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TRANS-HIMALAYAN TRANSMISSION, OR CONVERGENCE? STAUNTONIA (LARDIZABALACEAE) AS AN ETHNOVETERINARY MEDICINE

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SUMMARY

We explore the use of Stauntonia angustifolia (Wall.) Wall. ex Christenh., and Stauntonia latifolia (Wall.) Wall. ex Christenh. as ethnoveterinary medicines in the greater Himalayan region. This use, while not common and limited to mid-elevation mountain regions, stretches at least 1900 km from the Garwhal Himal in west Himalayan India to the Hengduan Shan in east Himalayan China. We trace the geographic and cultural distribution of the species, their uses, and their names. In sum, these suggest two possible scenarios, both connected to mountain pastoralism: 1) lateral transmission along the Himalayan mountains through seasonal transhumance interactions and 2) convergence on similar animal medical uses driven by use of Stauntonia vines as rope in animal handling. More pan-Himalayan ethnobotanical studies could support these hypotheses with other plant species and uses, and help to understand how knowledge moves in mountains.

Introduction

Reaching from a few hundred meters above sea level to more than 8,000 m elevation, the massive mountain ranges that make up the greater Himalaya are one of the world's largest terrestrial barriers. The range divides weather systems, organismal ranges, and cultures.

Key words: Himalaya - Knowledge Transmission - Ethnoveterinary - Lardizabalaceae

Trade routes have famously pierced this barrier, traveling from the lowlands south of the Himalaya to the high Tibetan Plateau, facilitating the movement of people, goods, and knowledge along a north-south axis. Linked by these north-south routes, but travelling only through the flat areas relatively distant from the mountains were the lateral routes: the Grand Trunk Road through northern India and the Ladakh-Lhasa route on the Tibetan Plateau[1]. Viewed in this context, the Himalayas might constitute a far more imposing barrier to east-west knowledge transfer then to north-south. In fact, political entities, tight networks of transmission, and formal systems of medicine have historically spanned swathes of the northern Indian subcontinent or the Tibetan Plateau, while the greater Himalayan mountainous regions have generally remained ethnically, politically and linguistically diverse[2]. Medicinal plant traditions and other ecological knowledge systems of the area are similarly complex[3]. In contrast to this, an emerging line of thought suggests that just as mountainous regions can act as archipelagos rather than barriers for montane organisms[4] so also can they be avenues of transmission for knowledge[5]. Knowledge widely spread along mountain chains suggests such transmission, and thus, may challenge the "barrier" notions about how knowledge moves in mountains.

In 2011, we conducted a series of surveys of plants cultivated in homegardens in the Hengduan Mountains at the eastern extreme of the Himalayan region, in Northwest Yunnan, China. Part of the diverse constellation of Himalayan ethnicities, the Naxi people with whom we worked have a long tradition of courtyard gardening that combines Chinese horticultural influences with the unique mountain flora of the area packaging a great number of plants of cultural and utilitarian salience into domestic space. In one garden, we encountered a vine identified with regional references[6] as *Holboellia angustifolia* (Fig. 1). The Naxi woman cultivating the garden reported that the leaves of this plant, crushed, were used to treat the

Fig. 1. *Stauntonia angustifolia* 'zaiyizhi' cultivated in a Naxi courtyard garden in Southwest China. This represents the westernmost extent of *Stauntonia*'s use as an ethnoveterinary medicine.

wound of horses or cattle. In 2011 - 2013, while conducting interviews in villages surrounding the Kedarnath Wildlife Sanctuary in the Garwhal Himal of west Himalayan India, we encountered a closely related species (or subspecies, as we discuss below), identified as *Holboellia latifolia*, the leaves of which were reported as being used to treat the "cuts and wounds of cattle"[7]. Intrigued by

the identical use across >1900 km from the far-western to the far-eastern ends of the greater Himalayan region, we conducted a comprehensive literature search to trace the geographic and cultural distribution of the species, uses, and names.

Holboellia has recently been absorbed by closely related *Stauntonia*, resulting in a genus of 28 species[8]. Genera within Lardizabalaceae are shrubs (especially *Decaisnea*) or, more commonly, vines or lianas. The family exhibits a disjunct distribution, with two monotypic genera, *Lardizabala* and *Boquila*, occuring in SW South America and the remaining 38 species in 5 genera distributed in east Asia and the Himalayas. Among these, *Stauntonia angustifolia* (Wall.) Wall. ex Christenh. and *Stauntonia latifolia* (Wall.) Wall. ex Christenh. are the only ones common throughout the Himalayas and extend far west of the other species (Fig. 2). They are monoecious vines with 3-9 foliate leaves, sepals in sets of three, and oblong fleshy fruits[9].

