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Review Article

A CRITICAL REVIEW ON *ALAMBUSHA* (*BIOPHYTUM SENSITIVUM* LINN)

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ABSTRACT

Alambusha (*Biophytum sensitivum*) belonging to the family oxalidaceae, commonly known as *Mukkutti*, is mostly found in marshy regions of south India, abundantly seen during rainy season. It is known as the "Small Tree Plant" with sensitive leaflets and bright yellow circular small flowers resembles like a tree in its texture and looks. The phytochemistry of *B.sensitivum* showed a wide range of chemical compounds, such as, two biflavones, three flavonoids and two acids. The plant is described in Ayurvedic classics, by *Nighantu* Acharyas, as *Krimighna* herb. The plant, is traditionally believed to exhibit antioxidants, anti-inflammatory and anti-tumor activity, radioprotection, immune-modulation, antibacterial, wound-healing, hypoglycemic actions. *B.sensitivum* has been used as traditional medicine for several purposes such as expectorant, stimulant, and tonic. It is recommended to be used in the treatment of stomach ache, asthma, treating insomnia, convulsions, cramps, chest complaints, inflammations, wound infections, tumors, and remedying chronic skin diseases. In the present review, all the available sources regarding the plant *B. sensitivum* was highlighted in a bird eye view.

INTRODUCTION

Medicinal plants are very amazing. They have the ability to produce a large number of remarkable chemical structures possessing diverse biological activities. *Alambusha* (*Biophytum sensitivum*) is one such plant, which is used as traditional medicine to cure variety of diseases. Within the last few decades, extensive research has been carried out, in order to find out the chemistry, biological activities, and medicinal applications of *B. sensitivum*. This plant is commonly known as "Life plant" in English[1].

Alambusha, popularly called as *Mukkutti* by the local peoples of South India. The plant is very important for its flowers. It's flowers have been used in *Athapoo*, a special floral formation that adores the courtyards and public places during Onam, the National festival of Kerala.

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The Western Ghats of Kerala is said to be famous for its medicinal plant wealth and the tradition of indigenous system of therapy, specifically the Ayurveda. It is known as the "Small Tree Plant" with sensitive leaflets and bright yellow circular small flowers resembles like a tree in its texture and looks. Another saying is that in Kerala, Kotakkal regions, *Alambusha* is considered as *Neptunia oleracea*, called water mimosa, as the leaf of *Neptunia oleracea* is having *Samveshana Sheela,* with *Sita Veerya, Grahi* and *Mutrala* properties like *Biophytum sensitivum.* Ayurveda mentions this little herb with immense therapeutic effects and has been used as medicine either as a single herb or in the form of formulations,

Vernacular Names

- English= Little tree plant / life plant
- Hindi= Laajjaalu, Lakshmana, Lakanchan
- Sanskrit= *Vipareetalajjaalu, Jhulapushpa, Alambusha, Pitapushpa*
- Malayalam= Mukkutti
- Kannada= Hara muni, Jalapushpa
- Tamil= Nilaccurunki, Tintaanaalee
- Telugu= Attapatti, chumi, Jalapuspa
- Marathi= Lajwanti
- Bengali= Jhala

Distribution

Biophytum is a genus consisting of 50 species of Annual and Perennial herbaceous plants which are distributed in tropical Asia, Africa, America and Philippines. In India, around nine species are found. Among these only three species *named Biophytum sensitivum* DC. (*Syn Biophytum petersianum* Klotzsch.), *B. reinwardtii* Edgew. and *B. umbraculum* Welw. are known to possess ethnomedicinal properties. *B. sensitivum* (Family- Oxalidaceae) is an annual herb which grows at the foothills of the Himalayas, around the inner Tarai region (east of Koshi river) in Eastern Nepal. This is a common weed distributed in Kerala, wet lands (mostly plains) of Nepal, tropical Africa, Asia India, and is found mostly under the shade of trees and shrubs, in grasslands and at low and medium altitudes[2].

