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Review Article

Review On Pharmacological Activity Of Bryophyllum Pinnatum

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ABSTRACT

Bryophyllum pinnatum (Lam.) Kurz, perennial herb from the Crassulaceae family, is widespread in tropical Africa, tropical America, India, China, and Australia, and is extensively utilized in traditional medicine. Both native and exotic, the plant is important to traditional healers for treating a range of ailments including kidney stones, high blood pressure, asthma, colds, abscesses and bleeding disorders. Renowned for its haemostatic and wound healing properties, it has become a staple in traditional medicine for treating various ailments. This article reviews and discusses pharmacological studies, highlighting that diverse extracts from Bryophyllum pinnatum demonstrate pharmacological activities, including immunomodulation, CNS depression, analgesia, antimicrobial effects, anti-inflammatory responses, antiallergic and antianaphylactic properties, antileishmanial activity, antitumor effects, antiulcer properties, antibacterial and antifungal actions, antihistamine and antiviral effects, febrifuge activity, gastroprotective qualities, immunosuppression, insecticidal properties, and muscle relaxation, along with sedative effects.

INTRODUCTION

The Bryophyllum pinnatum (Lam.) Oken plant is classified as an ecological wildflower of the Crassulaceae family, but paradoxically, it is a common traditional medicine throughout India. [1] Bryophyllum pinnatum, usually known as the

life plant, is a widely distributed perennial medicinal herb. Originally native to Madagascar, it has naturalized in several other regions of Asia, Australia, and New Zealand, and is also referred to as panfuti. [3] Secondary metabolites extracted from various parts of the Bryophyllum pinnatum

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plant exhibit numerous pharmacological activities, including anthelmintic, anticancer, antihypertensive, antioxidant, and anti-inflammatory properties. However, it's important to note that the species is considered poisonous to livestock due to the presence of cardiac glycosides. [3] Bryophyllum pinnatum is known for its many medicinal properties and plays an essential role in Nigerian traditional medicine. As documented by Okwu in 2007 and Okwu et al., it can be used to treat various conditions such as earaches, burns, abscesses, ulcers, insect bites, fistulas, diarrhea, and stone disease. year 2006. In southern Nigeria, as Okwu described in 2007, the herb plays an essential role in promoting the loss of the placenta in newborns. Additionally, lightly roasted leaves are used topically to treat skin fungi and inflammation, while leaf infusions are used to treat skin fungi and inflammation. As an oral therapy for fever, as noted by Egereonu et al. 2005. [2] The plant is widespread throughout India, particularly in hot and humid regions, with a notable presence in Bengal. This succulent perennial grows to a height of 1-1.5 meters, featuring a hollow, four-angled stem that is typically branched. The leaves are arranged oppositely and decussate, succulent, and measure 10-20 cm in length. The lesser leaves are single, the higher leaves have 3-7 leaves, and the petioles are lengthy. They have shady green flesh with distinctive scalloping and red decoration. The leaves are pinnately composite, with 3-5 leaflets, 10-30 cm long; the petiole ranges from 2-4 cm; the leaflets are oblong to elliptical, measuring 6-8 × 3-5 cm. The edges are crenulated, and each notch contains a dormant bud capable of developing into a strong plant. [5] The plant has a blunt apex and roots and vegetative buds on the leaves. The inflorescence is terminal cone-shaped, 10-40 cm long. The flowers are lush, bell-shaped, and drooping. The calyx is tubular, 2-4 cm long, and the corolla is red to purple, 5 cm long, with sparse

cilia at the base. The lobes are ovate-lanceolate, and the base of the stamens is attached to the corolla. The nectar scales are oblong, and the calyx and corolla tube contain follicles. The fruitlet pods have four septa and contain many oval, smoothly striped seeds. The flowering period is from November to March, and the fruiting period is in April. [4],[6]



Taxonomical Classification:

Kingdom: Plantae – Plants

Sub kingdom: Tracheobionta – Vascular plants

Division: Spermatophyta

Subdivision: Magnoliophyta – Flowering plants

Class: Magnoliopsida – Dicotyledons

Subclass: Rosidae

Order: Rosales

Family: Crassulaceae

Genus: Bryophyllum

Species: Bryophyllum pinnatum kurz

Synonyms:

Bryophyllum calycinum Salisb, Kalanchoe pinnata (Lam.) Pers, Cotyledon pinnata Lam., Sedum madagascariense Clus, Crassula pinnata [16], [17]

Vernacular names [18,19]

Sanskrit : Parnabeeja, Asthibhaksha

English : Air plant, Miracle-leaf

Hindi : Zakhmhaiyat, Pathharchoor, Panfuti

Kannada : Gandukalinga, Kadu basale

Malayalam : Ellamurunga

Tamil : Malaikalli, Ranakalli

Telugu : Ranapala, Simahmudu



Marati : Gayamari

Bengali : Koppatha, Pathar kuchi.

