

Patharchatta (*Kalanchoe pinnata*): A Comprehensive Review of its Traditional Uses, Pharmacological Activities, and Therapeutic Potential

Akshada Waghmare, Saurabh Wathodkar, Tushar More, Renuka Mahajan

Nagpur College Of Pharmacy

Abstract:

Kalanchoe pinnata (Syn. *Bryophyllum pinnatum*), referred to as Patharchatta in India, is a succulent perennial herb that is widely acknowledged in traditional medicine for its exceptional healing abilities. This review article consolidates existing research on *K. pinnata*, addressing its botanical classification, morphological traits, microscopy, drug specifications, and various pharmacological effects. Particular emphasis is placed on the scientific substantiation of its traditional applications, especially its clinical effectiveness in treating conditions such as urolithiasis (kidney stones), inflammation, diabetes, and infections. The review further assesses the safety profile of the plant, identifies potential areas for future investigation, and deliberates on the prospects of incorporating Patharchatta into contemporary therapeutic practices.

Keywords: *Kalanchoe pinnata*, *Bryophyllum pinnatum*, Patharchatta, Anti-urolithiatic activity, Kidney stone disease, Anti-inflammatory, Bufadienolides.

1. Introduction

Herbal medicine has been an integral part of human civilization for centuries, serving as a primary source of therapeutic remedies and disease management. Among the vast array of medicinal plants, *Kalanchoe pinnata* (Lam.) Pers., belonging to the family Crassulaceae, has attracted considerable scientific and ethnobotanical interest. Commonly known as Patharchatta, “Miracle Leaf,” or “Mother of Thousands,” this succulent herb is widely distributed in tropical and subtropical regions and has been extensively utilized in traditional systems of medicine such as Ayurveda, Unani, and folk healing practices across Asia, Africa, and South America.

Traditionally, *Kalanchoe pinnata* has been used for treating kidney stones—an application from which its Hindi name “Patharchatta” (meaning “stone-breaker”) is derived. Beyond its acclaimed anti-urolithiatic potential, the plant has been recognized for its diverse therapeutic actions, including wound healing, anti-inflammatory, analgesic, and antimicrobial effects. The leaves are often applied topically to cuts, burns, and insect bites, while extracts are administered internally for ailments such as cough, fever, gastric ulcers, and infections.

In recent years, the pharmacological potential of *Kalanchoe pinnata* has gained substantial attention in modern scientific research. Studies have revealed a rich phytochemical composition encompassing flavonoids, triterpenoids, glycosides, phenolic compounds, and unique bufadienolides—bioactive constituents that contribute synergistically to its wide spectrum of pharmacological activities. These compounds are known to exert strong antioxidant and anti-inflammatory effects, which play a crucial role in mitigating oxidative stress and inflammation-mediated disorders, including renal calculi formation.

Given its multifaceted biological properties and the growing global interest in plant-based therapeutics, *Kalanchoe pinnata* stands as a promising candidate for drug development and integrative medicine. The present review aims to provide a comprehensive overview of its botanical characteristics, traditional uses, phytochemical constituents, and pharmacological activities, thereby bridging the gap between ancient wisdom and modern scientific understanding of this remarkable medicinal plant.

2. Botanical classification and taxonomy

Kalanchoe pinnata is classified as a succulent perennial herb within the family Crassulaceae. Its taxonomic history is intricate, with initial classifications placing it in the genus *Cotyledon* before its reassignment to *Kalanchoe* and, in certain classifications, *Bryophyllum*.

Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Saxifragales
Family	Crassulaceae
Genus	<i>Kalanchoe</i> (syn. <i>Bryophyllum</i>)
Species	<i>K. pinnata</i> (syn. <i>B. pinnatum</i>)

3. Morphology

K. pinnata is noted for its unique appearance, featuring hollow, fleshy stems and ovate-oblong leaves.

Growth Form: It is an upright, perennial succulent herb that generally reaches a height of 1 to 2 meters.

Stem: The stems are hollow, robust, and frequently exhibit reddish or greenish hues.

Leaves: The leaves are thick, fleshy, and dark green, characterized by distinctly scalloped or crenated edges. A significant aspect of this plant is its asexual reproduction, where small plantlets develop in the notches along the leaf margins.

Flowers: The flowers are bell-shaped and drooping, forming a terminal panicle. Their coloration varies from greenish-yellow to pinkish-red.

