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Morphology, Anatomy, and Phytochemical Analysis of *Beaumontia jerdoniana* Wight: A Medicinal Liana Plant.

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ABSTRACT

Beaumontia jerdoniana Wight (Apocynaceae) is known as Swethpushpi and is endemic and critically endangered in the Western Ghats regions of India. The family Apocynaceae is a major source of natural drugs for Anticancer effects. The *Beaumontia* genus has been recorded to contain various anti-cancer compounds like Camptothecin, digitoxigenin, oleandrigenin, digitoxigenin, α-L-cymaroside, and digitoxigenin. Therefore, the genus *Beaumontia* can be useful for the synthesis of anticancer drugs. The present research work provides detailed information on distributions and ecology, taxonomic description, diagnostic characteristics, photographs, anatomy, phytochemical analysis, and other relevant information for easy identification and future pharmacological research.

Keywords: Beaumontia, Endemic and Endangered, Taxonomy, Anatomy, and Phytochemicals.

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INTRODUCTION

Beaumontia jerdoniana belongs to family Apocynaceae and endemic liana distributed in the Western Ghats regions (Chandore 2015; John et al. 2016). This species is critically endangered in India (Gowthami et al. 2021; Barik et al. 2018) and distributed in the states of Karnataka, Maharashtra, Goa, Tamil Nadu, and Kerala (Khanum 2022; Lakshminarasimhan et al. 2013). In Maharashtra, it is reported in Ratnagiri, Kolhapur, and Pune districts of evergreen forest and sacred groves (Devrai) regions (Singh and Karthikeyan, 2001). As per the Biological Diversity Act, 2002, Section. 38, Central Government, in consultation with the various state governments, has notified that the plant *Beaumontia jerdoniana* Wight is on the verge of extinction. Therefore, the central government and various state governments have taken special initiative for the conservation of this plant species (Kolhapur Forest Division Report, *2008-2018*). *B. jerdoniana* flower is useful to develop the Bach flower remedies (Gupta 2016). This remedy has high potential for pain relief and attention deficit hyperactivity disorder in children (Thaler et al. 2009; de Oliveira et al. 2023). The best responded symptoms of flower remedies of *B. jerdoniana* were indigestion, cramps, ear problems, urinary problems, giddiness, fever, vomiting/nausea, pain: neck, diarrhea, flatulence, breathlessness, dysmenorrhea, body aches, skin problems, appetite: low, sleep problems, stress, exhaustion, backache, pain in the abdomen, constipation, negative thoughts, anger, emotional instability, sadness/depression and unrefreshing sleep (Gupta *2016*). Apocynaceae is the fifth largest family of medicinal plants and is known for anticancer potential against various types of cancer, such as blood cancer, tumor cancer, lung cancer, breast cancer, prostate cancer, and basal cell cancer (Devi et al. 2019). The leaves, flowers, seeds, bark, and roots of numerous plants from the family Apocynaceae are the major sources of natural drugs (Islam and Lucky 2019; Wong et al. 2013). Antitumor activity is recorded in barks and root extracts of some Apocynaceae plants such as *Beaumontia, Alla*Yang,*manda, Alstonia, Calotropis, Catharanthus, Cerbera, Nerium,* and *Plumeria* (John et al. 2016). Genus *Beaumontia* recorded various anti-cancer compounds, such as Camptothecin (Kulkarni et al. 2010). digitoxigenin, oleandrigenin, digitoxigenin α-L-cymaroside, digitoxigenin β gentiobiosyl-α-L-cymaroside and 1, 6- digitoxigenin β-D-glucosyl-α-L-cymaroside. Therefore, genus *Beaumontia* is useful for the synthesis of natural anticancer drugs (Khaled et.al. 2010). *Beaumontia* has a great source of secondary metabolites like Alkaloids, flavonoids, phenols, glycosides, steroids (John et al. 2016; Yang et al. 2024). It is used in traditional medicine to cure various diseases, such as Abortifacient, loss of libido, fractures, injury, backache, and leg pain caused by rheumatism (Kulkarni 2020). By reviewing the available previous literature, it was found that insufficient information is available on other species of *Beaumontia* related to propagation, conservation, chemical constituents, and biological activities, but there is no further work on *B. jerdoniana* species. Therefore, the present paper focuses on the study of phytochemical investigation, morphological characterization, and conservation of *B. jerdoniana* Wight plant species.

