DOI: 10.55522/jmpas.v3i6.0065 **ISSN NO. 2320 – 7418**

International peer reviewed open access journal

Journal of Medical Pharmaceutical and Allied Sciences

Journal homepage: www.jmpas.com CODEN: JMPACO

Review article

On effective medicinal herb- *bryophyllam pinnatum-a*

Raman Bains, Junaid Niazi, Narinderpal Kaur*

School of Pharmacy & Emerging Sciences, Baddi University, Himachal Pradesh , India

Corresponding author: Narinderpal Kaur, ✉ narinder.sonia@gmail.com ,

School of Pharmacy & Emerging Sciences, Baddi University, Himachal Pradesh, India

Received – 20 October 2014**, Revised** – 20 November 2014, **Accepted** – 25 December 2014 **(DD-MM-YYYY)**

Refer This Article

Raman Bains, Junaid Niazi, Narinderpal Kaur, 2014. On effective medicinal herb- *bryophyllam pinnatum-a*. Journal of medical pharmaceutical and allied sciences, V 3 - I 6, Pages -246 – 250. Doi: https://doi.org/10.55522/jmpas.V3I6.0065.

ABSTRACT

Bryophyllum pinnatum is used in folk medicine in tropical Africa, tropical America, India, China, and Australia. It contains a wide range of active compounds, including alkaloids, triterpenes, glycosides, flavonoids, steroids, bufadienolides, lipids and organic acids. It is widely used in traditional medicine for the treatment of variety of ailments like anthelmentic, immune suppressive, hepato-protective, anti-nociceptive, anti-inflammatory and anti-diabetic, nephron- protective, anti-oxidant activity, anti-microbial activity, analgesic, anti-convulsant, neuro pharmacological and anti-pyretic. It is well known for its haemo-static and wound healing properties. This review focus on folk occurrence and the wide phytochemical and pharmacological activities of *Bryophyllum pinnatum.*

Keywords: Alkaloids, Bufadienolides, Flavonoids, immunomodulator.

INTRODUCTION

Medicinal plants have been known for millennia and are highly esteemed all over the world as a rich source of therapeutic agents for the prevention of diseases and ailments. The plant, Bryophyllum pinnatum (Crassulaceae) is commonly known as air plant, love plant, miracle leaf, life plant, Zakham-e-hyat, panfutti, Ghayamari has been accepted as a herbal remedy in almost all parts of the world etc.They widely grow in hot and humid areas, around the dwelling places, along road sides and in abandoned farm and fields. They are widely used in folk medicine of its indigenous region (Madagascar, Tropical Africa, India, China, Australia, Hawai and Tropical America). It is astringent, sour in taste, sweet in the post digestive effect and has hot potency. It is well known for its hemostatic and wound healing properties. The plant have considerable attention for their medicinal properties and find application in folk medicine, as well as in the contemporary medicine.

Plant description

Botanical Name: *Bryophyllum pinnatum*

Family Name: Crussulaceae **Sanskrit Name:** Pashanabheda **Hindi Name:** Patharchur

Common Names: Cathedral Bells, Air Plant (USA), Life Plant, Miracle Leaf, Goethe Plant and Katakataka. Also called "Wonder of the World" in the English speaking Caribbean.'Oliwa Ka Kahakai (Hawai'i), Mother Of Thousands, Herbe Mal Tete (Dominica) Never Dead, Parvu, Hoja Del Aire (Bolivia) [1].

Synonym: Bryophyllum calycinum, Bryophyllum pinnatum.

Taxonomical tree Kingdom: Plantae **Division:** Magnoliophyta **Class:** Magnoliopsida **Order:** Saxifragales **Genus:** Kalanchoe **Section:** Bryophyllum **Species:** *K. pinnata*.Preliminary phytochemical investigation of different partsof plant extracts of *B. pinnatum* showed the presence of alkaloids, phenols, flavonoids, saponins, tannins, carotenoids, glycosides sitosterol, anthocyanins, malic acid, quinines, tocopherol**,** lectins, coumarins and bufadienolideshe leaves are found to contain various chemical constituents including 1- octane3- O-α-L-arabinopyranosyl-(1-6) gluco pyranoside isorhamnetin-3-O-a-Lregion, which are traditionally used to recover from a disease. As it is not possible to discuss all the plants which are easily found in Assam for treatment of various diseases with antioxidant activity. Some plants are chosen in this paper.