Materials and Methods

Collection of Plant Materials

Garden-fresh leaves and stems of *Bryophyllum pinnatum* were collected from Etinan and Ikot Ekpene local government areas of Akwa Ibom State, Nigeria. The plant material was legitimate by the Department of Botany, University of Uyo, Nigeria. Voucher specimens numbered UUPH27(a) were prepared and kept in the herbarium for future reference, ensuring accuracy and traceability of the collected plant material.

Extraction Procedure

Wash the greeneries and stems exhaustively with purified water and then air-dry for two weeks. After the drying process, the plant parts are finely crushed and the resulting powder material is divided into individual parts. 750 g of each plant part was softened with 1.7 liters each of methanol and ethyl acetate for 72 hours at room temperature. After the 72-h maceration period, the various extracts were individually filtered through cotton plugs and subsequently through Whatman No. 1 filter paper. The obtained liquid filtrate was concerted and vaporized to dryness using a rotary evaporator (WG-tv311-V, Wilmad-LabGlass, USA) set at 40°C. Each of the resulting extracts was then transferred to properly categorized sterile glass bottles and stored at 4 °C until ready for use. [49]

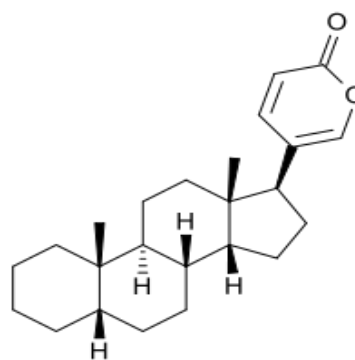
Phytochemical Screening of Plant Extracts

The methanol and ethyl acetate abstracts derived from the leaves and stems were subjected to screening to identify the existence of diverse bioactive constituents or phytochemicals. Standard procedures were employed for this assessment. [48],[50],[51]

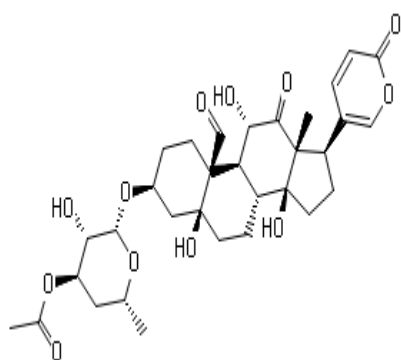
Phytochemical constituents:

Bryophyllum pinnatum is characterized by being rich in a variety of bioactive mixtures, containing alkaloids, triterpenes, glycosides, flavonoids,

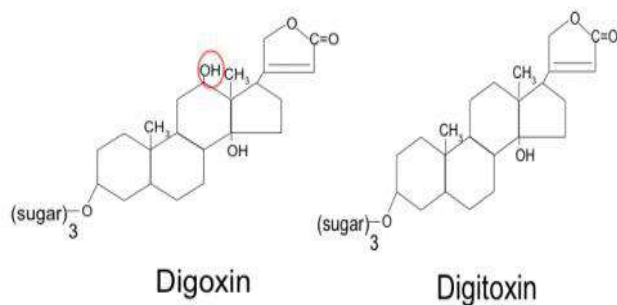
cardenolides, steroids, bufadienolides, and lipids. These components contribute to the pharmacological properties and medicinal value of the plant. [7-10] The leaves of *Bryophyllum pinnatum* have a group of elements called bufadienolides that are significantly active. Notably, bufadienolides such as bryotoxin A, B, and C share structural and functional similarities with two other cardiac glycosides, digoxin and digitoxin. These compounds demonstrate antibacterial, antitumorous, cancer preventative, and insecticidal actions, contributing to the plant's diverse pharmacological properties. [14,11-13] The plant *Bryophyllum pinnatum* contains various phenols, phenylpropanoids, and flavonoids, including syringic acid, caffeic acid, 4-hydroxy-3-methoxy-cinnamic acid, 4-hydroxybenzoic acid, p-hydroxycinnamic acid, paracoumaric acid, ferulic acid, protocatechuic acid, and phosphoenolpyruvate. Additionally, triterpenoids and steroids found in the plant include α -amyrin, α -amyrin acetate, β -amyrin, β -amyrin acetate, bryophollenone, bryophollone, taraxerol, pseudo taraxasterol, 18- α -oleanane, friedelin, and glutinol. These chemical constituents contribute to the plant's pharmacological and medicinal properties. [20]



