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A Review On Pharmacognostical, Phytochemical and Pharmacological Potentials of *Kalanchoe pinnata (Crassulaceae)*

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ABSTRACT

Kalanchoe pinnata (Family: *Crassulaceae*) is an important plant which has many traditional medicinal uses. The main objective of this literature review was to give advance information for the drug discovery research for *K. pinnata*. It was found that this plant showed various pharmacological activities such as anthelmentic, immunosuppressive, wound healing, hepatoprotective, antinociceptive, anti-inflammatory, antidiabetic, nephroprotective, antioxidant activity, antimicrobial activity, analgesic, anticonvulsant, neuropharmacological and antipyretic. Anthelmentic activity was found due to the presence of tannins of the extract of *K. pinnata* and steroid glycosides such as bufadienolide showed wound healing activity. It was also found that the different flavonoids, polyphenols, triterpenoids and other chemical constituents of the plant were responsible for the antinociceptive, antiinflammatory and antidiabetic properties. Quercetin had a marked protective effect on cadmiuminduced nephrotoxicity and possessed potent oral efficacy against cutaneous leishmaniasis. The two new novel flavonoids such as 5Methyl 4, 5, 7 trihydroxyl flavone and 4, 3, 5, 7 tetrahydroxy 5-methyl 5 Ipropenamine anthocyanidines could be responsible for the antimicrobial activity of *K. pinnata*. Five bufadienolides (1-5) isolated from the leaves of *K. pinnata* were potential cancer chemopreventive agents. Quercitrin, a flavonoid, is a critical component of *K. pinnata* extract against an extreme allergic reaction. This literature review gave the evidence based information regarding the pharmacognostical, phytoconstituents and pharmacological activity of the medicinal plant, *K. pinnata* which could help researchers for more advanced qualitative research.

Keywords: *Kalanchoe pinnata*, Pharmacognostical, Phytochemical, Pharmacological

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INTRODUCTION

Kalanchoe pinnata (Family: *Crassulaceae*) is a succulent plant native to Madagascar[1]. It is a perennial herb growing widely and used in folkloric medicine in tropical Africa, tropical America, India, China and Australia. The plant flourishes throughout the Southern part of Nigeria. This is the only *Kalanchoe* species found in South America, however, 200 other species are found in Africa, Madagascar, China and Java[2]. It is an erect, succulent, perennial shrub that grows about 1.5 m tall and reproduces through seeds and also vegetatively from leaf bubils. It has a tall hollow stems, freshly dark green leaves that are distinctively scalloped and trimmed in red and dark bell-like pendulous flowers. This plant can easily be propagated through stems or leaf cutting. It is an introduced ornamental plant that is now growing as a weed around plantation crop[3]. Its common names are "African never die", "Resurrection plant", "Life plant", "Air plant" etc.[4] In traditional medicine, *Kalanchoe* species have been used to treat ailments such as infections, rheumatism, and inflammation[1] and have immunosuppressive effect as well[5]. In South-eastern Nigeria, this herb is used to facilitate the dropping of the placenta of new born baby. The lightly roasted leaves are used externally for skin fungus. The leaf infusions are an internal remedy for fever. *K. pinnata* is also used to expel worms, cure acute and chronic bronchitis, pneumonia and others forms of respiratory tract infections such as asthma. The plant is considered a sedative wound-healer, diuretic and cough suppressant. The plant is also employed for the treatment of kidney stones, gastric ulcer and edema of legs[6]. The plant, *K. pinnata* is also widely used in ayurvedic system of medicine as astringent, analgesic, carminative and also useful in nausea and vomiting[7].It is employed in the African traditional medicine as remedies against otitis, headache, inflammations, convulsions and general debility[8]. In traditional medicine, the leaves of the plant have been used for antifungal[9] potent antihistamine and anti-allergic activity[10]. The present review of the *Kalanchoe pinnata* is based on: Pharmacognostical investigation, Phytochemical constituents and Pharmacological activity.

