

## KALANCHOE PINNATA (LAM.) PERS EXTRACT: A COMPREHENSIVE REVIEW ON PHARMACOLOGICAL APPROACH

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Article Received date: 31 July 2025

Article Revised date: 21 August 2025

Article Accepted date: 10 September 2025



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DOI: <https://doi.org/10.5281/zenodo.17223843>

### ABSTRACT

*Kalanchoe pinnata* (Family: Crassulaceae) is an important plant which has many traditional medicinal uses. The main objective of this literature review was to give advance information for the drug discovery research for *K. pinnata*. It was found that this plant showed various pharmacological activities such as anthelmintic, immunosuppressive, wound healing, hepatoprotective, antinociceptive, anti-inflammatory and antidiabetic, nephroprotective, antioxidant activity, antimicrobial activity, analgesic, anticonvulsant, neuropharmacological and antipyretic. The main purpose of this review is to provide advance information of herb *Kalanchoe pinnata*, this herb contains a many of active constituents i.e. alkaloids, triterpenes, glycosides, flavonoids, steroids, bufadienolides, lipids and organic acids. Nowadays this herb becomes imperiled plant which needs to be preserved as well as analyze for its significant green chemistry.

**KEYWORDS:** *Kalanchoe pinnata*, Crassulaceae, pharmacognostic and phytochemical investigation, pharmacological effects, Dosage form.

### INTRODUCTION

*Kalanchoe pinnata* commonly known as cathedral bells, air plant, life plant, miracle plant, and Goethe plant. These plant is to popular house plant and has become naturalized in tropical and subtropical areas. This plant is native to Madagascar, inhabiting warm and temperate climates from sea level to 2,600 meter. It is also found in parts of Asia, Australia, New Zealand, the West Indies, Bermuda, the Philippines, Macaronesia, the Mascarenes, Brazil, Suriname, the Galapagos Islands, Melanesia, Polynesia, and Hawaii. Much of the reason for the widespread naturalization of this plant can be traced to its popularity as a house plant. It is a succulent, perennial plant, Length-1 m (39 in) tall, Stems are cylindrical, Tinge-Raddish. The leaves of this species are thick, fleshy, elliptical in shape, curved, with a crenate or serrated margin. The fruits are follicles (10–15 mm) which are found in the persistent calyx and corolla. It has red-orange flowers. The calyx is formed of a long tube, red at the base, veined with yellowish green (or green spotted with reddish brown), with four very small triangular lobes at the end. The tubular corolla. The ovary has four carpels, slightly fused in the center, with slender styles. *Kalanchoe pinnata* is a active medicinal

plants largely used in treatment of kidney stone, rheumatoid arthritis, gastric ulcer, pulmonary infection.



Fig 1: *Kalanchoe pinnata* leaf.

### Synonyms

*Bryophyllum calycinum*, *B. germinans*, *B. pinnatum*, *Cotyledon calycina*, *C. caliculata*, *C. pinnata*, *C. rhizophilla*, *Crassuvia Floripendia*, *Crassula pinnata*, *Sedum madagascariense*, *Verea Pinnata*.

**Regional names--** Hindi: zakhm- hayat, Arabic: kushnulhayat, Bengal: koppata, Sanskrit: asthi-bhaksha, Telgu: simajamudu, Tamil: ranakalli, Kannad: ganduklinga, Malayalam: elamurunga.

**Biological source:** Botanical Name: Bryophyllum pinnata Family: Crussulaceae.

### Taxonomy of plants

**Kingdom:** Plantae (Plants)

**Subkingdom:** Tracheobionta (Vascular plants)

**Super division:** Spermatophyte (Seed plants)

**Division:** Magnolia -ophyta (Flowering plant)

**Class:** Magnoliopsida (Dicotyledonous)

**Subclass:** Rosidae

**Order:** Saxifragales

**Family:** Crassulaceae Stonecrop family

**Genus:** Kalanchoe

**Species:** Kalanchoe pinnata (Lam.)

### Geographical Source

Naturalized in temperate regions of Asia, Australia, New Zealand, West Indies, Macaronesia, Mascarenes, Galapagos, Melanesia, Polynesia, and Hawaii.

In India, it is cultivated in gardens and wild on the hills of north-western India, Deccan, and Bengal.

