

Preliminary and Pharmacological Profile of Kalanchoe Pinnata: An Overview

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ABSTRACT:

A significant plant with numerous traditional therapeutic properties is Kalanchoe pinnata. This literature review's primary goal was to provide background knowledge for K. pinnata drug discovery research. The pharmacological properties of this plant were discovered to include, neuropharmacological, anticonvulsant, anthelmintic, antimicrobial activity, antioxidant activity, analgesic, antidiabetic, wound healing, antinociceptive, hepatoprotective and immunosuppressive. Both cutaneous leishmaniasis and cadmium-induced nephrotoxicity were significantly protected from by quercetin's high oral effectiveness. The antibacterial action of K. pinnata may be attributed to two new novel flavonoids. K. pinnata had the potential to be used as chemotherapy preventatives. A key element of the K. pinnata extract that protects against a severe allergic response is the flavonoid quercitrin. The evidence-based information provided in this literature review of the pharmacognostic, phytoconstituent, and pharmacological activity of the plant K. pinnata may be useful to researchers conducting more sophisticated qualitative studies.

Key-words: Kalanchoe Pinnata, Phytoconstituents, Immunosuppressive, Anti-Urolithiatic, Antinociceptive.

INTRODUCTION:

The oldest form of medicine known to humanity is the use of medicinal herbs, and it has been practiced throughout history in all cultures. Since the beginning of time, people have understood how important nature is to a healthy lifestyle and have used a variety of plant resources as medicine to treat a wide range of illnesses. The development of traditional medical systems has greatly benefited from the transmission of this traditional medical knowledge from one generation to the next throughout the world (1,2). These plants are crucial to numerous types of research and the creation of the monograph, etc. formulations. Because different plant parts are used for different purposes, herbal medicines

are also referred to as botanical medicines or phytomedicines (3,4). The Vedas, the sacred texts of India, mention the use of plants for healing. India is the home of many of the spice plants still in use today, including nutmeg, pepper, and clove (5). The WHO predict that 80% of people in developing nations rely on traditional systems of medicine to treat diseases at their onset, in contrast to India's medical system, which contains about 2000 natural medicines, nearly all of which are derived from various traditional systems and folklore practices (6). Out of these medications made using the conventional method, 400 are made from minerals and animals, and the remaining 600 are made from plants. Indian traditional medicine has a rich history, and traditional healthcare systems are thriving throughout the world (5)

A succulent plant that is indigenous to Madagascar is called *Kalanchoe pinnata* (Family: Crassulaceae) (7). It is a perennial plant that grows abundantly throughout tropical Asia, India, China, and Australia, where it is also utilized in traditional medicine. The plant grows well all throughout southern Nigeria. There are 200 other *Kalanchoe* species found in Africa, Madagascar, China, and Java, but only one is found in South America (8).

It is a lovely herb that may be cultivated in gardens and houses. It is also succulent and glabrous. It has four obtusely angled stems that are between 0.2 and 1.2 meters tall. The lower leaves are normally simple or irregularly complex, whereas the higher leaves often contain three to seven leaves. Follicular has a long petiole. Leaflets that are elliptic or ovate, crenate or serrate. 2.5-3.8 cm Calyx Triangular teeth, inflated and octagonal at the base, constricted in the center, reddish purple, triangular lobes, long, striped in red and green at the base and pale green above; The persistent, papery calyx and corolla envelop the fruit. Filaments feature black anthers and are green at the base before becoming pinkish below. Small, smooth, oblong-ellipsoid seeds that are hardly striate (9-13).

Alkaloids, phenolics, tannins, microelements (iron, zinc), microelements (calcium, potassium, phosphorus), macro elements (magnesium, calcium), and vitamins are all present in the plant (ascorbic acid, riboflavin, thiamine, niacin) (14). Astragaloside, rutin, kaempferol, and quercetin are present in the leaves (8). Fresh plant leaves also contain three additional substances: bryophyllol, bryophollone, and bryophollenone. Bryophynol and two other new compounds, phenanthrene, are also present (15). Two insecticidal bufadienolides, bryophyllin A and bryophyllin C, were found in a methanolic extract of leaves (16). Among the amino acids included in leaves are thiamine, pyridoxine, ascorbic acid, glycine, cysteine, casein, and nicotinamide. There are also food components like carbohydrates, protein, and lipids as well as minerals like sodium, iron, copper, magnesium, phosphorus, potassium, calcium, Sugars like raffinose, lactose, sucrose, and glucose and zinc (16).