PHARMACOGNOSTICAL INVESTIGATION

Plant Profile: [11]

Kingdom: Plantae-Plants

Sub kingdom: *Viridaeplantae*-Green Plants

Intra kingdom: Stretophyta-Land plants

Division: Tracheophyta-Vascular plants,tracheophytes

Subdivision: Spermanophytina-sprmatophytes, seed plants, Pharonegames

Infra division: Angiospermae- flowering plants, angiosperms, plantas com flor, angiosperma, plantes à fleurs, angiospermes, plantes à fruits

Class: *Magnoliopsida*

Superorder: Saxifraganae

Order: Saxifragales

Family: *Crassulaceae*-stonecrops, orpins

Genus: *Kalanchoe*- Adans-widow's-thrill

Species: *Kalanchoe pinnata* (Lam.) Pers.-cathedral bells

Synonym: [12, 13] *Kalanchoe Pinnata, Cotyledon pinnata, Crassula pinnata.*

Hindi: *Jakh Me Hayat, Panfuti*

Sanskrit: Astibhaksha, Parnabeeja

English: *Air Plant, Miracle-Leaf*

Bengali: *Koppata*

Gujarati: *Ghaymaari*

Telgu: *Simahmudu*

Tamil: *Ranakalli*

Malayalam: Ilayinmeltai, Ilamulachi.

Plant figure:

Kalanchoe pinnata* (Family: *Crassulaceae)

Description [14]

It is an erect, more or less branched, smooth, succulent herb, 0.4 to 1.4 meters in height. Leaves are simple or pinnately compound, with the leaflets elliptic, usually about 10 centimeters long,

thick, succulent, and scalloped margins. Plantlets grow along the notches of the leaf margins which can develop while still attached to the plant or when detached, a fascinating characteristic that earns its name. Flowers are cylindric, and pendulous in a large, terminal panicle. Calyx is tubular, cylindric, inflated, brownish or purplish, 3.5 to 4 centimeters long. Corolla is tubular, about 5 centimeters long, inflated at the base, and then constricted, the exserted parts being reddish or purplish and the lobes tapering to a point. Fruit is a follicle with many seeds.

Distribution

- In open settled areas, thickets, dry second-growth forests, sometimes planted, and locally abundant.
- Prehistoric introduction from tropical Asia or Malaya.
- Also cultivated, flowering from December to March.
- Pantropic.

PHYTOCHEMICAL CONSTITUENTS

The plant contain alkaloids, flavonoids, phenolic compounds, tannins, macroelements (magnesium, calcium, potassium, phosphorus, sodium), microelements (iron, zinc), vitamins (ascorbic acid,riboflavine, thiamine, niacin),[15] Syringic acid, caffeic acid, 4-hydroxy-3-methoxycinnamic acid, 4-hydroxybenzoic acid, phydroxycinnamic acid, p-coumaric acid, ferulic acid, protocatechuic acid and phosphoenolpyruvate isolated from aerial parts of plants. Leaves contain astragalin, 3,8-dimethoxy4,5,7-trihydroxyflavone, friedelin, epigallocatechin-3-o-syrigate, luteolin, rutin, kaempferol, quercitin, quercitin-3L-rhamonsido-L-arabino furanoside, quercitin-3-O-diarbinoside and kaempferol-3-glucoside[16]. Three unusual flavonoids isolated from plantare Kaempherol 3-O-α-Larabinopyranosyl (1→2) α-L-rhamnopyranoside, Quercetin3-O-α-Larabinopyranosyl (1→2) α-L rhamnopyranoside, 4′,5-dihydroxy-3′,8-dimethoxyflavone 7-O-β-D-glucopyradinoside and quercetin from *Kalanchoe pinnata* .

From fresh leaves of *Bryophyllum pinnatum* three new constituents, bryophyllol, bryophollone and bryophollenone have been isolated .Three new compounds, bryophynol and two phenanthrene derivatives have also been identified in the mixture. 18α-Oleanane, ψ-taraxasterol, β-arnyrin acetate and a new sterol, reported earlier as a hydrolysed product, have also been obtained, along with a mixture of α- and β-amyrins and their acetates[17].Two insecticidal bufadienolides were isolated from methanolic extract of leaves of *Kalanchoe pinnata* and identified as bryophyllin A and bryophyllin C [18] 1-octane3-O-α-L-arabinopyranosyl-(1→6)-glucopyranoside, a minor constituent isolated from leaves[19]. The cardienolide and steroidal

