



Study on Uses and Trading of *Huperzia squarrosa* (G. Forst.) Trevis. (Lycopodiaceae) in Manipur, India

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Research

Abstract

Huperzia squarrosa (G. Forst.) Trevis. (Lycopodiaceae), locally known as **leishang** in Manipur, India, serves as a potential subsistence for livelihood to many people. It is extensively used by three main communities: Meiteis for cultural purposes and Nagas and Kukis for beautification, handicraft, and medicinal purposes. A critical analysis on the trading system showed that womenfolk dominated the entire workflow of activities like harvesting, transportation of plant materials from forests, and even regulating seasonal market prices. Detailed morphological parameters along with the biological life cycle are briefly highlighted. Introduction of conservation plans, training local communities on harvesting methodologies, and formulation of systematic marketing strategies are highly recommended.

Introduction

The tassel fern, *Huperzia squarrosa* (G. Forst.) Trevis. of Lycopodiaceae, is a graceful fern ally greatly acclaimed worldwide as an ornamental species and makes for a stunning specimen hanging in lawns, gardens, arboreta, corridors, verandas, glass houses, etc. (Jones 1987, May 1978, Singh *et al.* 2001). They are epiphytes which grow at high altitudes in moist forests and can adapt to terrestrial and lithophytic conditions. *Huperzia* is a potential medicinal herb that can be used to treat several disorders of brain functioning, including Alzheimer's disease, Parkinson's disease, treatment of contusions, strains, swellings, schizophrenia, and myasthenia gravis (Chang & But 1987, College 1985, Ma 1997). It possesses alkaloids such as Huperzine A (Hup A), Huperzine B (Hup B), N-methyl-huperzine B, Huperzidine, Lycoporine A, and Carina-tumine A. Even though *Huperzia serrata* (Thunb.) Trevis. was previously regarded as a potent producer of Hup A ($80.16 \pm 0.17 \mu\text{g/g}$), *H. squarrosa* also has been found

to yield significant amount of Huperzine ($378.83 \pm 0.33 \mu\text{g/g}$) (Singh & Singh 2010). Tassel ferns or "tassels" are significant in Manipur culture and tradition. Trading of **leishang** (local name for the species in Manipur) has been occurring for centuries. The main indigenous communities of Manipur, like Meiteis, Nagas, and Kukis, use it for diverse purposes. The Nagas and Kukis hill forest tribes harvest the plants and transport them to the valley where Meiteis do further trading.

The aforesaid two communities (Nagas and Kukis) are recognized as Schedule Tribes (ST) under Article 342 of the Indian Constitution and have adopted Christianity as their religion. They use tassels mainly for fernery and handicraft purposes. Even though tassels are widely accepted as an elite medicinal herb for curing Alzheimer's disease, knowledge on their ethno-medicinal property is limited to few indigenous people and remains undocumented. In order to achieve a clear picture of tassel-related ethnobotanical uses obtainable in Manipuri society, a research program was initiated under the Department of Science and Technology (DST), New Delhi, India. The study focuses on morphologi-

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Ethnobotany Research & Applications 11:153-161 (2013)

Published: August 27, 2013

www.ethnobotanyjournal.org/vol11/i1547-3465-11-153.pdf

cal and biological parameters which will serve as a guide in harvesting tassels for sustainable utilization. Further, it highlights various trading activities, potential of tassels as an emerging medicinal herb, and their endorsement as a non-timber forest product for the state of Manipur.

Materials and Methods

Study site

The present study was conducted in Manipur during 2009–2011. Manipur covers a total geographical area of 22,327 km² and is located at the extreme eastern part of India between 23°83'–25°68'N and 93°03'–94°78'E. An oval-shaped valley (1,843 km²) is located in the center of Manipur and is surrounded by hills with peaks rising up to 2,590 m. Ninety percent of the total state area is covered by hills. According to a 2011 census, total population of the state is 2.7 million distributed in nine administrative districts: Bishenpur, Chandel, Churachandpur, Imphal East, Imphal West, Senapati, Tamenglong, Thoubal, and Ukhrul. Among these, Imphal East, Imphal West, Thoubal, and Bishenpur are valley districts and house about 70% of the total population, while the remaining are hill districts. Three native communities dwell in the state: Hindu Meiteis in

the valley districts and Christian Nagas and Kukis in the hill districts (Figure 1).