## II. MACROSCOPICAL CHARACTERS

Kalanchoe pinnata is a succulent glabrous herb.

- 1) Height-1-2 m
- 2) Stems - obtusely four-angled.
- 3) Leaves -variable and decussate.
- 4) Leaflets - ovate or elliptic and crenate or serrate in plant
- 5) Flowers - pedicels -slender, Calyx - 2.5-3.8 cm. length, red colored striated, Corolla-octagonal, Lobes - triangular

### Chemical Constituents

- A) alkaloids, flavonoids, phenolic compounds, and tannins.
- B) Macroelements are magnesium, calcium, potassium, phosphorous, and sodium.
- C) Microelements are-iron, zinc, vitamins, ascorbic acids, riboflavin, thiamine, niacin.
- D) The herb contain gallic acid, caffeic acid, coumaric acid, quercetin, quercitrin isorhamnetin, kaempferol, bersaldegennin, bryophyllin a, bryophyllin c, bryophynol, bryophyllol and bryophollone, stigmasterol, campesterol, and another element.

### Pharmacological Activities

**Herbal Tonic:** The plant is good sources of ascorbic acids, riboflavin, thiamine and niacin. Natural ascorbic acid is vital for the body performance i.e. normal formation of intercellular substances throughout the body, including collagen, bone matrix and tooth dentine. Therefore, the clinical manifestations of scurvy that is hemorrhage from mucous membrane of the mouth, gastrointestinal tract, anemia, pain in the joints can be related to the association of ascorbic acid and normal connective tissue metabolism. This function of ascorbic acid accounts for its normal wound healing property. As

a result the plant is used in herbal medicine for the treatment of common cold and other diseases like prostate cancer. In a study an herbal composition comprised of extracts of number of herbs including B.Pinnatum acts as a tonic to improve respiration, aid in the elimination of toxins and improves overall vitality.

**Antileishmanial activity:** Infections caused by protozoa of the genus Leishmania are a major worldwide health problem, with high endemicity in developing countries. The incidence of the disease has increased since the emergence of AIDS. L.G. Rocha et al referred in a review on a plant extracts that a chemically defined molecules (coumarin, quercetin) of natural origin showing antileishmanial activity 23,24. Quercitrin, a flavonoid is responsible for the antileishmanial activity of B.Pinnatum. The quercetin aglycone-type structure, as well as a rhamnosyl unit linked at C-3, seem to be important for antileishmanial activity. Da Silva et al investigated the antileishmanial properties of three flavanoids. (quercitrin, quercetin and afzelin) of leaf extract in mice against L. amazonensis amastigotes and found oral route was more effective than other (i.v. or tropical) routes. The protective effect of plant in leishmaniasis may not be due to a direct effect on the parasite itself but rather activation of the reactive nitrogen intermediates pathway of macrophages.

**Hepatoprotective and Nephroprotective:** Juice of the fresh leaves is used very effectively for the treatment of jaundice in Bundelkhand region of India. Yadav et al studied that the juice of leaves was found more effective than ethanolic extract as evidenced by invivo and invitro histopathological studies for hepatoprotective activity of plant and justifies the use of juice of plant leaves in folk medicine for jaundice. The protective effect on gentamicin-induced nephrotoxicity in rats which may involve its antioxidant and oxidative radical scavenging activities. It is also used for the treatment of kidney stones in India where is goes by the name of Pather Chat or Paan-futti26. The Quercetin has neproprotective and antioxidant role.

**Neuropharmacological activities:** B. Pinnatum has been used since 1921 in traditional medicine as an antipsychotic agent. Salahdeen et al showed that the aqueous leaf extract possesses depressant action on CNS. The animals treated with 50 -200mg/kg was found to produce quite significant decrease in locomotor's activity in dose dependent manner, with no ptosis at these doses. Similarly in chimney, climbing and inclined screen tests, there was a significant loss of coordination and decrease muscle tone in animals treated intraperitoneally with aqueous extract in a dose dependent fashion. The result indicates significant alterations in general behaviour pattern, reduction in spontaneous mortality, potentiation of pentobarbitoneinduced sleeping time in a dose dependent fashion. Pal et al in his study found that the anticonvulsant effect of the aqueous leaf extract observed decrease or no effect compare to methanolic extract. The

