial chains. Phloem occurs as a thin zone on the outer border of the bundle; small nests of fibres are also present in the cortex. There are about 10 cortical sclerenchyma strands all around the stem (fig. 3, 1.2). Smaller bundle has a few vessels and a small cluster of phloem. Ground tissue consists of large, thin-walled compactly arranged parenchymatous cells (fig. 3: 1, 2).

Stem-diagnostic characters

1. Cortex is narrow and less conspicuous.
2. Small nests of fibers are seen in the cortex
3. Ground tissue is made up of large, thin-walled compactly arranged parenchyma.
4. There is a wide elliptical pith-canal surrounded by vascular bundles.

Macro and microscopical characters of leaf

Macroscopical characters

Leaves dorsiventral 2-3 pinnatisect 5-7.5 cm, segments 0.5-1.5 cm, taste bitter and no characteristic odour.

Microscopical characters

Leaf is shrunken and the ground tissue is collapsed as a result of which the cross-sectional outline of the leaf is irregular. There is a prominent, fairly large median vascular bundle and two lateral vascular bundles. Xylem elements consist of wide, circular vessels. Ground tissue is made up of thin-walled parenchyma cells. (fig. 4.1) (fig. 4, 2.3)

Leaf-diagnostic characters

1. Xylem elements consist of wide, circular vessels.
2. Ground tissue is made up of thin-walled parenchymatous tissue.

Histochemical tests

The sections were treated with different reagents and the observations are provided in table 1.

Table 1: Histochemical tests

Drug	Reagents	Test for	Reaction	Results
Section	Iodine solution	Starch	Blue colour	+
Section	Ferric chloride solution	Tannin	Black	+
Section	Sudan III solution	Oil globules	No effervescence	-
Section	Phloroglucinol+dil. HCl+Alcohol	Lignin	Magenta	+
Section	Conc. HCl	Crystals	No effervescence	-

+= Present; -= Absent

Table 2: Powder characteristics

Name of the plant	Colour	Appearance	Odour	Taste
Fumaria indica	Pale brown	Fine powder	No Characteristic smell	Slightly bitter

Table 3: Powder analysis

Treatment	*Fumaria indica*
Powder treated with water	Non-sticky
Powder shaken with water	Foam like froth
Powder treated with 5% aqueous NaOH	Brown
Powder treated with 60% aqueous sulphuric acid	Reddish brown
Powder pressed between filter paper for 24 h	No oil stain

Table 4: Ash values

Name of the plant	Total ash (%)	Water soluble ash (%)	Alkalinity of water soluble ash (ml)	Acid insoluble ash (%)
Fumaria indica	21.7	4.32	2.17	6.84

Table 5: Extractive values

Name of the plant	Alcohol soluble extract (% w/w)	Water soluble extract (% w/w)	Hexane soluble extract (% w/w)	Chloroform soluble extract (% w/w)
Fumaria indica	1.6	3.90	0.9383	1.033

Table 6: Fluorescence analysis of various extracts

Extract	Treatment	*Fumaria indica*
Alcohol (ethanol)	Daylight	Yellowish green
	Short UV	Fluorescent yellow
	Long UV	Yellow
Water	Daylight	Reddish brown
	Short UV	Green
	Long UV	Black
Hexane	Daylight	Yellowish green
	Short UV	Fluorescent green
	Long UV	Pale green
Chloro-form	Daylight	Dark olive
	Short UV	Green
	Long UV	Black

+Present; -Absent

Table 7: Fluorescence analysis of *Fumaria indica*

Experiments	Visible/Day light	UV Light	
		254 nm	365 nm
Drug powder	Pale brown	Pale green	Dark brown
Drug powder+1 N NaOH (aq.)	Brown	Pale green	Black
Drug powder+1 N NaOH (alc.)	Brown	Green	Black
Drug powder+1 N HCl	Brown	Pale green	Black
Drug powder+50% H_2SO_4	Reddish brown	Green	Black
Drug powder+50% HNO_3	Reddish orange	Fluorescent green	Black
Drug powder+Picric acid	Brown	Fluorescent yellow	Yellow
Drug powder+Acetic acid	Brown	Green	Pale green
Drug powder+Ferric chloride	Green	Fluorescent green	Pale green
Drug powder+HNO_3+NH_3	Reddish orange	Fluorescent green	Pale yellow

Table 8: Preliminary phytochemical analysis

Name of the secondary metabolites	*Fumaria indica*
Alkaloids	+
Terpenes	+
Steroids	+
Tannins	+
Saponins	+
Flavonoids	+
Quinones	+
Anthraquinones	+
Phenols	+
Proteins	-
Carbohydrates	+
Glycosides	+
Gum	+
Fixed oils or Fats	+
Lignans	+
Anthocyanidins	+
Indoles	+
Reducing sugars	+