MATERIALS AND METHODS

Selection of site, Collection of plant material

The cultivated and maintained healthy plant materials of *B. jerdoniana* were collected from the Botanical Garden of Chandmal Tarachand Bora College, Shirur, Pune. The aerial plant parts, such as leaves, stems, bark, latex, and seeds, were collected. Seedlings prepared from sowing seeds in the Botanical Garden were used for further research work.

Identification and authentication

The collected plant material was processed, like drying, poisoning, mounting, and labelling, to make a herbarium (Sangale et al. 2025; More et al. 2025). The processed herbarium specimens will be identified and authenticated by the Grade E-Scientist of the Botanical Survey of India (BSI), Pune.

Morphological studies

Whole plant parts such as leaves, stems, bark, latex, and flowers were studied under a compound microscope and described morphologically by observation and using e-flora, regional flora, and manuals (El-

Fiki et al. 2019). The morphological characterization considered only the external characteristics of different plant parts.

Anatomical analysis

The plant materials were washed with distilled water or running tap water 2-3 times. Each plant parts were dissected and sectioned by smooth hand sectioning. Safranin, light green, and glycerin were used to stain the slide for clarification of the different cells. The prepared slide was observed under the compound microscope (10X, 40X, and 100X) resolution for anatomical and histological studies (Kumar et al. 2022).

Preparation of plant materials

The freshly collected plant materials of leaves, stems, and bark were washed and air-dried under shade at room temperature for 7- 10 days. After drying, the samples were reduced to cut the small pieces, and ground into fine powder using a pestle and mortar, or an electric grinder. The powder obtained from each plant part was stored in a desiccator setup and used for the preparation of plant extraction (Dixit et al. 2014).

Preparation of Solvent Extracts

The dried powder was exhaustively extracted with methanolic, ethanolic, chloroform, and acetone in a conical flask. Extraction was carried out using 10 g of each sample of coarsely powdered plant material with 100 ml of methanolic, ethanolic, chloroform, and acetone for 72 hours with slight shaking. The extract was filtered through Whatman No.1 paper to get the filtrate as an extract. The filtrate was collected, covered, labeled, and used for the different qualitative phytochemical screening tests (Dixit et al. 2014).

Phytochemical Analysis

Qualitative analysis

The standard protocols were used for qualitative analysis of different plant parts, such as leaf, stem, and bark samples of *B. jerdoniana,* to check the presence or absence of different phytoconstituents like Alkaloids, Flavonoids, Steroids, Phytosterols, Tannins, Phenols, Cardiac glycosides, Terpenoids, and Proteins. (Prabhavathi et al. 2016 ; Shaikh and Patil 2020 ; Hashmi et al. 2021)

Test for Detection of Alkaloids

Dragendroff's test: Take 2 mL of plant extract and add 1-2 mL of Dragendorff's reagents to it. The reddish-brown precipitate confirmed the presence the Alkaloids (Kumar et al. 2022; Yadav and Joshi 2024)

Test for Detection of Flavonoids

$FeCl_3$ test: $FeCl_3$ solution, only a few drops were added to each extract of 1 mL. The blackish red precipitate formation showed the occurrence of flavonoids (Sankhalkar and Vernekar 2016)

Test for Detection of Steroids

10 ml of chloroform was added to 2 ml of each extract in a test tube. After that, 10 mL. Concentrated sulphuric acid was dissolved in this test tube. Two layers were formed; the lower layer expressed a yellow color. While upper layer showed red. The formation of these layers indicates steroids were present (Görög 2012)

Test for Detection of Phytosterols

Acetic anhydride test: Take 2 mL of plant extract and 2 mL of acetic anhydride, with 2 mL conc. H_2SO_4 was added; a Change in color from violet to green indicates the presence of phytosterol (Yang et al. 2023)

Test for Detection of Tannins

Take 2 mL of extract, 10 % of alcoholic ferric chloride was added; formation of brownish blue or black color indicates the presence of tannins (Deshpande et al. 1986).

