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Indian Journal of Pharmacy and Pharmacology

Journal homepage: <https://www.ijpp.org.in/>**Review Article****A review on kalanchoe pinnata (Crassulaceae)****Harjinder Singh^{1,*}, Amar Pal Singh¹, Ajeet Pal Singh¹**¹Dept. of Pharmacology, St. Soldier Institute of Pharmacy, Lidhran Campus, Behind NIT (R.E.C), Jalandhar-Amritsar by Pass NH-1, Jalandhar, Punjab, India**ARTICLE INFO***Article history:*

Received 16-08-2021

Accepted 23-08-2021

Available online 04-09-2021

Keywords:

Kalanchoe pinnata

Phytoconstituents

Names

Traditional use

Pharmacological activities.

ABSTRACT

The primary goal of this study is to offer preliminary data for drug discovery research using *Kalanchoe pinnata*, a heavenly plant that has a broad variety of active chemicals, including alkaloids, Phenols, Phenylpropanoids, Flavanoids, Triterpenoids, steroids, organic Salts. This plant was discovered to have a variety of pharmacological properties, including Antihypertensive activity, Hepatoprotective activity, Antimutagenic activity, Anti-ulcer activity, Uterine Contractility, Antidiabetic activity, Wound-healing activity, Antioxidant activity, Antitumour activity, Antiviral activity, Antimicrobial activity, Antileishmanial activity, Insecticidal activity, Antipyretic activity, Antilithiatic activity, Neuropharmacological, Immunosuppressive antibacterial activity, Cytotoxicity of testis. This study provides phytoconstituents and pharmacological activity of *K. pinnata*, a medicinal plant that may help researchers conduct more advanced qualitative research.

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For reprints contact: reprint@ipinnovative.com**1. Introduction**

Medicinal plants have been valued for millennia as a rich source of medicinal substances for the prevention of illnesses and afflictions all over the globe.¹ *Kalanchoe pinnata* (Crassulaceae) is an erect, succulent perennial shrub that grows to be approximately 1.5 metres tall and reproduces both vegetatively and via seeds. It features tall hollow stems, black bell-like pendulous blooms, and newly dark green leaves that are scalloped and trimmed with red. This plant may be readily propagated by cutting stems or leaves.^{2,3}

Phytochemicals may protect hominids against a wide range of diseases. Phytochemicals are nonnutritive plant combinations that provide caring, therapeutic, or disease-fighting properties. Plants generate these compounds to protect themselves; however, new research shows that

certain phytochemicals may protect animals from more than only syndromes. In pods and sages, there are many phytochemicals, each with its own mechanism.⁴

1.1. Taxonomical classification⁵

1. Kingdom: Plantae — plants
2. Subkingdom: Tracheobionta — vascular plants
3. Division: Spermatophyta — seed plants
4. Subdivision: Magnoliophyta — flowering plants
5. Class: Magnoliopsida - dicotyledons
6. Subclass: Rosidae
7. Order: Rosales
8. Family: Crassulaceae — stonecrop
9. Genus: *Bryophyllum*
10. Species: *B. pinnatum* (Lam.) Oken.

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1.2. Common names⁶

Cathedral Bells, Air Plant (USA), Life Plant, Miracle Leaf, Goethe Plant, and Katakataka are some of the common names for this plant.

In the English-speaking Caribbean, it's also known as "Wonder of the World." Mother Of Thousands, Herbe Mal Tete (Dominica), Never Dead, Parvu, Hoja Del Aire (Hawai'i), Oliwa Ka Kahakai (Hawai'i), Oliwa Ka Kahakai (Hawai'i), Oliwa Ka Kahakai (Hawai'i), Oliwa Ka Kahakai (Hawai'i) (Bolivia).

1.3. Vernacular name^{7,8}

1. Sanskrit: Parnabeeja, Asthibhaksha
2. English: Air plant
3. Hindi: Zakhmhaiyat, Pathharchoor
4. Kannada: Gandukalinga, Kadu basale
5. Malayalam: Elamarunga
6. Tamil: Malaikalli, Ranakalli
7. Telugu: Ranapala
8. Marathi: Gayamari
9. Bengali: Koppatha, Pathar kuchi.