Morphological Profile

Biophytum sensitivum is an Annual herb, which is like a miniature palm, having unbranched, erect, glabrous, hairy stems [3].

a) Height: The little plant grows up to maximum height of 20cm having unbranched woody erect stem.

b) Leaves: Leaves are green in colour. 3.7-12.7cm long, crowded into a rosette on the top of the stem They are abruptly pinnate, leaflets are opposite, 6 to 12 pairs, and each leaflet is up to 1.5 cm long, with the terminal pair as largest. One of the remarkable feature of its leaflets is their ability to fold together, representing an extreme form of "Sleep movement". This is exhibited by all the members in this family. While applying pressure, tapping or damaging them they get folded together in a few seconds. This plant also shows this behavior when the light drops at night. This ability is not only restricted to the leaves. This sleeping movement is also visible in the peduncle of the flowers.

c) Flower: The flowers are many and crowded at the apices of the numerous peduncles. They are normally yellow, white, or orange with red streak in the center of each of the five petals. The sepals are about 7mm long. It is subulate-lanceolate in appearance. Flowers are dimorphic, petals usually twice as long as the sepals, capsules elliptic, shining. Interesting feature of flowers of this plant is heterostyly. Heterostyly in *B. sensitivum* is responsible for 3 flower morphs.

d) Fruits: Fruits are ellipsoid capsules which are shorter than the persistent calyx. The entire capsule is covered with hairs, with a size of 4–5 x 3–4mm. It is ellipsoid-obovoid in shape.

e) Seeds: Ovoid and transversely striate

f) Flowering and Fruiting: July-December.

Fig No: 1 *Alambusha (Biophytum sensitivum)*

Fig No: 2 Flower & Seed

Fig No: 3 Root System

Fig No: 4 Leaf

Fig No: 5 Sleep Movement of Leaflets

Chemical Constituents

The phytochemistry of *B.sensitivum* showed a wide range of chemical compounds, which were isolated from the aerial parts of *B. sensitivum*. The two biflavones present are Cupressuflavone and Amentoflavone. The three flavonoids seen in the plant are, Luteolin 7- Methyl Ether, Isoorientin and 3'-methoxyluteolin 7-O-glucoside and the two acids present are 4-Caffeoylquinic acid and 5-Caffeoylquinic acid. The plant contains 3', 8"-biapigenin, proanthocyanidins (also known as condensed form of tannins) [4]. The plant also contains various phenolic and polyphenolic compounds, saponin, essential oil, polysaccharides and pectin. Amentoflavone is one of the active ingredient of *B. sensitivum* and other plants, has been shown to exhibit various pharmacological activities such as antiviral, anti-inflammatory, antidepressant, antioxidant, and analgesic activities. isoorientin is known to show hypoglycemic and anti-

hyperlipidemic effects, anti-nociceptive, Anti-inflammatory and gastroprotective activities, antioxidant potential, and myolytic activity on uterine smooth muscle of rats and guinea pigs. Luteolin-7-methyl ether is known to exhibit strong cytotoxicity against human lung cancer cell lines (NCI-H187).

Table 1: Various Chemical Constituents of *B. sensitivum* According to their Presence in Various Parts

S.No	Plant Part /Extract	Isolated Compounds
1.	Aerial parts	Amentoflavone & Cupressoflavone, (bioflavone) Polysaccharide, BP100 III, which is composed of galacturonic acid and rhamnose, Luteolin-7-methyl ether, isoorientin and 3-methoxyluteolin 7-O-glucoside (Flavonoids)
2.	Leaves	Orientin, isoorientin, isovitexin, isoorientin 7-O-glucoside, isoorientin 2-O-rhamnoside.
3.	Roots	Epicatechin
4.	Whole plant / Essential oil	1, 4-dimethoxy benzene, 1, 2- dimethoxy benzene, 2-methoxy-4-methyl phenol, (Z)-linalool oxide, (*E*)- linalool oxide, linalyl acetate, 1-octen-3-ol and isophorone

***Rasa Panchaka* – Pharmacodynamics**

In Ayurveda, the classification and categorization of drugs was done on the basis of qualitative analysis. This analysis is done through the *Rasapanchakas* or the five qualities attributes/the pharmacodynamics viz., *Rasa* (taste), *Guna* (property), *Vipaka* (final transformation of quality after primary and secondary digestion), *Veerya* (potency) and *Prabhava* (unexplainable special quality).

Table 2: *Rasapanchaka* of *Alambusha* are According to Different *Nighantus*

S.No	Rasapanchaka	Bhavaprakasha Nighantu [5]	Kaiyadev Nighantu [6]	Raja Nighantu [7]
1.	*Rasa*	*Madhura* (sweet)	*Madhura* (sweet) *Tiktha* (bitter) *Katu* (pungent)	*Kashaya* (astrigent) Slightly *Madhura*
2.	*Guna*	*Laghu* (light), *Sara* (flowing), *Ruksha*	*Laghu* (light)	-----
3.	*Vipaka*	*Katu* (pungent)	*Katu* (pungent)	-----
4.	*Veerya*	*Seeta* (cool and soothing)	*Ushna* (hot potency)	*Ushna* (hot potency)
5.	*Doshakarma*	*Kapha Pitta Shamana, Vata Anulomana*	*Kaphahara*	*Vatahara*

