

Pharmacological Activity of Bryophyllum Pinnatum

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ABSTRACT: Bryophyllum pinnatum is a medicinal plant used in traditional medicine to treat many health problems. Studies show it has healing properties like reducing inflammation, fighting bacteria, preventing cancer, and speeding up wound healing. It can also help with kidney stones and diabetes. The plant contains natural compounds that give it these benefits. Although it's effective in traditional medicine, more research is needed to understand its full potential and ensure it's safe for modern medical use.

KEYWORD: Bryophyllum pinnatum, anti-ulcer, anti-allergies, kidney stones, anti-inflammatory, antioxidant, antimicrobial, anti-cancer, wound healing, diabetes, bioactive compounds.

I. INTRODUCTION:

Bryophyllum pinnatum, also called Mother of thousands plants and as well as the stone kidney plant, is a special type of plant that can grow new plants from its leaves. It originally comes from Madagascar but can now be found in warm places all around the world.[1]

This plant has thick leaves that store water, which helps it survive in dry conditions. People have used it in traditional medicine to treat things like wounds, coughs, and kidney stones.

Because it's easy to grow and has health benefits, many people keep it in their homes or gardens. Usually the leaves are used in teas, applied to the skin, or made into extracts.[2]

Research has found that this plant has helpful chemicals like flavonoids and alkaloids, which give it health benefits such as reducing inflammation, fighting bacteria, and easing pain.

Scientists are now exploring its potential to treat serious conditions like kidney diseases and even certain cancers. Because of its ability to grow in many places and its health benefits, Bryophyllum pinnatum is an important plant that both traditional healers and modern researchers are studying.[3]

PLANT PROFILE[4]:

Kingdom : Plantae – Plants

Sub kingdom: Tracheobionta

Division: Spermatophyta

Subdivision : Magnoliophyta

Class : Magnoliopsida

Subclass: Rosidae

Order: Rosales

Family: Crassulaceae

Genus: Bryophyllum

Species: Bryophyllum pinnatum kurz

SYNONYM[4]:

Hindi: Panfuti

Sanskrit: Parnabija

Bengali : Koppata

Gujarati: Ghaymaari

Telgu : Simahmudu

Tamil : Ranakalli

MORPHOLOGY: Bryophyllum pinnatum is a succulent glabrous herb with a height of 0.3-1.2m.

• Stem:



Fig. Bryophyllum pinnatum stem[6]

The young stems of Bryophyllum pinnatum are reddish with white spots, while the older stems are pale in colour. The stems are upright, thick, smooth, and have a four-sided shape.[5]

• **Leaves:**



Fig.1: Bryophyllum pinnatum leaves[7]



Fig.2:B.Pinnatum leaf reproduction[8]

Bryophyllum pinnatum leaves are thick, fleshy, and oval-shaped with smooth, shiny surfaces. Younger leaves can have a reddish or purplish in colour and older leaves are yellowish in colour. These notches are unique because each one can sprout tiny plantlets. When these plantlets detach and fall to the ground, they can grow into new plants, making Bryophyllum pinnatum easy to propagate. The leaves are rich in water content, which helps them survive in dry conditions.[5]

• **Flower:**



Fig: Bryophyllum pinnatum flowers[9]

The flowers are pendent in large spreading panicles with opposite stout branches, pedicels are slender. Flowers are mainly bell-shaped, drooping and are arranged in branched clusters at the tip of the stem. The flowers are yellowish green or pale green coloured prominent sepals. Flowers are mainly produced during winter and spring.[5]

CHEMICAL CONSTITUENTS[10,11,12,13]:

1. Flavonoids

- Quercetin: A well-known antioxidant and anti-inflammatory compound.
- Kaempferol: Another flavonoid with anti-inflammatory, antioxidant, and antimicrobial properties.

2. Tannins

- These compounds are known for their astringent properties and contribute to the plant's wound-healing effects.

3. Alkaloids

- Bryophylline: An alkaloid with potential analgesic and anti-inflammatory activities.
- Berberine: Though more commonly found in other plants, some studies suggest its presence in Bryophyllum species.

4. Glycosides

- Bufadienolides: Cardiac glycosides that have shown potential in traditional medicine for treating heart conditions.

5. Organic Acids

- Citric Acid: Aids in metabolism and energy production.
- Malic Acid: Known for its role in the Krebs cycle and energy production in cells.

6. Phenolic Compounds

- Catechins: Antioxidants that help protect cells from damage.
- Gallic Acid: Has strong antioxidant properties and potential therapeutic uses in treating various diseases.

7. Saponins

- These are compounds known for their ability to lower cholesterol, enhance immune response, and exhibit antimicrobial properties.

