

# Review on phytochemical and pharmacological activities of *Bryophyllum pinnatum*

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**Abstract** - *Bryophyllum pinnatum* is well-known for its therapeutic properties and has been incorporated into numerous traditional medical systems. Steroids, flavonoids, terpenoids, fatty acids, bufadienolides, protein and peptides, vitamins, polysaccharides, and other substances are among the numerous secondary metabolites found in *B. pinnatum*. Moreover, a plethora of research has demonstrated that *B. pinnatum* extracts and isolated substances have a broad range of pharmacological actions both in vivo and in vitro. Anthelmintic, anti-ulcer, antihypertensive, antileishmanial, anticancer, and anti-diabetic are a few of them. This review article of *bryophyllum pinnatum* highlights the plant profile, phytochemistry and pharmacological activities of the plant.

## I. INTRODUCTION

The plant *Bryophyllum pinnatum* is a member of the Crassulaceae family, which is widely utilized in traditional medicine. *Bryophyllum pinnatum* is a perennial succulent herb is one of the medicinal plants growing widely in tropical and equator regions of Africa, tropical America, India, China, and Australia. The name *bryophyllum pinnatum* comes from the Greek language and the word “bryo” which means “to sprout”, and “phyllon”, which means “leaf”. The secondary metabolites that have medicinal potential are derived from many plant sections and include tannin, alkaloids, flavonoids, glycosides, and phenolic chemicals. The plant has a variety of pharmacological uses, including anticancer, antihypertensive, antileishmanial, analgesic, and antidiabetic properties.



Fig:1. *bryophyllum pinnatum* plant



Fig:2. *bryophyllum pinnatum* flower

## PLANT DESCRIPTION PROFILE

### VERNACULAR NAMES

Sanskrit: Parnabeeja, Asthibhaksha

English: Air plant, Miracle leaf

Hindi: Zakhmhaiyat, Pathharchoor

Kannada: Kadu basale, Gandukalinga

Tamil: Malaikalli, Ranakalli

Telugu: Ranapala

Marathi: Gayamari

Bengali: Patharkuch, Koppatha

Malayalam: Elamarunga

### TAXONOMICAL CLASSIFICATION

Kingdom: Plantae – plants

Subkingdom: Tracheobionta

Division: Spermatophyta

Subdivision: Magnoliophyta

Class: Magnoliopsida

Subclass: Rosidae

Order: Rosales

Family: Crassulaceae

Genus: *Bryophyllum*

Species: *Bryophyllum pinnatum* (Lam.) Oken.

## II. MICROSCOPY [1]

The microscopic characteristics indicate the presence of a thin layer on the adaxial side and a convex surface on the abaxial side. Its adaxial epidermal layer is thin and composed of tiny, inconspicuous cells. Midrib ground tissue is parenchymatous. The cells have three main shapes: round, angular, and compact. The vascular strand is hemispherical in form, solitary, and tiny. A broad band of phloem and a thick horizontal band of xylem make up this structure. Narrow, angular, thin-walled xylem elements are present. In both vertical and horizontal planes are the vascular bundles. Palisade and spongy parenchyma are the two distinct mesophyll types found in the flat lamina. Anisocytic stomata are prevalent and of a large size. Spiral vessels can be seen in the longitudinal section of leaves. On the adaxial and abaxial sides, there are no trichomes.

## III. MACROSCOPY [2]

It typically grows to a height of one to 1.5 meters, with a hollow, four-angled stem that is frequently branched. 10–20 cm long leaves are oriented oppositely. The top 3–7 foliate, long-petiole leaves are foliate, whereas the lower leaves are simple. The leaves are furnished with rooting vegetative buds. Terminal inflorescences paniculate between 10 and 40 cm. Most flowers are pendulous, or bell-shaped. The tubular calyx ranges from 2 to 4 cm, reddish-purple flower 5 cm with sparsely ciliate base, ovate lanceolate lobes, stamens inserted basally on corolla, oblong nectar scales; follicles incorporated in calyx and corolla tube. The fruit-pod contains several ellipsoid, smooth-striate seeds and has four septa. The shrub produces flowers from November to March and fruits in April.