Test for Detection of Phenols

Ellagic Acid Test: Take 2 mL. plant extract and added to 5% glacial acetic acid and 5% sodium nitrite solution. Muddy or brown precipitation confirmed the presence of phenols in the plant extract (Sankhalkar and Vernekar 2016)

Test for Detection of Cardiac Glycosides

Take 1 mL of plant extract, 0.5 mL of glacial acetic acid, and 3 drops of 1% aqueous ferric chloride solution were added; the formation of a brown ring at the interface indicates the presence of cardiac glycosides in the sample extract (Morsy 2017)

Test for Detection of Terpenoids

Take 1 mL of extract and add 0.5 mL of chloroform, followed by a few drops of concentrated sulphuric acid. Formation of reddish-brown precipitate indicates the presence of terpenoids in the extract (Bian et al. 2025).

Test for Detection of Proteins

Xanthoproteic test: Take 1 mL of the plant extract, and concentrated Nitric acid was added dropwise. The formation of yellow color showed the presence of proteins (Törnqvist et al. 2002).

Test for Detection of Saponins

Take 2 mL of extract, and 6 mL of distilled water were added and shaken vigorously; formation of bubbles or persistent foam indicates the presence of saponins (Kowalczyk et al. 2011).

Test for Detection of Carbohydrates

Take 1 mL of extract, add a few drops of Molisch's reagent, and then add 1 mL of concentrated sulphuric acid to the side of the tubes. The mixture was then allowed to stand for 2 to 3 minutes. Formation of red or dull violet color indicates the presence of carbohydrates in the sample extract (Johansson and Wallgren 2012).

Test for Detection of Acidic Compounds

Take 2 mL of extract was taken in warm water and filtered. The filtrate was then tested with litmus paper and methyl orange. The appearance of blue colour indicated the presence of acidic compounds (Yang et al. 2023).

Test for Detection of Reducing Sugars

Benedict's test : Take 0.5mL extract and 0.5mL Benedict's reagent were add. Boiled for 2 min. A yellowish colour indicates the presence of reducing sugar compounds in the plant extract (Hernández-López et al. 2020).

RESULTS AND DISCUSSION

Key Characteristics

Beaumontia jerdoniana Wight. It is commonly known as "Swethapushpi," a genus of evergreen woody liana in the Apocynaceae family, and the native range of this species is South India, Andaman Islands, and Myanmar. *B. jerdoniana* plants are often liana climbers and vines. They are mostly evergreen. Leaves are large,

smooth, and opposite, with sticky white sap from petiolar glands. The large white fragrant flowers are borne in terminal in form of clusters. The calyx is 5-lobed and the corolla is dark funnel- or bell-shaped with 5 lobes. Stamens are attached near the base of the corolla tube and have slender filaments with arrow-shaped anthers. They are very showy when in full bloom and are regarded as among the most outstanding vines of the world. The fruits (seed capsules) comprise a pair of thick woody follicles. The seeds are compressed, apex gradually narrows with a silky coma (a tuft of hairs).

Taxonomic Treatment: *Beaumontia jerdoniana* Wight. (1986) (Apocynaceae) in https://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:77541-1 (Figure 1).