1.4. Synonyms⁹

Bryophyllum calycinum Salisb., *Kalanchoe pinnata* (Lam.) Pers., *Cotyledon pinnata* Lam., and *Sedum madagascariense* Clus

1.5. Phytochemistry

The Phytoconstituents of plants shown in Table 1 and classified with compounds.

1.6. Worldwide ethnomedical uses

Worldwide traditional used of plant are shown in Table 2

1.7. Pharmacological activities

Pharmacological activities of *Kalanchoe pinnata* are shown in Figure 1 and discussed in details following are

1.8. Antihypertensive activity

This research examined the effects of aqueous leaf extract of *K. pinnata* on the blood pressure of anaesthetized cats, as well as the liver and kidney function of the rabbit. The findings indicated that the extract lowered the anaesthetized cat's blood pressure somewhat and also mitigated the impact of adrenaline-induced hypertension. This research demonstrated the pharmacological foundation for the Igbo's of Nigeria's usage of *K. pinnata* to reduce blood pressure. However, the fact that the blood pressure decrease is minimal and the *K. pinnata* leaf extract may be harmful to humans precludes its usage as a blood pressure reducing agent.²¹

1.9. Hepatoprotective activity

In the folk medicines of India's Bundelkhand region, the juice of fresh leaves is extremely useful for curing jaundice. The ability of the leaves' juice and the ethanolic extract of the marc left over after expressing the juice to protect against CCl₄-induced hepatotoxicity was evaluated in rats. In vitro, in vivo, and histology studies revealed that the test chemical was hepatoprotective. The juice was shown to be more effective than the ethanolic extract.²²

1.10. Antimutagenic activity

Antihistamine and antiallergic effects are found in the plant. Methanol extract from the leaves has also been found to inhibit histamine receptors (H₁) in the ileum, peripheral vasculature, and bronchial muscle, thus guarding against chemically induced allergic reactions and death by selectively inhibiting histamine receptors in the lungs. Quercetin-3-O-L-arabinopyranosyl (12) Obaseiki- Ebor et al. found that organic solvent extracts of leaves inhibited His — to His + reverse-mutations caused by ethyl methanesulfonate acting on *S. typhimurium* TA100 or TA1002, as well as reversions caused by 4-nitro-o-phenylenediamine and 2-aminofluorene in TA98. The alkaloidal/water soluble and acid fractions have no apparent antimutagenic efficacy.²³

1.11. Anti-ulcer activity

In this research, the incidence of ulceration and mean basal and histamine induced stomach acid production were significantly reduced in a dose-dependent manner, supporting its usage as an anti-ulcer drug in traditional medicine.²⁴

1.12. Antidiabetic activity

The presence of zinc in the plants may indicate that they could be useful in the treatment of diabetes caused by insulin dysfunction. The antinociceptive effect of the herb's aqueous leaf extract was tested in mice using the 'hot-plate' and 'acetic acid' pain models. Fresh egg albumin-induced pedal oedema and streptozotocin-induced diabetes mellitus were used to test the plant extract's anti-inflammatory and anti-diabetic properties in rats. In mice, the aqueous leaf extract had substantial antinociceptive effects (P0.05-0.001) against thermally and chemically generated nociceptive pain stimuli.

In rats, the plant extract reduced fresh egg albumin-induced acute inflammation and caused substantial hypoglycemia (P0.05-0.001). The herb's flavonoids, polyphenols, triterpenoids, and phytosterols are thought to be responsible for the plant's antinociceptive, anti-inflammatory, and antidiabetic effects. It is thought to have antinociceptive and anti-inflammatory properties

