



## **Bryophyllum pinnatum: Traditional Remedies, Growth, and Future Prospects in Medicine**

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### ABSTRACT :

Bryophyllum pinnatum, a succulent plant from the Crassulaceae family, is well-known for its therapeutic benefits and tolerance to many environmental factors. It is traditionally utilized in Indian medicine for treating urinary stones and many diseases such as hypertension, skin problems, and inflammation, it has received attention as an exotic species due to its quick proliferation in humid, tropical settings. The plant's vernacular names, notably Parnabeeja in Ayurveda, indicate its cultural significance. Bryophyllum pinnatum displays a varied spectrum of phytochemical components, including alkaloids, flavonoids, and saponins, contributing to its pharmacological effects. Research reveals its efficiency in anti-inflammatory, antibacterial, and wound healing applications, plus possible anticancer and hepatoprotective properties. Its capacity to grow from leaves makes it appealing as a houseplant, despite its exotic character. Continued research into its medicinal potential underlines the value of traditional knowledge and the necessity for sustainable management approaches when dealing with this diverse species.

**KEYWORDS ;** Bryophyllum pinnatum, Medicinal properties, Invasive species, Phytochemical constituents, Anti-inflammatory, Antimicrobial, Wound healing, Anticancer, Hepatoprotective, Traditional medicine, Sustainable management



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### Introduction :

Bryophyllum pinnatum plant is an environmental weed from the Crassulaceae family, This family consist 25 genus and around 425 species<sup>[1]</sup>, Bryophyllum pinnatum is derived from greek word Bryo means to sprout and phyllon means leaf <sup>[2]</sup>.it has been traditionally used as a medicine in many regions of India, mostly to treat urinary stones, as well as in other parts of the world.<sup>[3]</sup> This plant has become very famous as a house or yard plant because it has spread over naturally in hot, humid places in India, where it lives in warm, temperate climates from sea level to 8500ft. It is considered an invasive species<sup>[1]</sup>.

According to World Health Organization (WHO), medicinal plants are the high source which, a diverse range of potential therapeutic drugs and these drugs can be relatively safe and economical as compared to the synthetic medicines.<sup>[4]</sup> This plant is used by traditional practitioners around the world to treat a variety of diseases, such as hypertension, skin disorders, asthma, colds, insect stings, and inflammation. Bryophyllum pinnatum also known as Parnabeeja in Ayurvedic science.

The herb contains a broad range of chemical constituents that could be responsible for its various pharmacological effects<sup>[4]</sup>

It is used as a source plant for Pashanabheda [Berginia ligulata wall.] in Bengal regions, where the plant is locally known as Pathar kuchi, which is widely used in urinary stones in place of the original source of Pashanabheda<sup>[3]</sup>. The plant grows in Southern Nigeria. There is just one Kalanchoe species in

South America, although there are 200 others in Africa, Madagascar, China, and Java. Several kinds are popular tropical house plants and grown for decorative purposes. The plant is also known as *saião* or *coirama* in Brazil and *hoja del aire* (air plant) or *kalanchoe* in Peru.<sup>[5]</sup>

The majority of traditional practitioners in Bengal, including Unani and Ayurveda physicians This succulent perennial plant can reach height of 1-1.5 meters and has hollow, four-angled stems.



#### Vernacular names<sup>[1,4,6,7]</sup>

- Sanskrit : Parnabeeja, Asthibhaksha
- English : Air plant
- Hindi : Zakhmhaiyat, Pathharchoor
- Kannada : Gandukalinga, Kadu basale
- Malayalam : Elamarunga
- Tamil : Malaikalli, Ranakalli
- Telugu : Ranapala Marati : Gayamari
- Bengali : Koppatha, Pathar kuchi.

