



## Pharmacological review of *Bryophyllum pinnatum*

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### Abstract

Since the dawn of time, medicinal plants with natural treatment response against a wide range of ailments have been used in healthcare. Plants, according to the ancients, were intended to provide man with food, medicinal treatment, and other necessary healthcare needs. Around three - quarters of the world's 5.3 billion inhabitants are considered to live in developing nations, with the World Health Organization estimating that 75 percent of its population rely nearly entirely on traditional medicine to meet their needs <sup>[1]</sup>. This signifies that over 4.5 billion people in developing nations use medicinal herbs on a regular basis. There are almost 650 ethnic groups on the globe, and practically all of them have their own traditional medical knowledge and experiences <sup>[2, 3]</sup>. India is home to a variety of medicinal plants and has a long history of medical plant knowledge. India's many climates and geographical locations have resulted in a diverse range of medicinal plant species. India is the world's largest producer of medicinal plants, and it is appropriately referred to as the "Botanical Garden of the World." As a result, the inhabitants of this country have relied on traditional medicine and medicinal plants.

**Keywords:** *Bryophyllum pinnatum*, *Kalanchoe pinnatum*, anticancer, phenolic compound, antihistamine

### Introduction

The perennial succulent herb *Bryophyllum pinnatum* (or *Kalanchoe pinnatum*) grows in Africa and Asia. The plant was one of the most widely used medicinal plants, used to cure a variety of infectious disorders. Blennorrhoea, syphilis, jaundice, candidiasis, dysmenorrhoea, external sores, burns, and convulsions are all treated using the leaves or the whole plant. Ear infections, cough, and diarrhoea are all treated with this plant <sup>[5]</sup>. This plant has been found to contain isoprenoid, cytotoxic bufadienolides, and anti-leishmanial flavonoids in previous phytochemical research. Furthermore, a 65 percent methanol extracts of the plant's leaves showed bacterial inhibition, whereas aqueous extracts exhibited anti-ulcer, antinociceptive, anti-inflammatory, antidiabetic, neuro sedative, and muscle relaxant properties. The antinociceptive, neuropharmacological, bactericidal, antioxidant, anti-inflammatory, antidiabetic, anti-hypertension, antihistamine, anti-ulcer, and antimutagenic activities of the plant are described in various papers <sup>[4, 5]</sup>.

### Plant Description

*Bryophyllum pinnatum*, Kurz (Crassulaceae) Synonym: *Kalanchoe pinnata*, Pers, *Bryophyllum calycinum* Salisb. It is a perennial herb growing widely in tropical and equator regions of Africa, tropical America, India, China, and Australia, classified as a weed <sup>[4]</sup>. Several species are cultivated as ornamentals and are popular tropical house plants <sup>[4]</sup>. The plant grows all over India in tropical and temperate areas, especially in Bengal. It is a succulent

perennial plant that can reach a height of 1-1.4 m, with a hollow four-angled stem that is generally branched. The opposing, decussate, succulent leaves are 10-21 cm long. The lower leaves are simple and the upper ones have 3-6 foliate and are long-petioles. Leaf-blade pinnately compounds with 4-6 leaflets, 11-32 cm; petioles 2-3 cm; leaflet blades oblong to elliptic, 6-7 × 3-4 cm, margin crenate with each notch bearing a dormant bud <sup>[6]</sup>. Inflorescences terminal paniculate 10-42 cm. The bottom leaves are simple, while the higher leaves are foliate and long-petioled, with 3-6 foliate leaves. Leaf blades oblong to elliptic, 6-7 3-4 cm, edge crenate with each notch bearing a latent bud, 11-32 cm; petioles 2-3 cm; leaflet blades oblong to elliptic, 6-7 3-4 cm, margin crenate with each notch bearing a dormant bud <sup>[6]</sup>. Inflorescences are paniculate and measure 10-42 cm in length. Flowers resemble bell-shaped pendulums. 2-6 cm tubular calyx; 5 cm scarlet to purple corolla. The fruit pod is divided into four or five septa and contains numerous ellipsoid, smooth striate seeds. The shrub blooms from November to March and bears fruit in April <sup>[7, 8]</sup>. It has a hot potency and is astringent, acidic in taste as well as sweet in the post-digestive effect. The plant has received a lot of attention for its medical benefits, and it's used in both folk medicine and modern medicine. The current review summarises the results of several pharmacological studies on the plant <sup>[9]</sup>.

**Scientific classification** <sup>[10]</sup>.

Table 1

Kingdom:	Plantae
Clade:	Tracheophytes
Clade:	Angiosperms
Clade:	Eudicots
Order:	Saxifragales
Family:	Crassulaceae
Genus:	Bryophyllum
species:	B. pinnatum



Fig 1



Fig 2

### Toxicity and Traditional Medicine

Bufadienolide, a plant active component, and cardiac glycosides are found in the plant [11]. These, especially in animals, can cause cardiac toxicity. The active compounds discovered in the plant are Trinidad and Tobago that have been used to treat high blood pressure. The juice of the leaves is also used in ancient medicine to cure kidney stones. While there has been a lot of research done on the plant and some scientific proof for its effectiveness, further research is needed. *Kalanchoe pinnata* is also used in local applications against headaches. The people living in the Amazon use it for multiple purposes: they use it against inflammations and cancer and also a popular remedy for fever. A mixture of kalanchoe leaf juice and coconut oil is applied to the forehead to relieve headaches. [10, 12].