Karma

The drug is *Kapha Pitta Shamana*. *Kaphahara* action is because of bitter and astringent in taste and with pungent post digestion conversion. The plant has got selective scraping action on the unwanted cells that inhabit the body and hence is anti-tumorous, anti-metastatic, anti-angio-genetic and menagogue. It activates the uterus after child birth, inducing contractions and expelling the 1 Lochia and other secretions thereby cleaning up the uterus, thus is a *Garbhashaya Shodhaka Dravya* and hence useful for *Sutika.* With its *Vatanulomana* action the herb corrects all the muscular movements of the body [8]. The plant is showing excellent antibacterial, anti-inflammatory, anti-spasmodic, anti-oxidant, and wound-healing herb because of its astringent, bitter tastes and cold potency. The specific action of the herb on the uro-genital tract helps in treating conditions like diabetes, varicocele and gonorrhoea. It is also a proven radio-protective, chemo-protective, immune-modulatory and cardio-protective.

Pharmacological Actions

The crude extracts of this plant, are traditionally believed to be antioxidants, anti-inflammatory, and anti-tumor activity, radioprotection, immuno-modulation, anti-tumor, anti-bacterial, wound-healing, hypoglycemic, anti-metastatic, anti-angiogenesis, chemoprevention, anti-diabetic, anti-inflammatory are covered [9].

Anti-bacterial property

The use of *B. sensitivum* as an Anti-infective agent was established very recently. Previous research study shows its Antibacterial activity against several human pathogenic bacterial strains (*Bacillus subtilis, Staphylococcus aureus, Streptococcus pneumonia, Klebsiella pneumoniae, Salmonella typhi, Proteus vulgaris*, and *Escherichia coli*). This remarkable level of activity on different test organisms and the activity is quite comparable with the standard antibiotics.

Cardioprotection

Coronary heart disease is characterized by the presence of high blood cholesterol. This increased cholesterol level is the main risk factor for this major life-threatening disease. Also the administration of *B. sensitivum* can improve all the parameters of lipid profile including: very low-density lipoprotein and low-density lipoprotein, except high-density lipoprotein. It also causes slight lowering of plasma glucose, but without any risk of causing severe hypoglycemia.

Anti-inflammatory Response

Inflammation is one of the important causes responsible for association with several diseases like cancer, diabetes, arthritis, Parkinson's disease, Alzheimer's disease, and ulcerative colitis. Research studies were conducted to show the anti-inflammatory action of *B. sensitivum* from the aqueous and methanol extracts of the aerial parts and roots in the carrageenin-induced rat paw edema. The inhibition of edema was found to be maximum in aqueous extract of aerial parts and roots and methanol fraction of roots than the methanol fraction of aerial parts. The important targets for treatment of inflammatory disorders in LPS or Con A- stimulated primary macrophages were, proinflammatory cytokines like IL-1β, IL-6, and TNF-α, *B. sensitivum* shows the ability to inhibits the production of these and there by showing anti inflammatory actions. The gene expression profile showed that B. sensitivum down regulate the expression of Inducible NO synthase and COX-2 and acts as potential inhibitor in inflammatory conditions.

Natural Anti-oxidant Defense mechanism

Antioxidative action plays a major role in the protection of human beings against oxidative damage caused by the highly reactive unpaired electrons referred as free radicals. The increased flux of free radicals reacts with number of biomolecules including DNA, lipids, and proteins and produce toxic effects. The chemical constituent, flavonoids can scavenge these free radicals by means of directly donating the hydrogen atoms and also by various mechanisms. The possible mechanism by which flavonoids can act is through interaction with various antioxidant enzymes.

B. sensitivum was reportedly rich in flavonoids which includes Isoorientin, two biflavones: Amentoflavone and Cupressuflavone, and Phenolic compounds. Amentoflavone inhibits the cyclooxygenase-1- and cyclooxygenase-2-catalyzed prostagland in biosynthesis. The polysaccharide isolated from *B. sensitivum* can enhance the complement fixation. These phytocompounds are responsible for the antioxidant potential of B. sensitivum and also further research works need to be initiated to understand the possible role and to find out which active ingredient responsible for antioxidant action.