African Never Die, Resurrection Plant, Life Plant, Air Plant, and other such names are some of its common names (17). Traditional medicines have employed *Kalanchoe* species to treat conditions like infections, rheumatism, and inflammation as well as their immunosuppressive

effects (18–20). The leaves are applied externally to treat skin fungus. The leaf infusions can treat fever internally, treat pneumonia, other respiratory tract infections like asthma, and acute and chronic bronchitis. The plant is regarded as a cough suppressant, sedative, wound healer, and diuretic. Additionally, the plant is used to treat kidney stones, gastric ulcers, and leg edema (21). K. the plant in the ayurvedic medical system, pinnata is also frequently used as an astringent, analgesic, carminative, and as a treatment for nausea and vomiting as mentioned in **Figure 1** (22). In African traditional medicine, it is used as a treatment for otitis, headaches, inflammations, convulsions, and general weakness (24). The plant's leaves have been utilized in traditional medicine for their potent antifungal, antihistamine, and anti-allergic properties. (23).

The current review of *Kalanchoe pinnata* is based on the following elements pharmacognostic inquiry, phytochemical ingredients, and pharmacological action.

PLANT PROFILE:

Description of the plant is given **Table 1**.

Table 1: Plant profile (24–26)

Botanical Name	Bryophyllum pinnatum
Sanskrit Name	Pashanabheda
Hindi Name	Patharchur
Bengal Name	koppata
Telgu	simajamudu
Malayalam	Elamurunga
Common Names	Hoja Del Aire, Parvu, Herbe Mal Tete Never Dead, Mother of Thousands, Oliwa Ka Kahaka, Goethe Plant, Miracle Leaf, Life Plant, Air Plant, Cathedral Bells
Synonym	Bryophyllum pinnatum, Bryophyllum calycinum, C. calyculata

TAXONOMY:

Taxonomy of the medical plant is shown below in **Table 2**.

Table 2 : Taxonomy of *Kalanchoe pinnata* (11,27)

Kingdom	Plantae
Subkingdom	Tracheobionta
Division	Magnoliophyta
Class	Magnoliopsida

Subclass	Rosidae
Order	Saxifragales
Family	Crassulaceae
Genus	Kalanchoe
Species	Kalanchoe pinnata

ETHNOPHARMACOLOGY:

Kalanchoe pinnata is a well-known Ayurvedic ethnomedicinal herb. Its application in traditional Indian folk medicine is also well documented. Table 4 shows how different sections of Kalanchoe pinnata are used in traditional medicine.

Table 4 : Traditional medicine employs several Kalanchoe pinnata parts. (28)

Plant Part	Medicinal use
Leaves	Bruises, swellings, Tonic, Boils, sores, Scabies, leukoderma, Hypertension, Constipation, fever, pneumonia, dermatitis, UTI and kidney problems, Rheumatoid arthritis, Headache, pain, migraine, Antidiabetic.
Roots	Hypertension, Stomach ulcer, Skin diseases, wounds, scabies, Sexual transmitted infections, Cholera, diarrhoea, and dysentery, ulcer, UTI, Kidney stone, warts
Seed	Stye Disease ,Eye pain, Eye disorder