#### Taxonomical classification<sup>[3, 4,5,6,7]</sup>

- Kingdom : Plantae – Plants
- Sub kingdom : Tracheobionta – Vascular plants
- Division : Spermatophyta – seed plants
- Subdivision : Magnoliophyta – Flowering plants
- Class : Magnoliopsida – Dicotyledons
- Subclass : Rosidae
- Order : Rosales
- Family : Crassulaceae – stonecrop
- Genus : Bryophyllum
- Species : *Bryophyllum pinnatum* (lam.)Oken The word meaning of *Bryophyllum pinnatum*: Derived from Greek- Bryo means to sprout & phyllon is a leaf i.e. ability to propagate via leaf cutting, *pinnatum* is from Latin feathered, winged.

#### Ayurvedic properties<sup>[3]</sup>

- Rasa : Kashaya, Amla
- Guna : Laghu
- Virya : Sheeta
- Vipaka : Madhura
- Doshagnata : Vatakaphahara
- Karma : Ashmarighna, Vranaropaka, Mootrala, Shonita sthapana
- Rogagnata : Ashmari, Atisara, Raktasrava, Visuchika.
- Part used : Patra (Leaves)
- Dosage : Leaves powder 2.5-5g

#### Morphology<sup>[3,6]</sup>

##### PLANT ;

- *Bryophyllum pinnatum*, also known as the “miracle leaf” or “life plant,” is a smooth, succulent herb that grows between 0.3 to 1.2 meters tall. It’s known for its ability to propagate from its leaves, making it quite unique!



**STEM;**

- Stems obtusely four angled, older one are light coloured & younger ones are reddish speckled with white.

**LEAVES**

They can vary in shape and arrangement.

- **Lower Leaves:** Usually simple or compound.
- **Upper Leaves:** Have 3-5 or 7 smaller leaflets and long stems.
- **Stems:** The stems of the leaves are connected by a ridge around the main stem.
- **Leaflets:** They are oval or elliptical with edges that are either scalloped or saw-toothed.

**FLOWERS;**

- **Flowers:** Hang down in large, spreading clusters with strong, opposite branches and thin stems.
- **Sepals:** Red-striped, green at the base, and pale green above.
- **Petals:** Reddish-purple, swollen and octagonal at the base, with triangular tips.
- **Filaments:** Green at the base, turning pinkish below the anthers.
- **Anthers:** Black and shaped like arrows.
- **Styles:** Green.

**FRUIT AND SEEDS ;**

- **Fruit:** Enclosed in a thin, papery covering.
- **Seeds:** Small, smooth, and shaped like oblong ellipsoids.

**Ethinopharmacology<sup>[4,5,6]</sup>**

- Multiple varieties of *B.Pinnatum* are used medicinally in Indochina and the Philippines. It grow naturally in India's hot and humid regions.
- The leaves and bark are bitter tonic, astringent to the bowels, analgesic, carminative, and helpful for diarrhoea and vomiting<sup>[5]</sup>