Table 1: Phytoconstituents of *kalanchoe pinnata*

Classification	Plant part	Compound
Phenols phenylpropanoids and flavanoids	Aerial parts of plants ¹⁰	Syringic acid, caffeic acid ¹⁰ , 4-hydroxy-3-methoxy-cinnamic acid, 4-hydroxybenzoic acid, p-hydroxycinnamic acid, paracoumaric acid, ferulic acid, protocatechuic acid, phosphoenolpyruvate, protocatechuic acid
	Leaves ¹¹	astragalinal, 3,8-dimethoxy-4, 5, 7trihydroxyflavone, friedelin, epigallocatechin-3-osyringate, luteolin, rutin, kaempferol, quercetin, quercetin-3L-rhamnoside-L-arabino furanoside; quercetin-3-Odiaraboside, kaempferol-3-glucoside, quercetin-3-O- α -L-arabino pyranosyl (1 \rightarrow 2) α -L-rhamno pyranoside.
Triterpenoids	Whole plant ^{12,13}	α -amyrin, α -amyrinacetate, β -amyrin, β -amyrinacetate, bryophollone, bryophollone, taraxerol, Ψ -taraxasterol, pseudo taraxasterol, 18- α -oleanane, friedelin, glutinol.
Steroids	Aerial parts ^{12,13}	β -sitosterol, bryophyllol, bryophynol, bryophyllin B (Antitumor), bryophyllin A (bryotoxin C, bufadienolide 1, 3, 5-orthoacetate) with potent cytotoxicity, a insecticidal bufadienolide bryophyllin C and bersaldegenin-3-acetate, bryotoxin A, bryotoxin B, bersaldegenin-1, 3, 5-orthoacetate, campesterol, 24-ethyl-25-hydroxycholesterol, isofucosterol, clionasterol, codisterol, peposterol, 22-dihydrobrassicasterol, clerosterol, patuletin, 3-O-(4-O-acetyl- α -L-rhamno pyranosyl)-7-Orhamno pyranoside patuletin.
Organic salt	Leaves ¹⁴	Complexed between ahydro amino acid andmalic acid (1:2)

Table 2: Traditional uses of *kalanchoe pinnata*.

Leaf extract is taken in empty stomach is used in the treatment of urinary bladder stones and fewer in children's. , For diarrhea The leaves juice is used against cough, dysentery, Leaf juice externally applied to scabies and leucoderma and leaf decoction applied over cuts to stop bleeding. for abdominal discomfort, boils, bruises, cholera, cuts, diabetes, diarrhea, dysentery, flatulence, headaches, kidney stones, indigestion, insect bites, scabies, sores, urinary insufficiency, wounds. ^{15,16}	India
For eye infections, headaches, inflammation, menstrual disorders, pimples, wounds ^{17,18}	Mexico
For aches, burns, childbirth, colds, coughs, fever, headache, pain, respiratory infection ^{17,18}	Nicaragua
For bacterial infections, boils, broken bones, bronchitis, cancer (lymphoma), conjunctivitis, coughs, earaches ^{17,18} eye infections, epilepsy, erysipelas, fever, gas, headache, heartburn, inflammation, intestinal problems, migraine, nausea, skin problems, sores, ulcers, urethritis ^{17,18}	Peru
For asthma, chest colds, earaches, headaches, sores, strains, tumors ^{17,18}	South America
For chicken pox, fevers, stomachache	USA
For arthritis, asthma, bruises, burns, constipation, diabetes, earaches, headaches, malnutrition, migraines, nephritis, paralysis, respiratory infections, rheumatism, sprains, swelling, ulcers, wound, and to induce vomiting of blood, cut umbilical cord in new born baby, expel worms. ¹⁹	Elsewhere
For antibacterial and anti-inflammatory ²⁰	Vietnam

by reducing the release, synthesis, and/or production of inflammatory cytokines and mediators such as prostaglandins, histamine, polypeptide kinins, and others.²⁵

1.13. Uterine contractility

The phytotherapeutic tocolytic action of in human myometrium in vitro against the standard betamimetic, fenoterol Contractility was assessed in strips of term myometrium biopsied at caesarean section and subjected to escalating concentrations of B.Pinnatum vs +/- oxytocin 1 U/l in 14 women. The suppression of spontaneous contraction in the result state was concentration dependant. B. Pinnatum raised contraction frequency by 91% at constant amplitude while inhibiting oxytocin-stimulated contractions by 20% at constant amplitude but with a somewhat lower frequency. Fenoterol reduced contraction by 50% with a substantial reduction in frequency.²⁶

1.14. Wound-healing activity

The ethanolic extract of *K. pinnata* demonstrated substantial wound-healing activity by reducing the size of the affected region and oedema at the wound site. This may be because steroidal glycosides and phenolic antioxidants are present.²⁷ Water, petroleum ether, and alcoholic extracts of the plant were shown to have the ability to cure wounds in a research. Water extract was likewise shown to be more active than the other two extracts in the research.²⁸