Data collection

Relevant data was collected and analysed through frequent field trips during 2009–2011. Numerous and individual group meetings were conducted to discuss various ethnobotanic uses, cultural significance, and economic implications. Questionnaires modelled on the design by Parabia and Reddy (2002) and Rout and Panda (2010) were employed for collection of data. Respondents were comprised of 100 Meiteis, 50 Nagas, and 50 Kukis, all between 40–80 yrs, and were interviewed to assess cultural and other ethnobotanic uses. Mode of harvesting, routes of transportation, market price, and other livelihood benefits derived from the plant were studied. Wholesale and retail prices were calculated by taking mean average culled from 10 local markets in the valley and expressed in Indian Rupees (INR). One US dollar equalled 48 INR at the time the field study was conducted. It is noted here that prior consent was taken from every respondent and other related informants.

Morphological and biological parameters

Detailed morphological and biological parameters were assessed from the mature sporophytic body using

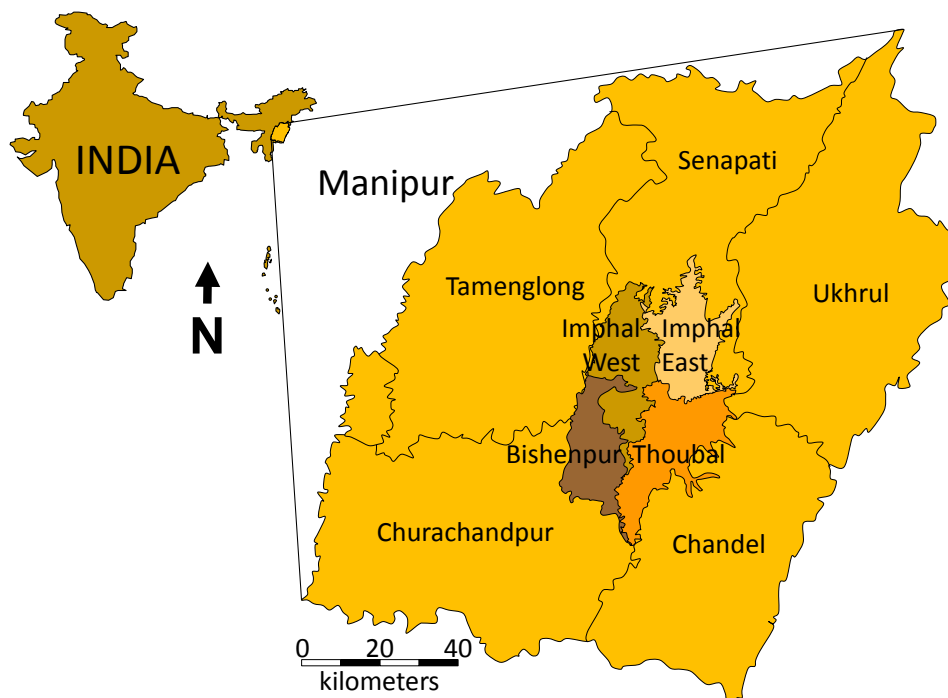


Figure 1. Location of the state of Manipur, India, and its nine districts. The outer five districts are considered hill districts while the inner four are lower elevation valley districts. Of the three native communities present in the state, Meiteis live in the valley districts while Nagas and Kukis live in the hill districts.

Baishya and Rao (1982), Bir *et al.* (1989), Cody and Britton (1989), Ghosh *et al.* (2004), and Wagner and Beitel (1992). The specimen was also compared with the herbarium at Botanical Survey of India (BSI); Central National Herbarium, Howrah, Kolkata; and BSI (Eastern Circle), Shillong. Spore samples were studied through scanning electron microscopy (SEM). Specimens were collected in triplicate and deposited in Manipur University Museum of Plants (MUMP).

Results

A. Morphometric features

The sporophytic body of *H. squarrosa* is differentiated into rhizomes and aerial stems (Figure 2A; Figure 3A). Rhizomes are thick and attach to the substrate for acquisition of nutrients and water. The stem is pendulous, with dichotomous, isotomous branching extending up to 60 cm. Leaves are microphyllous and arranged in a spiral manner. All the leaves are monomorphic, linear with size up to 1.5 × 0.1 cm, and sharply acute, with margins entire, coriaceous, and shining. Sporophylls are located at the terminal ends of pendulous stems, and strobili may range from 5–15 cm (Figure 2D). The sporangium is reniform with a distinguishable stalk and capsule (Figure 2B). It is unilocular and loosely arranged in whorls of 5 or 6 in number and raised on a short stalk to facilitate effective spore dispersal. Dehiscence takes place by transverse apertures on the upper surface. Spores are unicellular, averaging 29 × 30 µm, trilete via dissociation of tetrad, and sub-

triangular in outline with rounded angles. Surfaces exhibited foveolate ornamentation (Figure 2C).

