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Ethnobotanical and Medicinal Plant Diversity of Uttarakhand: A Geographical Indication Perspective

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Abstract

The Indian Himalayan Region (IHR) is home to an amazing diversity of medicinal plants, with strong linkages to the residential ethnobotanical practices of the indigenous people of Uttarakhand, namely, the Garhwali and Kumaoni communities. In this paper, the ethnobotanical value of GI eligible medicinal plants of Uttarakhand is discussed in the context of Rhododendron arboreum (Buransh) as a case study and the potential of Geographical Indication (GI) tagging for protection of TEK, conservation of biodiversity and rural livelihoods. The study employs quantitative ethnobotanical indices, namely Use Value (UV) and Fidelity Level (FL) for the purpose of placing Buransh in a wider context of medicinally important flora of the region. In the course of a systematic ethnobotanical survey in 6 districts (Chamoli, Tehri Garhwal, Pauri Garhwal, Rudraprayag, Almora, Pithoragarh), 84 KIIs were conducted that resulted in the identification of 38 medicinally important species and 12 potential GI candidates. From the cardiovascular use, the highest Use Value (UV = 0.87) was obtained for Rhododendron arboreum, while the highest Fidelity Level (FL = 78%) was obtained for R. leschenaultiae. A detailed registration process, including botanical classification, community surveys, chemical characterisation and georeferenced habitat mapping, was identified through analysis of the documents for the application (GI Application No. 866). The paper identifies and emphasizes some of the key research and policy needs to scale up the protection of other Himalayan medicinal species under GI and puts forward an integrated model of ethnobotany and GI with the inclusion of molecular authentication and community benefit sharing for sustainable development of the Himalayan region.

Keywords: "Ethnobotany, Geographical Indication, Uttarakhand, Rhododendron arboreum, traditional ecological knowledge, medicinal plants, GI tag, Use Value, Fidelity Level",

1. Introduction

The Indian Himalayan Region (IHR) is one of the world's 36 biodiversity hotspots and it contains more than 8000 species of plants, of which 1,748 species have been documented with medicinal properties and 900 species are used in classical medicine i.e. Ayurvedic, Unani and Siddha systems (Ved and Goraya, 2008). This immense phytodiversity is reflected in Uttarakhand, including both the Garhwal and Kumaon Himalayan ranges, which is an area of ethnobotanical richness where communities in both the Garhwal and Kumaon divisions have evolved over a long period sophisticated TK systems (Negi and Gaur, 2010). The knowledge systems, passed down orally from generation to generation by Vaidya or traditional healers, elders of villages and community practitioners, contain very high level information on plant identification, habitat ecology, seasonal harvesting, processing and medicinal uses; such knowledge is largely beyond the protection of formal laws and is a precious biocultural heritage that cannot be substituted (Das, 2010).

Uttarakhand is facing a serious challenge in the form of traditional ecological knowledge (TEK), which is being threatened by various concurrent factors. Urbanization has caused the loss of many young people from rural areas, which has prevented the passing on of plant knowledge by the older generation. The replacement of traditional medicine by allopathic medicine has dwindled active practice of the knowledge of the plants in the younger generation. At the same time, the global market for herbal medicine (USD 60 billion in 2021 with an annual growth rate of 7.9%) has encouraged over-collection of the medicinal plants in the Himalayas without corresponding investments in documentation and conservation, as well as in fair cooperation with knowledge-holding communities by the WHO (2019).

The Geographical Indication (GI) tags are legally recognized protection system under the Geographical Indications of Goods (Registration and Protection) Act, 1999, to safeguard products that are unique to a geographic location and whose quality, reputation or other distinguishing features are at least partly due to that location. GI protection is collective in nature (GI belongs to all producers within the defined geographic area who adhere to the specified production standards), and is a particularly appropriate instrument to protect the collective

traditional knowledge embedded in plant-based regional products.

The GI Registration of Uttarakhand Buransh (R. arboreum) in November 2023 as Uttarakhand Buransh Sharbat (Application No. 866 / GI Certificate No. 523) is a milestone in the protection of Himalayan ethnobotany heritage. It was a result of a multi-year process that started in April 2022 and included scientific documentation by Uttarakhand Council for Biotechnology (UCB), community organization by the Uttarakhand Organic Commodity Board (UOCB), and legal support from the GI Facilitation Centre (GIFC), Dehradun. This paper takes up Buransh as an anchor case and explores the potential of GI to be an ethnobotany policy tool for conservation of medicinal plants in Uttarakhand.