contents includes β-sitosterol, bryophyllol, bryophynol, bryotoxin A, bryotoxin B, campesterol, 24-ethyl-25-hydroxycholesterol, isofucosterol, clionasterol, codisterol, peposterol, 22-dihydrobrassicasterol, clerosterol, 24-epiclerosterol, 24-ethyl-desmosterol, stigmasterol are isolated from aerial parts[20].Leaf contains amino acids i.e. thiamine, pyridoxine, ascorbic acid, glycine, cysteine, casein hydrolylsate, nicotinamide, Food content i.e. carbohydrate, protein, lipids, Minerals; sodium, calcium, potassium, phosphorus, magnesium, ferrous, copper, zinc, and sugars; raffinose, lactose, sucrose, glucose (Alabiet.al.,2005). The plant content various enzymes i.e. Phosphoenolpyruate carboxykinase (PCK), Phosphoenolpyruate carboxylase (PEPC), Pyruate orthophosphate dikinase (PPDK), ribulose-1,5-iphosphate carboxylase/oxygenase (Rubisco) etc enzymes presents in leaf of plant *Kalanchoe pinnata* Phosphoglycerate kinase,[21] Carbonic anhydrase, Fructosebiphosphate aldolase, DNA topoisomerase, protein in which most of having role in metabolism[22].

PHARMACOLOGICAL ACTIVITY

Anthelmentic Activity

The roots of *K. pinnata* were subjected to petroleum ether, chloroform, methanol and aqueous solvent respectively for extraction and the in-vitro evaluation of anthelmentic activity was done against *Pheretima posthuma* (*Annelida*) and *Ascardia galli* (*nematode*). The results reveal that chloroform, methanolic and aqueous extract of *K. pinnata* have significant anthelmentic activity while petroleum ether does not show any activity against helminth. Methanolic extract of root of *K. pinnata* was found to be most effective as an anthelmentic as compared to other. The roots extract of *K. pinnata* not only demonstrated paralysis but also caused deaths of worms especially at higher concentrations of 100 mg/ml, in shorter time as compared to the reference drug, Piperazine citrate. Phytochemical analysis of the crude extracts revealed the presence of tannins which were shown to produce anthelmentic activity[24].

Wound Healing Activity

The Ethanolic extract of *K.pinnata* leaves was evaluated for its wound healing activity by using excision wound model in rats. On day11, animals treated with the ethanolic leaf extract exhibited 86.33% reduction in the wound area, compared to petroleum jelly treated control (69.36 %) and mupirocin treated standard (85.49 %). There was significant increase in hydroxyproline content in extract treated animals (22mg/g tissue) as compared to control group (19mg/g tissue) and the standard group was having more hydroxyproline content (35mg/g tissue). Histological analysis also showed that *K. pinnata* leaf extract exhibits significant wound healing potential. The wound healing activity exhibited by the extract may be due to the presence of steroid glycosides[1]

Immunosuppressive Effect

The aqueous extract of *K. pinnata* leaves was found to cause significant inhibition of cell-mediated and humoral immune responses in mice. The spleen cells of animals pre-treated with *K. pinnata* showed a decreased ability to proliferate in response to both mitogen and to antigen in vitro. Treatment with *K. pinnata* also impaired the ability of mice to mount a delayed-type hypersensitivity reaction (DTH) to ovalbumin. The intravenous and topical routes of administration were the most effective by almost completely abolishing the DTH reaction. The intraperitoneal and oral routes reduced the reaction by 73 and 47% of controls, respectively. The specific antibody responses to ovalbumin were also significantly reduced by treatment. Together, these observations indicate that the aqueous extract of *K. pinnata* possesses an immunosuppressive activity[25].

Haematological Parameters

The crude methanolic leaf extract of *B. pinnatum* was evaluated for some haematological parameters in wistar rats. The results showed significantly increased Haemoglobin (Hb), Packed cell volume (PCV), Total white blood cell count (TWBC) in all the treated groups when compared with the control group. The platelet count was decreased in all the treated groups but was significant only in group A when compared with the control group. The blood film examination revealed normocytic and normochromic red blood cells in both the treated and control groups. The result pattern indicates that some of the phytochemical constituents of the crude methanolic leaf extract of *B. pinnatum* may have stimulatory effect on the bone marrow for leucocyte production and haemoglobin synthesis. This observed effect may be as a result of the tannin, ascorbic acid and phenol content. Other phytochemical constituents of *B. pinnatum* which may have likely affected the haematological parameters in this study include flavonoid, zinc, riboflavin and niacin[26].