Taxonomic history

Stauntonia angustifolia is still often nominated in recent floras and ethnobotanical works as *Holboellia angustifolia* Wall[10], or *Holboellia fargesii* Réaub[11]. *Stauntonia latifolia* was often recently nominated as *Holboellia latifolia* Wall[12]. These names date back to Wallich's original 1824 description of the two species[13] (Fig. 2). Although only recently validly described, the names *Stauntonia latifolia* and *Stauntonia angustifolia* were published by Wallich for the two species as early as 1830[14], perhaps after he decided to re-use *Hoelboellia* for a genus of grasses[15]. Wallich gave no description at that time and cited the author of these names as Brown. Even so, Wallich is now the standard authority for these *nominem nudum*[16].

By 1872, Hooker & Thompson had combined the two species, treating *Stauntonia angustifolia* as *Holboellia latifolia* var. *angustifolia* and *Stauntonia latifolia* as *Holboellia latifolia* var. *latifolia*. This treatment persists in many modern resources, especially those for

Fig. 2. *Stauntonia latifolia* (A) and *Stauntonia angustifolia* (B) depicted in their first description by Wallich (Wallich, N. *Tentamen Florae Napalensis Illustratae*. Calcutta, Asiatic Lithographic Press, 1824) in which they were known as *Holboellia*.

the central and Western Himalayan area[17]. The species are separated in east Asian treatments[18] and in the recent retreatment as *Stauntonia* by Christenhusz, although the latter warns "it should be noted that the differences between species of *Stauntonia* are often minute, both morphologically and genetically, and may not warrant recognition[19]."

Local names - a deeper taxonomic history?

The local name *gophal* (including variants in typography or pronunciation *golfa, gofla/gophla/gufla, gupla, gooplea, guphala/gufala, gumphal/gomphal, ghomphala*, *gonfla* and sub-taxa *charigophala* and *seto guphala*) is widely applied to both *S. angustifolia*[20] and *S. latifolia* throughout the Himalaya[21]). In fact, the name is given (as *gooplea*) in Wallich's 1824 description of the two species. He also

gives the vernacular name *baegúl* (also seen elsewhere in the literature as *bagul*[22]), and reports that both names were used for both *S. latifolia* and *S. angustifolia*: "Hoboellia angustifolia, Wall …. Nomina vernacular, statio, tempus florendi, fructumque maturation eadem ac praecedentis"[23].

Gophal and its variants are reported from a variety of language groups, including Indo-European (Nepali, Kumaon) as well as Sino-Tibetan (Magar, Chantyal, Tamang and Sherpa). However, other less widely-spread names are associated with specific Himalayan language groups: in India generally *gukhnial* and *ranikepa*[24]; in Nepal *malkati*, *chiriyanauri*/*chiriyanaugri*[25] and '*paktasi* (Khaling[26]); in Sikkim *kaolrik*/*kuolrik*, *pronchadik*/*proncharik* (Lepcha, in which the *-rik* suffix indicates vines or creepers[27]) and *domhyem* (Bhutia); in Bhutan *adhurubji*/*enterobjay* (Dzongkha[28]), *throkckchangru* and *khrogchang sey* (Tshangla/Sharchop[29]); and in northeast India *khropchang* (Monp[30]), *sohlygnkait* and *mirangsa* (Khasi[31]), *mezutsuk*/*mezutsuk-moli* (Chungtia[32]) and *toktoim*[33]. In Southwest China, the Naxi informant growing *S. angustifolia* reported its name as *zaiyizhi*. The species also occurs in Joseph Rock's encyclopedic dictionary of the Naxi pictographic/ideographic writing system (Fig. 4)[34]. Here, it is identified as *Holboellia fargesii* (since combined with *Stauntonia angustifolia*[35]), and given a phonetically equivalent name (*tsan-yi-dshi*) to that elicited in 2011. In Chinese, *S. angustifolia* is 五月瓜 *wuyuegua* 'May melon' and *S. latifolia* 八月瓜 *bayuegua* 'August Melon'[36]. Two additional species with more easterly distributions but with Chinese cultural salience are *S. coriacea* 鷹爪枫 *yingzhaofeng* 'eagle claw maple', and *S. chinensis* 野木瓜 *yemugua* 'wild wood melon'[37]. The range of *S. chinensis* barely occurs in Yunnan[38], and so a reference in the Yunnan indigenous language Yi of *yaimogua* for *Stauntonia chinensis*[39] is probably in fact an instance of the Chinese name being borrowed into Yi to refer to a more common local species such as *S. angustifolia*. A similar process is possible for *S. coriacea,*

