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## A REVIEW ON ENDEMIC INDIAN RESURRECTING HERB *SELAGINELLA BRYOPTERIS* (L.) BAK. 'SANJEEVANI'

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**ABSTRACT:** *Selaginella bryopteris* (L.) Bak. usually known as "Sanjeevani", is a lithophyte with remarkable resurrection capabilities and medicinal properties. It is traditionally used for curing wounds and irregular menstruation, uterine disorders and other internal injuries. It contains a variety of secondary metabolites such as alkaloids, phenol and terpenoids etc due to which it can act as antioxidants, anti-inflammatory, anti-cancer, anti-allergic, antimicrobial, antifungal, antibacterial, antiviral etc. It is also used as a strength tonic to improve fitness and to extend lifespan by the local tribal communities of India. The herbs are extensively exploited and sold throughout the country in different markets. There is an urgent need to aware the scientist, researchers, forest officials and local peoples about its medicinal properties, traditional knowledge, economic potential, endemic nature, horticultural and aesthetic value. Its distribution, medicinal and economic potential, taxonomy, ecology, causes of depletion and conservation strategies discussed in brief.

**INTRODUCTION:** *Selaginella* P. Bauev. existed before 300 million years and comes under a group of plants which were the first vascular plants on earth. It is a medicinal plant that has been widely used, either traditional or modern. Small amounts of the species are also used as ornamental plants and vegetables. Family Selaginellaceae Reichb. has only one genus, *Selaginella* P. Beauv., consisting of 700-750 species and widespread in a cosmopolitan way<sup>1, 2</sup>. It is represented by about 62 species in India<sup>3</sup>. *Selaginella bryopteris* (L.) Bak. (Fig. 1) is an endemic pteridophytic species of India and Nepal distributed in warm hilly slopes between 400-1000m altitudes.

It is a lithophytic xerophyte that grows on the hills of tropical areas, particularly the Arawali mountain terrains from east to west in India. It has been reported to have the highest degrees of drought resistance. It is observed that this herb can with stand years of drought very effectively, and still there is no adverse effect in its vigor. The cause for this special power lies in its drought resistant gene<sup>23</sup>. The detached fronds of *Selaginella bryopteris* (L.) Bak. have been said to have unique ability to survive desiccation similar to that of whole plant. The fronds curl, become dry and virtually dead. The herb forms a lush green velvety carpet like landscape during the raining season and in summer it undergoes extreme desiccation<sup>3, 23</sup>.

It is popularly known as *Sanjeevani* which translates as "One that infuses life" derives from the medicinal properties of the herb. It was believed that medicines prepared from this herb could revive a dead person. It is hypothesized that this herb possesses a growth-promoting activity as

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well as protective action against stress-induced cell death that play vital roles in organismal growth and development, tissue homeostasis, and maintenance of genomic integrity. Most of the medicinal properties of the different species of *Selaginella* have been examined under non-native conditions that include extraction of the herb content using organic solvents. Traditional methods of its utilization include soaking them in water over night, preferably in an earthen pot<sup>6</sup>.

The herb infusion taken orally for curing burning sensation during urination, menstrual irregularities, for easy delivery and for curing jaundice<sup>12</sup>. The herb is extensively exploited in very large scale and sold-brought in various markets of the country (**Fig. 3**) under different trade names viz. *Sanjeevani*, *Sanjiwani Booti*, *Lakshnam Booti*, *Mrit-sanjeevani*, *Pathar Chatta*, *Sanjeevan* etc<sup>10</sup>. Therefore the exploitation of the herb should be checked immediately for its conservation; otherwise this magical endemic herb may be lost completely from nature in the near future.

Keeping this in view the general characters, taxonomy, distribution, chromosome number, uses, ecology, medicinal properties, economic potential and conservation strategies of this endemic herb is discussed here in brief. This is also hoped that it may also be useful for naturalist, botanical scholars and forest officials, who can take necessary efforts to check over exploration and formulate conservation strategies as well as methods for sustainable use of this endemic and endangered herb.

### General characteristics

*Selaginella bryopteris* (L.) Bak. is also known as Spike-moss plants that grow on rock crevices and feed off moss, nutrients in rain water, litter, and even their own dead tissue. These usually have dichotomously branched stems, microphylls (small leaves), alternate, opposite or whorled, one veined, sometimes dimorphic (two sizes), with scale like structures called ligules, outgrowths near the base of the upper surface of each microphyll and sporophyll. Unusually for the lycopods, each microphyll contains a branching vascular trace. Roots borne on wiry rhizophores. Life cycle includes various stages having micro sporangia,

megasporangia etc. Microspores are small, numerous, megaspores large, 4 per megasporangium. The gametophyte develops inside the megaspore<sup>3</sup>.