1.15. Antioxidant activity

The leaves were reported to show maximum scavenging effects than stems and the ethanolic extract showed more total phenolic and flavonoid content than other extracts. The high amount of phenols and flavonoids in the extracts may be the reason for their high antioxidative activity (Bhatti et al., 2012). The phenolic constituents have the ability to interact with the transition metals even in lipid phase and chelate them by filling their aqua-coordination sites and generating metal-coordinated insoluble complexes. Inhibition of lipid auto-oxidation could be attributed to the ability of phenolics to stabilise the radicals through generation of stabilised phenoxyl radicals by directly scavenging peroxy radicals.²⁹

1.16. Antitumour activity

Experiments were carried out on mice by causing tumour development in the peritoneal cavity. The plant's methanolic and aqueous extracts were used as medicines in precise doses. As a tumor-suppressing drug, these extracts reduced the amount of ascitic fluid and halted tumour development. As a result, the extracts were said to have antitumor action.³⁰

The plant's anticancer properties was investigated. The intake of the aqueous extract for N-diethylnitrosamine (DENA)-induced hepatocarcinogenesis in rats reduced liver damage, according to the findings. The protective effect may be attributed to antioxidant and antiperoxidative properties, as well as the capacity to rectify anomalies in lipid and lipoprotein metabolism by increasing the activity of a few lipid metabolising enzymes. DENA's metabolism in the liver tends to produce free radicals, disrupting antioxidant status and eventually contributing to oxidative stress and carcinogenesis, which is why it's classified as a significant environmental hepatocarcinogen. Histopathological study of DENA-treated rats' liver sections revealed severe centrilobular necrosis and vacuolisation. The aqueous extract neutralised free radicals, decreased necrosis, and protected hepatocytes against DENA's carcinogenic effects.³¹

1.17. Antiviral activity

The anticancer and anti-HPV properties of the plant's chloroform extract were investigated in a research. When the extract fractions were applied to cancer cell lines, they inhibited the production of viral proteins, limiting both viral and tumour development. The Epstein-Barr virus is a herpes virus that infects human B-lymphocytes, causing tumours to develop³²

1.18. Antimicrobial & antifungal activity

The antibacterial activity of *K. pinnata* was investigated, and it was shown that the methanolic extract had a higher inhibition rate. Bacteria that cause skin infections may also cause respiratory illnesses, food poisoning, wound infections, abscesses, osteomyelitis, endocarditis, pneumonia, and other problems when they enter the body. As a result, the produced extract may fight such illnesses and save the lives of those who are afflicted. The information provided may be utilised to create a commercial antibacterial and antifungal cream.³³

1.19. Antileishmanial activity

Leishmaniasis is caused by protozoans of the genus leishmania. Mice infected with leishmania amazonensis were administered an aqueous extract of *K. pinnata*. Following the experiment, a few findings were recorded, including the lesions shrinking in size and the parasitical load in the affected region. Continuous treatment with the extract not only slowed the development of the bacteria, but also stopped them from spreading. This technique may potentially be used to treat visceral leishmaniasis, according to some.³⁴

1.20. Insecticidal activity

The methanolic extract of *K. pinnata* yielded two bufadienolides. The inclusion of the 1, 3, 5-orthoacetate moiety of the bufadienolides was shown to be responsible for the isolated compounds' significant insecticidal action against silkworm third instar larvae.³⁵

1.21. Antipyretic activity

The impact of plant extract on hyperthermic conditions in experimental animals was shown. Brewer's yeast was used to cause pyrexia in rats. When *K. pinnata* hydroalcoholic extract was given to laboratory specimens, it lowered body temperature, demonstrating its antipyretic activity. This action may be due to the presence of flavonoids in the extract.³⁶

1.22. Antilithiatic activity

Calcium oxalate stones develop when oxalate excretion in the urine is decreased. On the basis of medical prophylaxis, fresh juice produced from the leaves of *K. pinnata* was given to patients with stones in their bodies. The juice, when consumed on a regular basis, successfully dissolved the stones, regardless of their location, nature, or prior treatments. The amount of urine voided increased, demonstrating the juice's diuretic properties. It also aided in the reduction of oxalate excretion while boosting citrate excretion. According to this research, the juice may have antilithiatic effects.³