Botanical Description

Woody climbers ; branchlets pale brownish, terete, 3-10 mm thick, glabrous. Leaves opposite, 12-25 x 3.5-12 cm, narrowly oblong, oblong-elliptic to obovate, obtuse to rounded at base, entire, abruptly caudate at apex (cauda 5-10 mm long), thinly coriaceous, glabrous, dark brown above when dry, paler beneath ; lateral nerves 8-14 pairs, faint above, prominent beneath, lax, arcuate ; nervules faint above, prominent beneath, scalariform, mostly branched ; petioles 1-4 cm long. Inflorescence terminal, few-flowered subumbellate cymes, often once branched towards apex, rusty-pubescent, up to 15 x 15 cm ; peduncles 1-4 cm long ; bracts foliaceous, up to 15 mm long. Flowers white ; pedicels 2.5-3.5 cm long, densely adpressed tawny- pubescent. Calyx lobes 5, foliaceous, almost free, elliptic-lanceolate to oblong-lanceolate, 10-15 x 4-5 mm, acute, densely tawny pubescent. Corolla campanulate ; tube ca 15 mm long, hairy at throat inside, lobes 5, spathulate-obovate, 6-7 x 3-3.5 cm, evanescently puberulous outside, glabrous inside. Stamens 5, inserted on the corolla tube ; filaments intertwisted ; anthers sagittate, adhering to the stigma. Ovary 1, 2-locular ; style filiform, puberulous ; stigma oblong-fusiform. Fruits split into 2 follicles at full maturity, 25 cm long, thick, and woody. (www.indiaflora.com/ www,ipni.com/ www.powo.com)

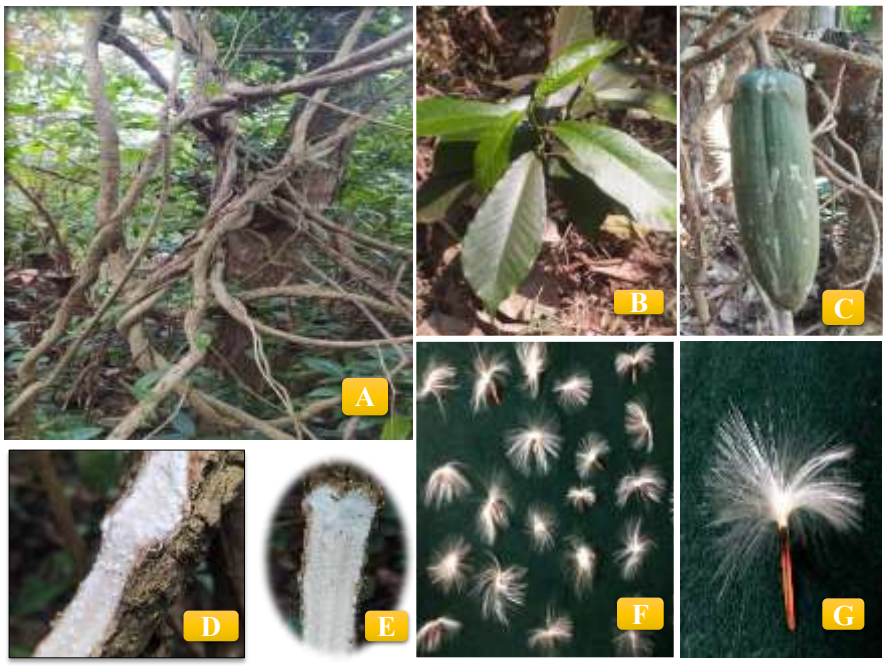

Figure 1 : Morphology of *B. jerdoniana* Wight plant. A. Habitat, B. Young plantlet, C. Pod or fruit, D. and E. Stem with milky latex, F.Seeds G. Single seed with hairy coma.

Flowering and fruiting period: November –December.