### Chemical Constituents

Bryophyllin A, Bersaldegenin-3-acetate, and Bryophyllin C are Bufadienolide compounds isolated from *Bryophyllum pinnatum*. Insecticidal properties were shown by the Bryophyllin C [13]. Phytochemical studies of *Kalanchoe pinnata* have identified the presence of triterpenes, steroids, phenanthrene, flavonoid, flavones, chalcones, caffeic acid, taraxasterol, ferulic acid, auronas, phenolic acid, syringic

acid, malic, oxalic, and organic acid. Bufadienolides and phenanthrene are toxic compounds. *K. pinnata* can cause death due to ataxia and severe cardiac arrhythmia [14, 15].

### Biological and pharmacological properties

#### Antinociceptive-anti inflammatory activity

The antinociceptive and anti-inflammatory effects of the plant's leaf aqueous extract are explored in experimental animal models. The antinociceptive effect in mice is assessed using the 'hot-plate' and 'acetic acid' test paradigms. The effect of fresh egg albumin on rat pedal (paw) edema is also examined. Diclofenac and chlorpropamide were employed as reference medicines to test the generally pro properties of the aquatic plant extract in rats. Antinociceptive effects of leaf aqueous extract of the plant produced significant action against thermally- and chemically- induced nociceptive pain stimuli in mice. The acute inflammation induced by the fresh egg albumin was also inhibited by the plant extract. The results of this study suggest that the plant leaf aqueous extract has anti nociceptive, anti-inflammatory properties [16-18].

#### Neuropharmacological Activity

The methanolic component of the plant possesses neuropharmacological activity, and researches in experimental animals have been done in mice and rats. The methanolic fraction of the plant demonstrates sleep-induced behavioural changes as well as significant analgesic efficacy. The plant has been used as an antipsychotic in traditional medicine. On the CNS, the aqueous leaf extract has a depressive effect. It causes a significant decrease in locomotor activity in a dose-dependent manner after animal treatments, with no ptosis at these levels. Animals treated with aqueous extract via the intraperitoneal route showed significant loss of coordination and muscular tone in the chimney, ascending, and inclination screen tests. The result shows that the alternation in general behavior pattern and anticonvulsant and CNS depressant activity [19, 21].

#### Antimicrobial Property

The presence of phenolic compounds in the plant has indicated that the plant possesses antimicrobial properties. The plant is effective in the treatment of many bacterial infections like typhoid fever and other bacterial infections, particularly those caused by *S. aureus*, *E. coli*, *B. subtilis*, *P. aeruginosa*, *K. aerogenes*, *K. pneumonia*, and *S. Typhi*. By using the agar diffusion method, the antibacterial activities of the plant extract are studied against the antibacterial activities of the infusion and methanolic extracts against *S. aureus*, *E. coli* and *S. Typhi*. Pure isolated alkaloids and their synthetic derivatives of the plant are used as bactericidal effects.

It was found to be bactericidal to a wide spectrum of gram-positive and gram-negative bacteria [22].

### Hepatoprotective and Nephroprotective Activity

The treatment of jaundice with fresh leaf juice is extremely efficient. In-vivo and in-vitro histopathological tests for plant hepatoprotective activities indicated that leaf juice was more effective than ethanolic extract, which justifies the use of leaf juice in folk medicine for jaundice. The antioxidant and oxidative radical scavenging activities of gentamicin, which may protect rats against gentamicin-induced nephrotoxicity [23].

### Antihistamine Activity

The plant possesses antihistamine and antiallergic properties. By specifically inhibiting histamine receptors in the lungs, the methanol extract of the leaves has been shown to exhibit histamine receptor (H1) antagonism in the ileum, peripheral vasculature, and bronchial muscle, protecting against chemically induced anaphylactic reactions and death [24].

### Antimutagenic Activity

The antimutagenic activity was observed in the alkaloidal/water-soluble and acid fractions. Anticancer action is strong in water-soluble antioxidants and free radical scavengers, which reduce oxidative cell damage. Supratman *et al* studied the antitumor enhancing effect of bufadienolides isolated from the plant and discovered that bryophyllin A inhibits tumor growth the most, whereas bersaldegenin-3-acetate inhibits tumor growth less. Several cancer cell lines were suppressed by bersaldegenin-1,3,5-orthoacetate [25, 26].

### Immunosuppressive Activity

Its fatty acids may be accountable for its immunosuppressive activity *in vivo*. Bergmann *et al* colleagues found that a water extract of leaves suppresses both cell-mediated and systemic immune responses in mice. In vitro, spleen cells from mice pre-treated with plant extract had a reduced capacity to grow in response to both mitogen and antigen. Extract administration also damaged mice's ability to mount a delayed-type hypersensitivity response to ovalbumin. The invitro and topical forms of delivery were the most effective since they essentially eliminated the DTH reaction. As a result, the immunosuppressive characteristics of the aqueous extract of leaves have been discovered [4, 27, 28].

