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Research Article

Taxonomy and Pharmacognosy of *Bergenia ciliata*

T. Sudhakar Johnson[1]*, Ashit Vora[1], Vatsavaya S. Raju[2], Sameer C. Patil[3]

ABSTRACT

Background: The crude drug (Pāshānabheda) described in several pharmacopoeias is the rhizome of the plant species *Bergenia ciliata* (Haw.) Sternb. (Saxifragaceae), an evergreen, perennial temperate herb that grows at an elevation of 900–3000 m AMSL in the Indian Himalaya. The rhizome has been used for centuries to treat kidney and bladder stones and rheumatoid arthritis besides the other therapeutic and nutraceutical applications in ethnomedicine, traditional, Ayurveda and Unani systems of medicine. **Objective**: In view of issues in identifying raw material and segregating the adulterants of the crude drug, a pharmacognostic study was undertaken to provide ways for its safe use by obtaining detailed anatomical features of both the rhizome and the root of *Bergenia ciliata* by means of fresh and dried material. **Methods**: A brief description of the crude drug and its powder is made available employing the standard microscopic and phytochemical evaluations. **Results**: Using in-house developed thin-layer chromatography and HPLC methods, bergenin has been isolated in rhizome extract for quality control purposes. Traditional and therapeutic uses of the principal bioactive constituent bergenin, arbutin and the other phytochemical constituents are discussed. Furthermore, an account of raw material specifications for the rhizome, standards used, and regulatory status are presented against the background of the published information. **Conclusion**: Results presented in the report will further lead to future studies on beneficial and quality control aspects of the rhizome and to develop a potential nutraceutical, dietary supplement.

Keywords: Bergenin, Dietary supplement, Kidney stones, *Pashanabheda*, Rheumatoid arthritis.

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INTRODUCTION

Bergenia ciliata (Haw.) Sternb. (Saxifragaceae, Eudicot, Angiosperms) is an evergreen, perennial herb that grows between 900 and 3000 m AMSL in the temperate Himalayan region, from Afghanistan to Kashmir, Nepal, Bhutan, and southeast Tibet. Its rhizome is the primary source of its bioactive compounds. In India, four species of the genus *Bergenia* have been reported, viz.: *B. ciliata, B. ligulata* (currently known as *B. pacumbis*), *B. stracheyi*, and *B. purpurescens*[1] (Figs. 1 and 3). Despite the taxonomic dispute about their status[1], *B. ciliata* and *B. ligulata* are being treated as distinct species by many authors[2-4].

The plants of *Bergenia* thrive well on rock crevices, surfaces, hill slopes, cracks and near water canals in wet and shady environment. Commonly known as *pashanbheda* (stone breaker) because of the ability to breakstones and grow in their natural habitat characteristics (traditional people used this signature to find medicinal uses and its application in Indian System of Medicine[5] in dissolving kidney and urinary bladder calculi was tried and met with success. As per NMPB (2020) report, annual demand for *Bergenia* rhizomes varies from 1000–2000 MT (http://envis.frlht.org/traded-medicinal-plants-database.php) for its extensive use in several traditional and ayurvedic medicines.

Pharmacognosy plays a crucial role in identifying raw materials and distinguishing the adulterants of crude drugs. It has been considered to provide important parameters in maintaining quality control. Often, raw material arrives at the factory gate in a dried form or as product of primary process and making species identification is a challenge. Pharmacognosy studies of *Bergenia* spp. are made available by a few scientific groups [6,7] and they have a limitation of proper interpretations.

In the present study, therefore, the authors attempted to detail the anatomical features of the rhizome and root of *Bergenia* species used as Pashanabheda, along with the microscopy of rhizome powder. Furthermore, it was attempted to provide TLC fingerprinting of the principal phytochemical component, bergenin along with a brief discussion on the uses of *Bergenia* species both traditional and Ayurveda.

The taxonomy of *B. ciliata* has been disputed. Our own publication[1] revisited the taxonomy of *Bergenia* species based on habit, habitat, external morphology, macromolecules and pharmacognosy to distinguish the contested taxa. For a deeper understanding of the problem address, the readers are encouraged to consult this publication.

Given *B. ciliata*'s role in treating kidney stones and managing rheumatoid arthritis, the results of the present study significantly contribute to maintain the quality of crude drug and offer directions for future research.

Description of crude drug

Crude drug consists of dried rhizome of *Bergenia ciliata* (Haw.) Sternb. forma *ligulata* Yeo[8] (Figure1 A-B)

Classification and Taxonomic dispute with Species

Botanical Name:*Bergenia ciliata* (Haw.) Sternb.