## IV. PHYTOCHEMISTRY

The different chemical constituents of different classes of bioactive compounds have been reported from *Bryophyllum pinnatum*. The Preliminary phytochemical screening of different parts of the plant showed the presence of flavonoids (ranging from 1.49% to 1.85% by weight), saponins (ranging from 1.4 to 1.71 mg/100mg of protein), alkaloids (ranging from 1.23% to 1.45% by weight), phenols (ranging from 0.6% to 0.7% by weight), and tannins (ranging from 0.06% to 0.7% by weight) (ranging from 0.04% to 0.05% by weight) [3]. The essential oils of air-dried leaves and stem were analyzed using GC MS, which revealed fifteen and seventeen compounds in the leaves and stem, respectively. The principal components of the leaves were 1-octen-3-ol (1), supraene (2), 1-heneicosanol (3), 2,5-dimethylheptane (4), and (E)-9-eicosene (5), while the principal components of the stem were (E)-5-eicosene (6), oleamide (7), isolongifolol (8), and  $\beta$ -gurjunene (9) [4]. The sections that follow address particular phytochemical groupings found in the plant.

### FLAVONOIDS

Flavones, flavans, flavanones, isoflavonoids, chalcones, aurones, and anthocyanidins are among the flavonoids found in leaves. Quercitrin (10) is a kaempferol diglycoside. It was termed kampinnatoside (9) and recognized as flavanol and flavone glycosides, kaempferol 3-O- $\alpha$ -l-arabinopyranosyl-(1 $\rightarrow$ 2)  $\alpha$ -l-rhamnopyranoside. 3-O- $\alpha$ -l-arabinopyranosyl quercetin (1 $\rightarrow$ 2)- $\alpha$ -l-rhamnopyranoside and trihydroxy-3C,8-dimethoxyflavone 4C,5,7,7-O- $\beta$ -d glucopyranoside (11) from the aqueous leaf extract have been shown to have some anti-leishmanial effect [5].

### PHENANTHRENE DERIVATIVES

There have been reports of two phenanthrene derivatives in the plant: 2-(9-deceny) phenanthrene (12) and 2-(9-undeceny)-phenanthrene (13). The ethanolic extract of the leaves also contained a phenanthrene alkaloid that was identified as 1-ethanamino 7-hex-1-yne-5'-oxophenanthrene (14).

### FATTY ACIDS

The fatty acids found in *B. pinnatum* are behenic acid (15), arachidic acid (16), stearic acid (17), and palmitic acid (18). It was discovered that the fatty acids derived from *B. pinnatum* exhibited lymphocyte suppressive action [6].

### PHENOLCARBOXYLIC AND CARBOXYLIC ACIDS

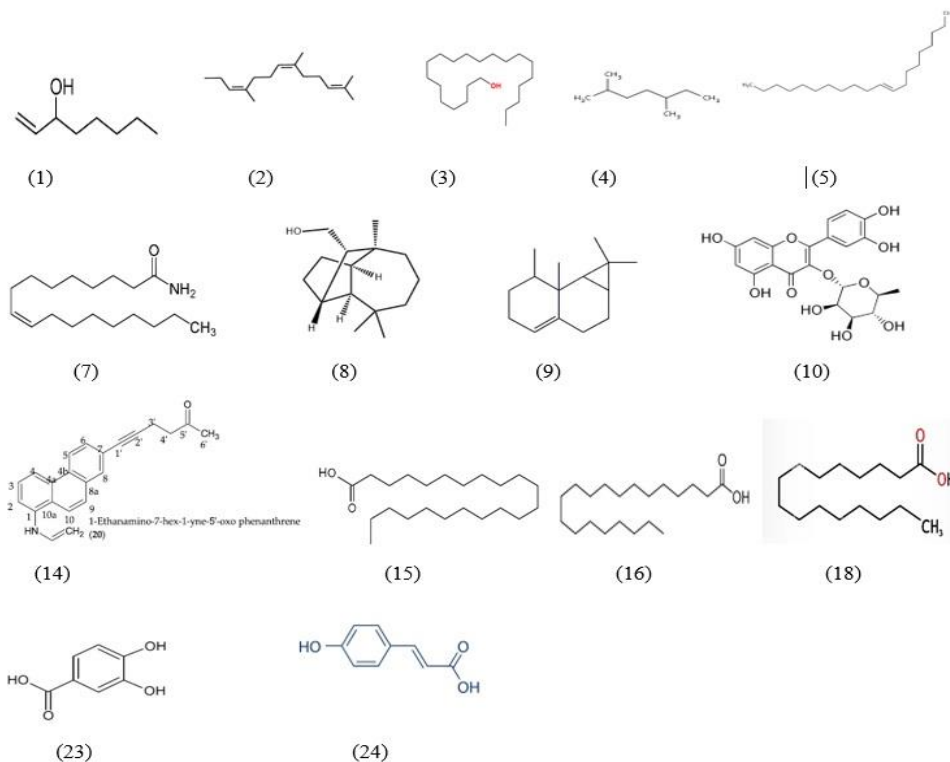
A number of phenolic compounds have been identified from *B. pinnatum*, including succinic acid (19) and threo-Ds isocitric acid, as well as syringic acid, caffeic acid, malic acid, gallic acid, and isocitric acid (20). In addition, the plant has been found to contain 4-hydroxy-3-methoxy-cinnamic acid (21), 4-hydroxybenzoic acid (22), p-hydroxycinnamic acid, protocatechuic acid (23), and para-coumaric acid (24). It has also been reported to contain certain carboxylic acids, such as phosphoenolpyruvate, isocitric acid, succinic acid and oxaloacetic acid (28). It is commonly recognized that phenols and phenylpropanoids have antibacterial and antileishmanial properties [7].