### Antihypertensive Activity

The plant is often used to treat hypertension of all sorts and severity levels. The most abundant macro element in the plant was calcium. For blood coagulation and the stability of intracellular cement components, normal extracellular calcium concentrations are required. Because of the direct link between salt intake and hypertension in humans, the plant decreased sodium content may be an added benefit. Using invasive and non-invasive approaches, the effects of aqueous and methanolic leaf extracts on arterial blood pressures and heart rates of normal and spontaneously hypertensive rats were studied. Both extracts reduced arterial blood pressures and heart rates in anesthetized normotensive and hypertensive rats in a dose-dependent manner. In hypertensive rats, the hypotensive effects of the leaf extracts were more apparent than in normotensive rats. The leaves extracts also inhibited electrical field stimulation (ES)-provoked, as well as potassium and receptor-mediated

agonist drug-induced contractions of rat isolated thoracic aortic strips in a nonspecific manner, and produced dose-dependent, significant decreases in the rate and force of contractions in guinea-pig isolated atria. Cardiac depression and vasodilation appear to play a substantial role in the herb's antihypertensive impact [4, 29, 30].

### Antidiabetic Activity

The presence of zinc in the plants could indicate that they can aid in the management of diabetes, which is caused by an insulin system malfunction. The plant extract's anti-inflammatory and anti-diabetic effects in rats were tested using fresh egg albumin-induced pedal edema and streptozotocin-induced diabetes. Fresh egg albumin provoked acute inflammation and severe hypoglycemia in rats, which the plant extract significantly reduced. The anti-diabetic properties of the herb are assumed to be due to flavonoids, polyphenols, triterpenoids, and phyosterols [29, 31, 32].

### Anti-Ulcer Activity

The methanolic fraction of the leaves was discovered to have antiulcer properties. Premedication tests in rats revealed that the extract had significant protective action against gastric lesions caused by aspirin, indomethacin, serotonin, reserpine, stress, and ethanol; as well as significant protection for aspirin-induced ulcers in pylorus-ligated rats and histamine-induced duodenal lesions in guinea pigs; and significant enhancement of the healing process in acetic acid-induced chronic gastric lesions. In their investigation, Adesanwo *et al* found a significant reduction in ulceration and mean basal and histamine stimulated stomach acid output in a dose-dependent manner, proving its usage as an antiulcer drug in folk medicine [33, 36].

### Antibacterial Activity

Antimicrobial action is shown by the presence of phenolic chemicals in the plant. The plant is beneficial in treating typhoid fever and other bacterial infections, according to Ofokansi *et al*. (2005), especially those caused by *S. aureus*, *E. coli*, *B. subtilis*, *P. aeruginosa*, *K. aerogenes*, *K. pneumonia*, and *S. Typhi*. Using the agar diffusion method, he tested the antibacterial activity of the infusion and methanolic extracts against *S. aureus*, *E. coli*, *Bacillus*, *P. aeruginosa*, *K. pneumonia*, and *S. Typhi*, as well as *S. aureus*, *E. coli*, *S. Typhi*, *Klebsiella* spp, and *P. aeruginosa*. These findings backed up its use in treating the placenta and navel of newborn babies, which not only heals quickly but also keeps infections at bay [14, 22, 37]. For their analgesic, antispasmodic, and antibacterial properties, pure isolated alkaloids and their synthetic derivatives are utilized as basic medical agents [38]. Obaseiki-Ebor *et al* looked at the antibacterial activity of leaf juice in vitro. The extract was found to be bactericidal to a wide range of gram-positive and gram-negative bacteria at a concentration of 5% v/v. *B. subtilis*, *S. aureus*, *S. pyogenes*, *S. faecalis*, and *Escherichia coli*, including clinical isolates of these organisms with multiple antibiotic resistance [39]. Subrata *et al* used the dilution tube method to demonstrate the antibacterial efficacy of decocting leaves against gram-positive bacteria [40]. In a study, Akinpelu discovered that at a concentration of 25mg/ml, 60 percent methanolic leaf extract inhibited the development of five of the eight bacteria tested. *B. subtilis*,

*E. coli*, *P. Vulgaris*, and *Shigella dysenteriae*, were shown to be inhibited by the extract <sup>[41]</sup>.

### Conclusion

The plant is a widely used divine herb. Modern pharmacological studies have generally confirmed the traditional use of *B. Pinnatum* and its extracts in ailments: inflammations, ulcers, fungal, viral and microbial infections, diabetes mellitus, spasms, and properties. Extracts and fractions tested on animals showed significant analgesic, anti-allergic, anti-anaphylactic, anti-inflammatory, anti-leishmanial, anti-tumorous, anti-ulcerous, antibacterial, antifungal, antihistamine, antiviral, CNS depressant, febrifuge, gastroprotective, immunosuppressive, immunomodulator, insecticidal, muscle relaxant, and sedative property.

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