

**General Article****MORPHOLOGICAL DIVERSITY AND ETHNOMEDICINAL USES OF LICHENS  
IN NORTHWESTERN HIMALAYAN REGION OF HIMACHAL PRADESH***Samriti, Nitesh Kumar and Rajeev Bhoria*

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**Abstract**

This paper aims to critically examine existing literature concerning the morphological diversity and ethnomedicinal applications of lichens in the Northwestern Himalayan region. Lichens are one of the most important components of the flora of Northwestern Himalayan regions. The region's extensive topographical and climatic variability has contributed to its abundant and diverse lichen flora. Lichens are symbiotic organisms resulting from a mutualistic association between a fungal component (mycobiont) and a photosynthetic partner (photobiont), which may be an alga, a cyanobacterium, or both, responsible for carrying out photosynthesis. Due to the absence of specialized defensive and protective tissues, lichens readily absorb water, nutrients, various compounds, and gases directly from the atmosphere. These physiological characteristics render them highly sensitive to anthropogenic disturbances, including atmospheric pollution, climate change, and particularly sulfur dioxide (SO<sub>2</sub>) pollution. Lichens exhibit remarkable diversity in terms of morphology, ecology, and symbiotic complexity. With over 20,000 described species globally, they occupy a wide range of habitats—from arid deserts and alpine tundra to tropical forests and urban environments. Based on thallus structure, they are generally categorized into crustose (crust-like and tightly attached to the substrate), foliose (leaf-like with distinct upper and lower surfaces), and fruticose (shrubby or hair-like and often branched) forms. The thallus may show various surface textures—smooth, lobed, granular, or powdery—and may possess specialized asexual reproductive structures such as isidia and soredia. Lichens have been an integral part of traditional medicine and natural healing practices across various cultures for centuries due to their ethnomedicinal values. Lichens synthesize unique chemicals that have antimicrobial, anti-inflammatory, antioxidant, and wound-healing properties. Traditional healers have even evaluated lichens for treating respiratory issues, skin conditions, digestive problems, and infections. In this documentation, seven research papers and some article are reviewed for the conclusions and analysis that are brought out.

**Keywords:** lichens, ethnomedicinal, anthropogenic interruptions, antioxidants & climatic diversity.

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## Introduction

Lichens are a fusion of organisms, possessing dual nature, and these are formed by the mutualistic association of two or more different types of organisms - the fungal partner (mycobiont) and the algal partner (phycobiont). This unique symbiotic association is believed to have evolved as an adaptive strategy to survive in diverse microhabitats characterized by extreme microclimatic conditions, which would be inhospitable for fungi and algae if existing independently (Negi & Upreti, 2000). The word lichen is Greek originated and it grows on a variety of substrata like thick barks and twigs of trees, rocks, soil and leaves in almost every suitable climatic conditions (provided little or no SO<sub>2</sub> pollution) starting from tropical to alpine regions and polar regions of Antarctica including the area under concern i.e., the Northwestern Himalayan regions. The father of botany, Theophrastus, was the one to first time introduce the term ‘lichen’. Lichens are regarded as pioneer colonizers of terrestrial ecosystems, exhibiting a widespread global distribution. Globally, approximately 19,387 lichen species have been documented (Lücking *et al.*, 2017). According to Mao *et al.* (2021), India is home to 2,961 lichen species, accounting for roughly 14% of the known global lichen diversity and representing about 5.41% of the country's total plant diversity. Lichen species are collectively referred to by various vernacular names across different regions and languages of India: ‘stone flower’ in English, ‘Kalachu’ in Kannada (Karnataka), ‘Patthar ka phool’ in Hindi, ‘Kalpasi’ in Tamil, ‘Shilapushpa’ in Sanskrit, ‘Dagadphool’ in Marathi, and ‘Richamkamari’ in Urdu (Shukla *et al.*, 2014).