4. Microscopic features

Microscopic examination is essential for the standardization and authentication of drugs. Microscopic features, also known as **histological** or **anatomical** characteristics, refer to the minute details of an object's structure as revealed under a microscope. In the context of biology, particularly botany or medicine, these features are crucial for identifying and classifying specimens. A thorough microscopy of *K. pinnata* uncovers several diagnostic traits:

Leaf anatomy: The leaf exhibits isobilateral symmetry, containing multiple layers of spongy parenchyma and a prominent cuticle.

Stomata: Anisocytic stomata are found on both the upper and lower epidermal layers.

Calcium oxalate crystals: The presence of calcium oxalate crystals, typically in the form of rosette aggregates and prisms, is a notable microscopic feature.

Vascular bundles: The midrib and veins are composed of distinct collateral vascular bundles.

For a plant like *Bryophyllum pinnatum* (Life Plant), its microscopic features include a single-layered **epidermis** covered by a thick **cuticle**, which is typical of succulent plants to prevent water loss. The leaves are characterized by the presence of **anisocytic stomata** (stomata surrounded by three subsidiary cells of unequal size) on both surfaces, classifying them as amphistomatic. Uniquely, the inner tissue, or **mesophyll**, is not distinctly separated into palisade and spongy layers but forms a uniform **parenchymatous** mass. Additionally, the presence of **calcium oxalate crystals** (often prismatic) embedded within the parenchyma cells is a distinguishing microscopic inclusion. The stem's anatomy typically shows a ring of **collateral vascular bundles** and a large, parenchymatous **pith** in the center. These distinct cellular and tissue arrangements are essential diagnostic markers.

5. Drug specifications and phytochemical profile

1. Phytochemical Profile of *Bryophyllum pinnatum* (Patharchatta)

Bryophyllum pinnatum is rich in various classes of secondary metabolites, which are responsible for its wide range of therapeutic properties.

Table 1.1: Major Compound Classes, Identified Compounds, and Activities.

Major Compound Class	Identified Compounds	Activities
Flavanoids	Quercetin, Kaempferol, Quercitrin, Luteolin, Astragalin, Afzelin, Rutin, Quercetin-3-O- α -L-arabinopyranosyl, rhamnopyranoside.	Antioxidant, Anti-inflammatory, Anti-allergic, Antileishmanial, Antitumor, Antidiabetic.
Bufadienolides	Bryophyllin A, B, C, Bryotoxin A, B, C, Bersaldegenin-1,3,5-orthoacetate.	Cytotoxic, Anti-tumor, Insecticidal, Chemo-preventive.
Phenolic Compounds	Protocatechuic acid, Caffeic acid, Ferulic acid, Syringic acid, p-Coumaric acid.	Antioxidant, Antimicrobial.
Triterpenoids / Steroids	Beta-Sitosterol, Stigmasterol, Bryophyllol, Friedelin, Taraxerol, Oleanolic acid.	Anti-inflammatory, Cytotoxic, Hepatoprotective, Cholesterol-lowering.

Organic Acids	Isocitric acid, Malic acid, Succinic acid, Oxalic acid, Citric acid.	Involved in metabolism, some linked to anti-nephrolithiasis (kidney stone) activity.
Other	Alkaloids, Tannins, Saponins, Glycosides, Lipids, Vitamins (Ascorbic acid, Riboflavin, Niacin), and various macro/microelements.	Diverse actions including diuretic, antimicrobial, and wound healing.

2. Drug Specifications (Focusing on an Extract Example)

While a formal "drug specification" requires defined quality control parameters (like purity, assay of active compounds, residual solvents, microbial limits, etc.) for a specific formulation, for a botanical extract like that of *B. pinnatum*, the key specifications revolve around **standardization** based on its active compounds.