Homotypic Synonyms: *Megasea ciliata* Haw.; *Saxifraga ligulata* var. *ciliata* (Haw.) Hook.f. & Thompson

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Figure 1: *Bergenia* stocks with leaves, rhizome and roots. **A**- *B. ligulata*; **B**- *B. ciliata.*

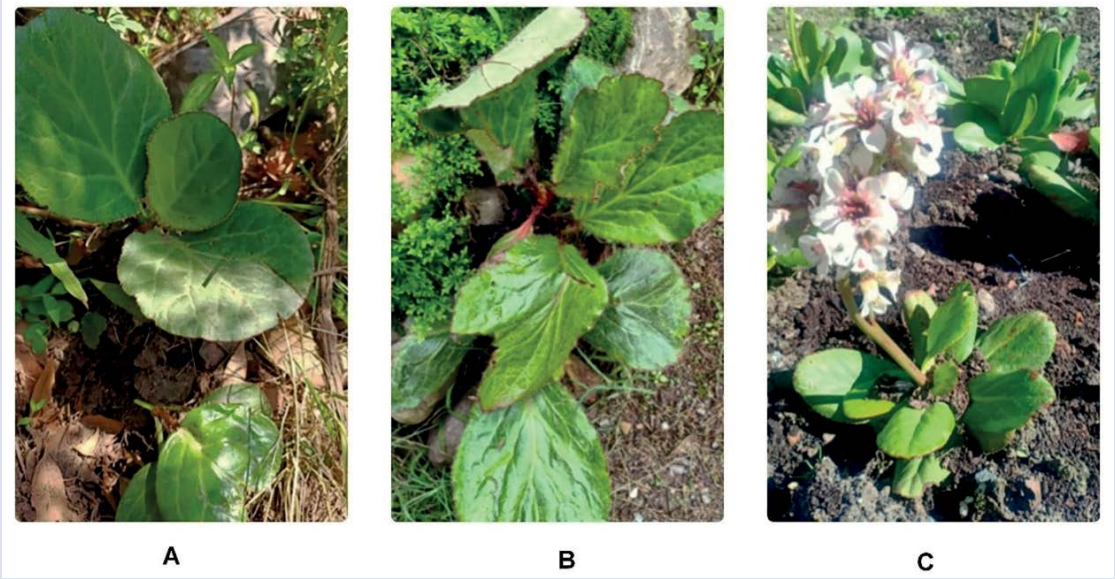

Figure 2: Three major species of *Bergenia* in their natural habitats in India **A**- *B. ciliata*; **B**- *B. ligulata*; **C**- *B. stracheyi.*

Family: Saxifragaceae Juss.

Botanical description

B. ciliata is a perennial, rhizomatous, spreading herb of 45–60 cm height (Figure 2A-C) with a rosette of leaves. The flowers are pink, in bisexual or occasionally unisexual cymes (rarely solitary) and subtended by an ovate leafy bract[7]. Those plants that withstand the winter frost, turns reddish brown.

In hilly areas, the rhizome emerges from rock crevices and hangs. The stem is short with simple glabrous, obovate leaves with lamina 5–30×2.5–15 cm, with base cordate to rotund apex, abruptly acute with denticulate margin. The petioles are fleshy and terete, can be 5–10 cm long.

Rhizomes are firm, cylindrical, up to 2 cm diam., dark brown and occasionally branching. Outer surface is rough, scaly, wrinkled longitudinally, and covered with numerous leaf and root scars, ensheathed with fragments of leaf bases. Lateral roots are dark brown, up to 0.5 cm diam. Fruit is a globose capsule; seeds are greyish, minute and numerous. The plant flowers between April and June and hibernate during the winter (rhizome geophytes), typical of temperate climate.

Nomenclature

There is a dispute with regard to the identification and rank of *Bergenia ciliata* and *B. ligulata.* Major flora and Regulatory systems such as API and FSSAI consider *B. ciliata* as a synonym of *B. ligulata*. Similarly, as per the Flora of Kullu district, Himachal Pradesh[9], *B. ciliata* (Haw.) Sternb. is synonym of *B. ligulata* sensu Blatter whereas Srivastava and Misra[10] and Gohain et al. (2022)[3] considered them as two distinct species.[10] successfully used the RP-HPLC method to estimate the bergenin content in *B. ligulata*, *B. ciliata* and *B. stracheyi*. It was estimate to be 3.275% in *B. ciliata*, 3.277% in *B. stracheyi* and 2.419% in *B. ligulata*. Raju et al (2025)[1] revisited the taxonomy of *Bergenia* species based first hand field study in terms of habit, habitat, exo-morphology, macromolecules and pharmacognosy to distinguish the species. Readers may consult the publication for detailed understanding of the issue the authors have arrived at.

IUCN conservation status

B. ciliata has been categorised as LC[11]; VU (Vulnerable) as per the local threat assessment[12].

Diversity

Bergenia Moench, nom. cons. Comprised 10 accepted species (POWO, 2025) and distributed across a wide geographical range, extending from Afghanistan (specifically Kunar/Nuristan, Laghman) to Tibet, China, India, Nepal and Pakistan (notably in regions such as Waziristan, Kurram, Chital, Swat, Hazara, Murree), with additional occurrences in Myanmar. The genus showcases a diversified presence throughout the temperate Himalaya, from Bhutan to Kashmir, and Khasi Hills, signifying its ecological amplitude.