methanolic fraction possesses a potent CNS depressant action. As alcohol is known to have depressant effect on respiration related hypoglossal nerve output in humans and other mammals. It is possible therefore that the inhibitory effect of methanolic extract on CNS activities may be due to effect of methanol and partly to the constituent of *B.Pinnatum* with its attendant higher dose. Radford et al investigated that the CNS depressant activity of aqueous leaf extract could be due to the presence of bufadienolide and other water soluble constituents in the extract 30. *Kalanchoe* has also shown sedative and central nervous system depressant actions in animal studies. These effects were attributed partially to the leaf extract demonstrating the ability to increase the levels of a neurotransmitter in the brain called GABA (gamma aminobutyric acid).

**Antimutagenic activity:** Plant has potent antihistamine and antiallergic activity. The methanol extract of the leaves has also been reported to have histamine receptor (H1) antagonism in the ileum, peripheral vasculature and bronchial muscle and protect against chemically induced anaphylactic reactions and death by selectively blocking histamine receptors in the lungs. Quercetin-3-o- $\alpha$ -L-arabinopyranosyl (1 $\rightarrow$ 2)- $\alpha$ -L-rhamnopyranoside showed anti allergic activity in rats. ObaseikiEbor et al investigated that organic solvent extracts of leaves had inhibitory activity for His - to His + reverse-mutations induced by ethyl methanesulfonate acting on *S. typhimurium* TA100 or TA1002 and were also active against reversions induced by 4nitro-o-phenylenediamine and 2-aminofluorene in TA98. The alkaloidal/ water soluble and acid fraction had no appreciable antimutagenic activity.

**Anti-ulcer activity:** Adesanwo et al in his study showed a significant reduction in incidence of ulceration and mean basal and histamine stimulated gastric acid secretion in a dose dependent manner thus justifying its use as an anti-ulcer agent in folklore medicine.

**Antibacterial activity:** The presence of phenolic compounds indicate that the plant possess antimicrobial activity. Ofokansi et al. (2005) reported that plant is effective in the treatment of typhoid fever and other bacterial infections, particularly those caused by *S. aureus*, *E. coli*, *B. subtilis*, *P. aeruginosa*, *K. aerogenes*, *K. pneumoniae* and *S. typhi*. In his study antibacterial activities of the infusion and methanolic extracts against *S. aureus* ATCC 13709, *E.coli* ATCC 9637, *Bacillus*, *P. aeruginosa*, *K. pneumonia* and *S. typhi* using the agar diffusion method; also against *S. aureus*, *E. coli*, *S.typhi*., *Klebsiella* spp and *P.aeruginosa* using a modification of checkerboard method. These findings supported its use in treating the placenta and navel of newborn baby, which not only heals fast but also prevent the formation of infections. Pure isolated alkaloids and their synthetic derivatives are used as basic medicinal agents for their analgesic, antispasmodic and bactericidal effects. Obaseiki-Ebor et al investigated the in-vitro antibacterial

activity of leaf juice. The extract at 5% v/v was found to bactericidal to a wide spectrum of gram-positive and gram negative bacteria such as *B.subtilis*, *S.aureus*, *S. pyogenes*, *S.faecalis*, *E.coli*; *Proteus* spp; *Klebsiella* spp; *Shigella* spp; *Salmonella* spp; *S. marcescens*; and *P. aeruginosa* including the clinical isolates of these organisms possessing multiple antibiotic resistance. Schmitt et al showed the antimicrobial activity of decoct of leaves against gram-positive bacteria by dilution tube method. Akinpelu in a study found that 60% methanolic leaf extract inhibits the growth of five out of eight bacteria used, at a concentration of 25mg/ml. *B. subtilis*, *E. coli*, *P. vulgaris*, *S. dysenteriae*, *S. aureus* were found to inhibited, while *K. pneumoniae*, *P.aeruginosa* and *C. albicans* were found to resist the action of the extract.

**Antidiabetic Activity:** The presence of zinc in the plants could mean that the plants can play valuable roles in the management of diabetes, which result from insulin malfunction. Ojewole evaluated the antinociceptive effect of the herb's aqueous leaf extract by the 'hot-plate' and 'acetic acid' test models of pain in mice. The anti-inflammatory and antidiabetic effects of the plant extract were investigated in rats, using fresh egg albumin-induced pedal oedema, and streptozotocin -induced diabetes mellitus. The aqueous leaf extract produced significant antinociceptive effects against thermally and chemically induced nociceptive pain stimuli in mice.