Bufadienolides



Bryotoxin A



Digoxin

Digitoxin

Activities:

1. Neuropharmacological activity:

The presence of bufadienolides, a water-soluble component, is suggested as a potential cause for the central nervous system (CNS) depressing effect observed in the aqueous form of the leaf extract. Additionally, the plant has demonstrated sedative properties. Studies using the aqueous leaf extract revealed CNS depressive effects, with treated rats exhibiting reduced locomotor activity and decreased muscular tone when administered doses ranging from 50 to 200 mg/kg. Furthermore, intraperitoneal administration of the medication induced behavioral changes in the rats. These findings indicate the potential neurological impact of the plant's aqueous leaf eliminate. [24] In mice, the neuropharmacological effects of *Bryophyllum pinnatum* aqueous leaf extracts were investigated. The extract revealed a significant and quantity-dependent reduction in exploratory activity at dosages of 50, 100, and 200 mg/kg. Furthermore, the extract demonstrated a noticeable sedative effect, as demonstrated by a considerable decrease

in impulsive behavior and the potentiation of pentobarbitone-induced sleep duration. These findings suggest that the aqueous leaf extract of *Bryophyllum pinnatum* may have an impact on neurobehavioral activities, including sedation. [22],[23]

2. Antibacterial activity:

The presence of phenolic compounds in *P. leucophylla* indicates the antibacterial activity of this plant. According to a study by Ofokansi et al. (2005), the plant is actual in treating typhoid disease and other bacteriological infections, especially those produced by *Staphylococcus aureus*, *Escherichia coli*, *Bacillus subtilis*, *Pseudomonas aeruginosa*, *Klebsiella aerogenes*, *Klebsiella pneumoniae* and *Typhimurium* Bacterial infection caused by salmonella. The antibacterial activity of infusions and methanolic extracts was studied against *Staphylococcus aureus* ATCC 13709, *Escherichia coli* ATCC 9637, *Bacillus* spp., *Pseudomonas aeruginosa*, *Klebsiella pneumoniae* and *Salmonella typhi* using the agar diffusion method. The study also evaluated the resistance of the extracts against *Staphylococcus aureus*, *Escherichia coli*, *Salmonella typhi*, *Klebsiella* and *Pseudomonas aeruginosa* using a modified checkerboard method. These outcomes support the traditional use of *Pinnaphyllum* algae to treat the placenta and navel of newborns, promoting rapid healing and preventing the formation of infections. [27],[28],[29] Purely isolated alkaloids and their synthetic derivatives can serve as essential medicines with important value for their analgesic, antispasmodic, and bactericidal effects. These compounds are used to treat various conditions due to their therapeutic properties, demonstrating their importance in modern medicine. [26] In a study conducted by Obaseiki-Ebor et al., the *in vitro* antimicrobial activity of *P. pinnata* leaf juice was investigated. The extract at a concentration of 5% v/v was bactericidal against a wide range of

bacteria, including Gram-positive and Gram-negative strains. Bacteria tested include *Bacillus subtilis*, *Staphylococcus aureus*, *Streptococcus pyogenes*, *Streptococcus faecalis*, *Escherichia coli*, *Proteus spp.*, *Klebsiella spp.*, *Shigella spp.*, *Salmonella spp.*, *Salmonella marcescens* and *Aeruginosa Pseudomonas sp.* Notably, the antimicrobial activity extended to clinical isolates of these organisms, which exhibit resistance to multiple antibiotics. This demonstrates the potential of *P. leucophylla* leaf juice as a source of antimicrobial agents, especially against antibiotic-resistant strains. [30] A study by Schmitt et al. The antibacterial activity of the leaf decoction of *Echinacea spp.* against Gram-positive bacteria was demonstrated. The researchers used the dilution tube method to evaluate the effectiveness of the decoction. The method involves diluting the decoction to different concentrations and observing its effect on the growth of Gram-positive strains. The outcomes of this study provide valuable information on the potential antimicrobial properties of *P. elongata* leaves, particularly against Gram-positive bacteria. [28] In Akinpelu's study, it was observed that a 60% methanolic leaf extract of *Bryophyllum pinnatum* inhibited the growth of five out of eight tested bacteria at a concentration of 25 mg/ml. The inhibited bacteria included *B. subtilis*, *E. coli*, *P. vulgaris*, *S. dysenteriae*, and *S. aureus*. However, *K. pneumoniae*, *P. aeruginosa*, and *C. albicans* were found to resist the action of the extract at the same concentration. This suggests that the methanolic leaf extract of *Bryophyllum pinnatum* may have selective antibacterial effects against certain strains. [25]