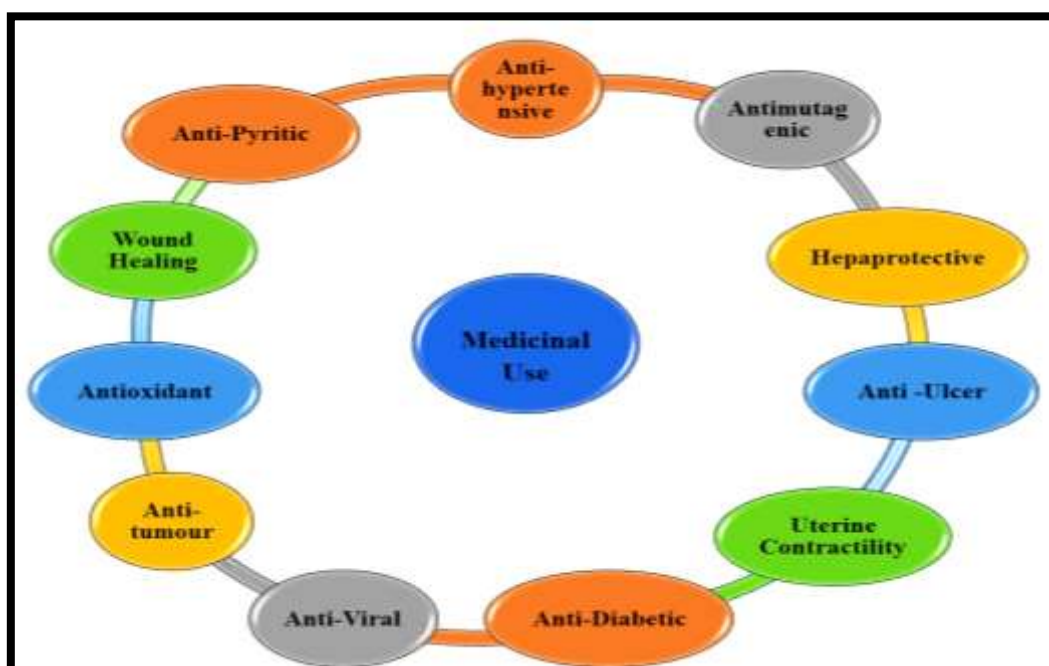


Figure 1: Medicinal Use of K.pinnata.

MORPHOLOGY:

The succulent, thick, and hairless *Kalanchoe pinnata* stem bears beautiful, succulent leaves that can be simple or complex, such as pinnate or trifoliate leaves (30). These leaves typically have opposing arrangements and have a varied number of leaflets that range in size from 2 to 12.5 cm in diameter and 5 to 25 cm in length. They have a glabrous hairless structure and are green to yellowish green in colour. They are borne on a 2 to 10 cm long stem(29).

Furthermore, if genuine leaves detach from the stem, small plantlets may occasionally sprout in the scalloped edges of leaflets. At the top of the terminal inflorescence, there are tubular, bell-shaped pendulous, drooping, and approximately 7 cm long flowers arranged in branching clusters. Every bloom has inflated, prominent, yellowish green to light green sepals that are partially fused to the tube and are usually striped with red or pinkish color patches. The stalks on which the blooms are carried have an average length of 10 to 25 mm. Petal lengths of 3 to 6 cm, varying from yellowish green to dark reddish, are usually joined to a tube that splits into four corolla lobes towards the tip(30).



PHYTOCHEMICAL CONSTITUENTS:

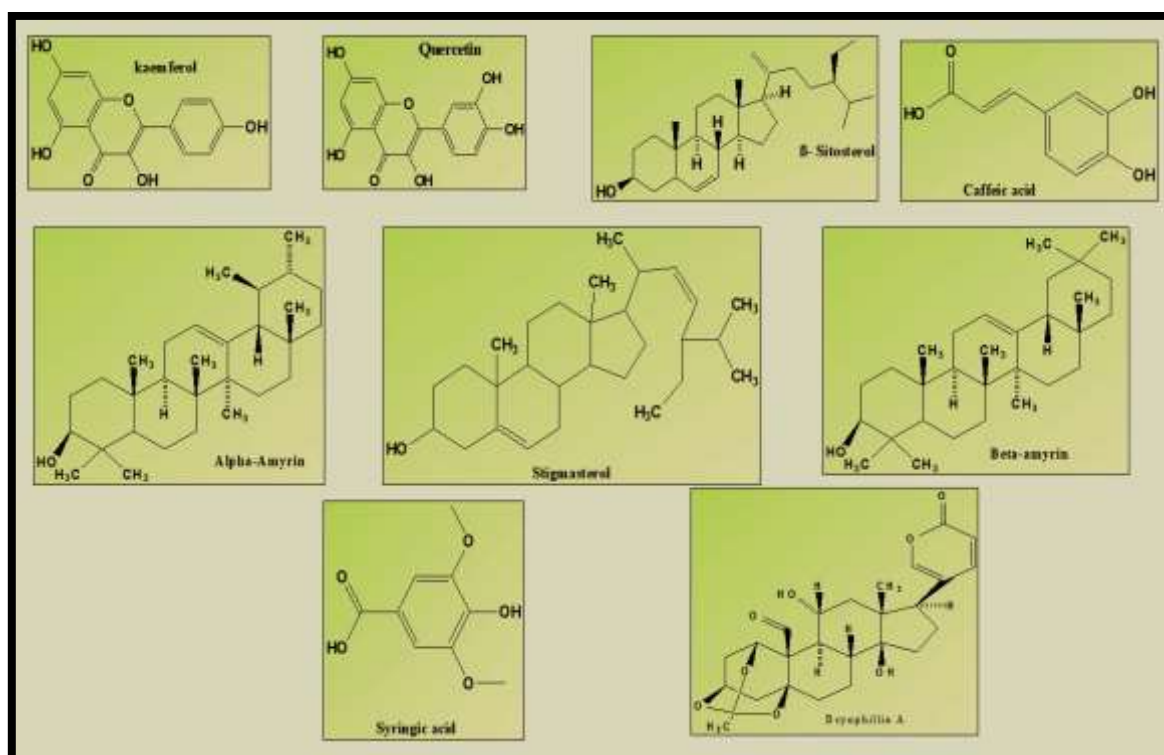
The herb *Kalanchoe pinnata* is an aromatic plant with a sweet and sour fragrance. Based on their flavor, several different *Kalanchoe pinnata* species have been identified. The plant has a height range of 1 to 1.5 meters. Sweet *Kalanchoe Pinnata* is a green plant with a sour flavour. Lipids, alkaloids, bufadienolides, steroids, glycosides, cardenolides, and flavonoids are abundant in this plant. Its leaves are high in "bufadienolides," which include bryotoxin-C, bryotoxin-B, bryotoxin-A, and have powerful chemo-preventive, anti-tumour, anti-bacterial, and insecticidal properties (31). The leaves and bark of this plant have a bitter taste and are anti-emetic as well as diarrhoea because they are carminative, analgesic, and astringent to the bowels (32).