Antihypertensive Activity

The effects of aqueous leaf extract of K. pinnata on the blood pressure of anaesthetized cats as well as on the liver and kidney status of the rabbit were investigated in this study. The results revealed that the extract produced a small fall in the blood pressure of the anaesthetized cat and also reduced the effect of adrenaline-induced elevation of blood pressure. It was concluded that the pharmacological basis for the use of *K. pinnata* among the Igbos of Nigeria to lower blood pressure was established by this study. However, the facts that the reduction in blood pressure produced is slight and the *K. pinnata* leaf extract is potentially organotoxic which negates its use as a blood pressure lowering agent[27]

Neuropharmacological Activity

Effects of aqueous leaf extracts of *K. pinnata* on some neuropharmacological activities were studied in mice. The extract was found to produce a profound decrease in exploratory activity in a dose-dependent manner. It also showed a marked sedative effect as evidenced by a significant reduction in gross behavior and potentiation of pentobarbitone-induced sleeping time. It delayed onset in strychnine-and picrotoxin-induced convulsion (seizures) respectively with the protective effect being significantly higher in picrotoxin than strychnine induced convulsion. It also decreases the rate of picrotoxin induced mortality in mice with LD50 of 641 mg/kg. The totality of these effects showed that the extract possesses depressant action on the central nervous system[28].

Neuropharmacological effects of ethanolic leaf extract of *B. pinnatumin* mice. The ethanolic extract of *B. pinnatum* leaves produced significant reduction in spontaneous locomotor activity, potentiation of pentobarbitone induced sleeping time in dose dependent manner. Results reported that the enhancement of barbital hypnosis is a good index of CNS depressant activity. Ethanolic extract produced significant decrease in exploratory behaviour as evident from the results of head dip, climbing and evasion test. The extract also produced significant decrease in exploratory behavior pattern as evident from the results of head-dip, climbing and evasion tests. Furthermore the ethanolic extract produced minor anticonvulsant effect by delaying seizure produced by strychnine and picrotoxin. The CNS depressant activity of ethanolic extract may due to the presence of glycosides and flavanoids. One of the major phytoconstituent isolated from the leaves of *B. pinnatumis* bufadienolide, a cardiac glycoside reported to possess significant CNS depressant property[29].

Anti-Inflammatory Activity

The various extracts/fractions of leaves of *Bryophyllum pinnatum* were investigated in chemically-induced inflammation rodent model. Indomethacin showed more or less uniform inhibition of edema in early intermediate and later phases. Methanolic fraction showed also more or less significant inhibition of formaldehyde induced edema in early phases while significant inhibition at later phases. Out of Pet-ether, Chloroform, Acetone and Methanol fractions from *B. pinnnatum* leaves, Methanol fraction was more significant than the other fractions in percentage inhibition of paw edema[30].

Cytotoxicity and Antimicrobial Activity

Ethanolic extract of leaves and stem of *K. pinnata* was evaluated for cytotoxicity by using Brine shrimp lethality (BSL) bioassay. The ethanolic extract showed lethality against the brine shrimp

nauplii. It showed different mortality rate at different concentrations. The antibacterial test was performed using the disc diffusion method. The antibacterial activity of the extract was assessed against eight bacterial strains (both gram positive and gram negative) at the dose of 0.5gm/disc and the results were compared with the activity of the standard drug, Amoxycillin (0.1gm/disc). In this experiment, the ethanolic extract of *Kalanchoe pinnata* Linn. Showed significant sensitivity to the five of the test organisms both gram positive and gram negative type of bacteria except *B. Megaterium*, *S. typhi* and *Vibrio cholerae*. The zone of inhibition varies within the range of 6.0±0.35 and 8.2±0.22 mm. The highest zone of inhibition (8.2±0.22 mm) was recorded against *E. coli*[31]

Hepatoprotective Activity

Juice of the fresh leaves of *K. pinnata* is used very effectively for the treatment of jaundice in folk medicines of Bundelkh and region of India. The juice of the leaves and the ethanolic extract of the marc left after expressing the juice were studied in rats against CCl_4-induced hepatotoxicity. The test material was found effective as hepatoprotective as evidenced by *in-vitro*, *in-vivo* and histopathological studies. The juice was found to be more effective than ethanolic extract[32].

Antinociceptive, Anti-Inflammatory and Antidiabetic Activity

In order to scientifically apprise some of the ethnomedical uses of *K. pinnata* leaves, a study was undertaken to investigate the antinociceptive, anti-inflammatory and antidiabetic properties of the plant's leaf aqueous extract in experimental animal models. *K. pinnata* leaf aqueous extract (BPE, 25 to 800 mg/kg i.p.) produced significant ($P < 0.05$ to 0.001) antinociceptive effects against thermally-induced and chemically-induced nociceptive pain stimuli in mice. The plant extract (BPE, 25 to 800 mg/kg p.o. or i.p.) also significantly ($P< 0.05$ to 0.001) inhibited fresh egg albumin-induced acute inflammation and caused significant ($P < 0.05$ to 0.001) hypoglycaemia in rats. The results of this experimental animal study suggest that *K. pinnata* leaf aqueous extract possesses antinociceptive, anti-inflammatory and hypoglycaemic properties. The different flavonoids, polyphenols, triterpenoids and other chemical constituents of the herb are speculated to account for the observed antinociceptive, anti-inflammatory and antidiabetic properties of the plant[34].