Specimens examined: INDIA. Kameng Frontier Division (NEFA): Amatala, 8 May 1958, G. Panigrahi 15169 (ASSAM 8972); Flora of Assam, 26 Apr 1942, G.K. Deka 21206 (ASSAM 36933).

BRAZIL. Bahia: Serra da Agua de Rega, 23 km N of Seabra, road to Agua de Rega, ca. 1000 m, 24 Feb 1971 (fr), Irwin *et al.* 30894 (HB, MBM, MO, NY).

B. Cultural significance

Leishang or tassel fern is required for most socio-religious traditional ceremonies besides being used in almost 15 auspicious cultural occasions by the Meitei community of Manipur. For a man, it is necessary in any important cultural activity, from birth to death. Tassels are believed to be a sacred plant. Hence traditional birth, marriage, and death ceremonies cannot take place or be complete without use of tassels either as dried or fresh twigs. However, many ceremonies associated with **leishang** have stopped using/incorporating it due to its scarcity. It has been replaced by similar-looking twigs like those of *Araucaria heterophylla* (Salisb.) Franco. Thus, the conventional belief of it being a sacred plant to be used for all religious ceremonies is getting diluted day by day. This change can be interpreted as a major cultural adjustment necessitated in the wake of biodiversity depletion.

Some essential modes of use and cultural applications along with vernacular names are listed in Table 1. Maximum usage (100%) is seen during marriages and child-

Table 1. Meitei cultural practices involving **leishang** in Manipur, India. Vernacular names are in Meitei language.

Purpose/Occasion	Vernacular name	Usage (%)
Meitei marriage	Lu-hongba	100
Child-bearing worshipping (by couples)	Macha-dhara-neebe	100
Christening of a baby	Lukun-thangba	92
Worshipping of sacred grooves god/goddess	Lai-haraoba	73
Birth celebrations	Swasti puja	65
Cleansing of body before funereal burning	Hakchang-shendokpa	61
Offerings to forefathers	Tarpan-katpa	41
Annual prayers to prosperity goddess	Emoinu	37
Remembrance of deceased	Utsav	24
Granary worshipping	Kot-lai-khurumba	18
Inauguration of new house, offices, etc.	Sang-gaba	8
First ear-piercing	Nahutppa	7
Charms for sports, exams, illness, etc.	Dao-yannaba	5
Lucky amulets for elections	Voteki-dao-purakpa	2
Coronation of kings (during monarchy)	Ningthou-khubam Sinaba	0