1C4-rhamnopyranoside, 40- methoxy- myricetin-3-O-a-L

1C4-rhamnopyranoside and proto catechuic-40-O-b-D-4C1 gluco pyranoside, 24- epiclerosterol (24(R)- stigmasta-5, 25-dien-3β-ol), 24(R)-5α- stigmasta-7, 25-dien-3β-ol, 5α-stigmast-24- en-3β-ol and 25-methyl-5α-ergost-24 (28)- en-3β-ol. A new steroidal derivative, Stigmast-4, 20 (21), 23-trien-3-one was also isolated from the plant leaves extract along with stigmata-5-en-3β-ol , α – amyrin- β-D-glucopyranoside , nundecanyl n-octadec-9- en-1-oate and n-dodecanyl noctadec- 9-en-1- oate. Different naturally occurring flavanoids from leaves are flavones, falvans, flavanones, isoflavonoids, chalcones, aurones and anthocyanidines, 5I Methyl 4I, 5, 7 trihydroxyl flavone 1 and 4I, 3, 5, 7 tetrahydroxy 5-methyl 5I-propenamine anthocyanidines 2. Compounds with potent biological activity are bersaldegenin- 1, 3, 5-orthoacetate (30) and bufadienolide-bryophyllin B and Bryophyllin bryophyllol, bryophollone, bryophollenone, bryophynol are isolated from the aerial part of the plant. Phenanthrene derivatives isolated from the plant extract are 2(9-decenyl)- phenanthrene and 2-(undecenyl)- phenanthrene (II) ,1 ethanaomino 7 hex-1- yne-5-one phenathrine diagremotianin. 18α-Oleanane, ψ- taraxasterol, β-arnyrin acetate was also elucidated along with a mixture of α- and β- amyrins and their acetates The aqueous leaf extract from the medicinal plant *B. pinnata* (Crasaceae) afforded a kaempferol diglycoside, named kapinnatoside, identified as kaempferol 3-O-a-Larabinopyranosyl (1! 2) a-L-amnopyranoside known to have anti leishmania activity(22).The major elements, comprising calcium, phosphorus, sodium, potassium malate, magnesium and trace elements (iron and zinc) were also determined in the plant extracts along with vitamins like ascorbic acid (26.42 to 44.03 mg/100 g), riboflavin (0.20 to 0.42 mg/100 g), thiamine (0.11 to 0.18 mg/100 g), and niacin (0.02 to 0.09 mg/100 g) casein hydrlylsate, nicotinamide. Syringic acid, caffeic acid (40), 4-hydroxy- 3-methoxy-cinnamic acid 4-hydroxyl benzoic acid, p-hydroxycinnamic acid, paracoumaric acid, ferulic acid, protocatechuic acid, phosphoenolpyruvate, protocatechuic acid isolated from aerial parts of plants). Extract obtained by decoction of the bryophyllum leaves contains various enzymes i.e Phosphoenol pyruvate carboxykinase (PCK), Phosphoenol pyruvate carboxylase (PEPC), Pyruvate orthophosphate dikinase (PPDK)ribulose-1, 5-biphosphate carboxylase/ oxygenase (rubisco) **(**42) along with Phosphoglycerate kinase, Carbonic anhydrase, Glycolate oxidase, Fructosebiphosphate aldolase, DNA topoisomerase which most of having role in metabolism [2].

Pharmacological Activities

Antimicrobial activity

Two novel flavanoids; 5 methyl 4,5,7 trihydroxyl flavones and 4,3,5,7 tetrahydroxy 5 methyl 5 propenamine anthocyanidines showed potential antimicrobial activities against Pseudomonas aeruginosa, Klebsiella pneumonia, E.coli, Staphylococcus aureus, Candida albicans and Aspergillus niger. When 60% methanolic extract of Bryophyllum pinnatum leaf used to inhibits the growth bacteria, at a concentration of 25 mg/ml it showed good antibacterial effects. Further the Plant is effective in the treatment of typhoid fever and other bacterial infections, particularly those caused by S. aureus, E. coli, B. subtilis, P. aeruginosa, K. aerogenes, K. pneumoniae and S. typhi due to the presence of phenolic compounds. Researchers findings supported its use in treating the placenta and navel of newborn baby, which not only heals fast but also prevent the formation of infections. Some researchers suggested that the active constituents Bufadienolides: bryophyllin A and bryophyllin C from B. Pinnatum showed strong insecticidal activity against third instar larvae of the silkworm.The Fungitoxic and phytotoxic effects of extracts on the fungal pathogens have also studied by the researchers.