- 1) **General Information and Identity:** It includes the approved pharmacopoeial or chemical name (e.g., Ginkgo Dry Extract), the part of the plant used (e.g., *Ginkgo biloba* L. leaf), the extraction solvent(s) used (e.g., 70% Acetone or Ethanol), and the crucial Drug-Extract Ratio (DER). The DER indicates the mass of the starting plant material required to produce a unit mass of the extract. Identity is typically confirmed using a combination of techniques, such as **Thin-Layer Chromatography (TLC)** or **High-Performance Liquid Chromatography (HPLC)**, which produce a characteristic "fingerprint" chromatogram specific to the reference material.
- 2) **Physicochemical Parameters:** It define the extract's physical characteristics. This includes macroscopic attributes like **Appearance** (e.g., fine, yellowish-brown powder) and **Odor** (e.g., characteristic). Other essential tests are **Loss on Drying** or **Water Content**, which sets a maximum limit for moisture to ensure stability and prevent microbial growth, and **Particle Size Distribution** for powdered extracts, which impacts manufacturing of the final dosage form.
- 3) **Assay and Purity:** This section is paramount for standardization. This section quantifies the key characteristic or active constituents. For *Ginkgo biloba* extract, the specifications would mandate limits for the two main groups of compounds: not less than *X%* of **Ginkgo Flavone Glycosides** and not less than *Y%* of **Terpene Lactones** (bilobalide and ginkgolides). Conversely, it would set a strict maximum limit for undesirable compounds, such as the potentially toxic **Ginkgolic Acids**, ensuring they are reduced to trace amounts during the purification process. The ratio of the different groups of active compounds is also often specified to confirm the correct extraction profile.
- 4) **Safety and Contaminants:** This specifications ensure the extract is free from harmful impurities. This includes testing for **Heavy Metals** (e.g., Lead, Cadmium, Mercury) with stringent limits typically measured in parts per million (ppm). **Pesticide Residues** must be below set pharmacopoeial limits, and a test for **Residual Solvents** (like acetone, ethanol, or methanol) is mandatory, with maximum levels

dependent on the solvent's toxicity class. **Microbial Contamination** limits are also set for the Total Aerobic Microbial Count, Yeasts and Molds, and the absence of specific pathogens like *E. coli* or *Salmonella* to ensure the safety and hygiene of the final product.

6. Pharmacological actions and properties

The pharmacological activities of *Kalanchoe pinnata* have been well-documented across a variety of in vivo and in vitro models. These findings support its traditional applications and reveal new therapeutic potentials across multiple organ systems. The following details summarize the principal pharmacological actions of this plant:

- 1) **Anti-urolithiatic activity** – Extracts of *K. pinnata* significantly reduce calcium oxalate deposition and modulate urinary parameters, thereby preventing the recurrence of urolithiasis. The mechanism involves inhibition of stone nucleation, aggregation, and crystallization through enhanced magnesium excretion and antioxidant protection.
- 2) **Anti-inflammatory and analgesic activity** – The ethanolic and methanolic extracts exhibit strong anti-inflammatory action in carrageenan-induced paw edema and cotton pellet granuloma models. They inhibit COX-2 and NF- κ B pathways, reducing prostaglandin and cytokine synthesis. Additionally, they show notable analgesic effects in acetic acid-induced writhing tests.
- 3) **Antimicrobial and antifungal activity** – Methanolic and aqueous extracts demonstrate broad-spectrum antimicrobial properties against bacteria such as *Staphylococcus aureus*, *E. coli*, and *Pseudomonas aeruginosa*. They also inhibit fungal growth of *Candida albicans* and *Aspergillus niger*. This is primarily due to triterpenoids and flavonoids that disrupt microbial membrane integrity.
- 4) **Antioxidant activity** – The high phenolic and flavonoid content of *K. pinnata* confers potent antioxidant properties. It scavenges free radicals, reduces lipid peroxidation, and increases endogenous antioxidant enzymes such as catalase, superoxide dismutase, and glutathione peroxidase. These effects contribute to its protective roles in hepatic, renal, and cardiac systems.
- 5) **Antidiabetic activity** – In diabetic animal models, the plant extracts demonstrate hypoglycemic effects by enhancing insulin secretion, improving β -cell regeneration, and inhibiting carbohydrate-hydrolyzing enzymes. This results in reduced blood glucose levels and improved glycogen storage in hepatic tissues.
- 6) **Hepatoprotective activity** – The ethanol extract provides significant protection against CCl₄ and paracetamol-induced hepatotoxicity by restoring liver enzyme markers and maintaining histoarchitecture. The presence of quercetin and bufadienolides contributes to stabilization of hepatocyte membranes and reduction of oxidative injury.
- 7) **Nephroprotective activity** – Studies indicate that *K. pinnata* mitigates cisplatin and gentamicin-induced renal damage by reducing lipid peroxidation and inflammatory markers. It normalizes serum creatinine and urea levels, suggesting its potential as a supportive nephroprotective herbal agent.
- 8) **Wound-healing activity** – Topical preparations accelerate wound contraction, collagen synthesis, and epithelial regeneration. Histological evaluations show increased angiogenesis and fibroblast proliferation, linked to the plant's triterpenoid and flavonoid components.

