PHYTOCHEMICAL AND PHARMACOLOGICAL PROFILE OF *BIOPHYTUM SENSITIVUM* (L) DC

A. T. PAWAR1,2*, N. S. VYAWAHARE3

1Centre for Research and Development, PRIST University, Thanjavur, India, 2Department of Pharmacology, MAEER’s Maharashtra Institute of Pharmacy, Kothrud, Pune, India, 3Dr. D. Y. Patil Pratishthan’s, Padmashree Dr. D. Y. Patil College of Pharmacy, Akurdi, Pune, India.

Received: 22 Sep 2014 Revised and Accepted: 20 Oct 2014

Dr. D. Y. Patil Pratishstan’s, Padmashree Dr. D. Y. Patil College of Pharmacy, Akurdi, Pune, India.

Email: anil_pawar31@yahoo.co.in

**ABSTRACT**

*Biophytum sensitivum* (L.) DC (Family: Oxalidaceae) is a medicinal plant widely used in the treatment of various health ailments throughout the world. The plant extract showed the presence of flavonoids, saponins, tannins, terpenes, steroids, amino acids, essential oil, polysaccharides and pectin. The plant has been extensively studied by various researchers for its biological activities and therapeutic potentials such as analgesic, anti-pyretic, anti-inflammatory, immunomodulatory, antitumor, antidiabetic, antioxidant, antibacterial, antihypertensive, chemoprotective, radioprotective and antifertility. The present review is an effort to provide detailed information on folkloric uses, chemical compositions, pharmacological activities of the extracts and isolated compounds and safety profile of *Biophytum sensitivum* for further research studies.

**Keywords:** Amentoflavone, *Biophytum sensitivum*, Oxalidaceae.

**INTRODUCTION**

The genus *Biophytum* is a member of the family Oxalidaceae and distributed in tropical Asia, Africa, America and the Philippines. In India, nine species of *Biophytum* are prominently found and out of these, three species viz. *Biophytum sensitivum* DC. Syn. *Oxalis sensitivum* Linn., *Biophytum reinwardtii* Edgew and *Biophytum umbraculum* Wehr. Syn. *Biophytum petersianum* Klotzsch are reported to have ethnomedicinal potential. *Biophytum sensitivum* (L.) DC (*B. sensitivum*), commonly known as ‘Life plant’, is a mesophytic under-shrub growing in slightly moist places. The plant is distributed up to an altitude of 1,800 m and is available during the rainy season in moist shady places [1]. The plant is traditionally used for centuries in the treatment of various health ailments. It is an important medicinal plant in the Indian traditional system of medicine like Ayurveda [2]. The plant is rich in a number of phenolic and polyphenolic compounds, saponins, tannins, essential oil, polysaccharides and pectin. *Biophytum sensitivum* has been extensively studied for its biological activities and therapeutic potentials such as analgesic, anti-pyretic, anti-inflammatory, immunomodulatory, antitumor, anti-diabetic, antioxidant, antibacterial, antihypertensive, chemoprotective, radioprotective and antifertility. The present review covers phytochemical, pharmacognostic, Pharmacological and toxicity updates of this plant.

**Botanical description**

**Taxonomy**

Botanical name: *Biophytum sensitivum*

Kingdom: Plantae
Division: Magnoliophyta
Class: Magnoliopsida
Order: Oxalidales
Family: Oxalidaceae
Genus: Biophytum
Species: Sensitivum

Botanical name: *Biophytum sensitivum*

**Vernacular names**

Common name: Life plant, Sensitive plant

Sanskrit: Lajjalu, Jalapuspa, Krichhraha, Laghvrikshaka, Lajjalaka, Panktipatra, Pitapushpa.

Hindi: Lakshmana, Lajalu

Marathi: Lajvanti, Jharela, Ladjiri, Lahanamulki

Bengali: Jhalai

Gujrathi: Jharera.