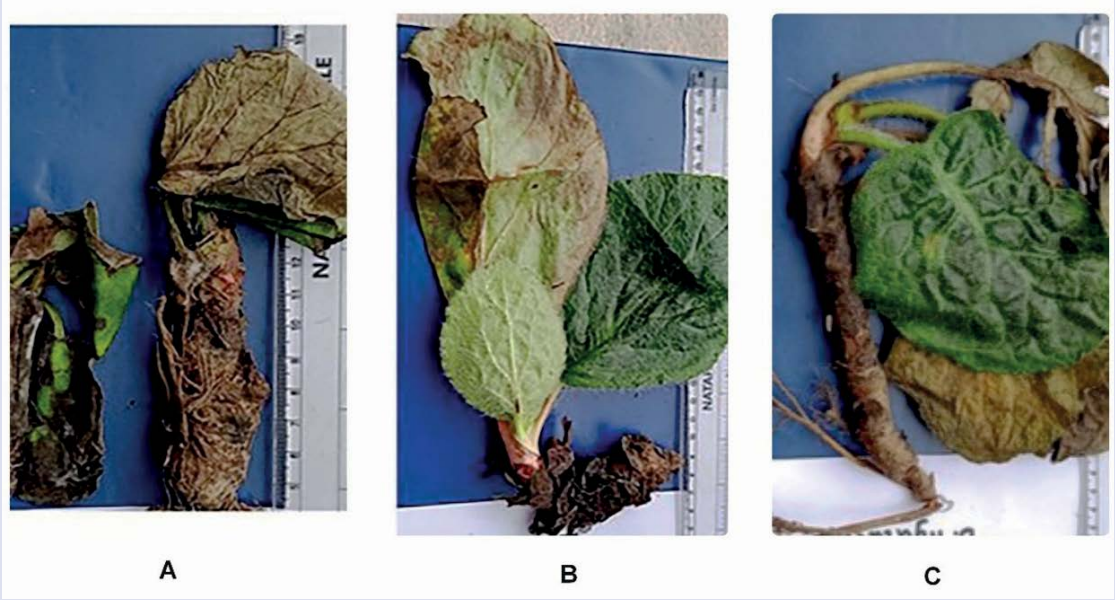

Figure 3: **A**-*B. ciliata* leaves and rhizome; **B, C**-*B. pacumbis* complete plan.

Mention in Ayurveda and other traditional systems

Since ancient times, *Bergenia* species have been used in the traditional medicine. In Ayurveda, the rhizomes of *B. ciliata* spp. are specifically employed to address bladder and kidney stones, as well as various urinary tract disorders (API, 2001)[13]. The system also uses for its multiple applications as astringent, antiscorbutic, dysuria, laxative, spleen enlargement, tonic and ulcers besides the treatment of abnormal leucorrhoea, piles and pulmonary infections. According to texts of *Ayurveda*, the root is bitter, pungent and cool, indicating its ability to balance *Vata, Pitta* and *Kapha* doshas. Furthermore, the herbal tea made from *Pashanabheda* from the rhizome help to alleviate asthma and high fever (CCRAS).

The Unani System of medicine incorporated rhizomes and roots of *Bergenia* for a wide array of ailments: biliousness, cough, dysentery, dysuria, eyesores, heart diseases, hydrophobia, fevers, lung and liver diseases, menorrhagia, spleen enlargement and tumors[14-16]. Overall, *Bergenia* are a valuable component in both Ayurvedic and Unani practices, highlighting its diverse therapeutic properties[4].

In Nepal, the paste (10g) or juice (10ml) of *B. ligulata* is administered orally two times a day for 2 or 3 days with molasses to help expel round worms and to treat colds in adults[17]. According to the Chinese Pharmacopoeia (ver. 2005), bergenin obtained from *Bergenia* used to relieve of cough and reducing sputum due to chronic bronchitis[18]. Arbutin, another major phytochemical found in *Bergenia* is employed as a urinary disinfectant, diuretic and antibiotic. In addition, Arbutin was found to inhibit degradation of insulin[19]. It is also valued for its cosmetic value for it skin-whitening effects (a brightening agent) by preventing the action of tyrosinase in the skin[20]. *Bergenia* has nutritional value as well. From a culinary perspective, it contains various amino acids and mineral elements that contribute to health, making it a potential ingredient in cooking[21].

MATERIALS AND METHODS

Plant material

Rhizome along with the root of *Bergenia* was collected from its natural habitat by one of our herb collectors.

Microscopy

For microscopy, the dry plant materials were cut into small pieces, boiled in water

with little glycerine and fixed in FAA (formalin-acetic acid-alcohol) and stored for use. Sections of plant parts were cut, washed and stained with safranin and TBO, destained and then mounted in glycerine and laying cover slip and labelled it. Images of the prepared sections were captured using an Olympus CX 33 light microscope.

Chemicals

The study utilized various HPLC grade chemicals, including formalin, acetic acid, absolute alcohol, safranin, TBO, glycerine, chloroform, methanol, and glacial acetic acid. Bergenin reference standard was procured from M/s TCI whereas TLC silica gel GF 254 plates were sourced from Merck, India. The bergenin standard purchased from M/s Sigma Aldrich.