3. Anticancer effects:

This study focused on Ehrlich ascites carcinoma (EAC) in Swiss albino mice when evaluating the antitumor effects of *Bryophyllum calycinum* Salisb. Methanol and aqueous extract of *Bryophyllum calycinum* were administered

intraperitoneally once daily for 7 days starting 24 hours after tumor inoculation at dosages of 100, 200, and 400 mg/kg body weight, respectively. Assessment included determination of percent embarrasment of fasted cells and percent inhibition of tumor weight. Results showed that animals treated with the extract had reduced tumor cell counts and tumor weights compared to animals treated with EAC alone. The observed effects were dosage-dependent, especially in the case of methanol extract. This suggests that *Bryophyllum calycinum* extract may have potential antitumor effects, reducing tumor growth in a dosage-dependent manner. [31] In one study, five bufadienolides insulated from plant leaves were investigated for their inhibitory properties on tumor growth. Activation of Epstein-Barr virus early antigen (EBV-EA) in Raji cells induced by the tumor promoter 12-Otetradecanoylphorbol-13-acetate. All tested bufadienolides showed inhibitory activity, with bryosin A showing the most significant inhibitory effect between the compounds studied. In contrast, bryosin C and bersaldegenin-3-acetate showed lower levels of inhibitory activity. This suggests that bufadienolides, specifically bryosin A, may have a potential inhibitory effect on the activation of Epstein-Barr virus early antigens in the presence of tumor promoters. [32]

4. Immunomodulatory effects: .

In a study involving mice allergic to ovalbumin, those who took the albumin by mouth were endangered from death. Oral defense was associated with compact production of ovalbumin-specific IgE antibodies, eosinophilia (increased number of eosinophils in the blood), and the cytokines IL-5, IL-10, and tumor necrosis factor- α . Additionally, oral cure with quercetin, a flavonoid insulated from plant extracts, prohibited serious allergic reactions in 75% of the animals. These results suggest that oral *Bryophyllum pinnatum* treatment has a down-regulatory effect



on pro-anaphylaxis, affects the immune response and provides protection against anaphylaxis. [33] The study found that an aqueous extract of *Bryophyllum pinnatum* leaves significantly inhibited cell-mediated and humoral immune responses in mice. Animals pretreated with plant extracts showed reduced splenocyte proliferation in response to mitogens and antigens *in vitro*. Furthermore, the exact antibody response to ovalbumin was considerably reduced after dealing with plant extracts. These findings suggest that aqueous extracts of *Bryophyllum pinnatum* leaves have immunosuppressive effects, affecting both cell-mediated and humoral immune responses in mice. [34]

5. Anti-Inflammatory activity:

In an experimental setting, the anti-inflammatory activity of *Bryophyllum pinnatum* leaves was evaluated using formaldehyde-induced hind paw edema in rats. Indomethacin, a standard medication with anti-inflammatory properties, was used for comparison. Various substances, including chloroform, methanol, pet ether extracts, and isolated fractions such as flavonoids, alkaloid, and phenolic acid fractions from the leaves extract, were administered orally once daily for two days.