From plant aerial parts, it has been possible to isolate syringic acid, caffeic acid, 4-hydroxy-3-methoxycinnamic acid, 4-hydroxybenzoic acid, p-hydroxycinnamic acid, p-coumaric acid, ferulic acid, protocatechuic acid. Astragalgin, 3,8-dimethoxy-4,5,7-trihydroxyflavone, friedelin, epigallocatechin-3-osyrygiate, rutin, kaempferol, quercetin, quercetin-3-L-rhamnosido-L-arabino gluconoside (33), quercetin-3-O-diabinoside, quercetin-3-O-diabino Plantare contains three unique flavonoids. Kaempferol 3-O- α -L-arabinopyranosyl Quercetin-3-O- α -L-arabinopyranosyl .

Three novel components, bryophyllol, bryophollone, and bryophollone, have been identified from fresh leaves of *Bryophyllum pinnatum*. The mixture also contained three novel chemicals, Bryophynol and two phenanthrene derivatives.

Two insecticidal bufadienolides obtained from *Kalanchoe pinnata* leaves were identified as bryophyllin A and bryophyllin C 18 1-octane-3-O—L-arabinopyranosyl-(16)-glucopyranoside, a minor component isolated from leaves (14,34,35).

Phytoconstituents are mentioned in Figure 1 .



PHARMACOLOGICAL ACTIVITY OF KALANCHOE PINNATA:

Anthelmintic Activity

The effectiveness of the *K. pinnata* roots' anthelmintic properties against two helminth species were assessed in vitro after they had been extracted with chloroform, petroleum ether, aqueous, and methanol solvent. According to the findings, petroleum ether has little helminth

activity whereas, methanolic, chloroform and aqueous extracts show strong anthelmintic activity. The *K. pinnata* root methanolic extract was shown to be the most effective anthelmintic when compared to other anthelmintics. In comparison to the reference medication Piperazine citrate, the roots extract of *K. pinnata* caused more worm fatalities, especially at concentrations of 100 mg/ml. It also confirmed paralysis. The crude extracts' phytochemical examination revealed the presence of tannins, which are known to cause anthelmintic action(22). Further research is necessary for future aspects, although another study was done to analyse the anthelmintic activity of *K. pinnata*. It was found that these plants had some form of anthelmintic activity (36,37).

Wound Healing Property

An excision wound model was used to test the wound-healing capacity of an ethanolic extract of *K. pinnata* leaves in rats. Compared to the mupirocin-treated standard (85.49%) and the petroleum jelly-treated control (69.36%), animals treated with the ethanolic leaf extract exhibited a wound area decrease of 86.33% on day 11. The standard group had a greater hydroxyproline content (35mg/g tissue), but the extract-treated animals had a considerably higher hydroxyproline concentration (22mg/g tissue) than the control group (19mg/g tissue). The presence of steroid glycosides in the extract may be responsible for its ability to heal wounds (7).