Phytochemical Extraction and isolation

TLC analysis (in-house method): The extraction process for *B. ciliata* rhizome was carried out. The rhizome powder (100 mg) was suspended in 10 ml of methanol and sonicated for one hr at room temperature. Then, the supernatant was carefully removed, evaporated to dryness, and then reconstituted in methanol. Pure bergenin was utilized as the reference standard for comparison.

For the TLC analysis, a Silica Gel GF 254 plate was employed. The eluent was a mixture of chloroform, methanol, and acetic acid in a ratio of 7.5:1.5. A standard bergenin solution was prepared at a concentration of 1 mg/ml in methanol, while a 5 mg/ml extract sample was also prepared in methanol.

To conduct the analysis, approximately 10 µL of both the standard bergenin solution and the rhizome extract samples were spotted onto the Silica Gel GF 254 plate. The chromatogram was run until 90% of the plate was developed. Afterward, the TLC plate was visualized under UV light at 254 nm. The plate was then placed in an iodine chamber for 2 minutes to develop and visualize the spots of the compounds present.

HPLC analysis: Rhizome extract was analysed by HPLC-UV detector. The column (25 cm x 4.6 mm, 5 µm) YMC Carotenoids column was used for the elution with the total run time about 70 min. at mobile phase flow rate of 1 ml/min. The elution of bergenin is achieved by gradient mobile phase using 0.1% orthophosphoric acid and acetonitrile. Acetonitrile concentration was achieved upto 80% in 55 minutes time interval, The analyte was analysed at 210 nm. The bergenin standard from M/s Sigma Aldrich used for identification and quantitation. 20 µL of Standard and test sample with concentration 100 µg/mL were injected for quantitation. The calculations were performed by external standard method.

RESULTS AND DISCUSSION

Traditional uses

B. ciliata has a long-standing reputation for its medicinal properties and is widely utilized across various traditional systems of medicine, particularly in Asian countries like India, Nepal and Pakistan. Its applications are wide-ranging and include treatments for renal/urinary disorders, muscular/skeletal disorders, respiratory diseases, gastrointestinal, worm infections, skin and eye diseases, oral infections and gynaecological disorders, ENT, fever, and even cancer.

All plant parts (roots, rhizome, stem, leaves, flower, latex and the whole plant) of *B. ciliata* is have been used in the treatment of different ailments specifically, in the context of kidney and urinary disorders, the roots and rhizome have been reported to be effective in treating kidney stones and various urinary disorders. In the Himalayan region, people use dried rhizomes to make tea and as a tonic to cure fever, diarrhoea and muscular pain. Moreover, root extracts are traditionally used for treating liver diseases and as a hair tonic[22, 23]. In Jammu & Kashmir and Ladakh, leaf, root and rhizome are employed as a tonic for a range of conditions, including fever, headache, digestive ailments, pulmonary infections and asthma, diarrhoea, kidney stones, bladder stones, skin disease, abrasions, wound healing and menstrual problems[24]. Additionally, local communities of Eastern India use rhizome juice as an anti-tussive for treating cough and cold[25].

TLC Profile of the plant material

Clear separation of bergenin has been successfully achieved and identified in the rhizome extracts (Figure 4)

HPLC

Separation of bergenin was achieved at 23.67 min. (Figure 5A and B). The separation of bergenin was also achieved in the rhizome extract sample (Figure 5B).

Pharmacognosy

Rhizome Macroscopic and Organoleptic Evaluation

Description under Light *Macroscope* (**API, Part-I, Vol-I**)[13]

The rhizomes are usually solid, barrel-shaped, 1.5–3 cm long 1–2 cm diam. with short lateral roots, surface with distinct ridges, furrows and root scars. Transversely cut rhizome shows an outer ring of brown-coloured cork, a short middle cortex, vascular bundles, and a large central pith. The rhizome emits an aromatic odour and tastes astringent. These characteristics (Table 1) help to identifying the rhizome.

Rhizome powder

Macroscopic characters

The rhizome when powdered appears dark brown to black, sandy with gritty texture. It smells aromatic with an astringent taste. The overall traits (Table 1) help to identify the herbal drug and its quality.

Microscopic characters

Several notable features are revealed under microscope. The xylem fibers are thin-walled with narrow ends often attached with fragments of xylem vessels with scalariform thickenings. Additionally, brown, irregularly-shaped fragments of variable sizes containing tannin were found. Cork cells present alongside rectangular parenchyma cells bearing simple starch grains which are largely ovoid to globose. Further diagnostic features are the copious prismatic calcium oxalate crystals present (Figure 6).

Diagnostic characters

The following features are diagnostic for species identification:

(i) Presence of calcium oxalate crystals in the form of druses.

(ii) Presence of ovoid to globose simple starch grains in parenchymatous cortical cells; and

(iii) Presence of xylem vessels with typical scalariform wall pitting.

Microscopic characters of rhizome:

The transverse section of the rhizome offers several species specific diagnostic microscopic traits (Figure 7) which will collectively help to identify the crude drug:

Periderm: It is divided into two zones, the outer zone consists of a few layers of brown-coloured cells and an inner zone comprises 15–20 layers of thin-walled, colourless cells.