### Taxonomy

*Selaginella bryopteris* (L.) Bak., J. Bot. 22: 376 (1884); Alston: 221 (1945).

*Lycopodium bryopteris* L., Sp. Pl. 2: 1567 (1753).

*Lycopodium circinale* L. ex A. Murray, Syst. Veg. ed.13: 794 (1774).

*Lycopodium imbricatum* Roxb., Hort. Beng.: 75 (1814), nom. nud.

*Lycopodium imbricatum* Roxb. in Griff., Calc. J. Nat. Hist. 1: 475 (1844), non Forssk. (1775).

*Selaginella imbricata* (Roxb. in Griff.) J.Scott, J. Agr. Hort. Soc. India, n.s. 2: 260 (1868).

<i>Selaginella bryopteris</i> (L.) Bak.	
Kingdom	Plantae
Division	Lycopodiophyta
Class	Selaginellopsida
Order	Selaginellales
Family	Selaginellaceae
Genus	<i>Selaginella</i>
Species	<i>bryopteris</i>

Xerophytic heterophyllous herbs; stem prostrate, creeping, stoloniferous, 6-25 cm, differentiated in to nodes and internodes, erect or suberect, simple in the basal lower 2/3, profusely branched and deltoid in the upper 1/3; rhizophores confined to the base<sup>3</sup>.

Isomorphic leaves on the main stem, green, distant, ca up 3 x 2 mm, ovate-lanceolate, denticulate, long-acuminate at tip; heteromorphic leaves on the other branches, contiguous, ascending; lateral leaves ovate, oblique at base, acute to acuminate at apex, midrib short, obscure, white translucent, imbricate, denticulate; axillary leaves similar to lateral leaves; median leaves small, ovate, oblique at base, acute to acuminate at apex, entire to minutely denticulate. Spike short, 3-5 x 1-2.5 mm, at the tip; sporophylls uniform, ovate, acuminate, cuspidate, entire to minutely denticulate. Microspores 12-24µm, yellow granulose. Megaspores 198-268µm, dull yellow, verrucoid<sup>3</sup>.

**Chromosome number:** 2n=20<sup>4</sup>

**Fertile:** July-September.

**Distribution:** India- Uttaranchal, U.P., M.P., Chhattishgarh, Bihar, Odisha, Maharashtra, Tamil

Nadu. Nepal- Common at Western and Central part.



FIG. 1. *SELAGILLELLA BRYOPTERIS* (L.) BAK. IN NATURE (FRONDS CURL AND DRIED)



FIG. 2. THE HERB FORMS A LUSH GREEN VELVETY CARPET LIKE LANDSCAPE DURING THE RAINING SEASON.

### Special ecological feature

*Selaginella bryopteris* (L.) Bak. plays a significant role in the soil conservation, humus and soil formation. It naturally produce dense underground network of stoloniferous long creeping rhizome which holds the soil and water to form dense velvety green carpet like structure (Fig. 2). It protects the soil from direct rain showers and also checks the flowing rainwater<sup>5</sup>.

They also trap the smaller fallen leaves, grass and other biodegradable materials useful for humus formation. This herb can grow well in xeric condition, as an indicator of atmospheric humidity. Leaves curled up in dry weather but retain original colour and shape if dipped upside down in water<sup>6</sup> (Fig. 4 and 5).



FIG. 3. HERB SOLD IN THE LOCAL MARKET



FIG. 4. DRIED FRONDS



FIG. 5. FRONDS AFTER SOAKING IN WATER

### Mythology behind ‘Sanjeevani’

According to Hindu mythology, ‘Sanjeevani’ is a magical herb which has the power to cure any malady. In the *Ramayana* poet *Tulsidas*, mentioned the description of wonder herb, ‘Sanjeevani’ when, Lakshmana fell unconscious, near death, hit by an arrow from Ravana, Sushena (Lankan Royal Physician) asked Hanuman to bring four plants: *Mrutha sanjeevani* (restorer of life), *Vishalyakarani* (remover of arrows), *Sandhanakarani* (restorer of the skin) and *Savarnyakarani* (restorer of skin colour) from Dronagiri Hills. Hanuman, not able to

identify them from the multitude and brought back with entire hill and Lakshmana was revived from near death back to life<sup>5</sup>.

Thus it is likely that *Sanjeevani* had properties capable of awakening or rejuvenating (and in that sense 'resurrecting') him. It is also likely that owing to similarities of the syndrome of this stage with that of death, story tellers have termed the herb as a 'life giver'. Accordingly, if *Sanjeevani* does exist, it should have the ability bringing coma patients back to normal living state<sup>6</sup>.