2. Neuropharmacological

The aqueous leaf mine has a sedative effect on the central nervous system (CNS). The CNS treatment of rats with 50–200 mg/kg was shown to cause a significant reduction in locomotory activity in a dose-dependent manner, with no ptosis at these dosages. Similarly, there was a significant defeat of management and reduction in muscular tone in animals given intraperitoneally with aqueous extract in a dose-dependent manner in the chimney, ascending, and inclined screen tests. The findings show significant changes in universal behaviour patterns, a reduction in impulsive lethality, and a dose-dependent potentiation of pentobarbitone-induced sleeping duration³⁷

3. Immunosuppressive

In mice, an aqueous extract of grasses produced a substantial reserve of cell-mediated and humoral immunological responses. The spleen cells of mice pre-treated with herbal extract had a limited capacity to proliferate in vitro in response to both mitogen and antigen. By almost completely eradicating the Ddelayed-type hypersensitivity reaction, the in vitro and topical techniques of directing were the most effective. The intraperitoneal and verbal methods,

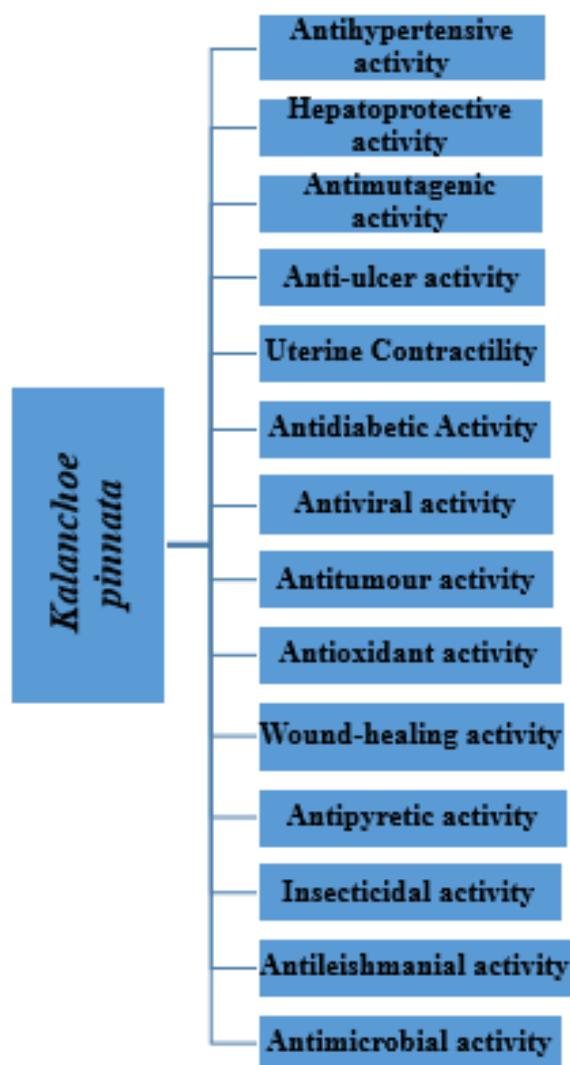


Fig. 1: Pharmacological activities of kalanchoe pinnata

respectively, decreased the response by 73 percent and 47 percent of controls. The precise antibody responses to ovalbumin were also summarized in a meaningful way by handling. As a result, the immunosuppressive properties of the aqueous extract of leaves are preserved. The lymphoproliferative tests were used to categories the immunosuppressive components found in Panphuti. A cleaned fraction (KP12SA) derived from the ethanolic extract was 20 times more effective than the crude extract in inhibiting murine lymphocyte explosion. As a consequence, the provides evidence that basil's saturated fatty acids have a substantial effect on lymphocyte proliferation, elucidating its immunosuppressive effect in vivo.³⁸

3.1. Antibacterial activity

Bacillus subtilis, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Klebsiella aerogenes*, *Escherichia coli*, *Klebsiella pneumoniae*, and *Salmonella typhi* are among the bacteria that cause typhoid fever and other bacterial illnesses, according to reports. Antibacterial activities of the infusion and methanolic extracts against *S. aureus* ATCC 13709, *E. coli* ATCC 9637, *Bacillus*, *P. aeruginosa*, *K. pneumoniae*, and *S. typhi* were investigated using the agar diffusion process, as well as adjacent to *S. aureus*, *E. coli*, *S. typhi*, *Klebsiella* spp., and *P. aeruginosa* using.^{39,40}

3.2. Cytotoxic to cattle

The effects of cardiac glycoside poisoning in calves fed flower heads of hybrid *Bryophyllum* species were studied, and it was discovered that for each plant (except *Bryophyllum tubiflorum*), two calves were given a single dosage of 20 g wet weight per kg body weight.