Secondary cortex: It is comprised of thick-walled, rectangular cells with intercellular spaces. Notably, some of these cells contain rosette-shaped calcium oxalate crystals (druses), along with simple ovoid to globose starch grains.

Vascular bundles: These are arranged in a ring; they are collateral, conjoint and open.

Secondary xylem: It is characterized by small, squarish, thick-walled fibers, along with round to oval 4 or 5 vessels forming a ring.

Secondary phloem: It consists of sieve elements and parenchyma cells.

Central Region: The pith is occupied by thick-walled, large circular to ovoid parenchymatous cells.

Microscopy of root (root with some secondary growth)

The microscopic structure of root (root with some secondary growth) can be summarized as follows (Figure 8):

Periderm: It is the product of cork cambium or phellogen. It produces outside the cork or phellum (the outer zone) consisting of a few layers of slightly compressed, brown cells and inside (the inner zone) called phelloderm or secondary cortex composed of seven layers of thin-walled, parenchyma cells with intercellular spaces.

Vascular bundles: They are six to seven collateral phloem bundles inside the vascular cambium and same number of exarch bundles, arranged in a ring. In contrast, by error Ghimire et al[6] wrongly described the vascular bundles as: "Xylem and phloem bundles are in separated by multilayered vascular cambium" which a typical character of dicot stem while the microphotograph indicates otherwise. Besides they wrongly labelled the xylem for phloem in Figure 4b of Ghimire et al. (2012)[6]. A clear pericycle borders the stele or ground tissue and above it is the typical endodermis.

Xylem: It occupies the central portion of the root.

Phloem: It is found in six discrete bundles. Abundant rosette-shaped calcium oxalate crystals (druses) within both the cortical cells and

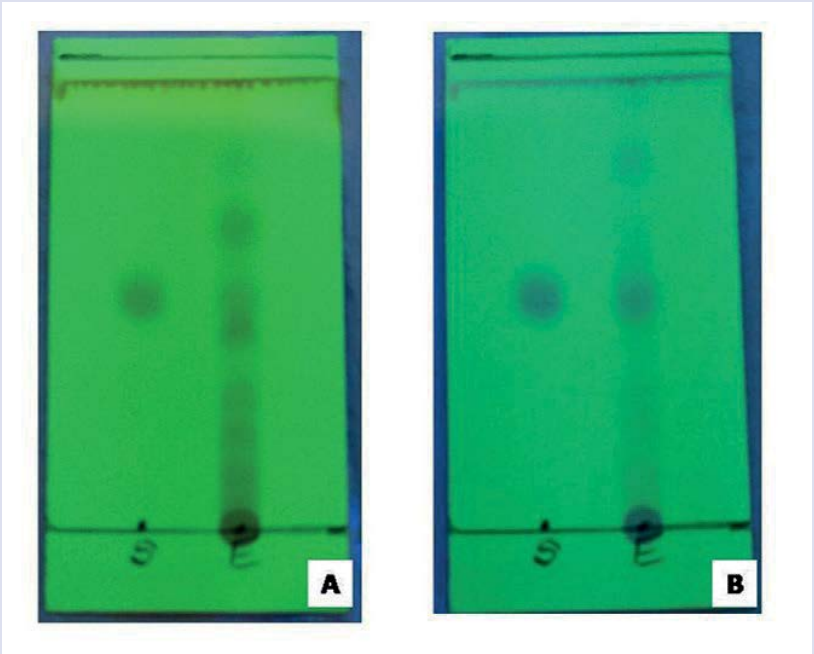

Figure 4. TLC profile of bergenin standard (S) and the rhizome extract (E). A-With Iodine treatment; B- Without Iodine treatment.