the range of which does not occur in Yunnan, but the Chinese name of which (*yingzhao-feng*) is phonetically similar to the Naxi name *zaiyizhi* (again, referring not to the eastern Chinese species, but to that which does occur locally, *S. angustifolia*). Indigenous-language borrowings from Chinese, and on the other hand Chinese transliterations of indigenous plant-names and place-names are common in Yunnan, whose diverse cultures and languages have existed at the borders of China for hundreds of years.

Other names also connote transmission or disjunction. *Gophal* is a notable example of this, but similarities in the less common names also exist. In cases where the languages are geographically and linguistically very close, such as Monpa *khropchang* in Northeast India and Tshangla *khrogchang sey* in adjacent eastern Bhutan, the names are certainly cognate. The similarities between *chhyamba* (Tamang, Nepal) and *satymbra* (Khasi, NE India) span a greater geographic and linguistic distance. Another intriguing phonetic similarity across a much greater geographic distance is *bagul* in Nepal and *bayegua* in China.

Distribution

The two species occur in similar mid-elevations throughout the Himalaya: *S. angustifolia* from 1000-2700 m and *S. latifolia* from 600-3000 m. *S. latifolia* has a more westerly distribution, extending from northern Pakistan[40] east to Guizhou[41], while *S. angustifolia* has a more easterly distribution, from northwestern India[42] to Anhui in eastern China[43], though the greater part of the Himalaya is a region of significant overlap in both species.When we used maximum entropy models[44] to predict habitat suitability for *S. angustifolia* and *S. latifolia*, based on collections identified in the Global Biodiversity Information Facility (GBIF) or stored in the Missouri Botanical Garden Herbarium (MO) as *S. angustifolia* (*/Holboellia angustifolia/ Holboelli fargessii/Holboellia latifolia var. angustifolia*) or *S. latifolia (/Hoboellia latifolia/Hoboellia latifolia var. latifolia),* both the

observed ranges and modeled habitat suitability largely overlapped. The western extension of *S. latifolia* into Pakistan and extension of *S. angustifolia* into eastern China were visible (Fig. 3). Himalayan specimens not identified to species occupy much of the intermediate space in the central Himalaya. Habitat modelling suggests that the cluster of indeterminate collections in Khasia (~25°N, 91° E) inhabit an area more similar to that of species identified as *S. latifolia*.

Uses

The fleshy fruits of most plants in the Lardizabalaceae are eaten across their range. This includes the South American genera *Lardizabala* and *Boquila*[45]. The most well-known fruits of the family are those of species in the genus *Akebia*, which are cultivated commercially in Japan and have been considered in domestication breeding programs there and in China[46]. Edible fruits are also by a large degree the most common use reported for both *Stauntonia latifolia* and *Stauntonia angustifolia*. This use extends from central and Southwest China[47] to the Khasi hills[48], Sikkim[49], Darjeeling[50], Nepal[51], Kumaon[52], Garwhal[53] and Pakistan[54]. Ripe fruits are eaten fresh, or more rarely processed into preserves or wine. There are no reports of other parts of either species being used as food, but in Myagdi in Central Nepal, it is a prized goat fodder to the extent that it is "so frequently cut for that purpose that it is disappearing and the edible fruits are nowadays seldom encountered[55]."