Anti-metastatic Quality

The current clinical challenge during the investigation of cancer, includes the eradication or prevention of highly complex metastatic process, which forms the major cause of mortality in various cancer patients. Various multistep, up and down regulation process are involved in the expression of specific genes. The Cancer cells from the primary neoplasm circulate in the body fluids after entering into the blood vessels or lymphatics, which then form a new colony at a distant site. An in – vivo study of B. sensitivum in B16F-10 melanoma-induced experimental lung metastasis in C57BL/6 mice shows significantly reduced lung collagen hydroxyproline, hexosamine, uronic acid levels, serum sialic acid, and gamma glutamyl transpeptidase. It shows an inhibition in the expression level of several proinflammatory cytokines (IL-1, IL-6, GM-CSF, and TNF) and the proteolytic enzymes matrix metalloproteinases.

***Amayika Prayoga*- Therapeutic Uses**

Application of whole plant paste along with butter is done, if bitten by hornets, wasps, bees or any other insects. Intake of 20gm of leaf paste of *Biophytum sensitivum* along with buttermilk helps in arresting diarrhoea. 300ml of decoction of the whole plant twice daily on empty stomach for 45 days is helpful in varicocele and male infertility. 20ml of the fresh juice or 200ml of decoction with jaggery given for two weeks post childbirth cleans the uterus and keeps the womb healthy. Fresh juice 20ml in adults and 10ml in children with one or two pinches of Pippali (long pepper) and honey relieves cough chest congestion and asthma [10]. One teaspoon of the plant ash mixed with lime juice is a good remedy for spasmodic headache and bloating. The seed powdered and mixed with warm water is applied on the abscess to induce and promote suppuration. The whole plant is dried and powdered and 20g of this powder is mixed with 20g each of turmeric powder and *Amla* powder and taken on empty stomach for diabetes. *B.sensitivum* has been used as traditional medicine for several purposes such as expectorant, stimulant, and tonic. It is recommended to be used in the treatment of stomach ache, asthma, treating insomnia, convulsions, cramps, chest complaints, inflammations, wound infections, tumors, and remedying chronic skin diseases. For Asthma and phthisis, the whole plant decoction is used and for gonorrhea and lithiasis, the decoction of root is used. The plant is known as “Nagbeli,” in folk medicine whose leaves are diuretic and pacifies strangury. Paste of the leaf is applied to wounds in order to stop bleeding. *B. sensitivum* is famous for its use against snake envenomation. The whole part of plant is used to counteract the snake venom activity. It is an

indigenous medicine, used against "*Madhumeha*" (diabetes mellitus). In case of bleeding from nose, two teaspoonful of the juice of the entire plant is taken in the evening and morning. For sore throat, *Dhupana* of the dried leaves is done in the morning and evening for 3 days. In the case of *Pittika jwara* and *Trishna*, the whole plant is made into Kalka and dissolved in water. This water is then used. In *Sutika Paricharya*, for the *Shudhi* of the *Garbhashaya*, the leaves of the plant are taken along with *Sarkara*.

Propogation and Cultivation

Biophytum sensitivum is easily propagated through seeds. The seeds are propelled away from the plant by built up tension from where they dry and sown in a mixture of moist peat and sand. In order to increase the humidity, after sowing it is been covered with a transparent cover. The plant requires bright indirect sunlight to partial shade with medium humidity. The temperature needed is about 16°C to 29°C. Also it should be provided with moist soil and water soluble fertilizers during growth season. Also B. sensitivum has been regenerated by callus culture and micro-propagation techniques. Micro-propagation of leaf and shoot tip explants in MS medium containing 0.05mg l-1 TDZ and 1mg l-1 BAP results in formation of 14 shoots. These in vitro regenerated plants from the callus, which is obtained from shoot tip and leaf explants were hardened and transferred to the field, established well and found normal[11]. The entire process is reported to be the regeneration of the plant through direct and indirect organogenesis and somatic embryogenesis using MS medium supplemented with 2, 4-D or NAA along with BAP induced callusing in stem, flower bud explants and inflorescence tip. It is been found that about eighty percent of the root plantlets and ninety percent of the somatic embryo derived plantlets survived on soil medium.

CONCLUSION

In the present era herbal plants with good medicinal value forms the source of life-saving drugs, in order to treat a majority of health problems. Also a remarkable progress in medicinal plants research such as chemical characterization, biological, pharmacological, and toxicological activity of the plants are advancing so fast. Various studies indicate the potential effectiveness of chemical constituents of *Alambusha* along with its diverse medicinal activities. Thus it is confirmed that *B. sensitivum* along with its active ingredients can be used in the maintenance of health and also in the prevention, treatment, or improvement of different disease areas. In the mere further, research works need to be initiated for exploring the various pharmacological activity of this plant extract and its chemical constituents in treating a variety of diseases.

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