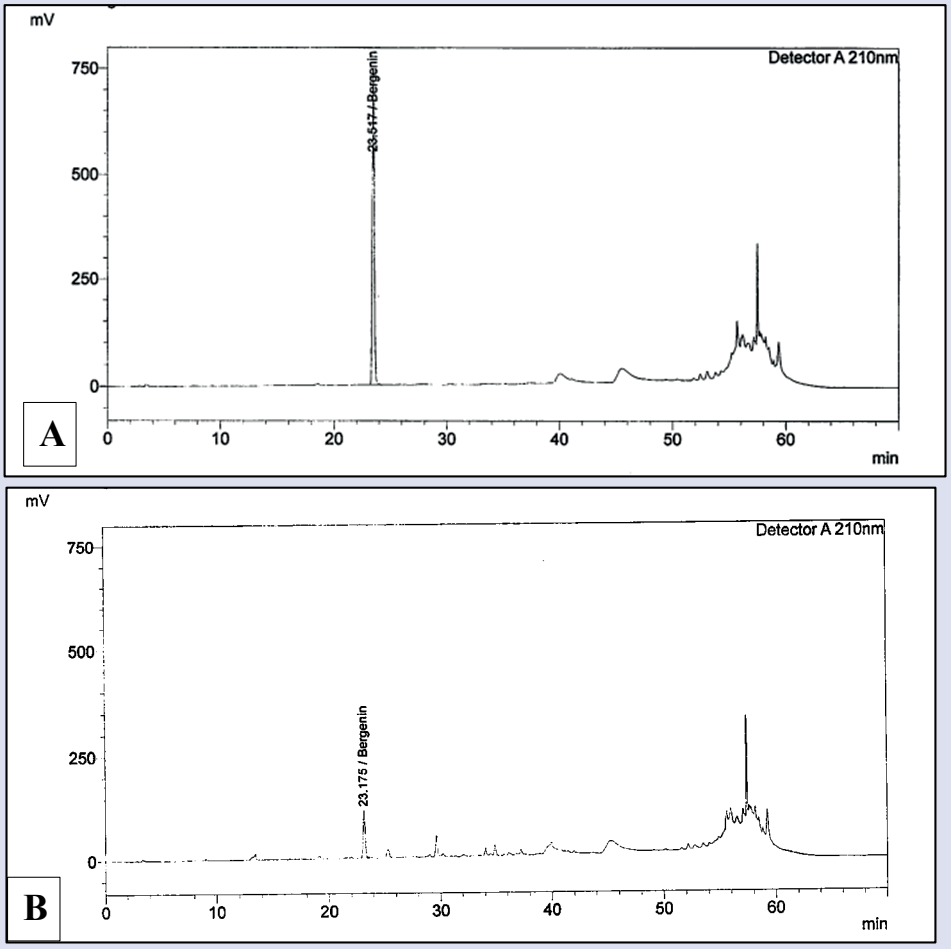

Figure 5A and B: Separation of bergenin by HPLC method. **A:** Separation of standard reference compound at RT 23.51; **B:** Separation of bergenin from rhizome extract.

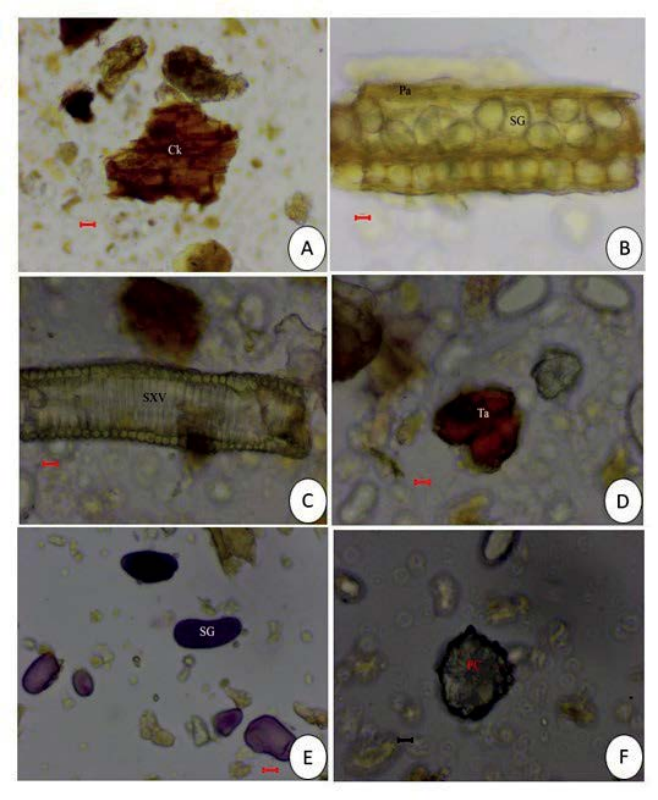

Figure 6: *Bergenia ciliata* rhizome powder under microscope. **A, B –**Cork and parenchyma with starch grains (40×; stained with safranin); **C, D** – Xylem vessel member with scalariform thickenings and tannin idioblasts (40×; stained with safranin); **E, F** –Simple starch grains and druse (40×; stained with I2). Ck: cork; Pa: parenchyma; PC: prismatic crystal (druse); SG: starch grains; XV: scalariform xylem vessels with scalariform wall thickening; Ta: Tannin idioblast.