The findings of the calf toxicity experiment, together with the quantities of bufadienolide found in the plants, indicate that bryotoxins A, B, and C are most likely to blame for the illness.⁴¹

3.3. Herbal tonic

Ascorbic acids, riboflavin, thiamine, and niacin are all abundant in the plant. Natural ascorbic acid is essential for body function, which includes the proper synthesis of intercellular components such as collagen, bone matrix, and tooth dentine throughout the body. As a result, the clinical symptoms of scurvy, such as bleeding from the mouth, gastrointestinal tract, anaemia, and joint aches, may be linked to the relationship between ascorbic acid and proper connective tissue metabolism.⁴²

3.4. Cytotoxicity of testis

The cytotoxic impact of an ethanolic extract of *B. pinnatum* leaf on cells of the rat testis was investigated at two dosages (100 mg/kg and 200 mg/kg) given orally for eight weeks. When compared to the control group, which showed intact normal histological features of the testes, the seminiferous tubules shrank and intracellular spaces were seen within the epithelium at a dose of 100 mg/kg, and a higher dose (200 mg/kg) showed a marked increase in intracellular spaces within the germinal epithelium and a reduction of spermatozoa.⁴³

4. Conclusion

The plants are well-known and have long been believed to be medicinal. It is hoped that the comprehensive information provided in this study on the plant's phytochemical components and different biological characteristics of extracts and constituents would provide

an impetus to evaluate the plant's application in medicine. The pharmacological potentials of *K. pinnata* which is extremely useful to researcher to know more about this important plant.

5. Source of Funding

None.

6. Conflict of Interest

None.

7. Acknowledgment

It's our privilege to express profound sense of gratitude and cordial thanks to our respected chairman Mr. Anil Chopra, Vice Chairperson Ms. Sangeeta Chopra & Pro-Chairman Mr. Prince Chopra, St. Soldier Educational Society, Jalandhar for providing the necessary facilities to complete this work.

References

- Joseph B, Priya RM, Helen P, Sujatha S. Bio-active compounds in essential oil and its effects of antimicrobial, cytotoxic activity from the *Psidium guajava* (L.) Leaf. *J Adv Biotechnol*. 2010;9:10–4.
- Okwu DE, Nnamdi FU. Two novel flavonoids from *Bryophyllum pinnatum* and their antimicrobial Activity. *J Chem Pharm Res*. 2011;3(2):1–10.
- Gahlaut A, Pawar SD, Mandal TK, Dabur R. Evaluation of clinical efficacy of *Bryophyllum pinnatum* Salisb. for treatment of lithiasis. *Int J Pharm Pharm Sci*. 2012;4(4):505–7.
- Pathak D, Alam K, Rohilla H, Rai AR, Agrawal A. Phytochemical investigation of *Boerhavia diffusa* and *Rorippa paniculata*: A comparative study. *Int J Pharm Pharm Sci*. 2012;4:975–1491.
- Some magnetic is land plants; 2014. Available from: <http://www.somemagneticislandplants.com.au/index.php/plants/396-bryophyllum-pinnatum>.
- Bryophyllum pinnatum*; 2014. Available from: http://www.keyserver.lucidcentral.org/weeds/data/030308000b07490a8d040605030c0f01/media/Html/Bryophyllum_pinnatum.htm.
- Gurudeva MR. Botanical and vernacular names of south Indian plants; 2001. p. 245246.
- Chunekar KC, Pandey GS. Bhavamishra. Varanasi: Chaukhamba Bharathi Academy;; 2010. p. 107.
- Environmental Weeds of Australia; 2014. Available from: <http://keyserver.lucidcentral.org/weeds/data/030308000b07490a>.
- Gaind K, Gupta R, Alkanes, Alkanols T, Kalanchoe S, Pinnata. Triterpenes and sterols of *kalanchoe pinnata*. *Phytochemistry*. 1972;11:1500–2.
- Mukul. *Kalanchoe Pinnata*(Patharchur); 2009. Available from: <http://findmeacure.com/2009/03/25/kalanchoe-pinnata/>.
- Supratman U, Fujita T, Akiyama K, Hayashi H. New insecticidal bufadienolide, *Bryophyllin C* from *Kalanchoe pinnata*. *Biosci Biotechnol Biochem*. 2000;64(6):1310–2. doi:10.1271/bbb.64.1310.
- Akinpelu DA. Antimicrobial activity of *Bryophyllum pinnatum* leaves. *Fitoterapia* . 2000;71(2):193–4. doi:10.1016/s0367-326x(99)00135-5.
- Costa SS, Souza M, Ibrahim T, Melo GO, Almeida AP, Guette C, et al. *Kalanchoe dimilata*, an anti-inflammatory salt from *Kalanchoe brasiliensis*. *J Nat Prod*. 2006;69(5):815–8. doi:10.1021/np050475+.
- Prabal S, Mihin D, Dutta M, Dhruvad C, C. Documentation and Traditional Herbal Knowledge of *Khamptis* of Arunachal Pradesh. *Indian J Tradit Knowledge*. 2008;5(3):438–42.