8. Steroids

- Stigmasterol: A plant sterol that may contribute to the plant's anti-inflammatory and anticancer properties.

9. Essential Oils

- The plant also contains various essential oils that contribute to its aroma and therapeutic properties, such as antimicrobial and anti-inflammatory effects.

APPLICATIONS AND USES:

• Medicinal Uses[2]:

Bryophyllum pinnatum is traditionally used in herbal medicine for treating wounds, ulcers, infections, and respiratory conditions. Its juice is often applied topically or consumed for its healing properties.

• Pharmacological Potential[14,15]:

Modern studies are investigating the pharmacological potential of Bryophyllum pinnatum, including its antimicrobial, anti-inflammatory, and anticancer effects.

BRYOPHYLLUM PINNATUM STOPS THESE REACTIONS:

1. Stops Harmful Chemicals:

When the body is inflamed, it produces chemicals like TNF- α , IL-1 β , and IL-6 that make the inflammation worse. Bryophyllum pinnatum helps lower the levels of these chemicals, which can reduce inflammation.

2. Lowers Nitric Oxide (NO):

Nitric oxide is a substance that is often produced too much during inflammation, causing damage. This plant can help reduce the amount of nitric oxide, preventing further harm to the body.

3. Blocks Inflammation Enzymes:

The body has an enzyme called COX-2 that makes substances that increase inflammation (prostaglandins). Bryophyllum pinnatum can block this enzyme, which helps decrease inflammation.

4. Reduces Cell Damage:

Inflammation can cause damage to cells through a process called lipid peroxidation. The plant has antioxidant properties, which means it can stop this damage by neutralizing harmful molecules (free radicals).

5. Stops Allergic Reactions:

The plant can block the effects of histamine and serotonin, which are chemicals involved in allergic reactions and inflammation.

6. Prevents White Blood Cells from Causing Harm:

During inflammation, white blood cells (like neutrophils) rush to the inflamed area and can cause more damage. Bryophyllum pinnatum helps stop too many of these cells from gathering, which reduces swelling and tissue damage.

ETHNOPHARMACOLOGY:

B. Pinnatum, native to Indo-China and the Philippines Islands, is used medicinally for various ailments, including diarrhea, vomiting, and infections[16]. Its leaves and bark are bitter, astringent, and carminative, and are used for various pains, inflammations, and infections. Traditional medicine uses the leaves for antimicrobial, antifungal, anti-inflammatory, analgesic, antihypertensive, anti-histamine, and anti-allergic properties[17]. The Creoles use roasted leaves for cancer, inflammations, fevers, migraines, headaches, boils, skin ulcers, broken bones, internal bruises, heartburn, urethritis, fevers, and respiratory conditions[18]. Palikur and Siona indigenous peoples heat leaves for boils and skin ulcers. In Ecuador, Rio Pastaza, Peru, and the Amazon, leaves are mixed with aguardiente for headaches, heartburn, and earaches. Mexico and Nicaragua use the plant to promote menstruation and childbirth, while Nigeria and West African countries use its fleshy leaves as herbal remedies for various disorders[19]. The leaves have numerous medicinal properties, including haemostatic, refrigerant, emollient, mucilaginous, vulnerary, depurative, anti-inflammatory, disinfectant, and tonic properties. They are also used for kidney stones, gastric ulcers, skin disorders, and leg edema[20]. The stone kidney plant (Bryophyllum pinnatum) has many traditional medicinal uses for both external and internal treatments:

1. External Uses:

The pulp or juice from the leaves is applied to wounds to stop bleeding, as it helps constrict tiny blood vessels and promotes healing. It's commonly used for issues like headaches, toothaches, earaches, eye infections, wounds, ulcers, boils, burns, and insect bites. For traumatic wounds, heated and crushed leaves are applied to reduce swelling and heal the wound without leaving scars[21].

2. Internal Uses:

The juice of the leaves, combined with cumin seeds and double the amount of clarified butter (ghee), is used to treat dysentery. The plant is beneficial for managing bleeding disorders, including piles (hemorrhoids) and heavy menstrual bleeding (menorrhagia)[22].

3. Other Uses:

Tribes in Kerala, India, use the plant for symptoms associated with cancer. However, the plant can cause poisoning symptoms in the heart if consumed in large amounts. Small repeated doses may lead to a condition called cotyledonosis, which affects the nervous and muscular systems of animals like sheep in certain regions of South Africa[23].

PHARMACOLOGICAL USES:

The leaves of *Bryophyllum pinnatum* are widely used in traditional medicine to treat various health issues. They are known for their effectiveness in addressing kidney and bladder stones, digestive problems, ulcers, arthritis, inflammation, conjunctivitis, menstrual disorders, migraines, wounds, and dysentery[24].