**Immunosuppressive effect:** The fattyacids present in *B.Pinnatum* may be responsible atleast in part, for its immunosuppressive effect in vivo. RossiBergmann et al showed the aqueous extract of leaves cause significant inhibition of cell-mediated and humoral immune responses in mice. The spleen cells of animals pre-treated with plant extract showed a decreased ability to proliferate in response to both mitogen and antigen in vitro. Treatment with extract also impaired the ability of mice to mount a delayedtype hypersensitivity reaction (DTH) to ovalbumin. The invitro and topical routes of administration were the most effective by almost completely abolishing the DTH reaction. The intraperitoneal and oral routes reduced the reaction by 73% and 47% of controls, respectively. The specific antibody responses to ovalbumin were also significantly reduced by treatment. Thus the aqueous extract of leaves possesses immunosuppressive activities. Almeida et al in an investigation also found that leaf extracts inhibited invitro lymphocyte proliferation and showed in-vivo immunosuppressive activity. An attempt to identify the immunosuppressive substances present in *B.Pinnatum* guided by the lymphoproliferative assays. From the ethanolic extract a purified fraction (KP12SA) found twenty-fold more potent to block murine lymphocyte proliferation than the crude extract. Thus provides evidence that saturated fatty acids present in herb plays an important role on lymphocyte proliferation, which explain its immunosuppressive effect in vivo.

**Antihypertensive activity:** Herb possesses hypotensive activity and lend credence to the folkloric use of the herb

in the management of hypertension. The plant commonly used in the management of all the types and grades of hypertension by some Yorubas of Western Nigeria. *Kalanchoe pinnata* has been recorded in Trinidad and Tobago as being used as a traditional treatment for hypertension.

**Diuretic and anti-urolithiatic activity:** Patil et al. (2009) studied the diuretic and anti-urolithiatic activity of *K. pinnata*. Hydroalcoholic extract of leaves of *K. pinnata* was administered to male Wistar rats orally and intraperitoneally. The effect of the extract on urine output was determined by comparing the urine volume collected by keeping the individual animals in metabolic cages. Calcium oxalate urolithiasis was induced in rats by giving ethylene glycol orally for 7 days and the effect of the extract was observed by its concurrent administration. The extract was found to have significant diuretic and anti-urolithiatic activity and the intraperitoneal administration of the extract gave more potent diuretic effect.

**Anti-allergic activity:** Cruz et al. (2008) reported on the protective effect of *K. pinnata* in fatal anaphylactic shock, likewise a Th2-driven immunopathology and the identification of its active component. In vitro, *K. pinnata* prevented antigen-induced mast cell degranulation and histamine release. Oral treatment with the quercitrin flavonoid isolated from the plant prevented fatal anaphylaxis in 75% of the animals. These findings indicate that oral treatment with *K. pinnata* effectively down-modulates pro-anaphylactic inducing immune responses. Protection achieved with quercitrin, although not maximal, suggests that this flavonoid is a critical component of *K. pinnata* extract against this extreme allergic reaction.

## CONCLUSION

A consolidated review on the pharmacological uses of the medicinal plant *K. pinnata* (Linn.) Pers. which included a broad spectrum of activities like wound-healing, antioxidant, anticancerous, antiproliferative, antimicrobial, antiviral, antiprotozoal, antileishmanial, anthelmintic, insecticidal, antiallergic, analgesic, antinociceptive, anti-oedematogenic, antiinflammatory, muscle-relaxant, antipyretic, anticonvulsant, antidepressant, sedative, antilithiatic, hepatoprotective, gastroprotective, antidiabetic, nephroprotective, haemoprotective, antihistamine, antihypertensive, immunosuppressive, tocolytic and anthroposophic effects have been briefly discussed. Research studies have been made to analyse the therapeutical ability of isolated biomolecules of the plant and its extracts. Though, the plant is traditionally known for its high clinical value, few scientists have reported presence of poisonous chemicals that harm animals. Yet, a knowledge base is required to carry on research and clinical trials in the future for industrialisation of the plant metabolites.

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