### BUFADIENOLIDES

One of the primary classes of active ingredients in *B. pinnatum* is bufadienolides. These include the structurally extremely similar bryotoxins A, B, and C, which have insecticidal, cytotoxic, and antibacterial properties. Younger leaves of *B. pinnatum* were discovered to have a greater amount of bufadienolides. The plant also contains bryotoxin A (25), bryotoxin B (26), bersaldegenin-1-acetate (27), bersaldegenin-3 acetate (28), and bersaldegenin-1,3,5-orthoacetate (29). Additional bufadienolides have been found in different species, including methyl daigremonate, daigredorigenin, diagremonianin, daigredorigenin-3-acetate, and kalantubosides A and B [8].

### OTHERS

Carbohydrates, protein, lipids, iodine, vitamins (ascorbic acid, riboflavin, thiamine, niacin, pyridoxine), and amino acids (phenylalanine, glycine, cysteine, glutamic acid, methionine, and tyrosine) are among the nutrients found in *B. pinnatum*. Mineral elements including Na, Ca, K, P, Mg, Mn, Fe, Cu, and Zn are also present in the plant. The components of sugar are glucose, galactose, fructose, lactose, raffinose, and sucrose.


 Fig.3: Bioactive compounds reported from *Bryophyllum pinnatum*.

## V. PHARMACOLOGICAL ACTIVITIES

### ANTI-INFLAMMATORY ACTIVITY

The plant's leaf aqueous extract is investigated in experimental animal models for its anti-inflammatory properties. Rats with formaldehyde-induced paw edema demonstrated statistically significant reduction of inflammation in response to several extracts and fractions of *B. pinnatum* leaves; the methanolic extract exhibited the strongest efficacy [9]. In addition, the anti-inflammatory and analgesic properties of the aqueous extract, as well as those of stigmasta-4,20(21),23-trien-3-one, and four additional compounds isolated from the plant, were evaluated using assay models triggered by carrageenan and acetic acid. Mice treated with Stigmasta 4,20(21),23-trien-3-one showed 87.29% reduction of inflammation and 75.72% protection against the acetic acid-induced writhing test [10]. Also, it was shown that *B. pinnatum* ethanol extract, administered at doses of 50 mg/kg and 100 mg/kg, significantly inhibited the effects of formalin-induced hind paw edema in rats and acetic acid-induced belly contractions in mice [11].

### NEUROPHARMACOLOGICAL ACTIVITY

The neuropharmacological impact of *B. pinnatum* has been the subject of several investigations. For example, it has been claimed that the plant's aqueous leaf extract has a depressive effect on the central nervous system since it reduces mice's exploratory activity in a dose-dependent way. The animals' noticeably less obscene behavior indicates that it also had a sedative effect. In addition, the extract postponed the animals' convulsions caused by picrotoxin and strychnine [12]. Additionally, it has been reported that saline leaf extract produces dose-dependent muscle in-coordination, a delayed onset to convulsion in both strychnine- and picrotoxin-induced seizures, and a dose-dependent prolongation of the onset and duration of pentobarbitone-induced hypnosis. A reduction in exploratory activities in mice model head-dip and evasion tests [13]. It has also been reported that the plant's ethanolic extract has CNS-depressant effects on mice [14].