- It is used both topically and internally to treat a variety of pains and inflammations, bacterial, viral, and fungal infections, leishmaniasis, earaches, upper respiratory infections, stomach ulcers, flu, and fever<sup>[5]</sup>.
- In traditional medicine, the leaves of this plant have been used for antibacterial, antifungal, antiulcer, anti-inflammatory, analgesic, antihypertensive, effective anti-histamine, and anti-allergic activity. The Creoles treat cancer and inflammation by lightly roasted leaves, and a leaf infusion decreases fevers.
- For migraines and headaches, combine it with coconut oil or andiroba oil and apply it to the forehead. The Siona indigenous people heated the leaves and used it directly on boils and skin sores.
- Natives around Ecuador's Rio Pastaza utilize a leaf infusion to treat fractured bones and internal injuries.
- In Peru, indigenous tribes combine the leaf with aguardiente (sugar cane rum) and apply it to the temples to treat headaches; they soak the leaves and stems in cold water overnight and drink it for indigestion, urethritis, fevers, and a variety of respiratory problems. The root infusion is also used to treat epilepsy. Other Amazonian tribes strain the juice from fresh leaves and blend it with mother's milk for earache.
- In Mexico and Nicaragua it is also used to promote menstruation and assist in childbirth.
- *Bryophyllum pinnatum* is used in ayurvedic medicine to treat several diseases including Menorrhagia.
- The root extract is used for hepatoprotective, laxative, diuretic, and antipsychotic impact.
- The plant's leaves are used both externally and orally and have considerable medical potential. The leaves have a variety of qualities, including emollient, refrigerant, and hemostatic. vulnerary, mucilaginous, purifying, anti-inflammatory, both a tonic and a disinfectant.
- They are beneficial in deteriorated circumstances of Cuts, wounds, hemorrhoids, menorrhagia, vata and pitta, skin discoloration, boils, sloughing ulcers, eye burns, scalds, corn, diarrhea, dysentery, headaches, bronchitis, vomiting, and severe inflammations.
- In addition, it is used to treat skin conditions, kidney stones, stomach ulcers, and legs swollen with fluid. From the outside, the leaf pulp.
- Kerala tribal people use the herb to cure the symptoms of cancer.
- Additionally, plants create the classic signs and symptoms of cardiac toxicity; however, repeated little dosages also cause cotyledonosis, a poisoning that affects the neurological small animals muscular systems, especially sheep's, in the South Africa's Karoo region.

#### Phytochemical constituent<sup>[2,5,8,9]</sup>

*B. pinnatum* has many active ingredients believed to help with its health benefits. These chemical constituents are obtained from the whole plant. The main active ingredients are:

**Alkaloids:** Bryophylline, a key alkaloid in *B. pinnatum*, is believed to help with diabetes, fighting infections, and reducing inflammation.

**Flavonoids:** Kaempferol, quercetin, and rutin are powerful antioxidants and anti-inflammatory compounds.

**Triterpenoids:** Beta-sitosterol and oleanolic acid are known for their ability to reduce inflammation and help with diabetes.

**Glycosides:** Flavonoid glycosides help with skin health and healing wounds.

**Saponins:** These have antifungal and antibacterial effects.

#### Biological and pharmacological effect

##### 1. Anti-inflammatory and Analgesic activity<sup>[1,4,6,10]</sup>

- The leaves and blossoms of *Bryophyllum pinnatum* are utilized for their analgesic and anti-inflammatory properties. Flavonoids found in it have the capacity to reduce the activity of the cyclooxygenase enzyme and Tissue necrosis factor- $\alpha$  activity.
- A new steroidal derivative has been isolated from leaves. This novel steroidal molecule was discovered in an aqueous extract. It has anti-inflammatory properties as evaluated by rat paw edema caused by carrageenan and contrasted with diclofenac. Moreover, it has shown 75.72% protection from analgesic effectiveness in rodent experiments test for mice, writhing test response to acetic acid.
- Thus, it has been demonstrated that the plant's aqueous extract has strong analgesic effects. It has been demonstrated that the ethanolic extract of leaves is beneficial against both topical acute and chronic inflammation, which is caused by the arachidonic acid pathway being overloaded.

##### 2. Treatment on renal calculi<sup>[4,6,11]</sup>

- Traditional medicine uses the medicinal plant to treat kidney stones.
- Aqueous extract of leaves significantly reduces the amount of oxalate in urine, and as a result, it can be beneficial in renal calculi treatment.
- In Pakistan, this plant is used medicinally to treat renal stones with conventional care. *Bryophyllum pinnatum* has been shown to be helpful in lowering kidney stones as it increases oxalate excretion crystals by shrinking their size and transforming them from calcium oxalate to dehydrated crystals. form of monohydrate. Research has verified that the plant extracts shield the kidney's cells against crystals of calcium oxalate.
- Decreases the development of kidney stones by making them more soluble and excretable in urine.