- 9) **Anticancer and cytotoxic activity** – Bufadienolides such as bryophyllin A, bersaldegenin, and daigremontianin possess cytotoxic properties against multiple cancer cell lines. These compounds induce apoptosis through mitochondrial disruption, caspase activation, and inhibition of cell proliferation. Studies suggest selective activity against liver (HepG2), breast (MCF-7), and lung (A549) cancer cells.
- 10) **Immunomodulatory activity** – The aqueous extract enhances both humoral and cell-mediated immune responses by stimulating macrophage activity and antibody production. This supports its traditional use for strengthening immunity and managing recurrent infections.
- 11) **Antipyretic activity** – *K. pinnata* extracts reduce yeast-induced pyrexia and inflammation in experimental models, providing evidence of its traditional use for fever management.
- 12) **Cardioprotective and antihypertensive activity** – The plant exhibits vasodilatory and antioxidant effects that protect myocardial tissue against ischemic damage. However, due to the presence of bufadienolides, excessive consumption may lead to cardiac glycoside-like toxicity; thus, controlled dosing is essential.

Overall, the pharmacological evidence strongly supports *K. pinnata* as a multi-target medicinal plant with diverse therapeutic potential. Future research should focus on molecular mechanisms, synergistic effects, and standardized dosage formulations for clinical application.

7. Traditional and Ethnomedicinal Uses

Kalanchoe pinnata has been valued in traditional medicine for centuries and is widely utilized across tropical and subtropical regions for treating a variety of ailments. In **Ayurveda**, it is known as *Patharchatta* or *Pashanbheda*, terms that literally mean “stone breaker,” highlighting its prominent role in the management of **urolithiasis (kidney stones)**. The fresh leaf juice is traditionally consumed with water or sugar to help dissolve and expel urinary calculi.

In **folk medicine**, the leaves are applied externally for **wound healing, burns, ulcers, insect bites, and skin infections**, owing to their cooling, soothing, and anti-inflammatory effects. The leaf paste is also used as a **natural poultice** to reduce swelling and promote tissue regeneration.

Decoctions or infusions prepared from the leaves are administered orally to manage **fever, cough, asthma, cold, and bronchial conditions**, suggesting its usefulness in **respiratory ailments**. In rural and tribal healthcare systems, *K. pinnata* is employed as a **remedy for dysentery, diarrhea, and gastric ulcers**, often in combination with other medicinal plants.

The plant also features in **African traditional medicine**, where it is used to treat **hypertension, abscesses, convulsions, and infections**, while in **Caribbean and South American** practices, it is considered a natural **anti-inflammatory and analgesic** agent. The **succulent leaf juice** is sometimes used as an eye drop for minor eye irritations and redness.

Overall, *Kalanchoe pinnata* occupies a central role in diverse ethnomedical systems, with its versatile therapeutic uses spanning **renal, respiratory, dermatological, and inflammatory disorders**. These extensive traditional applications form the foundation for modern pharmacological investigations into its bioactive compounds and therapeutic potential.

8. Clinical efficacy and safety

The common name "Pattarchatta" or "Patharchatta" refers to the plant **Bryophyllum pinnatum** (also known as *Kalanchoe pinnata*).

While this plant has a long history of use in traditional and folk medicine, particularly in Ayurveda, its clinical efficacy and safety are still being investigated through modern scientific studies, and **it is important to consult a healthcare professional before using it**.

Most available studies are *in vitro* (test tube), animal, or small-scale non-comparative clinical studies.