The stem of both species are reported as used for structural/utility purposes, perhaps not surprising in a vine. In the Solukhumbu area of eastern Nepal, the stem of *S. latifolia* is used as a rope[56], as it is also in Bhutan[57]. An overlap of the utility and medicinal uses is seen in the Kanchenjunga area of eastern Nepal, where the stems are used to make bangles to prevent orthopedic problems[58]. In China, Joseph Rock reported that *S. angustifolia* was used specifically for ropes in animal harnesses (*yidzhi*), although the rope appeared in another con-

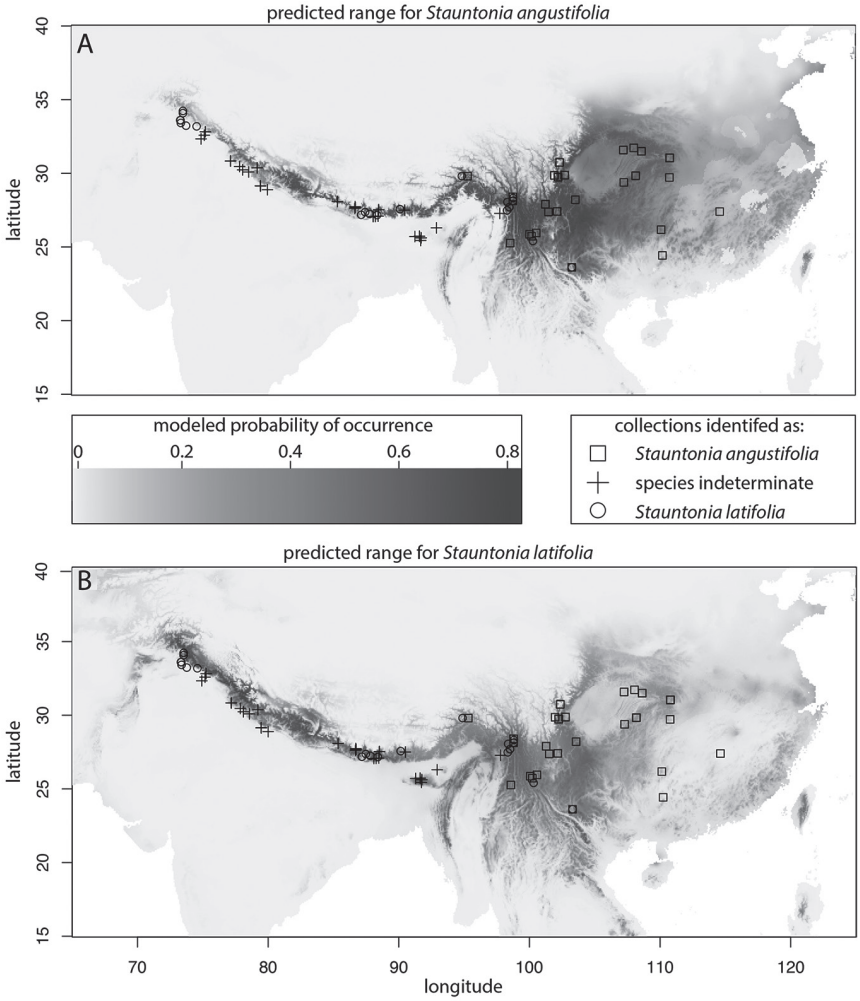

Fig. 3. Distribution and habitat suitability of *Stauntonia angustifolia* and *S. latifolia*. Maximum entropy models of habitat suitability for *S. angustifolia* and *S. latifolia* are based on collections identified in GBIF or stored in MO as *S. angustifolia* (boxes) or *S. latifolia* (circles). Himalayan *Stauntonia* collections not identified to *S. angustifolia* or *S. latifolia* (crosses) make up most of the collections that are geographically intermediate. Ranges and modeled habitat suitability largely overlap, although the extent of *S. latifolia* west into Pakistan and of *S. angustifolia* into eastern China are visible.

text in the Naxi creation myth, when "the pre-flood ancestor of the Nakhi, Ts'ozällüghügh, ascended to heaven and also descended on such a rope"[59].

Stauntonia angustifolia is a constituent of Traditional Chinese Medicine (usually as *Holboellia fargesii*)[60] although *S. coriacea* is more widely reported. *S. latifolia* and *S. angustifolia* are not frequently mentioned parts of widely spread medicine systems in India or Tibet. Where they are mentioned in conjunction with widespread traditional medicine systems, they form part of the local 'folk' medicine systems[61]. In Yunnan folk medicine the stems, roots, and fruits are reported as used internally for hernia, cough and nephritis, a function which has been connected to triterpenoid saponins[62].