16. Dash SK, Padhy S. Review of ethanomedicines for diarrhea diseases from Orissa: prevalence versus culture. *J Hum Ecol.* 2006;20(1):59–64. doi:10.1080/09709274.2006.11905903.
17. Raintree Stevia (Stevia rebaudiana) Powder 16 oz (1lb). Available from: <https://www.raintree.com/uk/>.
18. Plant List of Accepted Nomenclature, Taxonomy, and Symbols; 2014. Available from: <https://plants.usda.gov/home>.
19. Donatus EO, Nnamdi FU. Exotic Multifaceted Medicinal Plants of drug and pharmaceutical industries. *Afr J Biotechnol.* 2009;8(25):7271–82.
20. Thanh M, Suresh TN, Yasuhiro A, Shigetoshi W, Le Q, Hiroshi T, et al. Xanthin Oxidase Inhibitory Activity of Vietnamese Medicinal Plants. *Biol Pharm Bull.* 2004;27(9):1414–21. doi:10.1248/bpb.27.1414.
21. Ghasi S, Egwuib C, Achukwu PU, Onyeanusu JC. Assessment of the medical benefit in the folkloric use of Bryophyllum Pinnatum leaf among the Igbos of Nigeria for the treatment of hypertension. *Afr J Pharm Pharmacol.* 2011;5(1):83–92.
22. Yadav NP, Dixit VK. Hepatoprotective activity of leaves of Kalanchoe pinnata Pers. *J Ethnopharmacol.* 2003;86(2-3):197–202. doi:10.1016/s0378-8741(03)00074-6.
23. Nassis CZ, Haebisch EM, Giesbrecht AM. Antihistamine activity of Bryophyllum Calycinum. *Braz J Med Bio Res.* 1992;25(9):929–36.
24. Adesanwo JK, Raji Y, Olaleye SB, Onasanwo SA, Fadare OO, Ige OO. Antiulcer Activity of Methanolic Extract of Bryophyllum pinnatum in Rats. *J Biol Sci.* 2007;7(2):409–12. doi:10.3923/jbs.2007.409.412.
25. Ojewole J. Antinociceptive, anti-inflammatory and antidiabetic effects of Bryophyllum pinnatum (Crassulaceae) leaf aqueous extract. *J Ethno Pharmacol.* 2005;99(1):13–9. doi:10.1016/j.jep.2005.01.025.
26. Gwehenberger B, Rist L, Huch R, Mandach NV. Effect of Bryophyllum pinnatum versus fenoterol on uterine contractility. *Eur J Obstet Gynecol Reprod Biol.* 2004;113(2):164–71. doi:10.1016/S0301-2115(03)00370-1.
27. Nayak BS, Marshall JR, Isitor G. Wound healing potential of ethanolic extract of Kalanchoe pinnata Lam. leaf-A preliminary study. *Indian J Exp Biol.* 2010;48(6):572–6.
28. Khan M, Patil PA, Shobha JC. Influence of Bryophyllum pinnatum (Lam.) leaf extract on wound healing in albino rats. *J Nat Remedies.* 2004;4(1):41–6. doi:10.18311/jnr/2004/380.
29. Bhatti M, Kamboj A, Saluja AK, Jain UK. In vitro evaluation and comparison of antioxidant activities of various extracts of leaves and stems of Kalanchoe pinnatum. *Int J Green Pharm.* 2012;6:340–347. doi:10.4103/0973-8258.108255.
30. Devbhuti D, Gupta JK, Devbhuti P. Studies on antitumour activity of Bryophyllum calycinum Salisb. against Ehrlich ascites carcinoma in Swiss Albino mice. *J Pharma Sci Tech.* 2012;2(1):31–3.