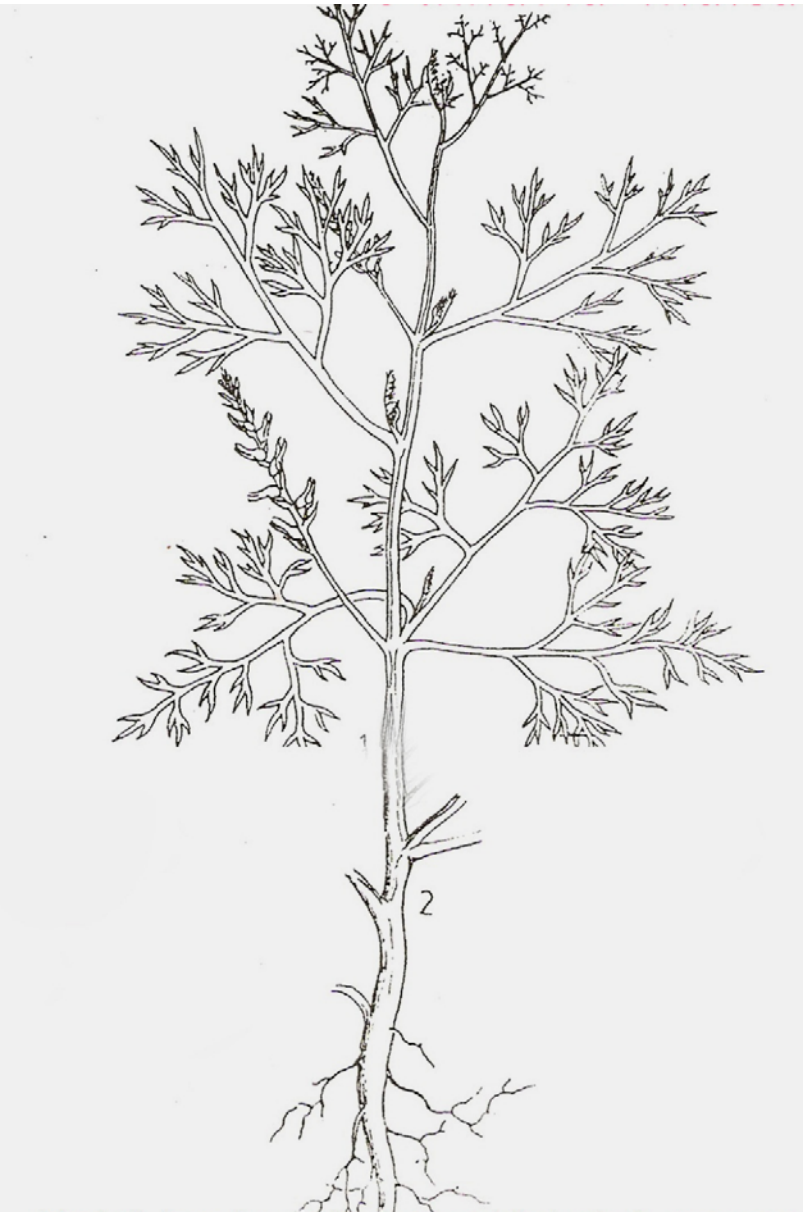
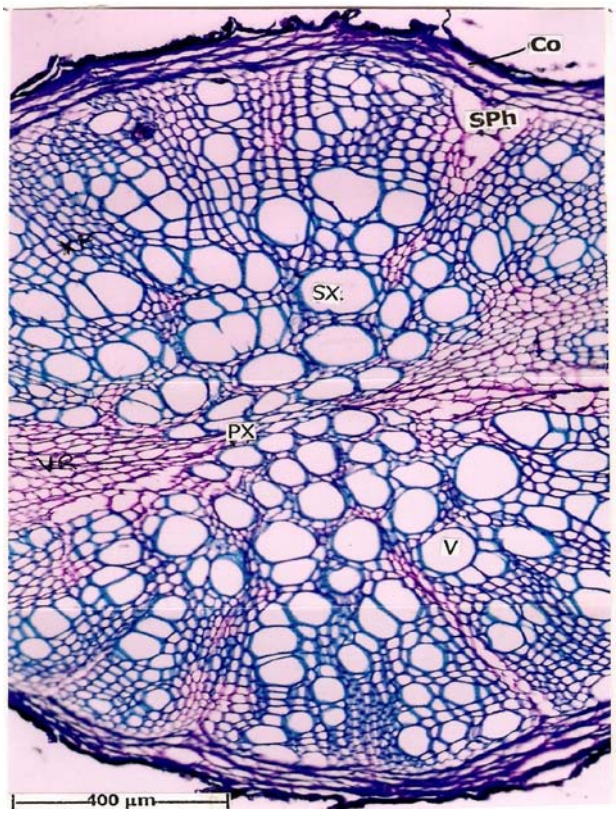
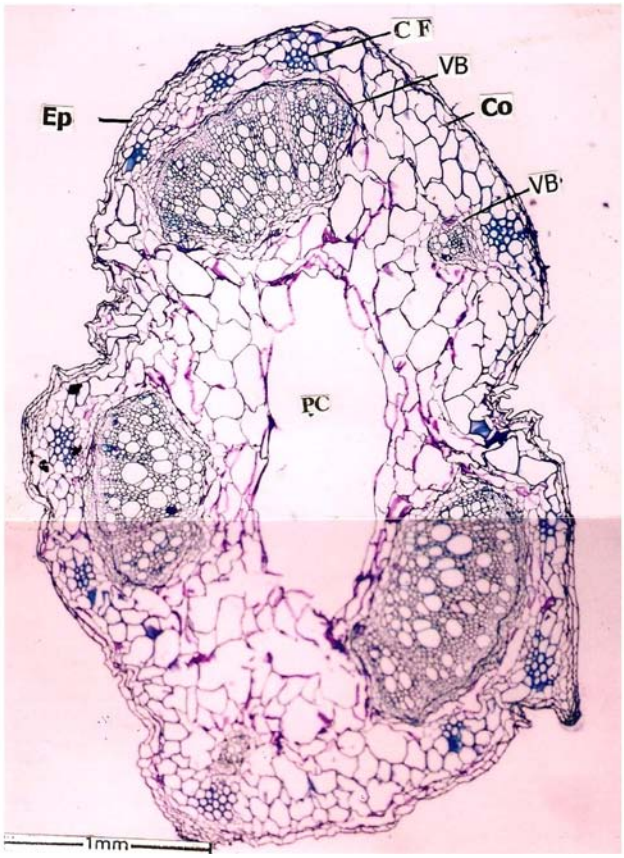