Anti-diabetic Activity

The presence of zinc in the plants could mean that the plants can playvaluable roles in the management of diabetes, which result from insulin malfunction. Ojewole evaluated the antinociceptive effect of the herb's aqueous leaf extract by the 'hot-plate' and 'acetic acid' test models of pain in mice. The anti-inflammatory and antidiabetic effects of the plant extract were investigated in rats, using fresh egg albumin-induced pedal oedema, and streptozotocin – induced diabetes mellitus. The aqueous leaf extract produced significant (P<0.05-0.001) antinociceptive effects against thermally and chemicallyinduced nociceptive pain stimuli in mice. The plant extract also significantly (P<0.05-0.001) inhibited fresh egg albumininduced acute inflammation and cause significant hypoglycaemia in rats. The different flavonoids, polyphenols, triterpenoids and phytosterols of the herb are speculated to account for the observed antinociceptive, anti-inflammatory and antidiabetic properties of the plant. It exert antinociceptive and anti-inflammatory effects probably by inhibiting the release, synthesis and /or production of inflammatory cytokines and mediators, including: prostaglandins, histamine, polypeptide kinins and so on.

Anti-ulcer activity

It also been demonstrated by the investigators that the Methanol-soluble fraction of B. pinnatum leaf extract inhibited the development of a variety of acute ulcers induced in the stomach and duodenum of rats and guinea pigs.

Anticonvulsant activity

CH2Cl 2/CH3OH extract of B. pinnatum were found to reduce seizures induced by pentylenetetrazol, strychnine sulphate and thiosemicarbazide and increases in the latency period of seizures and to reduced the duration of seizures induced by the three convulsive agents. The extract protected 20% of animals against death in seizures induced by TSC and STN [3].

Hepato-protective and Nephro-protective*:* Juice of the fresh leaves is used very effectively for the treatment of jaundice in Bundelkhand region of India. Yadav *et al* studied that the juice of leaveswas found more effective than ethanolic extract as evidenced by invivo and invitro histopathological studies for hepatoprotective activity of plant and justifies the use of juice of plant leaves in folk medicine for jaundice. The protective effect on gentamicin-induced nephrotoxicity in rats which may involve its antioxidant and oxidative radical scavenging activities.It is also used for the treatment of kidney stones in India where is goes by the name of Pather Chat or Paan-futti.The Quercetin has neproprotective and antioxidant role.

Anti-hypertensive

The aqueous and methanolic leaf extracts of B. pinnatum decreases in arterial blood pressures and heart rates of anaesthetized normotensive and hypertensive rats.

Analgesic, Anti-inflammatory and Wound Healing activity: The high saponins content justifies the use of the extracts to stop bleeding and in treating wounds. Saponins has the property of precipitating and coagulating red blood cells. Some of the characteristics of saponins include formation of foams in aqueous solutions, hemolytic activity, cholesterol binding properties and bitterness .These properties bestow high medicinal activities on the extracts from *B.Pinnatum.* Tannins have astringent properties, hasten the healing of wounds and inflamed mucous membranes. These perhaps, explain why traditional medicine healers in Southeastern Nigeria often use herb in treating wounds and burns. Dra Amalia *et al* investigated the anti-inflammatory activity of the fluid extract of the leaves against the edema caused by carrageen in rats. It was confirmed that the fluid extract with 4.5 % of total solids at doses of 100 mg/kg of weight has an anti- inflammatory effect. Aqueous extract of *B.Pinnatum* can demonstrate strong analgesic potency comparable in a time and dose-dependent manner to a non-steroidal anti-inflammatory drug. Igwe investigated that the aqueous extract was devoid of severe toxic effects, increased the pain threshold in rats using the hot plate or thermal methods, inhibited or reduced phenyl benzoquinone-induced writhing or abdominal stretches in mice in a dose- dependent manner, and produced a weak or an inferior anti-inflammatory activity thanAmaranthus spinosus *Amaranthus spinosus* Linn.

(Amaranthaceae) commonly known as Spiny amaranth or Pig weed, is an annual or perennial herb found throughout India as a weed in cultivated as well as fallow lands . in assam this plant in known as khutura sak. Though whole plant is used as laxative, the root are regarded as highly specific for colic. Traditionally boiled leaves and roots of *Amaranthus spinosus* are given to children as laxative. The plant is having medicinal value as diuretic, antidiabetic, antipyretic, anti-snake venum, antileprotic, and anti- gonorrheal.*the plant* is used as an expectorant and to relieve breathing in acute bronchitis In Malaysia. The plant also showing the anti-inflammatory properties, immunomodulatory activity, anthelmintic properties. To induce abortion some tribes of india, are frequently used this plant. In vitro antioxidant activity was determined by DPPH, superoxide, hydroxyl radicals, hydrogen peroxide and nitric oxide scavenging methods. In the study it was found that the plant having the antioxidant activity [4].