Aside from the mentions which motivated this study, we found only two recorded uses of *Stauntonia* that were clearly connected to the use of the leaves for animal wounds. These were the use of *S. latifolia* leaf for wounds in Pittogarh and Chamoli[63] and of *S. latifolia* leaf crushed into a paste and used to treat wounds in cattle in Bhabar[64]. Both areas are in Uttarkhand, very near the Kedarnath Wildlife Sanctuary area where we recorded its use in 2012[65].

External uses more similar to the ethnoveterinary uses noted in Garwhal and the Hengduan include *S. angustifolia* roots and vine used to treat bruises in Tibetan China[66] and as an anti-inflamatory[67]. *S. latifolia* roots are reported used for rheumatism in Sikkim[68] and in China[69] and leaves crushed and used for burns in Northeast India[70]. Other plants in the genus are also used. *Stauntonia chinensis* is used in Traditional Chinese Medicine for analgesic and anti-inflammatory effects, *Stauntonia obovatifoliola* in Guangxi folk medicine as an analgesic, and *Stauntonia coriaceae* for treating arthritis and rheumatism. These properties have been connected to triterpenoid glycosides[71]. In one recent study prompted by the use of *S. latifolia* in Northeast India, an ethanolic extraction from fresh *S. latifolia* leaves was found to have promising antimicrobial properties[72].

Certain uses are reflected in local names. The association with the fruit makes its way into some names: Lepcha *kulepot* (the *-pot* suffix indicates fruits[73]); Chinese *wuyuegua* and *bayegua* (*-gua* indicates cucurbit fruits - melons and gourds - and presumably refers to the vining structure of the plant as well as to its fruits). In Naxi, an animal-related use is reflected in the name *zai-yizhi* where *yizhi*/*yidzhi* are vine-rope loops that connect an ox's yoke with a plow shaft. Rock adds that the use of *S. angustifolia* for *yidzhi* ropes apparently supplanted the use of *Clematis montana*, another prominent vine in the area[74]. Despite this, both the Naxi name and the Naxi pictograph for *S. angustifolia* (Fig. 4) make clear reference to this use, while *Clematis montana* has no such linguistic connections.

On the other hand, the widely used name *gophal* and its variants do not seem to be associated with a particular use of the *Stauntonia*

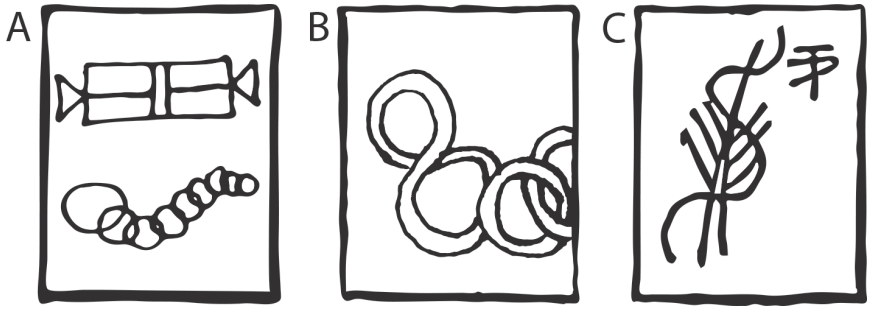

Fig. 4. Naxi pictographs from the *dongbawen* pictographic/ideographic script writing system, after Rock, (Rock J. F. *A* [1]*Na*-[2]*Khi–English Encyclopedic Dictionary*. Roma, Instituto Italiano Per Il Medio Ed Estremo Oriente, 1963.) A) *Stauntonia angustifolia*, identified by Rock as *Holboellia fargesii*. He writes "from it loops are made called *yidshi*, these are attached to the yoke of the oxen and the plow shaft. Formerly another vine was used… *Clematis montana*." B) *yidshi* "a tow-rope; it is the picture of a chain and is the rope used by the Nakhi in plowing; a short piece of it is attached to the yoke of the oxen and to the shaft of the plow. In the ms. Ts'ombert'u, it states that the pre-flood ancestor of the Nakhi, Ts'ozällüghügh, ascended to heaven and also descended on such a rope." C) *Clematis montana*; the vine is pictured entwining the symbol for pine tree; the ideographic component meaning 'white' at the top right indicates the color of the flowers.

spp., and are found in combination with reports of structural, medicinal/ethnoveterinary, and edible use categories.

Moving knowledge? Moving plants?