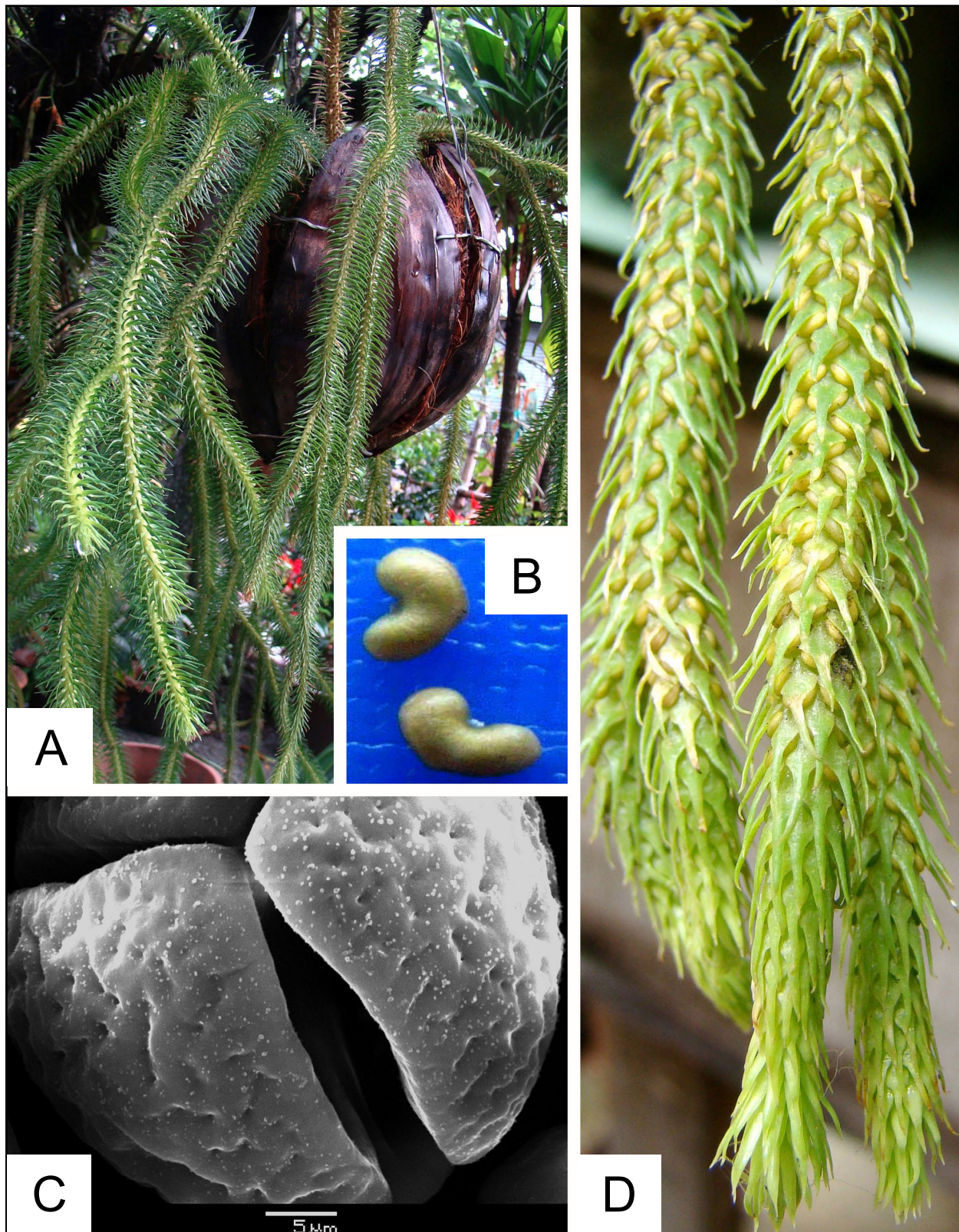


Figure 2. (A) Epiphytic habit of *Huperzia squarrosa* (G. Forst.) Trevis. (Yumkham & Singh 2012); (B) sporangia; (C) spores ornamented with foveolae; (D) stems with mature sporophylls.



Figure 3. (A) Lithophytic habit of *Huperzia squarrosa* (G. Forst.) Trevis.; (B) tribal woman collecting wild plants; (C) leishang along with other plants sold in a local market by tribal harvestors; (D) old twigs for sale.



Figure 4. (A) View of women's market (Nupi Keithel) in valley; (B) **leishang** inside a bronze pot for a Meitei marriage ceremony; (C) **leishang**-related handicraft work; (D) Meitei woman selling **leishang** with a variety of items; (E) **leishang** for a child-birth worship ceremony.

bearing ceremonies by married couples (Figure 4B, 4E).

C. Leishang in ferneries and handicraft works

Traditionally, the Nagas and Kukis are experts in fernery works. They are renowned for cultivating wild plants, orchids, bamboos, grasses, etc. for ornamental and commercial purposes. **Leishang** is highly valued as an orna-

mental fern. Mature sporophytes are planted in pots and sold in local markets at high prices. A mature plant bearing 4–5 pendulous stems cost 200–300 INR. A beautiful integration of **leishang** in tribal handicraft work was observed during the study. It is used as decorative stuffs in cane- and bamboo-related handicraft works like baskets, fans, trays, vases, ashtrays, gift boxes, seat bases, and flower and other decorative and utility