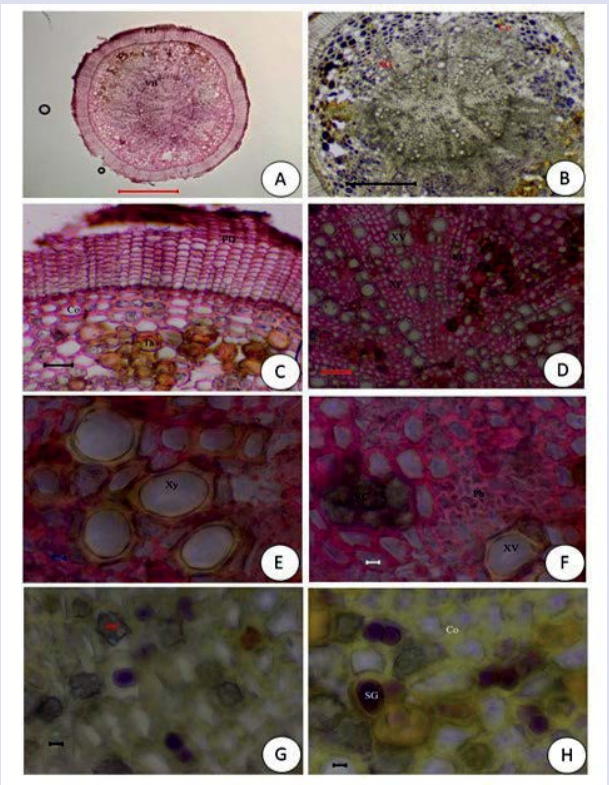

Figure 7: Transverse section of *Bergenia ciliata* rhizome. **A, B** –Outline and overview (4×; stained with safranin and I KI; **C, D** – A sector of periderm, cortical cell with tannin and vascular cambium (10×, stained with safranin); **E, F** – Enlarged view of xylem and phloem (40×, stained with safranin); **G,H** – Enlarged view of druses and starch grains (40×; stained withI KI).Co: cortex; PD: periderm; Ph: phloem; RC: rosette crystals; SG: starch grains; VB: vascular bundle; Xy: xylem, XV: xylem vessel; XF: Xylem fibres.

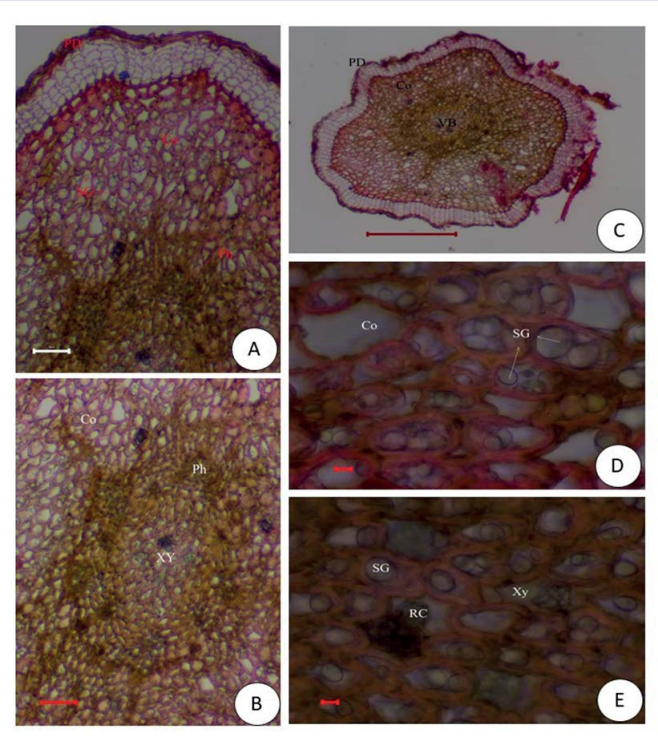

Figure 8: Microscopic profile of root hair of *Bergenia ciliata*. **A, B** – Periderm, cortex and vascular arrangement; **C** –TS overview; **D** –Enlarged view of cortex with simple starch grains; **E** – Closer view of xylem arrangement packed with druses. All sections stained with safranin; **A, B, D**: 10×, **C** 4×, **E** 40×. Co: cortex; PD: periderm; Ph: phloem; RC: rosette crystals (druses); SG: starch grains; VB: vascular bundel; Xy: xylem.

the vascular region while simple starch grains are can be found in the cortical tissues as well as within the xylem (Figure8).

Diagnostic characters

- Presence of rosette crystals in cortical and vascular bundles.
- Presence of simple starch grains in cortex indicates storage/ nutritional potential of the species.

Raw material specifications for Rhizome:

Specifications for the rhizome have been established based on in-house studies, including phytochemical assays. These specifications were then compared with the standards outlined in the API, Part-I, Vol-1 (Table 2).

Major chemical constituents

The main active ingredients in *B. ciliata* include an array of chemical constituents such as alcohol, carboxylic acids, cinnamic acid, fatty acids, flavonoids, glycosides, nitro compounds, phenol, sterol, terpenoids, and volatile organic compounds which can be found to make up to 16%. Among the various phenolic compounds present, bergenin, catechin, gallic acid and tannic acid are important [4]. Ahmad et al. (2018)[22] demonstrated that the rhizome specifically contains bergenin, (−)-3-O-galloylcatechin, catechin and - 3-O-galloylepicatechin. In addition, the phytosterol β-sitosterol is found in the roots and leaves. The glycoside arbutin is present in the rhizome while (+) Afzelechin - a flavonoid - is reported in the rhizome of both *B. ciliata* and *B. pacumbens (B. ligulata)*. Other flavonoids identified in the rhizome were quercetin 3-o-β-D xylopyranoside and quercetin 3-o-α-Larbinofuranoxide[26]. The rhizome of *B. ciliata* contains two terpenes: limonene and linalool, along with the sesquiterpene β-caryophyllene. Furthermore, the oil derived from the plant contains the terpenoid, α-terpineol.