In Ramayana it has been clearly mentioned that 'Sanjeevani booti' glows in the dark when made slightly wet and kept in dark it glows; emits light. Its properties and usage has also been described. But this has been interpreted to infer that the herb is capable of 'resurrecting' life from death itself. However, the acclaimed ability of the herb can be interpreted in several ways and analyzing these could drive us close to the possible nature of *Sanjeevani*<sup>6</sup>.

### **Ethnomedicinal importance and economic potential**

Human being has been utilizing medicinal plant wealth from time immemorial for the treatment of various types of diseases traditionally. The traditional system of medicine plays an important role in health care of rural and tribal people for all types of ailments. The traditional knowledge of medicinal plants has been well documented in *Charaka Samhita* and *Shusruta Samhita*. They have been used for centuries in Indian ayurvedic as well as in Chinese medicines to treat various diseases. According to the principles of traditional Chinese medicine, *Selaginella* has sweet, spicy, bitter and cold properties, and is associated with the Liver, Lung and Stomach meridians<sup>7</sup>.

Its main functions are to clear heat, reduce toxicity, and drain damp heat. It has been found in ethnomedicinal observation that *S. bryopteris* is used in curing heat stroke and Jaundice<sup>8,9</sup>. Some tribal peoples smoke it with tobacco for hallucination<sup>10,11</sup>. The herb is used as a major ingredient in making local pills for the treatment of spermatorrhoea, gonorrhoeal, venereal diseases, constipation, colitis, indigestion, urinary problems

(diuretic), unconsciousness, and to lower the body temperature in fever<sup>12,13,14,15,16</sup>.

It also used as remedy for liver and epilepsy<sup>17</sup>. In Madhya Pradesh the herb is traditionally used as strength tonic by Gond tribes. They used the fresh paste of young leaves along with sugar/honey in stomachache and urinary tract inflammation for children<sup>18</sup>. The women tribes of Bastar region of Chattishgarh uses dried powder of herb in gynecological problems like menstrual irregularities, leucorrhoea and to minimize the labor pain<sup>19</sup>.

Herb paste is used orally to cure beri-beri, dysentery and for rejuvenating when given with milk of cow used by local indigenous people of Songhati, Sonbhadra UP.<sup>20</sup> The chemopreventive and anticarcinogenic potential of *S. bryopteris* (L.) Bak. was examined. It could be an effective herb in preventing neuro-degeneration<sup>21</sup>. However, there is no evidence as yet to illustrate its possible effect in recovering patients from the state of coma or unconsciousness.<sup>22,23</sup>

The plant is beneficial for horticultural and trade value. It can use for indoor decoration and in flower bouquets for longer time<sup>24</sup>.

### **Molecular bioactivities**

The herb contains a variety of secondary metabolites and bioactive compounds such as alkaloids, phenol (flavonoids, tannins, saponins), and terpenoids (triterpene, steroid). The main secondary metabolite of this herb is biflavonoid, whose type is various depending on the species<sup>25</sup>.

These compounds act as antioxidants, anti-stress, antiinflammatory, anti-cancer, anti-allergic, antimicrobial, antifungal, antibacterial, antiviral, antiprotozoan, anti UV-irradiation, anti-spasmodic, vasorelaxant, heart boosters, antihypertensive, anti-clotting, and affect the metabolism enzymes<sup>25,26</sup> evaluate the antimicrobial, phytochemical, minimal inhibitory concentration (MIC) and minimal bactericidal concentration (MBC) activity of the *S. bryopteris* used in folkloric medicine compared to all test showed significant activity against tested microorganism like *Bacillus subtilis*, *Staphylococcus aureus* and *Staphylococcus*

*epidermidis*. Biflavonoids are naturally occurring compounds that are omnipresent in all vascular plants and have many favorable biological and pharmacological effects<sup>27</sup>.

A series of eleven biflavonoids containing amentoflavone and hinokiflavone derivatives from *S. bryopteris* had been investigated for their antiprotozoal activity using in vitro assays against the KI strain of *Plasmodium falciparum*, *Leishmania donovani*, *Trypanosoma brucei*, *rhodesiense* and *Trypanosoma cruzi*<sup>28</sup>. Out of these two biflavonoids hinokiflavone is also effective against HIV Infections too<sup>29</sup>.