Another study looked at how *Kalanchoe pinnata* leaf extract, especially petroleum ether, water extract and alcoholic extract affected albino rat wound healing in terms of excision, incision, and dead space wound healing. All three extracts greatly boosted the incision wound's breaking strength. In comparison to control groups, cotton pellet dry weight and the hydroxyprolin content of granulation tissue on the 17th post-wounding day demonstrated a substantial increase in wound contraction and scar formation. The results reveal that although Water extract sped up the healing of open wounds, all of the provided extracts systematically sped up the healing of incision wounds(38).

Another study's objective was to create and evaluate two creams that included the primary flavonoid (0.15%) and leaf aqueous extract of *K. pinnata*. In a rat excision model, both creams were evaluated topically for 15 days. The healing rates in the KP leaf-extract and KP major flavonoid treatment groups were 95.3 1.2% and 97.5 0.8%, respectively, on day 12. Both produced denser collagen fibers and better re-epithelialization. It has been demonstrated that KP main flavonoid cream, at a concentration 40 times lower, is just as effective as KP leaf-extract cream. These findings offer compelling evidence that the primary flavonoid in KP, KP major, is responsible for the extract's ability to promote wound healing. [51].

A study was conducted taking undiluted *K. pinnata* extract (1 mg/ml) treating on control animal group. The animals were inspected daily, and wound healing stages were recorded. The wound recovery percent-age was planimetrically analysed on the third, tenth, and fourteenth days after the start of cure. Following this, one echelon (10 animals from each

subgroup) was removed from the experiment. The animals were slaughtered after receiving an ether anaesthetic overdose. It shows promising result that undiluted *K. pinnata* extract can have wound healing activity (39,40).

Immunosuppressive Activity

An aqueous extract of the leaves of *K. pinnata* was shown to considerably reduce both humoral and cell-mediated immune responses in mice. Rats pre-treated with *K. pinnata* had spleen cells that were less capable of proliferating in response to mitogens and antigens in culture. Additionally, mice treated with *K. pinnata* were less able to respond to ovalbumin with a delayed-type hypersensitivity reaction. The DTH response was almost eliminated using the intravenous and topical administration methods. The reactivity was reduced by 73 and 47% of controls, respectively, using the intraperitoneal and oral approaches. Additionally, treatment significantly reduced ovalbumin-specific antibody responses. These results imply that *K. pinnata*'s aqueous extract has immunosuppressive properties. (41).

Various studies have found that flavonoid chemicals found in the ethyl acetate fraction of an aqueous extract of *K. pinnata* Pers leaves (EF-KP) have many beneficial effects for lupus treatment, particularly immunosuppressive effects (42).

Haematological Parameters

A crude methanolic leaf extract of plant was examined in wistar rats for specific haematological markers. All treatment groups considerably outperformed the control group in terms of blood components. All treated groups saw a decrease in platelet count relative to the control group, but only group A experienced a substantial decrease. Both the treatment and control groups exhibited normocytic and normochromic red blood cells, according to the blood film test. The pattern of results suggests that certain of the phytochemical elements of *B. pinnatum*'s crude methanolic leaf extract may have a stimulatory effect on bone marrow for leucocyte generation and haemoglobin synthesis. This impact could be due to the tannin, ascorbic acid, and phenol levels. Flavonoid, zinc, riboflavin, and niacin are other phytochemical elements of *B. pinnatum* that may have altered the haematological parameters in this study (18).

Antihypertensive Activity

In this study, the effects of an aqueous leaf extract of *K. pinnata* were investigated in connection to the blood pressure of anesthetized cats and the liver and kidney health of the rabbit. According to the findings, the extract both slightly decrease the anesthetized cat's blood pressure and lessened the effect of an increase in blood pressure brought on by adrenaline. This study revealed the pharmacological foundation for *K. pinnata*'s use in lowering blood pressure in Nigerian Igbos. However, the *K. pinnata* leaf extract's usage as anti-hypertension agent is disregarded due to the little blood pressure reduction and probable organ toxicity(43).

Kalanchoe pinnata, commonly known as Bryophyllum pinnatum, has a variety of therapeutic characteristics, including, to our knowledge, cardiovascular properties. In this investigation, the blood pressure of anesthetized cats and the liver and kidney health of the rabbit were examined in relation to the effects of an aqueous leaf extract of *K. pinnata*. According to the findings, the extract both slightly lowered the anesthetized cat's blood pressure and lessened the effect of an increase in blood pressure brought on by adrenaline. This study revealed the pharmacological foundation for *K. pinnata*'s use in lowering blood pressure in Nigerian Igbos. However, the *K. pinnata* leaf extract's usage as a blood pressure lowering agent is disregarded due to the little blood pressure reduction and probable organ toxicity (44).

