

A REVIEW ON PHARMACOLOGICAL ACTIVITY OF PLANT “KALANCHOE PINNATA”

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ABSTRACT

Kalanchoe pinnata, commonly known as the "Miracle Leaf" or "Air Plant," is a succulent plant from the Crassulaceae family, native to Madagascar and widely distributed in tropical and subtropical regions. This plant has garnered significant attention due to its diverse medicinal properties, which have been utilized in traditional medicine systems like Ayurveda, Unani, and African folk medicine. *Kalanchoe pinnata* is renowned for its therapeutic applications in treating a variety of ailments, including kidney stones, gastric ulcers, respiratory disorders, inflammatory diseases, and wound healing. Scientific studies have validated these traditional uses, highlighting the plant's rich phytochemical profile, which includes flavonoids, alkaloids, tannins, and bufadienolides. These compounds contribute to its pharmacological activities, such as anti-inflammatory, antioxidant, anticancer, nephroprotective, hepatoprotective, and antimicrobial effects. The plant has also demonstrated promising potential for use in drug development and integrative medicine. Despite its promising therapeutic benefits, challenges related to formulation stability, potential allergies, and regulatory concerns remain. This review discusses the therapeutic potential, pharmacological properties, and applications of *Kalanchoe pinnata*, with a particular focus on its use in cream formulations for skin care. The plant's bioactive compounds and their therapeutic mechanisms offer a natural, effective, and multi-faceted solution for various medical and cosmetic applications.

I. INTRODUCTION

Kalanchoe pinnata, commonly known as the "Miracle Leaf" or "Air Plant," belongs to the Crassulaceae family. Native to Madagascar, this succulent plant has been widely cultivated across tropical and subtropical regions for its remarkable medicinal properties. It has gained significant attention in traditional medicine systems such as Ayurveda, Unani, and African folk medicine due to its wide range of therapeutic uses. *Kalanchoe* is a restorative plant to a great extent utilized in society medication for the treatment of kidney stones, gastric ulcer, pneumonic disease, rheumatoid joint pain and so forth. *Kalanchoe pinnata* has become naturalized in mild locales of Asia, Australia, New Zealand, West Indies, Macaronesia, Mascarenes, Galapagos, Melanesia, Polynesia, and Hawaii and Bengal.

Kalanchoe pinnata, a species belonging to the family Crassulaceae, is an erect, succulent perennial shrub that is commonly found in tropical and subtropical regions around the world. Originally introduced as an ornamental plant, it has now become a widespread weed in plantation areas. The plant typically grows up to 1.5 meters in height and is characterized by tall, hollow stems, dark green, scalloped leaves with red margins, and bell-shaped, pendulous flowers. It reproduces both through seeds and vegetatively, with the ability to propagate easily through leaf cuttings or stem fragments.

In traditional medicine, *Kalanchoe pinnata* has been highly valued for its diverse pharmacological properties. Its leaves, stems, and roots have long been used in various ethnomedicinal practices for the treatment of conditions ranging from infections, inflammation, and respiratory disorders to kidney stones, skin infections, and wound healing. Additionally, the plant is recognized for its antifungal, antihistamine, immunosuppressive, anthelmintic, and hepatoprotective activities. Its medicinal uses span across different cultures, including those in Africa, India, and South-East Asia, where it is employed to treat ailments such as burns, abscesses, fever, and even conditions like bronchitis and asthma.



Fig 1: *Kalanchoe pinnata*

1.1 TAXONOMICAL CLASSIFICATION OF KALANCHOE PINNATA:

- Kingdom : Plantae
- Division : Magnoliophyta
- Class : Magnoliopsida
- Order : Saxifragales
- Family : *Crassulaceae*
- Genus : *Kalanchoe*
- Section : *Bryophyllum*
- Species : *K. pinnata*

1.2 VERNACULAR NAMES:

Hindi: zakhm-hayat Arabic: kushnulhayat Bengal: koppata Sanskrit: asthi-bhaksha Telgu: simajamudu Tamil: ranakalli Kannad : ganduklinga Malayalam: elamurunga Persian & Urdu: Chubehayat

1.3 BENEFITS:

Traditionally, *Kalanchoe pinnata* has been used to treat a variety of ailments, including:

- Wound healing
- Respiratory conditions (e.g., asthma, coughs)
- Fever and infections
- Inflammatory diseases
- Kidney stones
- Synonyms
- *Bryophyllum pinnatum*
- *Cotyledon pinnata*

1.4 MECHANISM OF ACTION:

1. Inhibition of Favorable to fiery Arbiters:

Kalanchoe pinnata stifles the creation of cytokines, for example, growth rot factor-alpha (TNF- α), interleukin-1 beta (IL-1 β), and interleukin-6 (IL-6), which are key middle people in the fiery fountain.