In Ayurveda, the plant's leaves are considered moderately toxic to insects, while in Unani medicine, the bark is described as toxic and capable of countering poisons but can irritate the digestive system[25]. The leaves also exhibit strong antimicrobial properties, making them effective against bacteria, viruses, fungi, and insects. They are known for their anti-cancer (antineoplastic), antibacterial, antiviral, anti-fungal, anti-inflammatory, anti-ulcer, anti-allergic, and antihistaminic properties. These diverse medicinal qualities highlight the plant's potential in treating a variety of health conditions[26].

ACTIVITIES:

➤ Anit-ulcer activity:

Studies on the methanolic extract of *Bryophyllum pinnatum* leaves have shown that it can prevent different types of acute ulcers in the stomach and small intestine (duodenum) of rats and guinea pigs. It also helps speed up the healing of stomach ulcers caused by acetic acid in rats[27]. The extract has a protective effect on stomach ulcers caused by indomethacin (a common painkiller), and this effect increases with higher doses. Additionally, it reduces stomach acid production, both under normal conditions and when triggered by histamine. This reduction in acidity depends on the dose and lasts longer with higher doses[28]

➤ Anti-inflammatory activity:

According to recent studies that *Bryophyllum pinnatum* plant can reduce the fevers and show antiinflammatory, pain relief and muscle relaxant effects. In anti-inflammatory effects have been partially attributed to the immune modulatory and immunosuppressant effect[29]. Leaves of *Bryophyllum pinnatum* are used against the inflammation and allergic reaction which provoked by insect bites in Brazil[30].

Scientists tested extracts from the leaves of the stone kidney plant using different solvents like petroleum ether, chloroform, and methanol, as well as specific compounds like flavonoids and alkaloids. At a dose of 50 mg/kg, the methanol extract worked particularly well in reducing swelling caused by formaldehyde. It was even more effective than the standard anti-inflammatory drug used in the study, showing the plant's strong potential to fight inflammation.[31]

➤ Anti-microbial activity:

The growing resistance of bacteria to synthetic antibiotics highlights the urgent need for new and safer antimicrobial agents, particularly from natural sources like plants. *Bryophyllum pinnatum*, commonly known as the stone kidney plant, has been traditionally used to fight bacterial infections, including typhoid fever. It is effective against various bacteria, such as *Staphylococcus aureus*, *Escherichia coli*, *Bacillus subtilis*, *Pseudomonas aeruginosa*, *Klebsiella aerogenes*, *Klebsiella pneumonia*, and *Salmonella typhi*.

The plant contains bioactive compounds like bryophyllin A and C, which show strong insecticidal activity against silkworm larvae. Additionally, two flavonoids, 5-methyl-4,5,7-trihydroxy flavones and 4,3,5,7-tetrahydroxy-5-methyl-5-propenamine anthocyanidines, have demonstrated promising antimicrobial effects against *Pseudomonas aeruginosa*, *Klebsiella pneumonia*, and *E. coli*. A 60% methanolic extract of *Bryophyllum pinnatum* leaves has been shown to effectively inhibit bacterial growth at a concentration of 25 mg/ml. These antimicrobial properties are believed to contribute to wound healing by reducing infections, controlling inflammation, and promoting tissue repair and cell growth[32]. In south-eastern Nigeria, *Bryophyllum pinnatum* is used in traditional medicine to treat burns, abscesses, ulcers, boils, and to help heal the placenta after childbirth. It is also used in herbal medicine for asthma, coughs, bronchitis, and various skin conditions such as carbuncles, sores,

and wounds. Moreover, a phenanthrene alkaloid isolated from the plant's ethanolic extract, called 1-ethan-amino-7-hexyne-5-one phenanthrene, has shown antimicrobial activity against *Pseudomonas aeruginosa*, *Klebsiella pneumonia*, *Staphylococcus aureus*, *E. coli*, *Candida albicans*, and *Aspergillus niger*[33].

➤ **Anticancer activity:**

The ethanolic extract of *Bryophyllum pinnatum* has been found to have anticancer properties. Studies show that bufadienolides, compounds found in the plant, are strong agents that may help prevent cancer. Using an MTT assay (a test to measure cell growth), researchers found that methanolic, aqueous, and methanolic-aqueous extracts from the plant have mild effects in slowing the growth of human fibrosarcoma cells (HT-1080), a type of highly invasive cancer[34]. Additionally, the chloroform extract of *Bryophyllum pinnatum* leaves has been shown to target HPV (human papillomavirus) and promote cell death (apoptosis) in cervical cancer cells. This research suggests that the plant's extracts could lead to the development of new anticancer treatments, especially for managing cervical cancer[35].