B. pacumbis (B. ligulata) is characterized by a variety of active compounds, with the major phenolic compound being bergenin, which constitutes about 2–3% of its composition, alongside other minor phenolic compounds. These include (+)-afzelechin, leucocyanidin, gallic acid, (+)-catechin, (+)-catechin -7-O-ß-D-glucopyranoside, 11-O-galloyl bergenin, methyl gallate and tannic acid. Additionally, the lactone known as Paashaanolactone, is also present. The species is noted for its sterol content, which includes compounds such as sitoindoside I, ß-sitosterol and ß-sitosterol-D-glucoside. Other significant constituents include glucose (5.6 %), mucilage, tannin (14.2-16.3 %), and wax[27].

On the other hand, the rhizomes of *B. ligulata* were found to possess several distinct chemical entities such as: *Benzenoids*: arbutin, 6-O-P-hydroxy-benzoyl arbutin, 6-O-protocatechuoyl arbutin and 4-hydroxy benzoic acid; *Coumarins*: bergenin, 11-0-galloyl bergenin, 11-O-P-hydroxy-benzoyl bergenin; 11-O-brotocatechuoyl bergenin, 4-0-galloyl bergenin; and *Flavonoids*: (+) afzelechin, avicularin, catechin and eriodictyol-7-O-β-D-glucopyranoside and reynoutrin. Conversely, the phytochemical profile presented above underscores the bioactive properties and therapeutic potential of *B. ligulata* (= ***Bergenia ciliata*** (Haw.) Stern. var. ***pacumbis*** (Buch-Ham. ex D. Don) Sameer Patil & V. S. Raju).

History of safe use

The historical use of *Bergenia ciliata* and *B. ligulata* (=*B. ciliata* var. *pacumbis*) dates back to at least 600 BC, as documented in the ancient text *Charaka Samhita*, which highlighted its role in dissolving calculi and alleviating painful urination[28, 29]. In Ayurveda, the sap obtained from *B. ligulata* leaves has been utilized to treat various ailments, including colds, gastrointestinal issues, epilepsy, and urinary tract disorders[30].

Table 1: Macroscopic features and organoleptic evaluation of *Bergenia ciliata* rhizome.[32]

S. No.	Parameter Studied	Fresh Rhizome	Dry Rhizome
1	Length	7-20 cm	6-19 cm
2	Width	1-2.3 cm	0.9-2 cm
3	Shape	Cylindrical	Irregularly cylindrical
4	Colour	Brown	Dark brown
5	Taste	Astringent	Indistinct
6	Odour	Pleasant	Indistinct
7	Fracture	Flexible	Hard
8	Fracture surface	Fibrous	Uneven
9	Texture	Solid rough	Ridges and groves

Table 2: Analytical specifications of *Bergenia ciliata* rhizome.

Sl. No.	Specification	Description/Limits
1	Plant part used	Rhizome, dried
2	Trade Name	Pashanabheda, Pakhanaved, Pakhanabheda, Patharcua, Silphara
3	Foreign matter	Not more than 2% (API)
4	Total Ash	Not more than 13% (API)
5	Acid-insoluble ash	Not more than 0.5% (API)
6	Alcohol-soluble extractive	Not less than 9% (API)
7	Water-soluble extractive	Not less than 15%
8	Bergenin (% w/w)	2.0 –3.0
9	Gallic acid (% w/w)	-
10	Tannins (% w/w)	14.2 –16.3

India's traditional medical systems, namely Ayurveda and Unani, have long recognized the therapeutic properties of *B. ligulata* roots for conditions such as vesicular calculi, blood in the urine, excessive uterine haemorrhage, bladder diseases, diarrhoea, menorrhagia, management of kidney and bladder stones. Additionally, it has been referenced in indigenous Indian texts like *Bhavaprakash, Rajnighantu* and *Chakradatta* for urinary ailments and bladder purification.

The leaves of *B. ligulata* are brewed into tea and consumed by the tribal populations in the Chamba district of Himachal Pradesh, India, for relief from common cold[32]. The Monpa tribes of Arunachal Pradesh apply the leaves to treat boils, wounds, and cuts while the Naga tribes in India utilize the roots for the treatment of tuberculosis and liver conditions. This highlights of *B. ligulata* and its extensive history of safe use in folklore and traditional medicine in India.

CONCLUSION

The results presented here provide a basis for identification of *B. ciliata* rhizome by way of microscopic and phytochemical evaluations. The report further provides raw material specification for rhizome and standards used. We conclude that the results presented in the report will further lead to future studies on beneficial and quality control aspects of the rhizome and to develop a potential nutraceutical, dietary supplement.

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AUTHORS' CONTRIBUTIONS

TSJ drafted the MS. **VSR** reviewed and edited the final version of the MS. **SP** provided figures of *Bergenia ciliata* from field studies and drafted the MS, **AV** did the final review and approved the MS.

COMPETING INTERESTS

SJ and AV are employees Phytoveda Pvt. Ltd., Mumbai, India and Viridis BioPharma Pvt. Ltd. Mumbai, India. The Authors declare no competing interests.

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GRAPHICAL ABSTRACT

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