Neuropharmacological Activity

The activity of *K. pinnata* aqueous leaf extracts were analysed in mice. In a dose-dependent way, the extract was found to dramatically inhibit exploratory activity. It also had a considerable sedative effect, as seen by decreased gross behavior and an increase in pentobarbitone-induced sleeping duration. It postponed the onset of seizures brought on by picrotoxin and strychnine, with the protective effect being significantly larger in the case of picrotoxin-induced seizures than in the case of strychnine-induced seizures. With an LD₅₀ of 641 mg/kg, it also lowers picrotoxin-induced mortality in mice. The aggregate of these effects suggested that the extract had a central nervous system depressing impact(45).

The neuropharmacological effects of *B. pinnatum* ethanolic leaf extract on mice. The ethanolic extract of *B. pinnatum* leaves reduced spontaneous locomotor activity and potentiated pentobarbitone-induced sleeping time in a dose-dependent manner. According to the findings, the augmentation, barbital hypnosis is a good indicator of CNS depressing action. The findings of the head dip, climbing, and avoidance tests showed that ethanol extract reduced exploratory behaviour significantly. The extract also caused a considerable reduction in exploratory activity, as seen by the results of head-dip, climbing, and evasion tests. The presence of glycosides and flavonoids in ethanolic extract may explain its CNS depressing activity. One of the principal phytoconstituents extracted from the leaves of *B. pinnatum* is bufadienolide, a cardiac glycoside with CNS depressive properties (24). Another study compared the anti-convulsant activity of methanolic extract from *Kalanchoe pinnata* (Lam.) stems and roots to diazepam anti-convulsant activity in mice and found good findings (46).

Anti-Inflammatory Activity

In a chemically-induced inflammatory rodent model, several extracts/fractions of *Bryophyllum pinnatum* leaves were studied. Indomethacin inhibited edema more or less uniformly in the early, moderate, and late stages. Methanolic fraction inhibited formaldehyde-induced edema more or less significantly in the early stages, but not in the later stages. Methanol fraction was more significant than the other fractions in percentage

prevention of paw edema than Pet-ether, Chloroform, Acetone, and Methanol fractions from *B. pinnatum* leaves (47).

To investigate their effects on formaldehyde-induced oedema, *kalanchoe pinnata* leaf extracts were created in methanol, acetone, chloroform, and petroleum ether. When compared to the other extracts, methanolic extract had the most pronounced effects in preventing paw oedema. In addition, levels of bradykinin, prostaglandins, serotonin, and histamine were assessed in inflammations brought on by formaldehyde in wounded cells with the capacity to produce endogenous mediators. These findings led to the conclusion that the reduction of the formalin-induced oedema in rats was mostly due to the presence of bufadienolides and other water-soluble extract ingredients(48).

Antimicrobial Activity

The Brine shrimp lethality experiment was used to assess the cytotoxicity of an ethanolic extract of *K. pinnata* leaves and stem. The brine shrimp nauplii were killed by the ethanolic extract. It showed a variable mortality rate at various doses. For the antimicrobial test, the disc diffusion technique was applied. The antibacterial activity of the extract was evaluated against eight bacterial strains at a dosage of 0.5gm/disc and compared to that of the conventional treatment, Amoxycillin. In this study, an ethanolic extract of *Kalanchoe pinnata* Linn. was employed. Except for *B. Megaterium*, *S. typhi*, and *Vibrio cholerae*, all of the bacteria tested exhibited substantial sensitivity to the five test species. The zone of inhibition varies between 6.355 and 8.2 ± 0.22 mm. The zone of inhibition against *E. coli* was the greatest (8.2 ± 0.22 mm) (49).

Many publications have been published in which a wide range of bioactive chemicals found in *K. pinnata* that display antimicrobial activity against a variety of pathogens and their mechanisms of action are explored. According to reports, the plant not only has antibacterial action but also antifungal and antiviral activity. Flavonoids, alkaloids, and phenolic chemicals are bioactive molecules that suppress bacterial growth (50). *K. pinnata*'s antibacterial activity was studied, and it was observed that the methanolic extract inhibited bacteria more efficiently. The extracted chemical may be capable of combating bacteria causing diseases and saving the lives of individuals affected(51).