➤ **Wound healing activity:**

The extract of *B. pinnatum* was evaluated for its wound healing activity by using excision wound model in rats. The histological analysis showed that plant leaf extract exhibited significant wound healing potential. The wound healing exhibited by the extract may be attributed to the presence of steroid glycosides.

Studies have shown that leaf extracts of *Bryophyllum pinnatum* can help wounds heal faster. Three types of extracts (petroleum ether, water, and alcohol) were tested on Albino rats at a dose of 400 mg/kg, given orally for 10 days. These extracts were tested on different types of wounds, including cuts (incision wounds), open wounds (excision wounds), and wounds with dead tissue.

All three extracts significantly improved the strength of healed incision wounds when compared to untreated wounds. For excision wounds, the water extract was applied directly to the skin for 21 days until a scab (eschar) formed, showing its effectiveness in wound healing[36].

➤ **Anti-allergies activity:**

An in vitro experiment shown that the herb is effective in lowering allergy. It has an anti-allergic action by preventing mast cell

degranulation brought on by antigens and also by reducing histamine release[37].

➤ **Anti-diabetes activity:**

The presence of zinc in *Bryophyllum pinnatum* suggests it may help manage diabetes, a condition caused by problems with insulin. Research by Ojewole tested the plant's pain-relieving (antinociceptive) effects using methods like the hot-plate test and acetic acid test on mice. The study also examined its anti-inflammatory and antidiabetic effects in rats. To test this, researchers caused inflammation using egg albumin and diabetes using a chemical called streptozotocin. The plant's aqueous (water-based) leaf extract significantly reduced pain, inflammation, and blood sugar levels in these animal models. The plant's pain-relieving and anti-inflammatory effects are believed to work by stopping the production or release of inflammatory substances, such as prostaglandins, histamine, and other molecules that cause pain and swelling. These benefits are likely due to the flavonoids, polyphenols, triterpenoids, and phytosterols present in the plant[38].

➤ **Neuroprotective activity:**

The aqueous leaf extract of *Bryophyllum pinnatum* (the stone kidney plant) has been shown to have calming and protective effects on the brain in mice. When given in increasing doses, the extract causes the mice to become less active, exploring their surroundings less. It also acts as a sedative, meaning it helps the mice relax and reduces their movement significantly. Additionally, it extends the sleeping time when combined with a sleep-inducing drug called pentobarbitone.

Moreover, the extract delays the onset of seizures caused by substances like strychnine and picrotoxin, which are known to trigger convulsions. It also lowers the death rate in mice exposed to these substances, with an effective dose (LD50) of 641 mg per kilogram of body weight. Altogether, these effects suggest that *Bryophyllum pinnatum* acts as a depressant on the central nervous system, helping to calm and protect it from overactivity[39].

➤ **Anti-hypertensive activity:**

The aqueous and methanolic leaf extracts of *Bryophyllum pinnatum* have shown the ability to lower blood pressure and slow down heart rates in both normal rats and those with high blood pressure. This means the extract may help relax blood vessels or affect the heart in a way that reduces pressure on the arteries.

Additionally, when tested on heart muscle from guinea pigs, the extract reduced the strength of each heart contraction, and this effect increased as the dose of the extract was raised. This dose-dependent response suggests that *Bryophyllum pinnatum* could help manage blood pressure and heart rate by calming the activity of the heart and reducing its workload[40].

➤ **Immunosuppressive effect:**

The water-based (aqueous) extract of *Bryophyllum pinnatum* leaves has been found to reduce immune responses in mice. Specifically, it decreases both cell-mediated immunity (direct immune response by cells) and humoral immunity (antibody production).

In mice treated with the extract, spleen cells showed less ability to multiply in response to substances that trigger immune reactions (mutagens and antigens). Additionally, when these mice were exposed to ovalbumin (a protein that typically causes an immune reaction), their response was slower, indicating reduced sensitivity[41].

II. CONCLUSION

From this review, it is clear that *Bryophyllum pinnatum* is a widely available medicinal plant in India with many health benefits. The plant contains important active compounds like flavonoids, steroids, bufadienolides, glycosides, and organic acids. It has a wide range of medicinal properties, including antimicrobial, antifungal, anticancer, anti-tumor, and insecticidal activities. It also has other effects such as anti-ulcer, anti-inflammatory, pain-relieving (analgesic), blood pressure-lowering (antihypertensive), liver-protecting (hepatoprotective), kidney-protecting (nephroprotective), diuretic, anti-diabetic, anticonvulsant, antioxidant, muscle relaxant, labor-suppressing (tocolytic), and calming (neurosedative) effects. This review highlights the plant's pharmacological potential and provides valuable information for researchers interested in exploring its medicinal uses further[42].

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