It additionally downregulates the statement of cyclooxygenase-2 (COX-2) and inducible nitric oxide synthase (iNOS), diminishing the combination of prostaglandins and nitric oxide, separately.³

2. Reduction of Oxidative Pressure:

The plant's flavonoid content adds to cell reinforcement movement, which mitigates oxidative pressure, a significant supporter of irritation. This, thusly, forestalls harm to cell structures and diminishes the enrollment of provocative cells.

3. Stabilization of Lysosomal Layers:

Kalanchoe pinnata extricates balance out lysosomal films, forestalling the arrival of hydrolytic catalysts that can fuel irritation in harmed tissues.⁴

4. Suppression of Leukocyte Movement:

Studies have shown that the plant diminishes the invasion of neutrophils and macrophages into aggravated tissues, further mitigating irritation.

II. PHYTOCHEMICAL CONSTITUENT

Phytochemical investigations reveal that *Kalanchoe pinnata* is a rich source of bioactive compounds, including:

- **Flavonoids:** Quercetin, kaempferol, and other antioxidants.
- **Alkaloids:** Known for anti-inflammatory and analgesic properties.
- **Tannins and Saponins:** Contributing to antimicrobial activity.
- **Bufadienolides:** Unique compounds with anticancer and cardioprotective potential.^{5,6}

2. PHARMACOLOGICAL ACTIVITIES:

Scientific studies validate the traditional claims, highlighting a range of pharmacological effects:

2.1 Anti-inflammatory Activity:

Exploratory models uncover that *Kalanchoe pinnata* diminishes irritation by restraining supportive of incendiary arbiters like prostaglandins, interleukins, and cancer rot factor-alpha (TNF- α). The mitigating impact is connected to bioactive mixtures, for example, flavonoids and saponins, which downregulate cyclooxygenase (COX) and lipoxygenase (LOX) pathways.⁷

2.2 Antioxidant Activity:

Phytochemicals in *Kalanchoe pinnata*, especially flavonoids and phenolic acids, go about as strong cell reinforcements. They rummage free extremists, lessen lipid peroxidation, and upgrade endogenous cancer prevention agent guards (e.g., superoxide dismutase, catalase), in this way safeguarding cells from oxidative harm related with different sicknesses.⁸

2.3 Anti-cancer Activity:

Kalanchoe pinnata displays cytotoxic impacts on a few malignant growth cell lines, including bosom, lung, and colon tumors. The anticancer action is credited to bufadienolides, a class of mixtures that incite apoptosis through mitochondrial brokenness, initiation of caspases, and tweak of cell cycle controllers.⁹

2.4 Nephroprotective and Hepatoprotective Impacts:

The plant shows defensive impacts on renal and hepatic tissues under harmful or neurotic circumstances. These impacts are intervened by its cancer prevention agent and calming properties, which alleviate oxidative pressure and aggravation in organs presented to nephrotoxins (e.g., gentamicin, cisplatin) or hepatotoxins (e.g., paracetamol, ethanol)¹⁰

2.5 Antimicrobial Movement: Concentrates of *Kalanchoe pinnata* show critical antimicrobial properties, exhibiting viability against a scope of microorganisms, including microscopic organisms (e.g., *Escherichia coli*, *Staphylococcus aureus*), parasites (e.g., *Candida albicans*), and infections. The antimicrobial impact is ascribed to auxiliary metabolites like flavonoids, alkaloids, and tannins, which upset microbial cell layers or disrupt metabolic pathways.^{11,14}

2.6 Anti-inflammatory Activity of *Kalanchoe pinnata*:-

The mitigating movement of *Kalanchoe pinnata* has been widely examined and approved through preclinical examinations. The plant's bioactive mixtures, including flavonoids, saponins, and alkaloids, assume a significant part in balancing fiery reactions.