### ANTI-HYPERTENSIVE ACTIVITY

This is frequently used to treat various forms and severity levels of hypertension. Calcium was the macroelement that the plant had the greatest abundance of. Normal extracellular calcium concentrations are necessary for blood coagulation and the stability of the components of intracellular cement. The plant's lower sodium content may be an added benefit because there is a clear correlation between salt consumption and hypertension in people. The impact of aqueous and methanolic leaf extracts on arterial blood pressures and heart rates of normal and spontaneously hypertensive rats were investigated using invasive and non-invasive methods. At concentrations between 0.25 and 5.0 mg/ml, the leaf extracts inhibited potassium and receptor-mediated agonist drug-induced contractions of the rat isolated thoracic aortic strips and caused a dose-dependent decrease in the rate and force of contractions of guinea pig isolated atria by electrical field stimulation (ES)[15]. The aqueous leaf extract in anesthetized cats also caused a reduction in the blood pressure and also reducing the effect of adrenaline-induced elevation of blood pressure[16].

### ANTI-DIABETIC ACTIVITY

Several ethnomedical practices worldwide use *B. pinnatum* to treat high blood sugar. The zinc content of the plants may suggest that they can help treat diabetes, which is brought on by an issue with the insulin system. A study evaluating *B. pinnatum*'s aqueous leaf extract's anti-diabetic efficacy in rats with streptozotocin (STZ)-induced diabetes mellitus found that the extract, at doses between 25 and 800 mg/kg p.o., significantly ( $P < 0.05$  0.001) reduced hyperglycemia in rats [10]. In rats, the 500 mg/kg body weight dose of 80% aqueous ethanol extract also decreased triglyceride levels, low-density lipoprotein (LDL) level, and raised high-density lipoprotein (HDL) level in addition to lowering postprandial and STZ-induced diabetic blood glucose levels [11].



**ANTI-DIARRHEAL ACTIVITY**

The anti-diarrheal properties of *B. pinnatum*'s hydroethanolic leaf extract were demonstrated by studies conducted on mouse models of normal intestinal transit, castor oil-induced intestinal transit, castor oil-induced diarrhea, gastric emptying, and enteropooling. An connection between the  $\beta$  adrenoceptor, muscarinic cholinergic receptor, and nitric oxide pathway was assumed to be the mechanism underlying the anti-diarrheal effect [9]. An ethanolic *B. pinnatum* leaf extract was showed to have an *in vivo* anti-diarrhea effect on *E. coli* induced diarrhea in rats [12].

**ANTI-ULCER ACTIVITY**

The traditional usage of *B. pinnatum* to treat ulcers is well-supported by research. The anti-ulcer impact of this application has been evaluated in nine experimental animal models to provide a scientific foundation. The leaf's methanolic extract was found to have significant protection against gastric lesions induced by stress, ethanol, aspirin, indomethacin, serotonin and reserpine [13]. It also aided in the healing of guinea pigs' duodenal lesions caused by histamine, rats' chronic gastric lesions caused by acetic acid, and pylorus-ligated rats' ulcers caused by aspirin [13]. Rats' incidence of ulceration and histamine-stimulated stomach acid secretion were both decreased by the plant's methanolic extract in a dose-dependent manner [14]. At 40 mg/kg body weight, the extract exhibited superior cytoprotective effects compared to propranolol at the same dosage [14]. Additionally, the methanolic extract reduced basal and histamine-induced stomach output in a gradual dose-dependent manner.

**ANTI HELMINTIC**

The anthelmintic action of the crude extract was shown to be attributed to tannins, according to phytochemical screening. The four extracts of *B. pinnatum* were examined petroleum ether, chloroform, methanol, and water. At doses of 30 and 50 mg/ml for activity against Indian earthworm *Pheretima posthuma*. Significant anthelmintic activity was observed in the methanolic extract when compared to the positive control piperazine citrate at 15 mg/ml [15]. All extracts showed dose-dependent activity with the mean paralyzing time and death time of *P. posthuma* at concentrations of 30 and 50 mg/ml of the methanolic leaves extract being  $0.57 \pm 0.02$ ,  $3.17 \pm 0.07$  and  $0.40 \pm 0.03$ ,  $1.34 \pm 0.07$  minutes respectively, while that of the standard drug at 15 mg/ml was  $1.14 \pm 0.01$  and  $3.08 \pm 0.08$  minutes [16]

**VI. CONCLUSIONS**

Traditional medicine has made extensive use of the medicinal plant *Bryophyllum pinnatum* to treat a variety of illnesses which include ulcers, cancer, diabetes, depression, insomnia, and hypertension throughout the world. . This paper has covered a thorough analysis of its phytoconstituents and documented pharmacological activity. In order to standardize products based on the active principles and clinically analyze extracts of this plant, more research is necessary.

**VII. REFERENCES**

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