Immunomodulatory effect

The aqueous extract ofL eaves causes significant inhibition of cell-mediated and humoral immune responses in mice.The spleen cells of animals pre-treated with plant extract showed a decreased ability to proliferate in response to both mitogen and antigen in vitro as well as the specific antibody responses to ovalbumin were also significantly reduced by treatment. Investigation found that leaf extracts inhibited invitro lymphocyte proliferation and showed invivo immunosuppressive activity, hence it has been proved that the aqueous extract of leaves possesses immunosuppressive activitie.

It has been stated that the fattyacids present in *B.Pinnatum* may be responsible for its immunosuppressive effect invivo as from the ethanolic extract a purified fraction (KP12SA) of *B.Pinnatum* found twenty-fold more potent to block murine lymphocyte proliferation than the crude extract Further the resrachers studied immunomodulatory effect of bryophyllum pinnatum and reported that mice daily treated with oral *B.pinnatum* during hypersensitization with ovalbumin were all protected against death. It was stated that Oral protection was accompanied by a reduced production of OVA-specific IgE antibodies, reduced eosinophilia, and impaired production of the IL-5, IL-10 and TNF- α cytokines. Oral treatment with the quercitrin flavonoid isolated from plant extract prevented fatal anaphylaxis in 75% of the animals. The abovesaid findings indicated that oral treatment with *Bryophyllum pinnatum* effectively downmodulates proanaphylactic inducing immune response [5].

Antileishmanial activity

Infections caused by protozoa of the genus *Leishmania* are a major worldwide health problem, with high endemicity in developing countries. The incidence of the disease has increased since the emergence of AIDS. L.G. Rocha *et al* refered in a review on a plant extracts that a chemically defined molecules (coumarin, quercetin) of natural origin showing antileishmanial activity. Quercitrin, a flavonoid is responsible for the antileishmanial activity of *B.Pinnatum.* The quercetin aglycone-type structure, as well as a rhamnosyl unit linked at C-3, seem to be important for antileishmanial activity . Da Silva *et al* investigated the antileishmanial properties of three flavanoids (quercitrin, quercetin and afzelin) of leaf extract in mice against *L. amazonenis* amastigotes and found oral route was more effective than other (i.v. or tropical) routes. The protective effect of plant in leishmaniasis

may not be due to a direct effect on the parasite itself but rather activation of the reactive nitrogen intermediates pathway of macrophages [6].

Anti-cancer

Prescreening method for cytotoxic effect showed that the ethanolic extract of bryophyllum pinnatum has anti-cancerous activity. In BSL bioassay, the ethanolic extract showed lethality against the brine shrimp nauplii. It showed different mortality rate at different concentrations. Five bufadienolides isolated from the leaves of *B. 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- Otetradecanoylphorbol-13-acetate. All bufadienolides showed inhibitory activity, and bryophyllin A exhibited the most marked inhibition among the tested compounds. Bryophyllin C, a reduction analogue of Bryophyllin A, and bersaldegenin-3-acetate lacking the orthoacetate moiety were less active. These results strongly suggest that bufadienolides of Bryophyllum pinnatum are potential cancer chemopreventive agents. MTT assay on a highly metastatic human HT- 1080 fibrosarcoma cell line showed that metanolic. Methonolic aqueous, aqueous extract have mild antiproliferative activity.

Uterine relaxant and uterine contractility

B. pinnatum showed its relaxant effect invitro on thecontractility of human myometrium on oxytocin-stimulated contraction at a minimum concentration almost 100-fold lower than in the case of spontaneous contraction [7, 8].

CONCLUSION

*Bryophyllum pinnatum*is a perennial herb growing widely and used in folkloric medicine in tropical Africa, India, China, Australia and tropical America. A number of active compounds, including flavonoids, glycosides, steroids, bufadienolides and organic acids, have been identified in *Bryophyllum pinnatum*. Its bufadienolides are structurally similar to Cardiac glycosides and have demonstrated in clinical research to possess antimicrobial, antifungal, anticancer, anti tumour, insecticidal actions. It also possess other activities like anti-ulcer, anti-inflammatory and analgesic, antihypertensive, hepato-protective, Nephro- protective, diuretic, anti-diabetic, anticonvulsion, anti-oxidant, uterine relaxant, muscle relaxant and neuro-sedative activity and tocolysis activity. Thepresent review shows the pharmacological potentials of *Bryophyllum pinnatam* which is very helpful to researcher to explode more about this valuable plant.

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