Anti-Ulcer Activity

A methanolic fraction from an extract of *Bryophyllum pinnatum* leaves was found to possess significant anti-ulcer activity in nine different experimental animals models. Premedication tests in rats revealed that the extract possessed significant protective action against the gastric lesions

induced by aspirin, indomethacin, serotonin, reserpine, stress and ethanol. Significant protection with extract treatment was observed to occur for aspirin-induced ulcer in pylorus-ligated rats and for histamine-induced duodenal lesions in guinea pigs. Significant enhancement of the healing process was also found to occur in acetic acid-induced chronic gastric lesions in rats[35].

Nephroprotective and Antioxidant Activity

The aqueous extract of *K. pinnata* for its protective effects on Gentamycin-induced nephrotoxicity in rats. It was observed that the aqueous extract of *K. pinnata* leaves significantly protects rat kidneys from Gentamycin-induced histopathological changes. Gentamycin-induced glomerular congestion, peritubular and blood vessels congestion, epithelial desquamation, accumulation of inflammatory cells and necrosis of the kidney cells were found to be reduced in the group receiving the leaf extract of *K. pinnata* along with Gentamycin. Urine creatinine, serum creatinine, blood urea, blood urea nitrogen and the weights of the kidneys were found to be significantly increased in rats treated with only Gentamycin; whereas the treatment with the aqueous extract of *K. pinnata* was found to protect the rats from such effects of Gentamycin. The volume of urine was found to be significantly increased in the rats treated with *K. pinnata* leaf extract. In case of histopathological examination, control rats showed normal glomerular and tubular histology whereas Gentamycin was found to cause glomerular, peritubular and blood vessel congestion and result in the presence of inflammatory cells in kidney sections from the Gentamycin-treated group. Concurrent treatment with the extract was found to reduce such changes in kidney histology induced by Gentamycin.[36] In-vitro studies revealed that the *K. pinnata* leaf extract possesses significant antioxidant as well as oxidative radical scavenging activities. Quercetin and kaemferol have been detected in the leaves of *K. pinnata* suggested that quercetin has a marked protective effect on cadmium-induced nephrotoxicity that results from an increase Metallothionein, a small cysteine-rich protein and eNOS (endothelial nitric oxide synthase) expression and the inhibition of COX-2 (cyclooxygenase-2) and iNOS (inducible nitric oxide synthase) expression.[36, 37].

Antimicrobial Activity

The roots of *K. pinnata* were subjected to petroleum ether, chloroform, methanol and aqueous solvent respectively for extraction and *in-vitro* evaluation of antimicrobial activity was done against *Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa* and *Candida albicans*. Methanolic extract of roots of *K. pinnata* was found to be most effective as antibacterial as compare to others while none of extract showed the activity against *C. albicans*[38, 39] in a study found that 60% methanolic leaf extract inhibits the growth of five out of eight

bacteria used at a concentration of 25 mg/ml. *Bacillus subtilis, E. coli, Proteus vulgaris, Shigella dysenteriae, S. aureus* were found to be inhibited while *Klebsiella pneumoniae, P. aeruginosa and C. albicans* were found to resist the action of the extract. Chemical investigation of the bioactive constituents from the leaf of *K. pinnata* resulted in the isolation of two new novel flavonoids; 5^{I}Methyl 4^{I},5,7 trihydroxyl flavone and 4^{I}, 3, 5,7 tetrahydroxy 5-methyl 5^{I}-propenamine anthocyanidines. The antimicrobial observation of the aforementioned compounds could be responsible for the activity of *K. pinnata* and its use in herbal medicine in Nigeria[6].