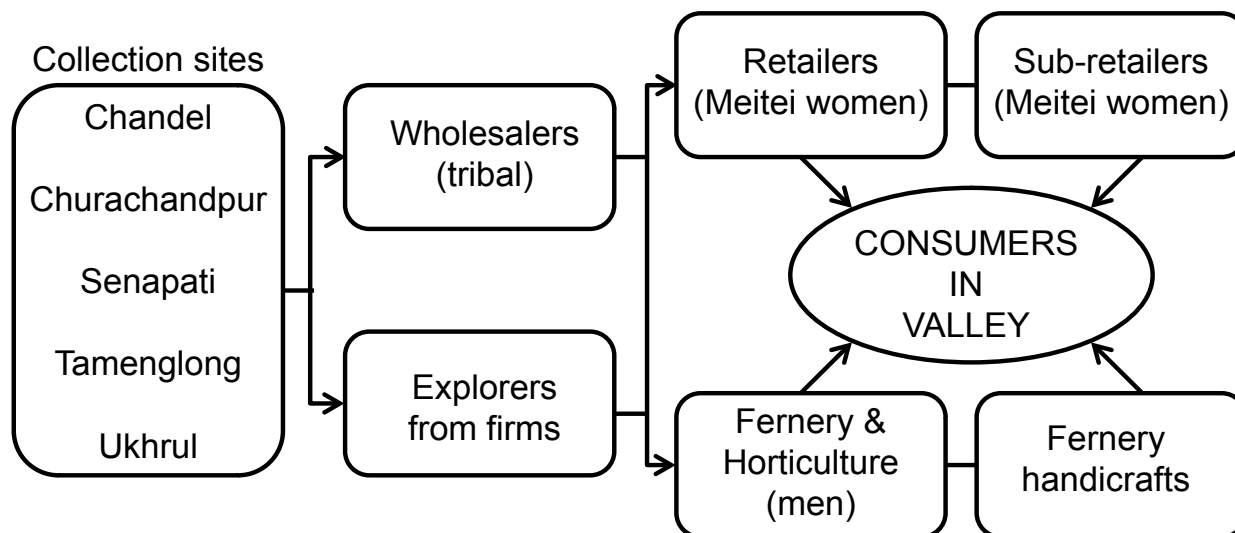


Figure 5. Flowchart showing routes of **Leishang** trade. In general, trade moves from the collection sites (left) to consumers (right).

articles (Figure 4C). Parts of these plants are dried, colored, weaved, knitted, and even used for tying garlands, thus providing an excellent alternative decorative item. Stems remain green for many days without withering and remain devoid of infections if preserved carefully.

D. Leishang as a source of economic trade

Leishang trade plays an important role as a non-timber forest product in Manipur’s socio-economy. A unique feature in the trade is women’s dominant role; they exclusively run the market. This has empowered women as they are the key marketers in the women’s market known as Nupi Keithel (Fig-

ure 4A). All plant products including **leishang** are sold here. Women traders are mostly between 40–80 yrs old. In contrast, tribal women are comparatively younger, and the upper age limit never exceeds 70 yrs. Nagas and Kukis traders are 10% literate, whereas Meitei traders are 40% literate. Earnings derived from the trade have helped secure financial independence for the women, hence helping in the family expenditures (76% and 62% in valley and hill districts, respectively). Among the women traders, 23% in valley and 22% in hills are widows. Divorcees (15% in valley; 20% in hills) also have significant representations. Many women are also involved in other secondary business like weaving, farming, and wood collecting from forests. An overall profile on women in the tassel trade is listed in Table 2.

Table 2. Profile of women in the tassel (*Huperzia squarrosa* (G. Forst.) Trevis.) trade in Manipur, India.

Attributes of women in trade	Valley (%), n = 100	Hill (%), n = 100
Age in years:		
(40–50)	29	46
(51–60)	41	35
(61–70)	26	19
(71–80)	4	–
Family responsibility (financially) as:		
• House leaders	76	62
• Secondary	24	38
Marital status:		
• Married	62	58
• Widowed	23	22
• Divorced single	15	20
Education level (Primary–High School)	40	10
Secondary business besides tassel trade	100	100
Years in trade	7–20 yrs	5–8 yrs