31. Afzal M, Kazmi I, Khan R, Singh R, Chauhan M, Bisht T, et al. Bryophyllum pinnatum: A review. *Int J Res Biol Sci.* 2012;2(11):143–9.
32. Mahata S, Maru S, Shukla S, Pandey A, Mugesh G, Das BC, et al. Anticancer property of Bryophyllum pinnata (Lam.) Oken. leaf on human cervical cancer cells. *BMC Complement Altern Med.* 2012;10(12):15–15. doi:10.1186/1472-6882-12-15.
33. Patewar SV, Patil DN, Dahikar SB. Antimicrobial potential of extract from leaves of Kalanchoe pinnata. *Int J Pharm Sci Res.* 2013;4(12):4577–80. doi:10.13040/IJPSR.0975-8232.4(12).4577-80.
34. Muzitano MF, Falcão C, Cruz EA, Bergonzi MC, Bilia AR, Vincieri FF. Oral metabolism and efficacy of Kalanchoe pinnata flavonoids in a murine model of cutaneous leishmaniasis. *Planta Med.* 2009;75(4):307–11. doi:10.1055/s-0028-1088382..
35. Supratman U, Fujita T, Akiyama K, Hayashi H. New insecticidal bufadienolide, bryophyllin C, from Kalanchoe pinnata. *Biosci Biotechnol Biochem.* 2000;64(6):1310–12. doi:10.1271/bbb.64.1310.
36. Biswas D, Mondal TK. Evaluation of anti-pyretic activity of hydroalcoholic extract of Kalanchoe pinnata leaves against yeast-induced pyrexia in rat. *Int J Innovat Pharm Sci Res.* 2015;3:483–92.
37. Salahdeen HM, Yemitan OK. Neuropharmacological effects of aqueous leaf extract of Bryophyllum pinnatum in mice. *Afr J Biomed Res.* 2006;9(2):1017. doi:10.4314/ajbr.v9i2.48782.
38. Rossbergmann B, Costa SS, Borges MB, Silva SAD, Noletto GR, Souza ML. Immunosuppressive effect of the aqueous extract of Kalanchoe pinnata in mice. *Phytothera Res.* 1994;8(7):399–402. doi:10.1002/ptr.2650080704.
39. Okwu DE. Evaluation of the chemical composition of indigenous spices of Southeastern Nigeria. *Glob J Pure Appl Sci.* 2001;7(3):4559. doi:10.4314/gjpas.v7i3.16293.
40. Ofokansi KC, Esimone CO, Anele CK. Evaluation of the in vitro combined antibacterial effect of the leaf extracts of Bryophyllum pinnatum (Fam: Crassulaceae) and Ocimum gratissimum (Fam: Labiatae). *Plant Prod Res J.* 2005;9:23–7. doi:10.4314/pprj.v9i1.35242.
41. Reppas GP. Bryophyllum pinnatum poisoning of cattle. *Aust Vet J.* 1995;72(11):425–7. doi:10.1111/j.1751-0813.1995.tb06194.x.
42. Hunt, Groff IL, Holbrook J. Principles and Chemical Practice; 1980. p. 456.
43. Akpantah AO, Obeten K, Edung ES, Eluwa AM. The effect of ethanolic extract of Bryophyllum pinnatum on the micro anatomy of the testes of adult males wister rats. *Eur J Biol Med Sci Res.* 2014;2014(2):37–44.

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Cite this article: Singh H, Singh AP, Singh AP. A review on kalanchoe pinnata (Crassulaceae). *Indian J Pharm Pharmacol* 2021;8(3):182-188.