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Threatened Category: Endemic and Critically *Endangered* to the Western Ghats of India. https://indiaflora-ces.iisc.ac.in/www.powo.com/www.IPNI.com

Ecology and Habitat: *B. jerdoniana* is an evergreen woody liana found in tropical evergreen dense forests, especially in sacred grove regions. It prefers tropical to subtropical climates with warm temperatures (John et al. 2016)

Distribution: *B. jerdoniana* Wight species is native to the Western Ghats regions of India. while it is reported in other states of India, viz. Karnataka: Coorg, Hassan, Mysore, N. Kanara, Kerala: Wynad, Tamil Nadu: Nilgiri forest. In the North Western Ghats region in Maharashtra state, its distribution is very rare in Kolhapur, Ratnagiri, and Pune. (John et al. 2016; Barik et al. 2018)

Voucher specimen: Voucher specimen of *B. jerdoniana* Wight housed in the herbarium of the Department of Botany at Prof. Ramkrishna More Arts, Commerce and Science College, Akurdi, Pune, Maharashtra, on 20 August 2024

Specimen Examined: India: Maharashtra state; Pune District, Tamhini ghat regions 08 August 2024, P. P. Sangale & S. M. Kamble PPS 05; Kolhapur District, Ajara Forest Division, 08 July 2024, P. P. Sangale and S. M. Kamble. PPS 03; (Herbarium, Department of Botany at Prof. Ramkrishna More Arts, Commerce and Science College, Akurdi, Pune, Maharashtra.)

Taxonomic Affinity: *B. jerdoniana* Wight is very closely related to *B. grandiflora* in having large whitish, funnel-shaped flowers, but differs distinctly in some floral and morphological characteristics.

Anatomical Characteristics

Stem anatomy

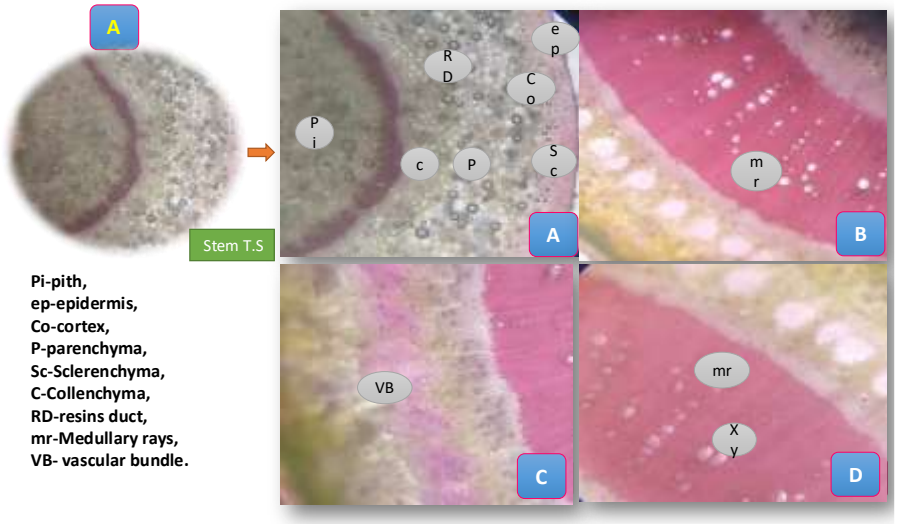


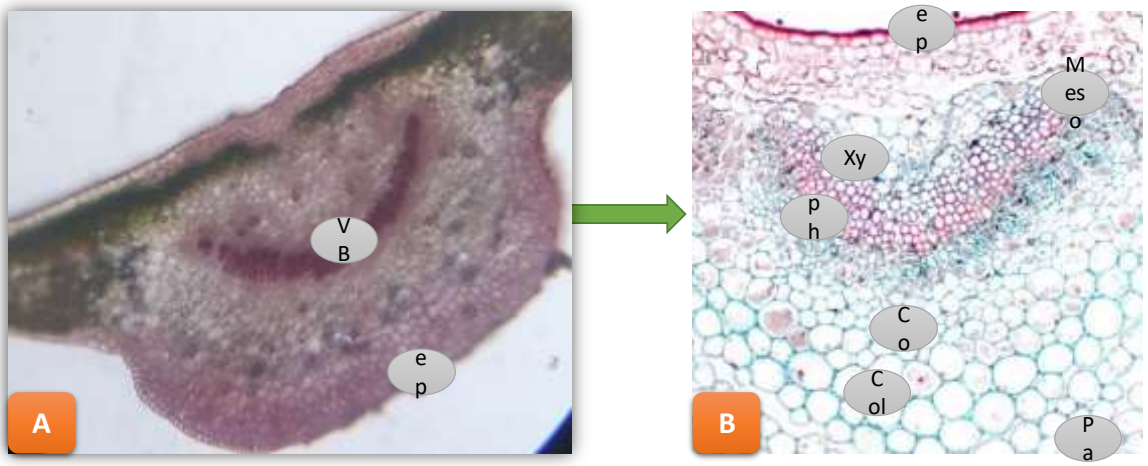
Figure 2 : A, B,C, D Shows the stem T.S of *B. jerdoniana* Wight.