It makes three specific contributions to this field: (1) it documents in a systematic and quantitative fashion the medicinal plant knowledge of the Garhwali and Kumaoni communities, using standardized indices (UV, FL) that facilitate inter-species and inter-community comparisons; (2) it documents the evidence required, stakeholder participation, and the key steps in the Buransh GI registration process of a successful GI application for a medicinal plant product; and (3) it outlines a pipeline of medicinal species in Uttarakhand that can be systematically GI nominated, along with an evidence-based framework.

2. Literature Review

Das (2010, 2011) laid the foundation for GI tagging and TK in India, and discussed their potential to be used as a tool for rural development, and its implications for producer groups and indigenous communities. Das (2010) showed a price premium of 20% to 200% in the case of GI products, and it highlighted how GI are able to start a chain of new benefits that flow back to primary producers rather than the corporate middleman, and attributed to the regional brand reputation. In medicinal plant products, the economic redistribution function becomes especially important as the knowledge used in the traditional methods often goes to people without proper compensation.

Rangnekar (2004) has explored the issue of GI tags in the context of international trade and local product identity, claiming that GI systems are a type of collective intellectual property which is most appropriate for the protection of traditional knowledge of geographically local communities. He examined the conflict between GI protection and the TRIPS agreement of the WTO, focusing on Article 22 (general protection) and Article 23 (additional protection of wines and spirits); he also recommended that enhanced GI protection be extended to traditional plant-based products of developing countries, which was reflected in the subsequent Doha Declaration and the relevant provisions of the CBD.

The World Intellectual Property Organization (WIPO) has also offered many technical resources on GIs, such as a comparative study of GI laws in 69 member states of WIPO (WIPO, 2021). This study revealed three models for protection of traditional plant-based products: the sui generis systems (as in India), the trademark-based systems (as in the USA) and the administrative designation systems (as in France's Appellation d'Origine Contrôlée) and their advantages and disadvantages.

Recently, quantitative ethnobotanical approaches have been used to study medicinal plants in the Himalayan region. Kala et al. (2015) used the indices of Use Value (UV) and Fidelity Level (FL) for 42 medicinal plant species in the alpine region of Uttarakhand, and found that these indices were useful in discriminating between primary and secondary medicinal plants of the area, and could be used as evidence-based prioritization tools for conservation and GI nomination. Pei (2001) reviewed quantitative methods in ethnobotany and suggested that standardized indices facilitate cross-cultural comparison and longitudinal time-series monitoring of traditional knowledge systems, which are important tools to monitor the changing situations and evolution of TEK over time.

Several researchers have studied the socioeconomic aspects of rural livelihoods based on NTFP in Uttarakhand. According to Sundriyal et al. (2014), NTFP collection and processing accounts for 22-35 % of the annual income of the households living in the forest villages of Chamoli, Tehri Garhwal and Almora districts. In order to document the production volume, cost structures and income generation among collector households, primary processors, and market intermediaries, Singh and Chatterjee (2022) undertook a comprehensive economic study of cottage industries based on Buransh. Their analysis found that GI certifiers had only collected 18-25% of the final consumer price before the certification process, whereas the rest would have been collected by processors and retailers. This imbalance in the value chain is being addressed by the GI certification process.

There is a growing trend to combine conservation genetics and molecular tools with ethnobotanical studies to obtain a comprehensive evaluation of medicinal plant resources. Utilizing ethnobotanical survey in conjunction with genetic diversity assessment (based on ISSR) of priority species, Bhatt et al. (2016) showed that species with high UV values and FL values often showed significant genetic differentiation between their populations, thus underscoring the importance of protection of their cultural and genetic resources in Uttarakhand. Patel et al. (2020) reviewed the utility of Geographic information systems (GIS) and remote sensing along with ethnobotanical studies for GIS mapping of distribution of medicinal plants with potential to be

used as GIs, which shows the potential of geospatial tools for the definition and monitoring of GI GA.

3. Methodology

3.1 Study Area and Survey Design

The study was done in 6 districts of Uttarakhand, namely Chamoli, Tehri Garhwal, Pauri Garhwal, Rudraprayag, Almora and Pithoragarh. The choice of these districts was based on representation of both the major sub-regions (Garhwal and Kumaon) and a representative altitudinal range (800-3200 m). Three administrative units (villages/gram panchayats) were selected from each district, using stratified random sampling, based on forest proximity and altitude (<1500 m, 1500–2500 m, > 2500 m). Two growing seasons (March to May 2022 and February to May 2023) were surveyed in total 18 locations in 6 Districts, which corresponds to the flowering time of Buransh and the highest harvesting of medicinal plants.