Plate 1: *Fumaria indica* (Hassk.) Pug. (Fumariaceae), Adopted from Ayurvedic Drugs and their plant sources V.V. Sivarajan and Balachandran. I (1994)



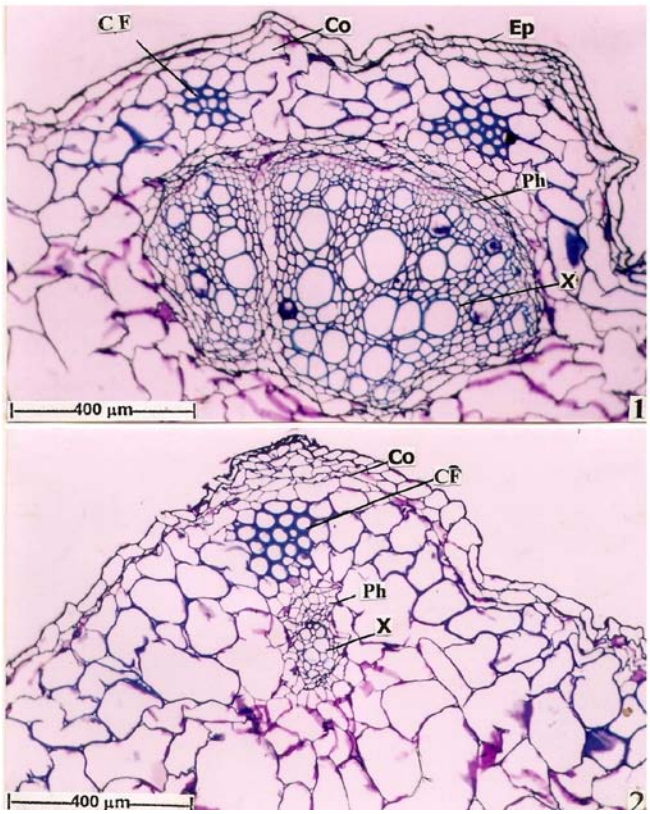
Fumaria indica

Fig. 1: Microscopical characters of Root



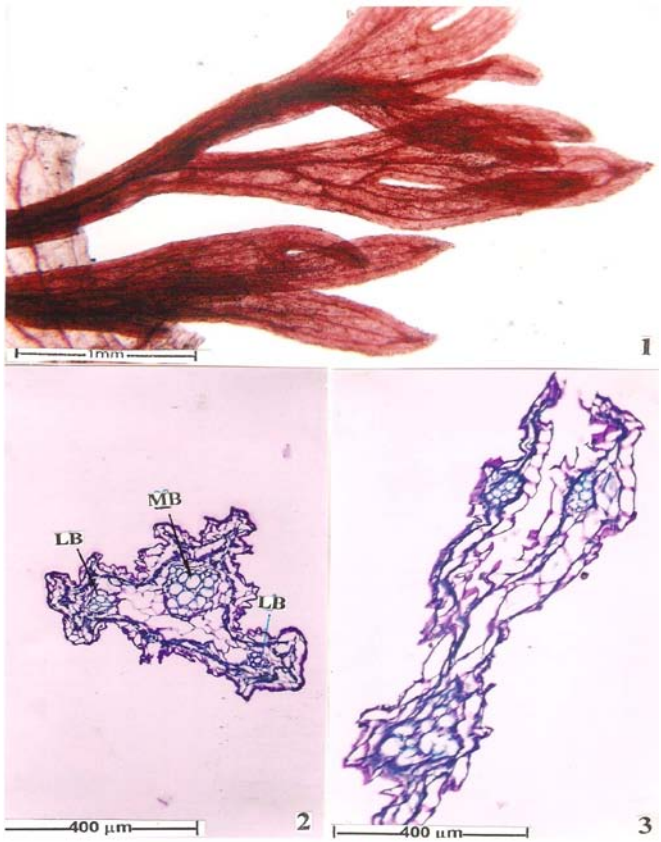
Fumaria indica

Fig. 2: Microscopical characters of stem-entire view



Fumaria indica

Fig. 3: T. S. of Stem–Structure of Vascular bundles, 1. One larger bundle enlarged, 2. One Smaller bundle enlarged



Fumaria indica

Fig. 4: Venation pattern and microscopical characters of leaf, 1. Venation pattern, 2. T. S. of petiole region, 3. T. S. of leaf with lamina

DISCUSSION

Drugs came into existence from very early times to alleviate pain and cure diseases. The traditional systems of medicine like Ayurveda and Siddha derive more than 85% of the drugs from the plant source. Hence identification of drugs is of paramount importance for the survival of these systems of medicine. However, the correct botanical identification of the several drug materials mentioned in Ayurveda and Siddha have remained a problem until today. One of the important problems in Ayurveda and Siddha is the use of more than one botanical source for the same drug and these different botanical sources are claimed to possess similar therapeutic efficacy by the Ayurvedic and Siddha physicians. Such drugs are termed as controversial drugs in Ayurveda. It is also found that quite often substitutes and adulterants are sold in the crude drug markets from where present-day physicians and drug manufacturers procure their raw drug requirements. Thus, there is an urgent need to undertake standardization of drugs in Ayurveda and Siddha based on scientific parameters like taxonomical, pharmacognostical and phytochemical evaluation. The various exomorphic characters found in the plants/drugs help in the taxonomic method of identification. The several endomorphic characters found in the part used help in the pharmacognostical identification while phytochemical screening provides parameters for identification of the drug in powder form.