- **Kidney Stones (Lithiasis):** This is one of the most prominent traditional uses.
 - One small non-comparative open clinical study on patients with kidney or gallbladder stones (less than 10 mm) reported **effective or moderate improvement in a high percentage of patients** (around 87% effective, 13% moderate improvement) using fresh leaf juice daily for 30 days.
 - The plant's compounds (like saponins) are thought to **help dissolve calcium oxalate crystals** (a common component of kidney stones) and its diuretic properties may help flush them out.
 - However, some modern medical experts caution that there is **not enough large-scale scientific, empirical evidence** to replace standard medical treatment for kidney stones.
- **Wound Healing:** Traditional use and some animal studies suggest that the leaves may **promote wound healing** due to antimicrobial and anti-inflammatory properties.
- **Anti-inflammatory and Analgesic (Pain Relief):** Some research, often in animal models, suggests it may have anti-inflammatory and pain-relieving properties, which could be beneficial for conditions like arthritis or ulcers.
- **Antimicrobial and Antifungal:** The plant contains compounds with potential to **inhibit the growth of various microorganisms and fungi**.
- **Antidiabetic:** Some studies indicate it may **help reduce blood glucose levels** by potentially stimulating insulin secretion.

Note: For many of these uses, further large-scale clinical trials on humans are required to confirm the benefits and establish proper dosages.

Safety and Side Effects

- **General Safety:** Patharchatta is generally considered to be safe when consumed in appropriate traditional doses.
- **Reported Side Effects (often associated with large quantities or in sensitive individuals):**
 - 1) Fatigue
 - 2) Dry throat
 - 3) Agitation
 - 4) Difficulty in digestion (indigestion)
 - 5) Stomach pain, heartburn, acid reflux
 - 6) Nausea, vomiting, or diarrhea
- **Precautions and Warnings:**
 - 1) **Heart Conditions:** Individuals with heart diseases should be cautious and consult a doctor before consuming it, as some of its compounds (bufadienolides) can have effects on the heart.
 - 2) **Pregnancy and Lactation:** Pregnant women and lactating mothers should **consult a doctor** before use.
 - 3) **Diabetes:** Due to its potential effect on blood sugar, individuals with diabetes should monitor their glucose levels closely and consult a doctor, especially if taking medication.
 - 4) **Drug Interactions:** There is not enough evidence on its interaction with conventional drugs. If you are on any medication, especially for chronic diseases, you **must consult your doctor** before taking Patharchatta.
 - 5) **Replacement of Treatment: Do not discontinue or replace an ongoing prescription medicine or treatment with Patharchatta** without consulting a qualified medical doctor.

While traditional knowledge and preclinical studies have laid the groundwork for understanding these effects, further research is essential to fully establish the clinical efficacy and safety of these applications.

9. Future scope

The future scope of research into *Bryophyllum pinnatum* (Patharchatta) is broad, primarily focusing on validating its traditional uses through rigorous scientific methods and exploring its potential for new pharmaceutical applications.

Here are the key areas for future investigation:

1. Clinical Validation of Traditional Uses

- **Large-Scale Clinical Trials:** The most crucial step is conducting large-scale, randomized controlled trials (RCTs) to conclusively establish the efficacy and precise dosage for its most popular traditional uses:
 - **Kidney Stones (Lithiasis):** Establishing clear evidence on its effectiveness in dissolving and preventing different types of kidney and gallbladder stones in human subjects.
 - **Anti-diabetic Activity:** Validating its ability to lower blood glucose and investigating its potential for synergistic effects when combined with conventional anti-diabetic drugs like glibenclamide.
 - **Wound Healing:** Clinical trials to confirm its effectiveness as a topical agent for various wounds, burns, and ulcers.

2. Pharmaceutical Development and Safety

- ❖ **Toxicity and Safety Profile:** Conducting comprehensive toxicological studies, particularly to fully understand the concentration-dependent toxicity associated with **bufadienolides**—a class of compounds in the plant that can have cardiac effects. This is vital for establishing a safe dosage range for human consumption.
- ❖ **Active Compound Isolation and Standardization:** Identifying, isolating, and chemically synthesizing the specific bioactive compounds (e.g., flavonoids, bufadienolides, saponins) responsible for each therapeutic effect. This will allow for the development of **standardized herbal drugs** with consistent potency and purity.
- ❖ **Drug Interactions:** Thoroughly investigating potential interactions between *B. pinnatum* extracts or isolated compounds and common prescription medications to ensure patient safety.

3. Emerging Therapeutic Areas

- ❖ **Oncology Research (Anti-Cancer):** Continuing to explore its anti-tumor and cytotoxic effects, focusing on the molecular mechanisms by which its compounds (especially bufadienolides) inhibit cancer cell growth or induce cell death across different cancer cell lines.
- ❖ **Neuropharmacology and Mental Health:** Expanding on initial studies suggesting anxiolytic (anti-anxiety) and sedative properties. Future research should include RCTs to assess its role in managing anxiety, sleep disorders, and other neurological conditions.
- ❖ **Anti-Malarial and Antileishmanial Agents:** Deepening the investigation into its effectiveness against parasitic infections, such as malaria and leishmaniasis, to potentially develop new, plant-derived antiparasitic drugs.