3.2 Ethnobotanical Data Collection

A total of 84 key informants were interviewed, comprising of Vaidya (traditional healers, N=22), Elder community members with plant knowledge (N=31), members of the self-help group (SHG) involved in collection of NTFPs (N=19) and forest officials having community liaison position (N=12). Purposive sampling (Vaidyas and recognized knowledge-holders identified through community networks) and snowball sampling (additional informants recommended by initial participants) were used for identifying key informants. The criteria for eligibility included having lived in the study area for at least 20 years and having a working knowledge of the use of medicinal plants.

Interviews were conducted in Hindi and in the local Garhwali/Kumaoni language using trained local field assistants who acted as interpreters, when needed. Information obtained in each interview included: (a) local, Hindi and Sanskrit names for medicinal plants; (b) parts used; (c) method of preparation (fresh or dried, decoction, infusion, juice, paste); (d) therapeutic indications; (e) dosage and administration; (f) contraindications and cautions; and (g) where the plants were found (wild collection, cultivation, or purchased). Explicit informed consent was obtained for audio recording of interviews, which were then transcribed and coded. Free-listing was used in the beginning of each interview to derive medicinal plant knowledge without prompting and followed by closed questions on specific species. Wherever possible the voucher specimens of the plants mentioned were collected, pressed and dried and deposited in Department of Botany Herbarium, HNB Garhwal University.

3.3 Quantitative Ethnobotanical Indices

Value (UV) was derived from the sum of use-reports for a species (ΣU) divided by the number of informants (N=84) (UV = ΣU/N). UV values vary from 0 (no use reported) to the number of the use categories documented; the higher the UV value, the more cultural importance is attributed to it. Fidelity Level (FL) was calculated as the percentage of informants reporting a primary medicinal use: FL = (Np/N) × 100, with Np being the number of informants reporting the use of a given primary medicinal use and N being the total number of informants. Species with FL values close to 100% have a high level of consensus and are used predominantly for one therapeutic purpose, while lower FL values are associated with more diverse usage patterns. Relative Importance (RI) was calculated as the average of the relative frequency of citation (RFC) and the relative number of use categories (RNU) so as to rank the species according to its overall ethnobotanical importance. A mean of the Informant Consensus Factors (ICFs) was used to sort the disease categories. These were calculated as ICF = (Nur − Ns)/(Nur − 1), where Nur is the number of use-reports and Ns is the number of species used by informants for a given disease category.

3.4 GI Documentation Analysis

All publicly available documents about GI applications for Uttarakhand Buransh were systematically reviewed from the IP India portal (www.ipindia.gov.in). The documents looked at were: GI Application Form 1 (filed April 2022, application number 866); Formality Check Report (FCR) and the Applicant's Response; Show Cause Examination Report and Response; GI Journal No. 176 (September 2023, advertisement of public objections) and GI Certificate of Registration No. 523 (dated 8 November 2023, Class 32 – Beverages). The UCB phytochemical validation report, UOCB sustainable harvesting guidelines and a list of registered producers (424 farmers) were the supplementary documents obtained through formal information requests.

4. Results

4.1 Ethnobotanical Survey Outcomes

Thirty-eight medicinally important plant species, representing 31 plant families were recorded in the six study districts. The most common families were Ericaceae (3 spp.), Ranunculaceae (4 spp.), Lamiaceae (5 spp.), Apiaceae (3 spp.) and Rosaceae (4 spp.). Of the 38 species recorded, 12 were selected as potential GI candidates as they were found to be: (a) regional specific (i.e. endemic or characteristic species of Uttarakhand altitude range); (b) existing market demand (cited in the NTFP market survey); and (c) documented traditional use (at least 15 informants reporting therapeutic use).

The Use Value (UV = 0.87) for Rhododendron arboreum was highest among all 38 species surveyed, and was reported by 73 of the 84 informants in all six districts — a significant level of agreement from informants from across the districts. It had a Fidelity Level for cardiovascular use (cardiac tonic, blood purifier, anti-fatigue) of 78%, which reflects the high level of agreement of the culture regarding its main therapeutic use. The importance of the plant was confirmed by the Relative Importance index (RI = 0.82). The highest agreement across species for cardiac conditions was seen with the Informant Consensus Factor for cardiovascular disease (ICF = 0.89) which points to a good level of consensus of species used and hence a knowledge base that would be suitable for this application.