The **leishang** trade is active throughout the year, mainly in the valley region. It starts with direct collection of raw materials from hill forests of Chandel, Churachandpur, Senapati, Tamenglong, and Ukhrul districts, and then subsequent transportation towards the valley area through different routes (Figure 5). Nagas and Kukis are forest dwellers and are primary producers and wholesalers. During collection, the whole plant can be uprooted or small plantlets from host trees can be taken out with the help of long bamboo sticks or by directly climbing (Figure 3B, 3C). Not only tassels but a variety of rare orchids and plants (e.g. *Asplenium* L., *Citrus* L., *Magnolia* L., *Rhododendron* L., *Rosa* L., and *Platyserium* Desv.) are also usually collected. The method of raw material transportation is very primitive and unscientific. After being harvested and carelessly stacked inside a sack, the plants reach the capital city, Imphal, after almost 10–20 days. Many times plants are uprooted without any manual tools, and therefore mature potential sporophyllous stems are broken off from the mother plant. Such spoiled segments are also sold at lower prices. In valley districts, the wholesalers supply their materials to two groups of traders: Meitei women or private ferneries/horticultural companies. The valley women traders are the retailers, and the goods are dispersed to various sub-retailers, thus reaching out to every nook and corner of the valley region (Figure 4D). Prices are seasonal and depend on the number of stems with healthy rhizomes. Tassels are most expensive during winter (102 ± 7 INR for wholesalers; 283 ± 10 INR for retailers) as the sporophytic body becomes dormant and vegetative growth ceases. During the rainy season, commercial activity is high due to greater supply of plants, and therefore prices decrease (43 ± 3 INR for wholesalers; 161 ± 7 INR for retailers). This is the time when Meiteis store reserved plant materials in dried form for future lean seasons. As Meiteis are Hindu by religion, most marriages and religious ceremonies take place October–March as these months are considered more auspicious. During this time, tassels are in great demand, which drives prices upwards. Dried fragmented stems are sold in pieces of about 13–25 cm or more (Figure 3D). A 13 cm segment of stem may cost 20 INR. There is another group that orients the trade only for horticultural or fernery purposes. They are independent representatives from private firms, and collect the tassels themselves or from tribal wholesalers. Only men are involved in this category. Plants are sold by these firms for ornamental and handicraft related purposes.

E. *Leishang* as a medicinal plant

Huperzia squarrosa contains 378.83 ± 0.33 $\mu\text{g/g}$ of Huperzine A (Hup A) which is an important alkaloid used in treating various brain disorders and enhancing memory (Sun *et al.* 1999). In Manipur, the medicinal property of this plant is rarely investigated, and few herbal healers

use or recommend it. This is mainly because there is an ethnic communication gap (topography, religion, tradition) among the diverse communities. Many within the youngest generation today are not familiar with this plant as it is seldom seen growing. The extract of this plant species mixed with honey is taken as a health tonic by women over 40 yrs to cure infertility and frigidity problems. It is sometimes mixed in equal proportions with extracts of *Panax ginseng* C.A. Mey., *Allium sativum* L., and *Withania somnifera* (L.) Dunal to increase sexual urge and stamina and cure impotency. Twigs harvested during winter are sun-dried and finely powdered and taken as supplementary tonic to boost memory, mainly during examinations, and to cure epilepsy and sleeping disorders. In the past, the general public was prohibited to consume **leishang** by tribal heads/kings (locally known as **khulakpa**) because the leaders feared its intake may enhance more thinking power and intelligence. Sporophylls with mature spores and sporangia are collected and powdered for year-long storage. These are dusted as antiseptics during accidental cuts, bruises, skin ruptures, etc., mainly by tribal communities in hilly interior regions.

Conclusions

The present study showed the influence of traditional and religious beliefs on the ethnobotanic uses of **leishang** in Manipuri society. The study also highlighted its explicit acknowledgment as an ornamental plant throughout Manipur State. Women perform key tasks in **leishang** trade like plant gathering and post-harvest preservation. Socially and economically, women occupy fair and equitable positions and can play an instrumental role in future conservation of *H. squarrosa*. Therefore, a policy that can assure full participation of women in biodiversity conservation and relevant management programs is needed. Training and orientation programs of local traders on simple harvesting methodologies and systematic marketing strategies are very effective steps towards sustainability of tassel ferns. Finally, we come to know that *H. squarrosa* is a highly versatile plant, both economically and medicinally. As the family Lycopodiaceae is native to South East Asia, species diversity of *Huperzia* in Manipur is also high. Allied family members like *Huperzia phlegmaria* (L.) Rothm. and *H. serrata* are also collected and sold in local markets. It is therefore necessary to evaluate the baseline information for these species so that tassels can be protected as one of the main non-timber forest products. In addition, it can dimensionally enhance various cultural uses, preserving ritual traditions and advancing conservation strategies for sustainable utilization.

Acknowledgments

The authors are thankful to Department of Science and Technology (DST), New Delhi, for financial support (Grant

No. F.SSD/SS/012/2009). The support received from herbal healers, practitioners, women folk, street vendors, informants, and various academicians during the course of study are acknowledged.

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