The present study deals with the studies on standardization of the controversial Ayurvedic drug Parpataka with the respect of *Fumaria indica*. Parpataka is a well-known Ayurvedic drug, esteemed as a specific remedy for all types of fevers. The drug is diuretic, anthelmintic, digestive and constipating. The accepted botanical source of the drug is *Fumaria indica* [7].

Fumaria indica is annual diffuse herb with small flowers white or pink, with purple petals, confined to India. Whole plant is used as drug. Roots are bitter, characterized by crushed cortex, diarch condition of primary xylem and secondary xylem in two broad triangular bands. The stem is bitter, cortex narrow and less conspicuous, small nests of fibres observed in cortex, pith surrounded by vascular cylinder. Leaf is bitter, ground tissue made up of thin-walled parenchyma and there is a prominent median vascular bundle and two lateral vascular bundles. Histochemical tests, Powder characteristics, Powder analysis, Ash values, Extractive values, Fluorescence analysis of various extracts were established results are included in table 1-7.

CONCLUSION

In conclusion, the present studies have revealed the macro-, and microscopical characters, physicochemical, florescence and phytochemical parameters are essential for providing authentic scientific characterization and identification of the *Fumaria indica* used in Ayurveda and Siddha systems as a source of Parpataka drug. Such parameters also help in establishing pharmacopoeial standards, which are urgently required not only for the survival of the age-old traditional system of medicine but also in view of the fact that these systems are attaining global importance.

AUTHORS CONTRIBUTIONS

All the author have contributed equally

CONFLICT OF INTERESTS

Declare none

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