Other species with high UV values were: Swertia chirayita (UV = 0.74 and FL for liver disease = 71%), Nardostachys jatamansi (UV = 0.68 and FL for neurological conditions = 63%), Aconitum heterophyllum (UV = 0.61 and FL for digestive disorders = 58%), and Bergenia ciliata (UV = 0.59 and FL for kidney disease = 67%). The above species are the best candidates for future GI nomination, given the current ethnobotanical information.

4.2 Traditional Uses of Buransh Across Communities

In all six districts, the flowers of Buransh were reported with seven main medicinal uses. (1)Cardiac tonic and fatigue relief – fresh flower juice taken daily for the blooming period (FL = 78%). The purifier in the anti-inflammatory blood (FL = 63%) is obtained by soaking the flower petals in water overnight. (3) Antidiarrheal: leaf decoction, which is made from the dried leaves (FL = 48%). Wound healing: Poultice made from macerated fresh leaves applied to wounds and abrasions (FL = 41%). (5) Fever Relief – Bark Decoction of ginger and pepper (FL = 36%). (6) Cough and respiratory: flowers infused with honey in warm water (FL = 52%). (7) Veterinary: whole plant decoction given to animals to treat digestive problems (29% FL). The cardiac tonic use had the highest geographical consistency being mentioned in all six districts and all the altitude zones, and veterinary use was more geographically limited to higher altitude pastoral communities.

There were systematic changes in the preparation methods with increasing altitude. The fresh cold pressed juice and squash were the common preparations done at lower altitude (< 1500 m) and similar to the cottage industry reported by Singh and Chatterjee (2022). Infusions and decoctions were more frequently prepared in higher altitude communities (> 2500m); this could be due to both tradition of preparation and the logistical challenges of being remote. Conventional storage methods included clay vessel storage with a lime coating (documented by 12 informants, mainly from Pithoragarh) while modern refrigeration was documented by 34 informants, mostly in the lower altitudes peri-urban areas.

4.3 GI Tag Documentation Analysis

The analysis of the submitted GI Application No. 866 revealed that it is a multi-component evidence based process and needs a comprehensive documentation for the different components, namely, Botanical, Chemical, Geographical, Socio-economic dimensions. The essentials of the application filed in April 2022 included: (a) botanical classification and description with the type specimen; (b) traditional use records from 424 registered farmers from Chamoli, Tehri Garhwal, Pauri Garhwal, Rudraprayag, Almora districts; (c) georeferenced production area maps certified by the Survey of India—delineating the GI geographical area, covering an area of approximately 4200 km^2 of rhododendron forest in the Garhwal Himalaya; (d) ethnobotanical evidence of traditional association of the Garhwali community with preparation of Buransh Sharbat; (e) chemical characterization of Buransh juice (phytochemical parameters confirming unique quality attributes); and (f) quality standards for the GI certified Buransh Sharbat (minimum total flavonoid content: 800 mg/100 ml; minimum total phenolics: 600 mg/100 ml; Brix: 12-18°; pH: 3.2-3.8).

The GI Certificate No. 523 was issued under the class 32 – Fruit juices and beverages on 8 November 2023. The registered proprietor is Uttarakhand Organic Commodity Board (UOCB) and registered users are 424 farmers who are listed in the application form and are members of SHG and cooperatives registered with UOCB. The GI is valid for 10 years and can be renewed.

4.4 Comparative Analysis of GI-Eligible Species

A total of 12 species are selected as GI candidates based on a combination of UV, FL, market demand (as obtained from district market surveys) and the habitat specificity. The top five are: (1) Swertia chirayita (Chirayata) — high UV, established market demand (₹800-1200kg), liver disease and diabetes therapeutic potential, restricted to 1500-3000m altitude; (2) Nardostachys jatamansi (Jatamansi) — globally rare species, CITES, premium international market price (₹3000-5000kg); neurological and cosmetic applications, restricted to 1500-3000m altitude; (3) Valeriana wallichii (Mushkbala) — sedative and anxiolytic properties documented, habitat-restricted at 2500-4000m; (4) Picrorhiza kurrooa (Kutki) — critically endangered, hepatoprotective activity superior to silymarin documented, restricted to 2500-4000m; (5) Aconitum heterophyllum (Atis) — important in traditional fever management, premium international market price (₹3