##### 3. Wound healing activity<sup>[3,4,12,13]</sup>

- In traditional therapies, the plant is applied topically to promote wound healing.
- The plant may contain huge levels of saponins, which encourage the healing of wounds by gathering the red blood cells.
- Furthermore, the plant's tannins also accelerate the healing of wounds due to their drying impact.
- In research, the animals were divided into three groups of ten for a study.
- Group 1 received a placebo gel, Group 2 got Fibrinase® cream, and Group 3 was treated with a gel containing 5% *B. pinnatum* leaf extract. The animals were kept in separate cages and wounds were created on their back while they are given anesthesia.
- Treatment was started immediately and continued daily for 14 days.

- Wound healing was measured and photographed on days 1, 7, and 14 using ImageJ software.
  - At the end each period, five animals from each group were put up for further analysis of cytokines, histology, and immunohistochemistry
- 4. Antimicrobial and antifungal activity<sup>[3,4,6,14]</sup>**
- The study found that extracts from *B. pinnatum* leaves (using water, methanol, palm wine, Omidun, local gin, and fresh leaf juice) at different concentrations (256, 128, 64, 32, 16, 8, 4 mg/ml) have varying antibacterial effects on both Gram-positive and Gram-negative bacteria.
  - Among these, the methanol extract showed significant antibacterial activity against control strains of *Staphylococcus aureus*, *Enterococcus faecalis*, *Bacillus subtilis*, and *Pseudomonas aeruginosa*, comparable to the antibiotic Ciprofloxacin.
  - Even the juice from squeezed *B. pinnatum* leaves had a notable effect on some Gram-positive and Gram-negative bacteria.
  - Other extracts showed moderate to weak activity against the tested organisms.
  - Another in-vitro study identified antibacterial activity in two flavonoid compounds isolated from *B. pinnatum* leaves. Compound 1 (5-Methyl-4, 5, 7-trihydroxyflavone) and Compound 2 (4, 3, 5, 7-tetrahydroxy-5-methyl-5-propenamine anthocyanidines), at a concentration of 100 mg/ml, were tested against three Gram-negative bacteria (*Escherichia coli*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*), one Gram-positive bacterium (*Staphylococcus aureus*), and two fungi (*Candida albicans* and *Aspergillus niger*). Both compounds successfully inhibited *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Aspergillus niger*, and *Candida albicans*, but Compound 1 did not inhibit *Escherichia coli*.
- 5. Anticancer activity<sup>[3,4,6,15,16]</sup>**
- The study found that extracts from *B. pinnatum* leaves can stop the growth of human cervical cancer cells.
  - One specific part of the extract, called fraction F4 (a mix of Petroleum Ether and Ethyl Acetate in equal parts), showed that it can kill cancer cells in a dose-dependent manner. This means the more of the extract used, the more cancer cells it killed.
  - Additionally, fraction F4 was less effective at stopping the HPV18 virus from making copies of itself, suggesting it has a higher amount of active ingredients.
- 6. Antihypertension<sup>[3,4,17]</sup>**
- The study found that *B. pinnatum* aqueous and methanolic leaf extracts (50-800mg/kg i.v. or i.p.) had anti-hypertensive activity on arterial blood pressure and heart rates of normotensive and spontaneously hypertensive rats.
  - The hypotensive impact was more noticeable in hypertensive rats than in normotensive ones.
  - Even leaf extracts (0.25-5.0 mg/ml) caused a dose-dependent decrease in the rate and force of contractions of guinea-pig isolated atria.
- 7. Antidiabetics<sup>[3,4]</sup>**
- The study found that *B. pinnatum* aqueous leaf extract has anti-diabetic efficacy at four distinct doses (200, 400, 800mg/kg, and 800mg/kg plus glibenclamide 2mg/kg) in diabetic rats (Glucose D-3g/kg).
  - The 200mg/kg aqueous extract resulted in a considerable drop in blood sugar levels when compared to the other dose.
  - However, the combination of 800mg/kg aqueous extract + glibenclamide 2mg/kg proved more efficacious and efficient than the usage of 200mg/kg and the other single doses .
- 8. Hepatoprotective.<sup>[1,3,4]</sup>**
- The plant has been studied for its hepatoprotective properties.
  - Carbon tetrachloride-induced hepatic damage in rats was studied, and it was shown that an ethanolic extract of the leaves lowers the levels of liver enzymes, serum bilirubin, serum cholesterol, and serum total protein.
  - The results show that the herb has an obvious hepatoprotective effect.
  - It Increased regeneration of hepatocytes and suppression of microsomal enzymes protect the liver against injury.
- 9. Cytotoxicity of testis.<sup>[3,18]</sup>**
- The study found that an ethanolic extract of the leaf of *B. pinnatum* had a cytotoxic impact on rat testis cells in two distinct dosages (100 mg/kg and 200 mg/kg) given orally for eight weeks.
  - At the dose of 100 mg/kg, the seminiferous tubules shrank and intracellular spaces were seen within the epithelium, and the higher dose (200 mg/kg) showed a marked increase in intracellular spaces within the germinal epithelium and a reduction of spermatozoa when compared to the control group, which showed intact normal histological features of the testes.
- 10. Protein profiling.<sup>[3]</sup>**
- Proteins were extracted from *Bryophyllum pinnatum* leaves using a phosphate extraction buffer (pH).
  - The outcomes of sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE) separation revealed that bands on the gel were excised and digested with trypsin before being submitted to liquid chromatography tandem mass spectrometry (LC/MS/MS) for protein identification.
  - Proteinase K has been found using MS/MS data. The protein found was Proteinase K, which is utilized commercially in degrading undesirable proteins like keratin.
- 11. Neuropharmacological activity.<sup>[1,3,4,6,19,20]</sup>**
- *Bryophyllum pinnatum* is well-known in folklore for its nephroprotective properties, and investigations have confirmed this.