Hepatoprotective Activity

In traditional medicines from many parts of India, the juice of freshly cut leaves of the *K. pinnata* plant is used to treat jaundice. Rats were tested for CCl₄-induced hepatotoxicity using the juice from the leaves and the leftover ethanolic extract of the marc. Histopathology, in vitro, and in vivo tests all supported the test substance's hepatoprotective properties. It was determined that the juice was more efficient than the ethanolic extract(52).

Anti-Ulcer Activity

In nine separate experimental animal models, a methanolic fraction of a Bryophyllum pinnatum leaf extract was found to have strong anti-ulcer activity. In pre-medication tests on rats, the extract demonstrated a potent protective effect against stomach lesions brought on by aspirin, indomethacin, serotonin, reserpine, stress, and ethanol. Both histamine- and aspirin-induced duodenal ulcers in guinea pigs and pylorus-ligated rats were significantly prevented by extract administration. In rats with acetic acid-induced chronic stomach ulcers, there was also a significant improvement in the healing process (53).

One research found that it dramatically decreased the incidence of ulceration and mean basal and histamine-induced stomach acid production in a dose-dependent way, suggesting that it can be used as an anti-ulcer medication in conventional medicine(54).

Traditional medicine use Kalanchoe pinnata to cure gastric ulcers and inflammatory conditions. A study was carried out to identify the phytochemical as well as assess the gastroprotective activity of the plant's leaf juices in acute gastric lesions models. In the ethanol induction paradigm, plant juice at doses of 250 mg/kg and 500 mg/kg effectively decreases the lesions. In indomethacin induction model, and k.pinnata demonstrated substantial results at 250 and 500 mg/kg dosages (55).

Gastric ulcer is a common ailment that, if not treated effectively, can result in complications such as haemorrhages and perforations. A study was conducted to investigate B. pinnatum's ulcer healing activities against an acetic acid-induced chronic ulcer model, as well as Bp1's gastroprotective activity against ethanol and indomethacin-induced stomach lesions. Treatment with the extract at 250 and 500 mg/kg speed up healing process in the gastrointestinal mucosa, resulting in a significant reduction in the ulceration index and an improvement in the antioxidant defence system (56).

Diuretic and Anti-Urolithiatic Activity

The author examined K. pinnata's diuretic and anti-urolithiatic properties. Male Wistar rats received an intraperitoneal injection and oral administration of a hydroalcoholic extract of K. pinnata leaves. By contrasting the urine output acquired by maintaining the several animals in metabolic cages, the effect of the extract on urine production was ascertained. Ethylene glycol was given orally to rats for seven days to induce calcium oxalate urolithiasis; the impact of the extract was then tested by giving it at the same time. Both diuretic and anti-urolithiatic effects of the extract were found, with intraperitoneal administration having a stronger diuretic impact(57).

Diuretics enhance the amount of water and ion excretion in urine to maintain fluid balance and composition in a range of clinical situations. One study found that K. pinnata ethyl acetate fractions significantly increased urine volume by acting as a strong kaliuretic and natriuretic. The total amount of urine produced by K. pinnata (100 mg/kg) and the standard

medication was statistically significant when compared to the control. By increasing the levels of Na⁺ and Cl⁻ in urine, *K. pinnata* generated a rapid and considerable diuresis. Male Wistar rats were given hydroalcoholic extracts of *K. pinnata* leaves orally and intraperitoneally at doses of 100, 300, 500, and 800 mg/kg. Comparing the amount of pee that various rats kept in metabolic cages collected allowed researchers to estimate the impact on urine output. The antiurolithiatic effect was identified by comparing urine electrolyte levels, biochemical markers, and kidney histology in control and standard drug-treated mice. It was discovered that a plant extract has strong diuretic and antiurolithitic action.. (58).

Another study discovered that *Kalanchoe pinnata* has a high concentration of phytochemicals like flavonoids, quercitrin, carotenoids, saponin, kamferol, and alkaloids, as well as a significant ability to dissolve, which is the most common element in the formation of stones in the urinary tract. These flavonoids prevent CaOx crystals and calcium oxalate deposits from forming in renal tubules. The plant extract *Kalanchoe Pinnata* also reduces the size of calcium oxalate stones and possesses urolithiasis therapy and preventative characteristics. (59–61).