- ❖ **Immunomodulation:** Studying its role in modulating the immune system, particularly its anti-inflammatory effects, to explore its use in managing chronic inflammatory and autoimmune disorders.

4. Biotechnological and Sustainable Production

- ❖ **Plant Biotechnology:** Utilizing advanced methods like plant tissue culture and genetic engineering to enhance the sustainable production of the plant and its high-value bioactive compounds, preventing overexploitation of wild resources.
- ❖ **Machine Learning (ML) and In Silico Studies:** Employing computational tools (molecular docking, molecular dynamics) and ML to model and optimize the plant's phytochemical potential, predict new drug candidates, and understand the mechanisms of action for its various health benefits.

10. Conclusion

In conclusion, *Kalanchoe pinnata* stands as a remarkably significant medicinal plant, validated by a robust history of traditional use, notably for the treatment of nephrolithiasis and various inflammatory and infectious ailments. Contemporary scientific investigation has powerfully corroborated these empirical applications, systematically isolating and characterizing its complex phytochemical arsenal. This research has already unveiled a broad spectrum of potent pharmacological activities, positioning the plant as a natural source of diverse therapeutic agents. However, the transition from traditional remedy to standardized pharmaceutical product necessitates a concentrated, forward-looking effort. Future steps must critically focus on executing rigorous clinical trials to substantiate efficacy in humans, developing globally compliant standardization protocols to ensure batch-to-batch consistency, and undertaking sophisticated mechanistic studies to fully elucidate the pathways governing its action. Only through this concerted scientific rigor can we fully unlock the therapeutic potential of this "Miracle Leaf," integrating its proven benefits into modern conventional medicine and, in doing so, advancing the frontier of quality herbal drug development worldwide.

10. REFERENCE

- 1) Biswas, S. K., Chowdhury, A., Das, J., Hosen, S. M. Z., Uddin, R., & Rahaman, M. S. (2021). A review of the traditional medicinal uses of *Kalanchoe pinnata* (Crassulaceae). *International Scholars Journals – International Journal of Pharmacy & Pharmacology*, 10(1), 001-005. [International Scholars Journals+1](#)
- 2) Singh, S. K., Patel, J. R., & Dangi, A. (Year). Physicochemical, Qualitative and Quantitative Determination of Secondary Metabolites and Antioxidant Potential of *Kalanchoe pinnata* (Lam.) Pers. Leaf Extracts. *Journal of Drug Delivery and Therapeutics*. [Drug Delivery Journal](#)
- 3) Jaiswal, S., Chawla, R., & Sawhney, S. (2014). "Kalanchoe pinnata – a Promising Source of Natural Antioxidants". *European Journal of Medicinal Plants*, 4(10), 1210-1222. [journalejmp.com](#)
- 4) Kendeson, C. A., Kagoro, M. L., & Adelakun, E. A. (2021). Phytochemical and Pharmacological Evaluation of Nigerian *Kalanchoe pinnata* (Lam.) Stem-Bark. *Journal of Chemical Society of Nigeria*, 46(4). [journals.chemsociety.org.ng](#)