Malayalam: Mukkuti, Nilaccurunki, Tintanalii

Kannada: Haramuni, Jalapushpa

Tamil: Nilaccurunki, Tintaanaalee

Telugu: Pulichinta, Attapatti, Chumi, Jala pupa

**Fig. 1:** *Biophytum sensitivum*(L.) DC

**Morphological Characters**

It is a small plant, rarely exceeds 2.5-20 cm in height and form an unbranched woody erect stem. All leaves grow on the top of the stem. Leaves are abruptly pinnate, sensitive, 3.8-12.7 cm long and are made of 8-17 pairs of leaflets. Leaflets are opposite, 1 cm long, terminal pairs the largest and pairs becoming smaller downwards. Flowers are dimorphic, 8 mm across, yellow and crowded at apices of the peduncles. The sepals are lanceolate, 7 mm long with parallel nerves. Corolla is much exceeding the sepals. Lobes are rounded and spreading. Style is nearly glabrous. Fruits are ellipsoid capsule. Seeds are prominently ridges and transversely striated. The plant has been observed flowering and fruiting in the month of September to December [3, 4].

**Traditional claims**

The plant is bitter, thermogenic, diuretic, lithotriptic, suppurative, expectorant, stimulant and tonic. The leaves are astringent and antiseptic. It is useful in strangury, urinary calculi, hypertipsia in
bilious fevers, wounds, abscesses, asthma, phthisis, gonorrhea, stomachalgia, insomnia and snake bite [1].

The whole plant is dried, powdered and given internally to cattle to stop excessive salivation. In the Philippines, the powdered seeds are used as vulnerary and along with butter they are applied to abscesses to promote suppuration [2]. The crushed whole plant is used in chronic skin troubles and is also eaten to induce sterility in man [3]. A decoction of the leaves is given in asthma and phthisis. The plant is also used in chest complaints, insomnia and convulsive cramps and inflammatory tumors [4]. The plant decoction is used in amenorrhea and dysmenorrhea and its powder for the gonorrheal infection and lithiasis [5].

Phytochemistry

The whole plant extracts of B. sensitivum showed presence of phenolic and polyphenolic compounds, saponins, essential oil, polysaccharides and pectin [6]. The methanolic extract of whole plant of B. sensitivum was reported to have significant anti-inflammatory activity at the dose of 100 and 200 mg/kg in the carrageenin-induced, histamine-induced and dextran-induced paw oedema model in the rats [10]. Anti-inflammatory activity of aqueous extracts of aerial parts and roots, methanol extract of aerial parts and ultrafiltration fractions of a methanol extract of roots of B. sensitivum were also evaluated in the carrageenin-induced rat paw edema. All the fractions except the methanol extract of aerial parts inhibited the formation of carrageenin-induced paw edema [11]. Amentoflavone and procyanidines isolated from the B. sensitivum has been reported to possess in vivo anti-inflammatory activity and to inhibit COX when tested in vitro. Amentoflavone has been reported to downregulates COX-2 expression with concomitant inhibition of NF-κB/DNA binding activity with inhibition of degradation of IkBα and NF-κB translocation into the nucleus in TNFα-activated A549 cells [12]. It is concluded that the B. sensitivum possesses significant anti-inflammatory activity due to the presence of amentoflavone and other polyphenolic compounds.

ImmunoModulatory activity

The methanolic extract of whole plant of B. sensitivum increased the total WBC count and number of bone marrow cells at a dose of 0.5 mg/animal. In all the different in vivo immune parameters such as splenic weight and thymic weight of competent cells and macrophages [15]. The pectic polysaccharide (BP1002) obtained from the aerial parts of B. sensitivum and its fragments (BP1.1 and BP1.2) expressed immunomodulating activity against Peyrier’s patch immune competent cells and macrophages [16].