Stauntonia angustifolia and *S. latifolia* have great similarities in morphologies, ranges, local names, uses, and even in past taxonomy. With nomenclatural changes and geographical bias in nomenclature (western references being more likely to combine the two species and eastern works more likely to split them), most central Himalayan ethnobotanical works which cite *Holboellia latifolia* could either be referring to *S. angustifolia* or *S. latifolia*.

Treating for the moment these species as one entity (whether they are two closely related species or subspecies), the disjunct in ethnoveterinary practice which we first observed remains. The Garwhal area in the western Indian Himalaya has several reports of leaves being crushed to use on animal wounds, and the only other reference for this use is in the Hengduan Shan at the easternmost extent of the greater Himalayan region. Between, no other veterinary uses are reported, although the use of crushed leaves for burns in Northeastern India could be analogous. Few uses or plant distributions were reported from lowland areas - both the plant and the knowledge connected to it seem to be limited to the mid-elevation hills and mountains in the greater Himalayan region (including the Khasi Hill region, Nagaland, and the Hengduan).

Two possible scenarios - perhaps not entirely mutually exclusive - are suggested by this distribution pattern. Both are connected to mountain pastoralism. If we assume that the topographies and cultural differences along the Himalayas themselves provide too great a barrier to knowledge transfer, convergence is suggested. The species in question grow at mid-elevations and along trails, where those with animal-related livelihoods may encounter them. Indeed, they may already have animal-associated uses, as evidenced by possible uses

as fodder[75] and especially as tack or ropes associated with animal husbandry[76]. In the Hengduan area, the animal-associated use of the vine is at least a century old - documented by Joseph Rock based on interviews in the beginning of the 20th century[77] - and possibly much older, as it is represented in the Naxi pictographic writing system dating back at least to the 17th century (Fig. 4). Given the use of crushed leaves to treat human burns in Northeast India[78] and recent assays that suggest its anti-microbial properties[79], it is certainly possible that *Stauntonia* leaves for wounds are a convergent ethnoveterinary innovation: at the two ends of the Himalayas, an apparent[80] and efficacious plant was independently employed for identical purposes.

However, while long-range lateral movement through the Himalayan mountain chain is impeded by topography, short-range movement from valleys to ridges is the norm. Seasonal transhumance is practiced across the Himalaya, allowing herders to take advantage of the elevational gradient by moving animals to higher-elevation seasonal pastures. While mountain ridges may divide watersheds, their pastures can be places of meeting and exchange of practices, knowledge and even plant material[81]. If herders sometimes ascend to an eastern ridge, and sometimes to a western one, a chain of transmission is not impossible to imagine. Indeed, just such a scenario has been suggested for the mountains north of the Tibetan Plateau by Michael Frachetti, who sees these ranges as a "mountain corridor" rivaling the lower elevation Silk Road in its capacity to transmit knowledge[82]. The "non-uniform complexity" of shifting connections he invokes in Central Asia also has parallels in the Himalaya and south-eastern Asian hills. In these highland areas, transnational and shifting "process geographies" of trade, travel and movement have been proposed to connect mountain peoples and spaces of diverse languages, cultures, and other attributes[83]. In the instance of *S. angustifolia* and *S. latifolia*, the efficacy and apparency noted above do not in themselves argue against transmission, but rather would be the

reason for such transmission. At the same time, widely-spread common names indicate knowledge transmission of some kind, though they do not speak to specific ethnoveterinary uses. Further, the use of *Stauntonia* vines as animal tack implies the physical movement of the plant. Given that the vine is hardy and easily propagated by cuttings as well as by seeds[84], human-aided movement of the plant itself certainly seems possible. In fact, small scale movement - of *S. angustifolia* from the wild into a home-garden - created the planting in a Naxi garden that motivated this paper. The owner of the courtyard where it was observed reported that the plant had been transplanted from the wild without much difficulty. Possible evidence of larger-scale plant movements appears in two other places where *S. latifolia* cultivation is reported: in the Khasi Hills[85], where it appears in a distribution discontiguous from the rest of its habitable range (Fig. 3), and in northern Pakistan[86], at the farthest western extent of its distribution.

Further ethnobotanical studies of plants with pan-Himalayan distributions could test this model of transmission, and ultimately help to understand whether mountains are a barrier to knowledge, or a corridor along which it may disseminate.

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