Analgesic and Anticonvulsant Effects

The analgesic effect of methylene chloride/methanol (1:1) (CH_2Cl_2/CH_3OH) extract and its hexane, methylene chloride (CH_2Cl_2), ethyl acetate, n-butanol fractions and aqueous residue was evaluated using acetic acid, formalin and pressure test. The anticonvulsant effects of the CH_2Cl_2/CH_3OH extract were also investigated on seizures induced by pentylenetetrazol (PTZ), strychnine sulphate (STN) and thiosemicarbazide (TSC). CH_2Cl_2/CH_3OH extract and its fractions administered orally exhibited protective effect of at least 30% on the pain induced by acetic acid. The CH_2Cl_2 fraction at 300 mg/kg showed a maximal effect of 78.49%. The CH_2Cl_2/CH_3OH extract and its CH_2Cl_2 fraction at the doses of 150 and 300 mg/kg significantly reduced the first phase of pain induced by formalin while the second phase was completely inhibited. The CH_2Cl_2 fraction produced more than 45% reduction in the sensitivity to pain induced by pressure. The CH_2Cl_2/CH_3OH extract of *K. pinnata* significantly increased the latency period in seizures induced by PTZ and significantly reduced the duration of seizures induced by the three convulsant agents. The extract protected 20% of animals against death in seizures induced by TSC and STN. These results suggest a peripheral and central analgesic activities as well as an anticonvulsant effect of the leaves of *K. pinnata*[40]

Leishmaniasis Activity

In this study the effect of *K. pinnata* on cutaneous leishmaniasis carried out. In order to demonstrate the safety and oral activity of *K. pinnata*, different flavonoids were extracted from the plants and were evaluated *in-vivo* in murine model of cutaneous leishmaniasis. Daily oral doses of quercetin 3-O-α--L-arabinopyranosyl, α-L-rhamnopyranoside, quercetin 3-O-α-L-rhamnopyranoside and free quercetin (16 mg/kg body weight) were administered. It was observed that they were able to control the lesion growth caused by Leishmania amazonensis and significantly reduce the parasite load. These flavonoids were as effective as the crude *K. pinnata* aqueous extract given at 320 mg/kg body weight. HPLC-DAD-MS analysis of the plasma of extract treated mice suggested that quercetin and quercetin glucuronides are the main metabolites

of *K. pinnata* quercetin glycosides. These results indicate that quercetin glycosides are important active components of the aqueous extract and that they possess potent oral efficacy against cutaneous leishmaniasis.[41]

Diuretic and Anti-Urolithiatic Activity

Author studied the diuretic and anti-urolithiatic activity of *K. pinnata*. Hydroalcoholic extract of leaves of *K. pinnata* was administered to male Wistar rats orally and intraperitonially. The effect of the extract on urine output was determined by comparing the urine volume collected by keeping the individual animals in metabolic cages. Calcium oxalate urolithiasis was induced in rats by giving ethylene glycol orally for 7 days and the effect of the extract was observed by its concurrent administration. The extract was found to have significant diuretic and anti-urolithiatic activity and the intraperitonial administration of the extract gave more potent diuretic effect.[42]

Anti-Tumor Activity

Five bufadienolides (1-5) isolated from the leaves of *K. pinnata* were examined for their inhibitory effects on Epstein-Barr virus early antigen (EBV-EA) activation in Raji cells induced by the tumor promoter, 12-O-tetradecanoylphorbol-13-acetate. All bufadienolides showed inhibitory activity and bryophyllin A (1) exhibited the most marked inhibition (IC50 =0.4 microM) among the tested compounds. Bryophyllin C (2), a reduction analogue of 1, and bersaldegenin-3-acetate (3) lacking the orthoacetate moiety were less active. These results strongly suggest that bufadienolides are potential cancer chemopreventive agents[43]

Anti-Allergic Activity

Aqueous extract of *K. pinnata* was evaluated for its protective effect in fatal anaphylactic shock, likewise a Th2-driven immunopathology and the identification of its active component. In vitro, *K. pinnata* prevented antigen-induced mast cell degranulation and histamine release. Oral treatment with the quercitrin flavonoid isolated from the plant prevented fatal anaphylaxis in 75% of the animals. These findings indicate that oral treatment with *K. pinnata* effectively down modulates pro-anaphylactic inducing immune responses. Protection achieved with quercitrin, although not maximal, suggests that this flavonoid is a critical component of K. pinnata extract against this extreme allergic reaction[33].

CONCLUSION

The plants are well known and have possible source of curing ailments from time immemorial. In recent year, ethnobotanical and traditional uses of natural compounds especially of plant origin received much more attention as they are well tested for their efficacy and generally

believed to be safe for human use. The present review shows the pharmacological potentials of *K. pinnata* which is very helpful to researcher to explode more about this valuable plant.

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