The aqueous extract of the herb possesses significant growth promoting and protective activities against several stress-induced apoptosis in experimental cell systems<sup>30, 31</sup>. Water extract of *S. bryopteris* also significantly reduces potent cell dying caused by UV irradiation and increases endurance to oxidative stress, assists cell growth and protects from free radical stress caused by H<sub>2</sub>O<sub>2</sub><sup>33</sup>.

Chemical analysis shows that the herb contains hexoses and proteins<sup>32, 34</sup> suggest that *S. bryopteris*, has about 250 proteins that expressed in response to dehydration and rehydration, and involved in transport, targeting and degradation in the desiccated fronds. Methanolic extract of *S. bryopteris* significantly improved learning and memory of Swiss Albino Mice.

Antioxidant property of herb may be contributing favourably to the memory enhancement effect<sup>35</sup>.

Various physiological and biochemical changes of the fronds during desiccation and rehydration, to get an insight as to how this plant adapts and survives through the dry phase has been studied<sup>36</sup><sup>37</sup> observed silica deposition of biological origin in different parts of 14 species of pteridophytes including *S. bryopteris* and proposed that the presence of silica in the early land plants suggests that the mechanism of silica absorption and accumulation was developed early in the evolution of terrestrial vegetation, because silica was important for the survival of terrestrial life as it gave mechanical stability of tissues, protection

against fungi and pests, and resistance against drought by checking evaporation.

### Conservation

Starts from next line moisture and shade loving like other pteridophytes. Their life cycle depended upon the microclimatic conditions of the region for their successful survival. They are facing several hurdles for their survival. Any kind of habitat disturbance in microclimatic conditions can destruct the growth and evolutionary processes occurring naturally, which enormously decline their populations.

Thus, factors like climate change, increasing urbanization, industrialization, encroachment of forest lands, unplanned developmental activities, over exploitation of natural resources, pose a major threat to the survival of the species. Due to deforestation the number of economically valuable plants have been reducing day-by-day. The uprooting of plants before sporulation makes the risk double which inhibit both vegetative and sexual reproductive cycles of plant. Over exploitation of medicinally/economically important species from the forests by the visitors and local people for medicinal purpose and during excursions also increases the pressure on these plants.

As the causal factors leading to depletion of species are immense and continued, further efforts are required to document more such taxa from the field. In view of this the factors leading to depletion of species in the forest area has been studied. Both types of conservation (*ex-situ* and *in-situ*) and multiplication measurements are proposed. The local tribes are cultivating them in abandoned sites of shifting agriculture and also in scared groves as *in situ* conservation of biodiversity and ecological restoration<sup>38</sup>.

Habitat preservation is important and only way to save this taxa because a little habitat disturbance may be cause extinction of the taxa. For *ex situ* conservation special efforts are not given much to the case of pteridophytes as compared to the flowering plants. In majority of the gardens there are very few ferns which are grown mostly as ornamental ferns and not as a medicinal ferns. The *ex-situ* conservation of medicinally important ferns may be strengthened by setting up more and more

ferneries in different parts of the country particularly near by the sanctuary or biospheres. The *ex-situ* conservation through *in vitro* tissue culture or spore culture has to be done at least in the some medicinally important species like *Selaginella bryopteris* (L.) Bak.

The reproductive biology of the species should be studied and scientifically approved well managed harvesting methods should be recommended for its cultivation and sustainable use. It is necessary to organize the awareness program especially for local public and forest officials about the endemic taxa of the area. There is an urgent need to aware the scientist, forest officials and local peoples/stake holders about its endemic nature, threatened status and risk of depletion.

This is moreover a large percentage of the Indian fern flora is endemic to the country and therefore needs special attention as far as conservation is concerned. Any disturbance inflicted on ferns is sure to affect the biological equilibrium in the forest ecosystem. Cultural symbols such as sacred groves may yet be another way of *in-situ* conservation of plant biodiversity. The trade should be organized and well managed under the control of forest department, NGOs or any local agency approved by the government.

**CONCLUSION:** Several species of *Selaginella* are also used as food (raw vegetables), ornamental plants, handicrafts materials as well as socio-cultural and packaging materials. The utilization of *Selaginella bryopteris* (L.) Bak. is limited compared to the other of species. The herb has many therapeutic properties and traditionally used by local people in curing heat stroke and the burning sensation during urination, to control menstrual irregularities, helping in easy child birth to minimize the labor pain and in the treatment of Jaundice.

It is also used as a tonic to improve fitness and to expand life span. It requires further ethnobotanical and phytochemical researches.

This paper may also be advantageous for nature lovers, botanical scholars and forest officials, in conservation and sustainable use of this endemic

and endangered plant. So it is important to explore more and more about this wonder herb and effort should be made for its conservation.

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