Anti-Tumour Activity

Using column chromatography and a step- gradient of petroleum ether and ethyl acetate, a chloroform extract was extracted from a bulk of botanically well-characterized crushed *B. pinnata* leaves. TLC, HPTLC, and NMR were used to describe fractions for Phyto-chemical substances. Electrophoretic Mobility Shift Assay, MTT-based cell viability assay and immunoblotting were used to assess the biological activity of the fractions in human cervical cancer cells. The IC₅₀ of the crude leaf extracts was 552 g/ml, which resolved to a fraction with an IC₅₀ of 91 g/ml (62).

Antinociceptive, Anti-Inflammatory and Antidiabetic Activity

Research was conducted to explore the anti-inflammatory, antinociceptive, antidiabetic properties of the plant's leaf aqueous extract in experimental animal models in order to better understand some of the ethnomedical uses of *K. pinnata* leaves. Aqueous leaf extract from *K. pinnata* showed notable antinociceptive effects in mice when exposed to chemically and thermally generated nociceptive pain stimuli. Furthermore, the extract effectively decreased the acute inflammation generated by raw egg albumin in rats and caused severe hypoglycemia. The findings of this animal study indicate that the aqueous extract of *K. pinnata* leaves has antinociceptive, anti-inflammatory, and hypoglycemic activities. (63).

In a different investigation, alloxan-induced diabetic Swiss albino mice were used to examine the anti-diabetic effectiveness of *Bryophyllum pinnatum* leaf extracts. Different extracts of *K. pinnata* were analysed to the activity of anti-diabetic medication glibenclamide. In diabetic mice, hypoglycaemic activity, blood glucose measurement using the glucose oxidase technique, and total cholesterol were all measured. The dosage was determined using data

from an OECD-recommended acute oral toxicity study. On the 14th day of the study, the blood glucose levels of the *K. pinnata* ethyl acetate extract (500 mg) and aqueous extract (500 mg) were 114 and 121 mg/dL, respectively. On the 14th day of the investigation, blood glucose levels of these extracts were 355 mg/dL and 98.67 mg/dL in contrast to diabetes control in an alloxan-induced mouse. Blood glucose levels of 500 mg of *K. pinnata* ethyl acetate extract showed 321 mg/dL on the first day and ultimately fell to 117 mg/dl. On the first, seventh, and fourteenth days, alloxan-treated animals had maximal blood serum glucose levels of 333, 346, and 367, respectively. Extracts of *K. pinnata* were found to be a potential anti-diabetic medication in all of these trials (64).

A study used rodent models, phytochemical screening, alpha amylase inhibition, and hydroalcoholic extracts of *K. pinnata* leaves to show that they had anti-diabetic activities. *K. pinnata* leaves were used to make crude extracts by infusing them with ethanol and decocting them with water. Rats were given extracts orally at doses of 250, 500, and 750 mg/Kg to test the hypoglycaemic action, and blood sugar levels were measured every four hours using a glucometer. After one hour, rats given 500 mg/Kg of LAED extract gives a decrease in blood glucose levels. Blood sugar levels were statistically significantly lower at 90-, 180-, and 240-minutes following treatment with 750 mg/Kg LAEI, demonstrating that the extract's ability to decrease blood sugar was stronger at higher concentrations (65).

Cytotoxicity

Although most investigations have demonstrated that the plant exhibits minimal toxicity and good safety, acute toxicity of *K. pinnata* was examined. Cytotoxicity has been documented in some research. Addition to this, abnormalities in the animals were showed in a study. Therefore, it appears reasonable to conclude that this plant are safe to use topically, but further research is required to fully understand their sub-chronic and chronic toxicity (66,67).

MARKETED FORMULATION:

Amantol – cream

Diseases of the upper respiratory tract, sinusitis, bronchitis, allergic responses, and illnesses involving nasal obstructions. Ingredients: Ginger extract, yantria, escanel, and mint extract. Water, cream base, ajo de monte, menthol extract, and kalanchoe pinnata extract. only for use externally.

Parnabija svarasa

Anti-obesity Formulation (68).

CONCLUSION:

The plants are widely known and have been long thought to still be therapeutic agents. The traditional and ethnobotanical applications of natural substances, particularly those with plant

origins, have recently drawn a lot more attention because they have undergone extensive efficacy testing and are widely regarded as safe for use by humans. The pharmacological potentials of *K. pinnata* are highlighted in this paper, which will help researchers learn more about this priceless plant.

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Conflict of Interest

None

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