The transverse section of the stem is circular and rounded in the examined *B. jerdoniana* Wight plant. The epidermal cells are covered by a thin cuticle layer. The cork and lenticels are observed in the plant. Apocynaceae was semi-circular in cross-section with one or two epidermal layers. The cork was formed of 2-3

layers of thin-walled cells. The cortex consists of aerenchymatous tissue in examined, and storage parenchymatous tissue was observed. Collenchymatous cells were shown below the parenchymatous cells. The Cortical vascular bundles are present, and rosette crystals are noticed. Laticifers canals, Secretory cells, and secretory cavities or canals were noticed. The pericycle consists of parenchymatous and collenchymatous cells were notified and rosette crystals were also observed in the pericycle region. Vascular bundles in plants are bicollateral and present in a complete ring. The vascular bundles were an association of Xylem and Phloem cells. The xylem cells of Apocynaceae plants were formed of thick-walled elements consisting of vessels, fibers, tracheids, and xylem parenchyma separated by 2-10 rows of medullary rays. The medullary rays were uni or multi-seriate. The phloem was narrow and composed of sieve tubes, companion cells, and phloem parenchyma. The phloem parenchyma cells were polygonal in shape. The medullary rays were uniseriate or biseriate and consisted of elongated parenchyma. The pith of the stem of Apocynaceae was formed of solid, large, rounded, water-storing cells, thin-walled parenchymal cells containing numerous starch granules and calcium oxalate.

Leaf anatomy

Both the upper and lower epidermal cells were covered by a thin cuticle layer. The cuticle layer was thin and smooth. Both epidermis layers were single-layered in the leaf section of plants. The mesophilic tissue consists of spongy and palisade cells. The palisade tissue is one row, while the palisade tissue is monolateral. Spongy tissue is noticed in the cross-section of the leaf parts of plants. Aerenchymatous cells and armed parenchymatous cells. Rosette crystals, resin canals, and secretory cells were recorded in the *B. jerdoniana* Wight plant. The midrib region is convex in the lower surface of the leaf in most of the studied plants, as in the *B. jerdoniana* Wight plant. Rosette crystals are also noticed. Vascular bundles are bicollateral, and the shape of vascular bundles is crescent. The vascular bundle is made up of xylem and phloem cells.



Ep- epidermis, Co- Cortex, Pa-Parenchyma, Co-collenchyma, VB-Vascular bundle, xyl-xylem, phl- phloem RD-resins duct, and mesophyll cell consist of Pallisade cell and spongy cell.

Figure 3. A and B Shows the leaves T.S of *B. jerdoniana* Wight.

Phytochemical analysis

Qualitative analysis of the plant parts of *Beaumontia jerdoniana* Wight

In present investigation, the screening of phytochemicals of the leaf, stem, latex, and Bark with methanolic, ethanolic, and chloroform extracts of *B. jerdoniana* revealed the presence of acidic compounds,

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phenols, flavonoids, alkaloids, tannins, Cardiac glycosides, steroids, phytosterols, terpenoids, saponins, carbohydrates, reducing sugar, and proteins.