- The outcomes of a research revealed that this impact is dosage dependent.
- The nephroprotective action against genatmicin-induced nephrotoxicity in the Wistar rat kidney was investigated, and it is expected that this effect is attributable to the plant's antioxidant and radical scavenging characteristics.
- Evidence suggests the juice of leaves is more successful in the treatment of overactive bladder and has less adverse effects than anticholinergic drugs.

## 12. Gastroprotective / antiulcer <sup>[4,21]</sup>

- Bryophyllum pinnatum shows gastroprotective benefits, as evidenced by its potent dose-dependent defensive activity against ethanol-induced stomach damage.
- To study how well (a plant extract) protects against stomach ulcers in female rats.
- There were six groups of rats, each receiving different treatments:
- **Group 1:** Received PBS (a harmless solution) and served as the control group
- **Group 2:** Received PBS and served as the ulcer control group.
- **Group 3:** Received rabeprazole (a medicine for ulcers).
- **Groups 4 and 5:** Received different doses of AEBP (500 mg/kg and 750 mg/kg).
- **Group 6:** Received MUC (another substance being tested).
- **Procedure:**
- All rats were given their respective treatments for 7 days.
- After fasting for 24 hours, groups 2 to 6 were given ethanol to induce ulcers.
- 30 minutes later, the rats were sacrificed, and their stomachs were examined for ulcers.
- The size of the ulcers was measured.
- The percentage of protection provided by each treatment was calculated using a specific formula.
- However, further trials should be conducted to verify its usage in stomach ulcers.

## 13. Antioxidant activity <sup>[1,3,22]</sup>

- When tested on rats, the leaf extract displayed antioxidant activity, with a concentration-dependent rise in percentage antioxidant activity in DPPH radical scavenging.
- The extract generated the highest antioxidant activity at 400µg/mL concentration when compared to ascorbic acid and observed the value of P.

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## Conclusion :

- The current study focuses on the latest proof base information concerning pharmacognostical, phytochemical and pharmacological profile of Bryophyllum pinnatum
- It determined that the divine herb contains many significant active pharmacological constituents that are responsible for plant several therapeutic effects.
- Numerous research support its use in traditional treatments and also prove safety and efficacy .

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