The results showed that, in comparison to the standard medication, the methanolic extract of *Bryophyllum pinnatum* leaves significantly inhibited formaldehyde-induced edema in the hind paw of rats. This suggests that the methanolic extract, along with the isolated fractions, may possess anti-inflammatory properties, as evidenced by the reduction in paw edema in the experimental model. [35] In the experimental study, pet ether, chloroform, and methanol extracts, along with purified fractions of flavonoids and alkaloids from the leaves of *Bryophyllum pinnatum*, were administered at a quantity of 50 mg/kg. The assessment was conducted with formaldehyde-induced edema in rats as a model. The results indicated that,

compared to standard drugs, the methanolic cutting of the leaves significantly repressed the formation of formaldehyde-induced edema. This suggests that the methanolic extract, as well as the purified fractions of flavonoids and alkaloids, may possess anti-inflammatory properties, as evinced by their ability to reduce edema in the experimental model. [36]

6. Anti-hypertensive activity

This study demonstrates the antihypertensive activity of *Bryophyllum pinnatum* through aqueous and methanol leaf extracts. The extract was controlled intravenously (i.v.) or intraperitoneally (i.p.) at dissimilar quantities (50-800 mg/kg) to evaluate its effects on arterial blood pressure and heart rate in normotensive and spontaneously hypertensive rats. The blood pressure lowering result was significantly more prominent in hypertensive rats compared with normotensive rats.

7. Antileishmanial:

Demonstration of the importance of flavonoids for the anti-leishmanial activity of *Bryophyllum pinnatum* by isolating quercetin from methanolic extracts of the plant. The existence of three flavonoids, namely quercitrin, quercetin, and ofzelin, was identified, and these compounds exhibited antileishmanial activity. This finding suggests that flavonoids, particularly quercitrin, play a significant role in the observed antileishmanial properties of *Bryophyllum pinnatum*. [38]

8. Hepatoprotective activity:

The liquid of *Bryophyllum pinnatum* has traditionally been utilized in Indian folk medicine for the treatment of jaundice. To investigate its potential protective effects against CCl₄-induced hepatotoxicity, both a concerted press juice and an ethanolic extract of the marc (left after expressing the juice) were examined *in vitro* and *in vivo*.

The study found that the leaf press juice was more potent than the extract, showing significant



decreases in elevated serum bilirubin (SBLN) levels (105% recovery) and serum glutamyl pyruvate transaminase (SGPT) levels (92% recovery) at a quantity of 200 mg/kg body weight. The ethanolic extract also exhibited a notable reduction in SGPT levels (81% recovery). These results suggest that the juice of *Bryophyllum pinnatum* may have a protective effect against CCl₄-induced hepatotoxicity, as indicated by its impact on bilirubin and transaminase levels. [39]

9. Wound Healing activity:

In a study using Sprague Dawley rats, topical presentation of ethanolic leaf cutting of *Echinacea* at a dosage of 100 mg/kg body weight was found to accelerate wound healing. On the 11th day after resection, the wound area in the treatment group was significantly reduced by 86.3%, while that in the control group was only reduced by 68.0%. Additionally, wound contraction was significantly increased and wound site edema was reduced in the treatment group. These findings suggest that the ethanol leaf extract of *Bryophyllum pinnatum* has potential wound healing properties that may

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promote faster wound closure in experimental models. [40]

10. Antilithogenic activity:

In a clinical study involving 23 clinically diagnosed patients with lithiasis (stone size ranging between >5mm to <10mm diameter), the antilithogenic activity of fresh leaf juice of *Bryophyllum pinnatum* was investigated. The patients were treated with a daily dose of 10 ml for 30 days, administered orally in the early morning on an empty stomach. Throughout the study, twenty patients passed stones, and three experienced a reduction in stone size. Actual enhancement was observed in 87% of the patients, while the left over 13% showed reasonable enhancement. Additionally, the study found decreased urinary oxalate and phosphate levels, along with increased citrate excretion, which was considered favorable in the context of preventing stone formation. These outcomes suggest a prospective role for *Bryophyllum pinnatum* in the management of lithiasis. [41]





CONCLUSION

The information you provided emphasizes the diverse therapeutic potential of *Bryophyllum pinnatum*, highlighting its applications in wound healing, antiulcer, antidiabetic, anti-inflammatory, antinociceptive, and antibacterial activities. The plant's chemical constituents, including flavonoids, alkaloids, saponins, and triterpenoids, are identified as responsible for these beneficial effects. Phytochemical analysis shows that leaves, stems, and roots contain more physiologically active constituents than other plant parts. The studies discussed focus on acute toxicity, antiulcer efficacy, and pharmacognostic properties, providing valuable insights into the medicinal qualities of *Bryophyllum pinnatum*. The presence of bioactive compounds in roots, stems, and leaves

suggests the potential for further research and exploration of this plant in the development of pharmaceuticals. Identifying and studying these compounds could pave the way for the development of effective medications derived from *Bryophyllum pinnatum*.

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