Antitumor activity

The methanolic extract of B. sensitivum found to inhibit the growth of solid tumor induced by Dalton’s lymphoma ascites (DLA) cells and monoterpenes (Z)-linalool oxide (81%), (E)-linalool oxide (52%) and linalyl acetate (3.4%) as well as 1-octen-3-ol (9.5%) and isophorone (3.1%) as main constituents [9].
ascites tumor induced by Ehrlich ascites carcinoma (EAC) cells. The extract was 100% toxic at a concentration of 0.5 mg/ml to both DLA and EAC cells. It was also found to be cytotoxic towards L929 cells in culture at a concentration of 0.1 mg/ml [13]. Methanolic extract of B. sensitivum have reported to produce apoptotic effect by regulating bcl-2, Caspase-3 and p53 genes in B16F-10 cells and regulates nitric oxide and proinflammatory cytokine production in B16F-10 cells, TAMs and peritoneal macrophages [17, 18]. Amentoflavone isolated from the B. sensitivum found to augment lymphocyte proliferation, natural killer cell and antibody dependent cellular cytocytotoxicity through enhanced production of IL-2 and IFN-gamma and restrained serum sialic acid and gamma glutamyl transpeptidase production in Ehrlich ascites carcinoma cells bearing mice [19]. The aqueous extract of B. sensitivum leaves also found to inhibit the tumor volume, viable cell count and enhancement of survival time of DLA bearing mice. It is concluded that aqueous extract of B. sensitivum leaves has significant anti-tumor activity [20].

Antiangiogenic activity
Amentoflavone isolated from B. sensitivum reported to inhibit tumor directed angiogenesis by disrupting the integrity of endothelial cells and by altering the endogenous factors such as IL-8, IL-6, TNF-α, GM-CSF and VEGF that are required for the process of neovascularization. This antiangiogenic activity of amentoflavone is responsible for inhibition of tumor growth and metastasis [21, 22].

Antimetastatic activity
Amentoflavone isolated from B. sensitivum reduced experimental tumor metastasis at the dose of 50 mg/kg for 10 consecutive days in C57BL/6 mice injected with B16F-10 melanoma cells [23]. Amentoflavone found to produce antimitastatic effect by altering proinflammatory cytokine cytokine production and inhibiting the activation and nuclear translocation of p6, p50, c-Rel subunits of nuclear factor-kappaB, and other transcription factors such as c-fos, activated transcription factor-2, and cyclic adenosine monophosphate response element binding protein in B16F-10 melanoma cells [24].

Hypoglycaemic activity
The aqueous solution of B. sensitivum leaf extract was administered to rabbits at the dose of 200 mg/kg to study its effect on alloxan-induced diabetes. There was significant improvement in the glycaemic state in subdiabetic and mild diabetic rabbits only. Tested microorganism [29].

Considerable and variable inhibitory effects against most of the tested microorganisms [29].

Antioxidant activity
B. sensitivum extract was found to scavenge superoxide radicals, hydroxyl radicals and inhibited in vitro lipid peroxidation at concentrations of 50, 95 and 20 µg/ml (IC50) respectively. The extract also scavenged nitric oxide (IC50 = 100 µg/ml). The extract found to induce the dose-dependent scavenging of nitric oxide in culture. Intraperitoneal administration of B. sensitivum extract inhibited superoxide generation in macrophages in vivo in mice. The extract also produced significant increase in catalase activity, glutathione, glutathione-S-transferase and glutathione reductase. The levels of glutathione peroxidase decreased after administration of B. sensitivum extract. These results indicate that B. sensitivum extract has significant antioxidant activity both in vitro and in vivo [30].

Antihypertensive activity
The whole plant extract of B. sensitivum is reported to possess antihypertensive potential on guinea pig and rat model. The extract non-competitively antagonized calcium chloride and high-K+-induced contraction of isolated rat aorta in a concentration-dependent manner. The extract also found to inhibit noradrenaline-induced contractions of aorta. These results strongly indicate that antihypertensive effect of B. sensitivum results from inhibition of calcium influx via both voltage and receptor operated calcium channels [31].