- 5) Dwivedi, M., Dwivedi, S. K., Singh, C. P., Dubey, A., Mishra, A., Tripathi, A., & Sachan, A. (2022). Preliminary and pharmacological profile of *Kalanchoe pinnata* — an overview. *International Journal of Food and Nutritional Sciences*, 11(Special Issue 2). [IJFANS](#)
- 6) Menon, N. R., et al. (Year). Insights into the Therapeutic Use of *Kalanchoe pinnata* Supplement in Diabetes Mellitus. *Pharmaceuticals*, 18(10), 1518. [mdpi.com](#)
- 7) Nayak, B. S., Marshall, J. R., & Isitor, G. (2010). Wound healing potential of ethanolic extract of *Kalanchoe pinnata* leaf—a preliminary study. *Indian Journal of Experimental Biology*, 48(6), 572-576. [nopr.niscpr.res.in+1](#)
- 8) Suprpto, A. K., Tih, F., & Evacuasiyany, E. (2015). Effect of Methanolic Extract in Ointment and Powder of *Kalanchoe pinnata* (Lamk) Leaf in Ointment towards Incision Wound Healing in Mice. *Journal of Medicine and Health*, 1(1). [Maranatha Journals](#)
- 9) Saravanan, V., Murugan, S. S., Navaneetha Krishnan, K. R., Mohana, N., Sakthivel, K., & Sathya, T. N. (2021). Toxicological Assessment of Ethanolic Leaves Extract of *Kalanchoe pinnata* in Rats. *Indian Journal of Forensic Medicine & Toxicology*, 15(2), 1148-1155. [Medico Publication](#)
- 10) Nagara, G. (Year). Pharmacological approach on *Kalanchoe pinnata* – a concise report. *International Journal of Indigenous Herbs and Drugs*, 7(6). [saapjournals.org+1](#)
- 11) Khan, S., Rakholiya, S., & Tiwari, R. (2024). *Kalanchoe pinnata* (Patharchatta): “the versatile *Kalanchoe pinnata*: a review of its pharmacological activities and clinical relevance”. *International Journal of Medical Studies*, 9(11). [ijmsonline.in](#)
- 12) Atypon (Year). Wound healing cream formulated with *Kalanchoe pinnata* major flavonoid is as effective as the aqueous leaf extract cream in a rat model of excisional wound. (PubMed) [PubMed](#)
- 13) Kolodziejczyk-Czepas, J., & Stochmal, A. (Year). Biological activities of leaf extracts from selected *Kalanchoe* species and their relationship with bufadienolides content. *Journal/PMC*. [PMC](#)
- 14) Oufir, M., et al. (Year). Anti-tumor Promoting Activity of Bufadienolides from *Kalanchoe pinnata* and *K. daigremontiana* × *tubiflora*. *Bioscience, Biotechnology, and Biochemistry*, 65(4), 947-? [J-STAGE+1](#)
- 15) (2018/2019) Bufadienolide Penetration Through the Skin Membrane and Anti-aging Properties of *Kalanchoe* spp. Juices in Dermal Applications. (PubMed) [PubMed](#)
- 16) (Year) Local anti-inflammatory activity: Topical formulation containing *Kalanchoe brasiliensis* and *Kalanchoe pinnata* leaf aqueous extract. (PubMed) [PubMed](#)
- 17) (Year). Induction of wound-periderm-like tissue in *Kalanchoe pinnata* (Lam.) Pers. leaves as a defence response to high UV-B radiation levels. *Annals of Botany* (PubMed) [PubMed](#)
- 18) (2024). Quality standardisation and comparative study of leaf and root of *Kalanchoe pinnata* in the treatment of wound healing on albino rats. *International Journal of Pharmaceutical & Scientific Management (IJPSM)*. [IJPSM](#)
- 19) (2023). The Cactus King website: *Kalanchoe pinnata* – overview of distribution, traditional uses. [thecactusking.com](#)
- 20) Sarita Jaiswal, Chawla, R., & Sawhney, S. (2014). “*Kalanchoe pinnata* – a Promising Source of Natural Antioxidants.” *European Journal of Medicinal Plants*, 4(10). (Already listed above.)
- 21) (2024). Toxicological investigation of *Kalanchoe pinnata*. *International Journal of Enhanced Research in Science, Technology & Engineering*, Vol. 11 Issue 8. [ER Publications](#)
- 22) (2024). World Journal of Pharmaceutical Science and Research. Safety and toxicity issues of *Kalanchoe pinnata*. Vol. 3, Issue 6. [wjpsronline.com](#)
- 23) (2021). Antioxidant, Anti-inflammatory, and Antimicrobial Activity of the *Kalanchoe pinnata* and *Piper longum* Formulation Against Oral Pathogens. (PubMed) [PubMed](#)
- 24) (2024). *Kalanchoe pinnata* (Lam.) Pers. Leaf ethanolic extract exerts selective anticancer activity through ROS-induced apoptotic cell death in human cancer cell lines. *BMC Complementary Medicine and Therapies*. [PubMed+1](#)
- 25) (Year). “Bioactive Compounds from *Kalanchoe* Genus Potentially Useful for the Development of New Drugs.” *Life* (MDPI) 13(3):646. [mdpi.com](#)