

Morphological and Ethnobotanical Assessment of Some Foliose Lichens from Himachal Pradesh

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ABSTRACT

Foliose lichens of Himachal Pradesh constitute an important reservoir of bioactive secondary metabolites and traditional ethnobotanical knowledge. The present study focuses on the morphological and ethnobotanical characteristics of six foliose lichen species, namely *Parmotrema austrosinense*, *Parmotrema nilgherrense*, *Flavoparmelia caperata*, *Punctelia borreri*, *Dermatocarpon vellereum*, and *Xanthoparmelia tinctina*, collected from Sikandra Dhar (Mandi), Potter Hill (Shimla), Sanjauli, and regions of Kangra, growing on bark and siliceous rocks. Morphologically, *Parmotrema* species are generally characterized by large, loosely adnate thalli, broad rounded lobes with marginal cilia, and the presence of isidia and/or soredia. *Parmotrema nilgherrense* is eciliate and sorediate and is reported to contain alectoronic acid, whereas *P. austrosinense* is sorediate and associated with hymecromone and phenolic compounds. *Flavoparmelia caperata* possesses a yellow-green upper cortex associated with usnic acid, together with protocetraric and caperatic acids; its lower surface is black with brown margins. *Punctelia borreri* is distinguished by white punctiform pseudocyphellae on the upper surface and contains lecanoric acid. *Dermatocarpon vellereum* is an umbilicate, monophyllous, leathery, dark-brown lichen attached centrally to rocks. *Xanthoparmelia tinctina* is a yellow-green, saxicolous foliose lichen with narrow, sublinear lobes and reported salazinic and usnic acids. Ethnobotanically, *P. nilgherrense* is reported as a commercially important lichen used for export, resinoid extraction, and high-grade perfumery. *P. austrosinense* is traditionally used as a spice in garam masala and for meat flavouring. *F. caperata* is applied in powdered form to wounds and is also used as a natural dye, producing brown to light-purple shades depending on the extraction or fermentation method. *P. borreri* has been documented in Himachali folk medicine for conditions including chronic dermatitis, uterine bleeding, blurred vision, sores, and swelling, and has also been reported as an α -amylase inhibitor. *X. tinctina* has been reported as a raw material for antibiotic-related applications and to exhibit reducing, neuroprotective, and phytoremediation-related potential, including the accumulation of heavy metals for biomonitoring air pollution. The findings highlight the ecological, medicinal, commercial, and ethnobotanical importance of foliose lichens in Himachal Pradesh.

Keywords: Antimicrobial activity; Bioactive metabolites; Lecanoric acid; Himachal Pradesh.

1. Introduction

Lichens are important ecological indicators used in environmental biomonitoring because they are highly sensitive to atmospheric pollution and climate change. Their lack of a vascular system enables them to absorb nutrients and pollutants directly from their surrounding environment (Rajendran et al., 2023). Lichens are symbiotic associations involving a fungal partner and one or more photosynthetic partners, including green algae and/or cyanobacteria. The fungal component, which constitutes the major portion of the lichen body, largely determines its morphology, structure, and colour, while the photobiont contributes to photosynthesis. Approximately 85% of lichen-forming fungi establish associations with members of Chlorophyta, whereas about 10% form associations with cyanobacteria. A smaller group forms associations with both green algae and cyanobacteria (Honegger, 2008).

Lichens have a long history of use in Ayurveda and Unani medicine and have been employed as antibiotics, anti-inflammatory agents, herbal contraceptives, and remedies for digestive disorders, skin diseases, and tuberculosis. They are also used in perfumes, spices, agrochemical applications, and environmental monitoring because of their capacity to

accumulate pollutants (Singh et al., 2018). One of the earliest records of medicinal lichen use is associated with ‘Shiphal’ in the Atharvaveda. The vernacular name ‘Charilla’ is commonly used in Ayurveda for various diseases and disorders, including headache, skin diseases, urinary problems, boils, vomiting, diarrhoea, dysentery, heart ailments, cough, fever, leprosy, and as a blood purifier (Kumar et al., 2001). Lichens are also used as sensitive indicators for assessing the physiological effects of contaminants through community-level monitoring and analysis of persistent toxic substances, including heavy metals (Printsos and Lopp, 2008). Epiphytic lichens are widely used to assess air quality, particularly in industrial areas, and to evaluate geographical variation in the concentration of environmental pollutants (Garty et al., 2001; Carignan et al., 2002; Purvis et al., 2004). Furthermore, lichens have been used in traditional foods and medicines for millennia and contribute to ecosystem functioning and human welfare (Crawford, 2015). From an ecological perspective, a lichen may be regarded as a self-sustaining ecosystem resulting from the interaction of a lichen-forming fungus with one or more photosynthetic partners and numerous associated microorganisms (Hawksworth and Grube, 2020). Approximately 20,000 lichen species are known worldwide. The lichen flora of India is estimated to comprise 2,532 species belonging to 324 genera and 78 families, including approximately 541 endemic species (21.3%). Himachal Pradesh, situated in the western Indian Himalayan region, supports luxuriant lichen growth as well as diverse plant communities because of its varied climatic conditions and pronounced altitudinal gradients. The lichens of the state have been extensively studied over the past several decades through floristic, monographic, and revisionary investigations (Awasthi, 1953; Hoeg, 1953; Sharma and Sharma, 2000; Sharma et al., 2001, 2002a,b; Srivastava et al., 2004a,b; Sharma and Kaur, 2005; Yadav, 2005). Nayaka et al. (2002a) reported 112 species belonging to 44 genera and 26 families from Sirmour district. Nayaka et al. (2002b) documented 102 species belonging to 41 genera and 18 families from Solan district, including six new records for India. Srivastava et al. (2004a) enumerated 70 species from Bilaspur, Hamirpur, and Una districts, while Srivastava et al. (2004b) recorded 192 species belonging to 58 genera and 23 families from Shimla district.