5. Discussion

The ethnobotanical information of the present study supports and enhances the previous study of the cultural importance of Buransh in Uttarakhand. This is a very high value of UV (0.87), the highest of all recorded for 38 documented medicinal species across geographical and altitude ranges. This transregional, transaltitudinal uniformity sets Buransh apart from most other Himalayan medicinal plants that exhibit more localized utilization patterns linked to the availability of microhabitats and/or community traditions. The high FL (78%) for cardiovascular use gives a strong ethnopharmacological justification for the phytochemical and pharmacological investigations reported in Paper 1 of this series with justification for the cultural claims in the GI registration.

The Buransh is not only an economical label, but also a formal acknowledgment and recognition of ethnobotanical knowledge by the state. The GI tag guarantees the authenticity of indigenous knowledge in the process of Buransh cultivation, harvesting and preparation. The 424-farmer list of applicants to the GI application represents a community scale participation and collective intellectual ownership that fits with the principles of equitable benefit sharing which are presented in the Convention on Biological Diversity (CBD 1992) and implemented by the Nagoya Protocol on Access and Benefit-Sharing (2014). The GI framework, in practice, establishes a legal protection for a collective knowledge asset that is based on informal community knowledge.

The ICF analysis of the data shows that there is an important pattern: cardiovascular disease has the highest ICF (0.89) indicating high agreement on the species used (mainly R. arboreum) and a reliable and a culturally validated therapeutic tradition. The categories of disease, which were generally pain and fever (ICF = 0.52-0.63) indicated less homogeneous species selection and lower level of cultural consensus, meaning that more extensive ethnobotanical evidence is needed for the nomination of species in these disease categories.

The proposed GI candidates, namely, Swertia chirayita, Nardostachys jatamansi, Valeriana wallichii, Picrorhiza kurrooa, Aconitum heterophyllum are the next candidates to be opened up for ethnobotany-driven GI registration in Uttarakhand. Both have their own advantages and disadvantages. The high market value and the documented therapeutic benefits of Swertia chirayita make it an immediate candidate, although in some districts it is in an endangered state with its limited habitat and threat to population levels, it needs to be carefully considered in terms of sustainable production volumes. The CITES listing of Nardostachys jatamansi (Appendix II) poses challenges to export GI development, but a domestic GI can help to prevent internal market adulteration. Because of the critical threat-rating of Picrorhiza kurrooa, GI development must now be linked to cultivation and not to wild collection, though it will be a more challenging but more sustainable process.

Both quantitative ethnobotanical indices (UV and FL) offer a scientific, evidence-based strategy for prioritizing future GI candidates which is both science-driven and policy-focused. Species with UV > 0.60 and FL > 55% for particular therapeutic uses and an ICF > 0.75 for the specific disease category are considered to have a strong evidence base for GI nomination. A three-index (UV, FL, ICF) screening system is suggested as a standard screening system to identify the medicinal plant species eligible for GI from IHR.

6. Conclusion

This study shows that with a solid ethnobotanical documentation and with a strategic management, GI tagging can be a strong tool for the protection of TEK and rural economic development. Uttarakhand Buransh is a template: systematic ethnobotanical surveys, quantitative plant-use indices, community participation, and chemical validation provided the foundation for a successful application of the GI, which led to legal protection for a heritage of medicinal plants from the Himalayas in November 2023. The quantitative ethnobotanical framework designed here that incorporates the UV, FL, RI and ICF indices offers a repeatable and evidence-based approach for selecting and selecting priority of GI candidates from the IHR's rich medicinal plant diversity.

The pipeline of GI candidates identified in this study, especially Swertia chirayita, Nardostachys jatamansi, and Picrorhiza kurrooa could offer opportunities for systematic GI development that could have similar economic and conservation benefits as recorded for Buransh. Future research priorities are: (a) phytochemical validation of the selected species to be used in the Buransh; (b) genetic diversity study of the selected populations to ensure the availability of quality source material from all regions of the country; (c) feasibility studies for the cultivation of species where the wild harvest is unsustainable; (d) socioeconomic impact assessment of the Buransh GI on the income of the local communities (the Buransh processing is largely a female enterprise); and (e) the development of an IHR-wide GI medicinal plant database, which integrates ethnobotanical, genetic and geographic data to support a coordinated development strategy for the region.

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