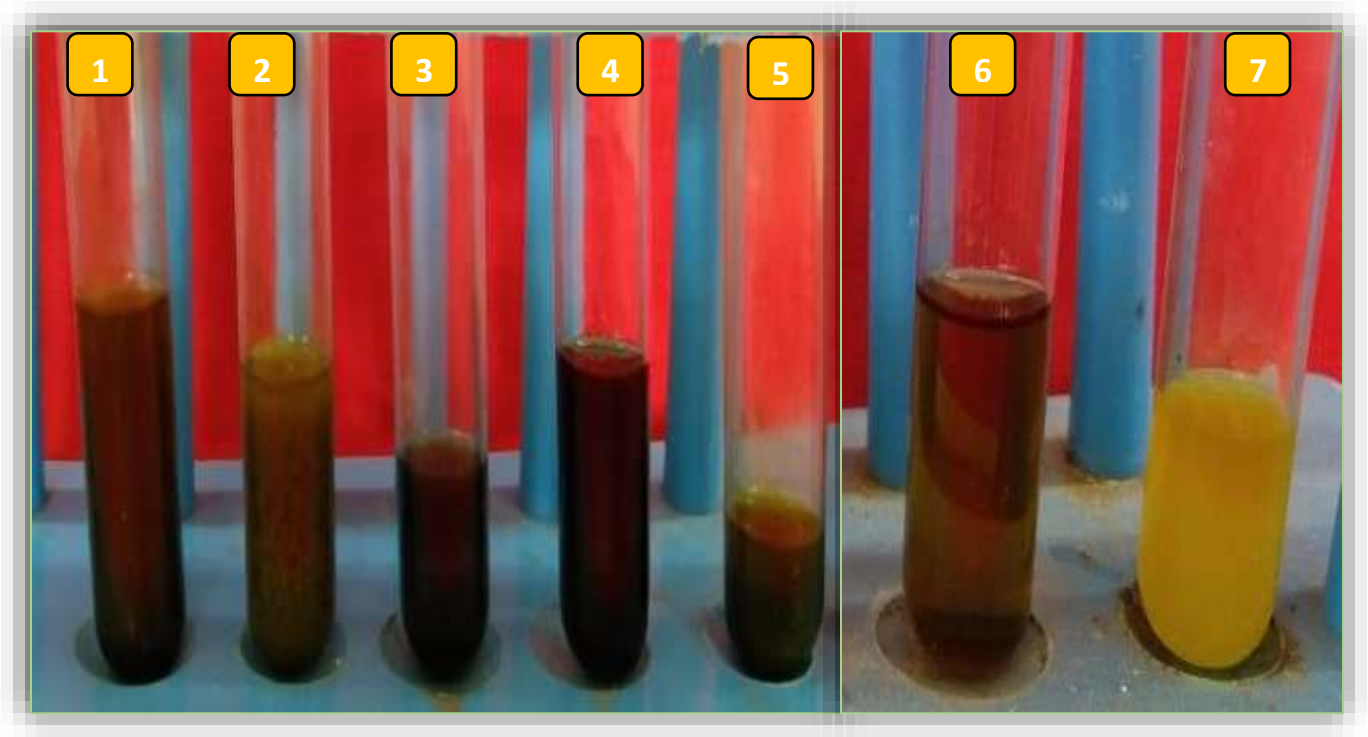

Table 1 : Qualitative analysis of phytochemicals of the Leaves, Stem, Bark, and Latex of *Beaumontia jerdoniana* Wight. in the Methanolic, Ethanolic, and Chloroform extracts.