2. Morphological and Ethnobotanical Characteristics

Table 1: Morphological and ethnobotanical characteristics of some foliose lichens of Himachal Pradesh

S. No	Species	Family	Local name	Morphology	Ethnobotanical aspects
1	<i>Dermatocarpon vellereum</i>	Verrucariaceae	Shilapushp	It is a foliose lichen attached to the substrate at the centre. The thallus is mono- or polyphyllous, reaches up to about 5 cm across, and is grey in colour.	It is traditionally reported for hypertension, as a potent diuretic and for eliminating parasites. It is also associated with uses for childhood malnutrition, diarrhoea, digestive problems, and abdominal distension. It may be consumed as a soup and used as a natural dye.
2	<i>Flavoparmelia caperata</i>	Parmeliaceae	Hara Chharila	It has broad lobes, a yellow-green upper surface, a sorediate thallus, and a dark black lower surface.	The lichen is dried, pulverised, and applied to skin abrasions. A decoction is traditionally consumed to help alleviate elevated body temperature.
3	<i>Parmotrema austrosinense</i>	Parmeliaceae	Kala Chharila	It is a leafy foliose lichen with rotund lobes approximately 6–20 mm wide. The upper surface is whitish-grey, smooth, and shiny, with marginal soralia.	Lecanoric acid isolated from the mycobiont culture has been reported to exhibit antifungal activity. Extracts of the mycobiont have also been investigated for anti-inflammatory activity.
4	<i>Parmotrema nilgherrense</i>	Parmeliaceae	Nilgiri Chharila	It has a loosely adnate foliose thallus reaching about 10 cm. Lobes are 4–8 mm wide. The upper surface is pale grey to greenish-grey, while the lower surface is black with brown margins and rhizines.	It is traditionally used for rheumatism, fever, headache, sore throat, broken bones, musculoskeletal pain, constipation, loss of appetite, flatulence, diarrhoea, stomach disorders, kidney stones, and painful urination. It is also used by Hindus as sacrificial material during hawan.
5	<i>Punctelia borrieri</i>	Parmeliaceae	Chhota Charilla	It is an adnate foliose lichen, approximately 5–10 cm across, with rounded and dissected lobes. The	Preparations from this lichen are traditionally reported for visual impairment, uterine bleeding, external

				upper surface is green-grey to pale, with soralia, while the lower surface is black and bears dense simple or fasciculate rhizines.	bleeding, skin ulcers, inflammation, and chronic dermatitis.
6	<i>Xanthoparmelia tinctina</i>	Parmeliaceae	Peela Charilla	It occurs on exposed rocky surfaces at approximately 1,200–3,000 m. The foliose thallus is tightly attached to rocks, with broad, flat, often overlapping lobes, a well-developed protective upper cortex, and a white medulla.	It is reported to possess antimicrobial and antioxidant properties. It is also used as a lichen dye, while a paste prepared from the thallus is applied to cuts and burns. Traditional uses include treatment of infections, stomach ailments, and respiratory disorders.

3. Conclusion

The present investigation highlights the considerable diversity and ethnobotanical significance of foliose lichens in Himachal Pradesh, particularly their traditional applications in the management of infections, wounds, inflammatory conditions, digestive disorders and other ailments. Secondary metabolites such as usnic acid and lecanoric acid, together with other lichen-derived compounds, are recognized for antioxidant, anti-inflammatory, and antimicrobial activities, indicating their potential for pharmaceutical and biotechnological applications. As global interest in natural products continues to increase, systematic phytochemical, pharmacological, and ethnobotanical investigations of these and other native lichen species are warranted. Such studies may contribute to the identification of novel bioactive compounds while promoting the sustainable utilization and conservation of lichen resources for traditional medicine, biotechnology, and allied industries. The study also underscores the need to conserve lichen-rich Himalayan habitats, which remain comparatively underexplored despite their considerable ecological and medicinal importance.

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