III. MICROSCOPIC AND MACROSCOPIC OF PLANT KALANCHOE PINNATA

3.1 Leaves

Variable decussate, the lower normally straightforward or every so often compound, 8-12 and 6- 8cm in size, the upper normally 3-5or some of the time 7-folio late, long pointed, the petioles joined by an edge round the stem. Pamphlets applaud or elliptic, crenate or serrate. The leaves frequently produce, on their crenature at the limits of the sidelong nerves, buds outfitted with root, stems and leaves, which drop off and immediately become new plants¹



Fig 2: leaves of *Kalanchoe pinnata*

3.2 Flowers

Blossoms rosy purple, swinging in enormous spreading panicles with inverse bold branches; pedicle slim. Calyx red and green at the base, striated, light green above, teeth three-sided. The corolla enlarged furthermore, octagonal at the base, rosy purple, tightened in the center. Fibers green at the base, pinkish beneath the anther. Anther hastate furthermore, dark



Fig 3: Flowers of *Kalanchoe pinnata*

3.3 Stems

Heartlessly four calculated the more seasoned light shaded, more youthful parts rosy dotted with white¹



Fig 4: Stem of *Kalanchoe pinnata*

3.4 Seed

Little smooth elliptical - ellipsoid, barely striate, smooth. The leaves frequently produce, on their crenature at the limits of the sidelong nerves, buds outfitted with root, stems and leaves, which drop off and immediately become new plants²



Fig 5: Seeds of Kalanchoe pinnata

IV. CHEMICAL CONSTITUENTS

B.Pinnatum is wealthy in alkaloids, triterpenes, glycosides, flavonoids, cardienolides, steroids, bufadienolides and lipids. The leaves contain a gathering of synthetic substances called bufadienolides which are extremely dynamic. Bufadienolides like bryotoxin A, B, C which are practically the same in design and movement as two other heart glycosides, digoxin and digitoxin and has antibacterial, antitumorous, malignant growth protection and insecticidal activities .Bufadienolides-Bryophyllin A(bryotoxin) ,Bryophyllin ,Bryophyllol, Bryophollone , Bryophollenone , Bryophynol^{12,13}

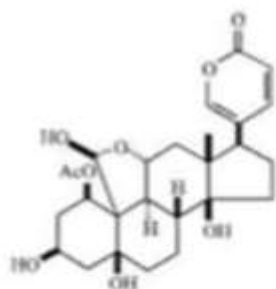


Fig 1. Bryophyllin

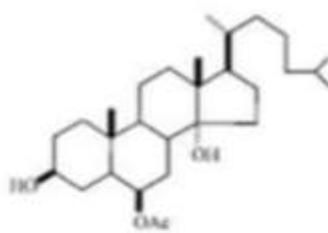


Fig 2 Bryophyllol

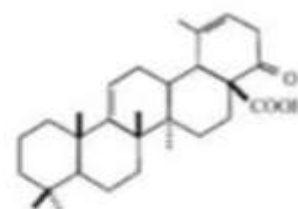


Fig 3 Bryophollone

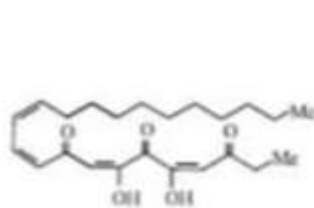


Fig 4 Bryophollenone

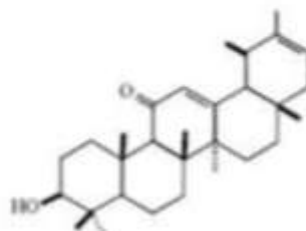


Fig 5 Bryophynol

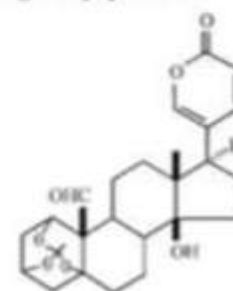


Fig 6 Bersaldegenin

V. CONCLUSION

Kalanchoe pinnata, often referred to as the "Miracle Leaf," is a highly adaptable and potent medicinal plant with a long-standing history of use in traditional medicine across various cultures. Its diverse array of bioactive compounds, such as flavonoids, alkaloids, bufadienolides, and tannins, contribute to its broad therapeutic effects, including anti-inflammatory, antioxidant, antimicrobial, anticancer, and nephroprotective properties. The plant has been valued for its ability to promote wound healing, alleviate respiratory issues, manage kidney stones, and combat infections. Both traditional practices and scientific research affirm its medicinal potential, particularly its bufadienolide compounds, which offer promising opportunities for further pharmaceutical development. With its wide range of health benefits, Kalanchoe pinnata stands as a promising natural remedy for integration into modern medical treatments.

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