Phytochemical components	Leaves			Stem			Bark			Latex		
	Presence or Absence			Presence or Absence			Presence or Absence			Presence or Absence		
	ME	EX	CE	ME	EX	CE	ME	EX	CE	ME	EX	CE
Acidic compounds	++	++	++	++	--	--	++	++	--	++	++	++
Phenols	++	++	++	++	++	++	++	++	++	++	++	++
Flavonoids	++	++	--	++	++	++	++	++	++	++	++	++
Alkaloids	++	++	++	++	++	++	++	++	++	++	++	++
Tannins	--	++	--	--	--	--	- -	- -	- -	- -	- -	- -
Cardiac Glycosides	++	++	++	++	++	--	++	++	--	++	++	++
Saponins	- -	--	--	--	--	--	- -	- -	- -	- -	- -	- -
Terpenoids	- -	--	--	--	--	--	- -	- -	- -	- -	- -	- -
Steroids	++	++	++	++	++	++	++	++	++	++	++	++
Carbohydrates	++	++	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
Reducing sugar	+ +	--	--	- -	- -	- -	- -	- -	- -	- -	- -	- -
Protein	- -	++	--	- -	- -	- -	- -	- -	- -	- -	- -	- -

(ME : Methanolic Extract, EX: Ethanolic Extract, CX: Chloroform Extract)

Phytochemicals, such as Alkaloids, Phenols, and Steroids, have been reported in almost all plant parts and extracts. Therefore, it indicates that the *B. jerdoniana* plant has a rich source of antioxidant compounds, and the presence of Alkaloids and Steroids suggests that strong potential for antimicrobial properties and anti-inflammatory effects. The Flavonoids were absent in only the leaf chloroform extract, but were present in all other parts and solvents. Flavonoids are especially known for their anti-inflammatory and antioxidant properties. Cardiac Glycosides were detected in all other extracts, except the stem and bark chloroform extracts. Acidic compounds are absent in parts of the stem, ethanol, and chloroform extracts, and present in all other plant parts and extracts. The carbohydrates were detected only in leaves of methanolic and ethanolic

extracts, and were negligible in other parts. The reducing sugars were observed only in the leaves' methanolic extract and were almost absent elsewhere. While the protein was reported in only the leaves' ethanol extract, and absent in all other plant parts and solvents. The Saponins, Terpenoids, and Tannins were mostly absent across all parts and solvents. Except that Tannins were observed only in the leaf's ethanol extract. The leaves of *B. jerdoniana* have shown the highest phytoconstituent diversity, containing nearly all types of compounds across solvents. Methanolic and Ethanolic extracts are more effective solvents than chloroform for extracting a wide range of phytochemicals. The chloroform extracts generally yielded fewer active components, especially in the stem and bark. The latex showed significant amounts of alkaloids, phenols, flavonoids, and steroids, indicating high medicinal potential.

CONCLUSION

Beaumontia jerdoniana species is endemic and critically endangered in India and distributed few states such as Karnataka, Maharashtra, Goa, Tamil Nadu, and Kerala. In the state of Maharashtra, it is reported in a few patches of the Western Ghat regions like Ratnagiri, Kolhapur, and the Pune district (Chandore 2015), therefore, there is an urgent need to reduce overexploitation and promote conservation. Sacred groves are considered for the evergreen forest vegetation, especially lianas, which exist in the locality due to anthropogenic interference like shifting cultivation, overexploitation of forest produce, and cattle grazing. Therefore, the high conservation and biodiversity values of sacred groves, increasing attention due to their potential as a tool and model for biodiversity conservation. (Kawde and Berde 2013). As per the Biological Diversity Act, 2002, and IUCN, the species *Beaumontia jerdoniana* has been notified as a plant which is on the verge of extinction. Hence, the central government and various state governments have taken special initiatives for the conservation of *B. jerdoniana* due to their high-potential medicinal importance. In the *B. jerdoniana,* the leaf parts have rich sources of pharmacologically important phytoconstituents such as alkaloids, phenols, flavonoids, and steroids (Kulkarni 2020). The selection of solvent significantly affects extraction efficiency, with methanol and ethanol performing better than chloroform. These findings suggest that, especially focusing on leaf extract, further phytochemical and pharmacological studies are needed.

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