Antifertility activity
Ethanol, ethyl acetate, chloroform and n-butanol extracts of whole plant of B. sensitivum were studied for the antifertility potential at the dose of 400 mg/kg in female Wistar albino rats. All the extracts inhibited pregnancy with a significant reduction in number of implants as compared to control animals. The ethanol extract exhibited maximum (100%) antifertility activity. The activity was reversible on withdrawal of the treatment of the extracts [32].

Chemoprotective activity
Intraperitoneal administration of alcoholic extract of Biophytum sensitivum increased the total WBC count, bone marrow cellularity, alpha-esterase positive cells and weight of lymphoid organs in mice with cyclophosphamide induced toxicity. The extract treatment found to restore GSH in liver and intestinal mucosa, serum and liver ALP, GPT and lipid peroxidation. The B. sensitivum extract reduced the level of the pro-inflammatory cytokine, TNF-α and increased the levels of cytokines IFN-γ, IL-2 and GM-CSF in cyclophosphamide treated mice. It was concluded that Biophytum sensitivum has significant protective activity against cyclophosphamide induced toxicity [33].

Radioprotective activity
Methanolic extract of B. sensitivum was found to enhance immunity as well as stimulate production of IL-1β, IFN-γ and GM-CSF at the dose of 5.0 mg/kg in mice exposed to whole body gamma irradiation. It is concluded that B. sensitivum extract provides protection against radiation-induced hemopoietic damage [34].

Larvicidal activity
Acetone extract of leaves of B. sensitivum was found to be effective larvicial, pupicial and also interfered with the normal development and emergence of adult mosquitoes at the concentration of 10, 15 and 25 µg/ml on Aedes aegypti mosquito in a dose dependant manner. It is concluded that B. sensitivum extract has an excellent potential as Larvicidal agent against A. aegypti strain [35].

Complement fixing activity
The aqueous extract of aerial part has the polysaccharide fraction, BP100 III, and has a monosaccharide composition typical for pectic substances, that exhibits potent dose-dependent complement fixing activity. The fractions of BP 100 III were prepared by the endo-β-1→4-polygalacturonase degradation. The highest molecular weight fraction is BP 100 III, which has more potent activity in the complement test system than the native polymer which consists of galacturonic acid and rhamnose sugar having additional arabinogalactan type II in polymer [36].

Anti-fungal activity
The acetone extract of leaves of B. sensitivum had significant antifungal activity. The leaf extract of B. sensitivum inhibited the
growth of fungal pathogens A. fumigatus, A. niger, C. neoformans and Norcardia sp. in disc method [37].

Hypcholesterolemic effect

The oral administration of the water extract of leaves of B. sensitivum to hypercholesterolemic rabbits at the dose of 200 mg/kg restored the lipid profile near to normal level. It is concluded that B. sensitivum has significant hypcholesterolemic effect [38].

Safety and toxic profile

Acute toxicity of B. sensitivum extracts were studied in rodents. The methanolic extract of the B. sensitivum whole plant is well tolerated up to an oral dose of 4000 mg/kg of body weight as no mortality was observed within a period of 24 h [10]. The aqueous extract of leaves of the plant is studied and found non-toxic at the dose levels of 100, 200 and 300 mg/kg body weight by oral route in mice [20]. The median lethal dose (LD₅₀) of the hexane, chloroform, ethyl acetate, n-butanol and ethanol extracts of the plant were found to be greater than 1 mg/kg when administered by intraperitoneal route to rats [52].

CONCLUSION

B. sensitivum (L) has been used for the treatment of various health ailments by various traditional systems of medicines. The research carried out so far have confirmed the pharmacological potential of B. sensitivum and found to be relatively safe. Further research is required to reveal the molecular mechanism of most of these pharmacological properties.

CONFLICT OF INTERESTS

Declared None

REFERENCES