In the lichen symbiosis, the fungal component constitutes the majority of the lichen thallus, with its hyphae forming a dense, reticulate network that closely envelops and integrates with the algal cells, creating a mesh-like structure. Fungi acquire nutrients either saprophytically, by decomposing dead organic matter, or through a parasitic mode of nutrition, extracting resources from the living tissues of host organisms (Ahmadjian *et al.*, 1993). Lichens absorb the majority of their mineral nutrients directly from the air and rainfall, as they lack true roots for nutrient uptake. This physiological trait renders them particularly vulnerable to atmospheric pollution, as they can retain and accumulate harmful concentrations of heavy metals, sulfur compounds, radioactive elements, nitrogen oxides, and ozone. Sulfur dioxide (SO<sub>2</sub>) is particularly harmful to lichens as it lowers the pH within their tissues and degrades photosynthetic pigments, ultimately disrupting the photosynthetic process and causing it to cease. The chemical substances present in lichen are Depsides, Depsidones and Dibenzofuran (Asahina & Shibata, 1954) and many of such chemicals are not known in other organisms. The first record for the utilizations of a lichen as medicine is ‘Shiphala’ that is mentioned in Atharveda (around 1500 BCE). In Ayurveda, the vernacular term ‘Charilla’ is commonly applied to various diseases and disorders, including headache, skin ailments, urinary problems, boils, vomiting, diarrhea, dysentery, heart conditions, cough, fever, leprosy, and is also regarded as a blood purifier, reflecting its use within this ancient Indian medicinal system (Kumar *et al.*, 2001). Synonyms from Sanskrit like ‘*Shailaya*’ (“rock-lichen”), ‘*Shila Pushpa*’ (“rock-flower”) have also been mentioned in our Vedic findings. In the Western Himalayan regions (e.g. Uttarakhand, Tehri Garhwal, Himachal Pradesh), local inhabitants use lichens therapeutically and pharmaceutically. For example, *Hypotrachyna cirrhata* is one of the most extensively used lichens in Tehri Garhwal for medicinal purposes due to its ethnomedicinal importance. *Usnea barbata* is utilized as an ingredient in deodorants produced by Earth Science Naturals (California, USA). Additionally, powdered extracts of lichens such as *Xanthoparmelia scrobosa*, *Usnea barbata*,

and *Cetraria islandica* are commercially available online through NutriCargo, LLC. (Wholesale Botanical, Clifton, USA). Furthermore, thallus extracts from *Cetraria islandica*, *Cladoniarangiferina*, various *Usnea* species (including *U. barbata*, *U. subfloridana*, and *U. filipendula*), and *Lobaria pulmonaria* are incorporated into a syrup marketed under the brand name Melato di Licheni (Weleda, UK), which is intended to support the body's natural defense mechanisms and upper respiratory health (Sutar et al., 2021). In present time, numerous research and expeditions have been carried out to explore the vast flora of lichens, still there remains a lot to explore.

The northwestern Himalayan regions including – Himachal Pradesh, Jammu and Kashmir, Uttarakhand, are bestowed with the extraordinary lichen diversity contributing to its significance worldwide. Their wide altitudinal range from about 300m in the foothills to about 6000m in the alpine zones supports a wide range of microclimates ensuring different lichen growth forms. The northwestern Himalayan regions possess a wide range of climatic variations receiving both monsoonal and western disturbance precipitation i.e., snow and rain, ensuring moisture availability which is critical for lichen survival. The diverse topography of these regions creates numerous microclimatic niches like rock crevices, fissured tree barks, exposed cliffs, etc. allowing unique species of lichens to thrive. Additionally, the rich forest varieties e.g., oaks, pines, deodars, rhododendrons, etc. provides barks for the corticolous lichens whereas exposed rocky slopes of high altitudes homes saxicolous lichens. Terricolous lichens are supported by the soil crusts in alpine pastures and meadows. Recent data indicate that 192 lichen species have been recorded in the Great Himalayan National Park (GHNP), encompassing 31 families and 65 genera. This represents over 10% of the lichen species documented in India and 50% of those found in the central Himalayan region. Within GHNP, Tirthan Valley hosts 101 species, Jiwa Valley 100 species, and Sainj Valley 67 species. Notably, 78% of these species are corticolous (bark-inhabiting), while the remainder are classified as saxicolous (rock-inhabiting), terricolous (ground-inhabiting), or foliicolous (leaf-inhabiting). A total of 70 lichen species, representing 29 genera and 15 families, were documented across eight different localities in the Mandi district of Himachal Pradesh, India (Thakur et al., 2020). The lichen genus *Lecanora*, comprising 11 species, demonstrates predominance in the area (Thakur et al., 2020). Among the various localities within the district, Sikandra Dhar exhibited the highest lichen diversity with 19 species, followed by Balh Valley (18 species), Barot (17 species), and Mandi City (16 species) (Thakur et al., 2020). The temperate region of the district, characterized by abundant growth of *Quercus leucotrichophora* trees, supports the prolific growth of lichen species such as *Parmotremanilgherrense*, *Ramalina conduplicans*, *Ramalina sinensis*, *Heterodermiadiademata*, and various *Usnea* species (Thakur et al., 2020). Among the various localities within the district, Sikandra Dhar exhibited the highest lichen diversity with 19 species, followed by Balh Valley (18 species), Barot (17 species), and Mandi City (16 species) (Thakur et al., 2020). The temperate region of the district, characterized by abundant growth of *Quercus leucotrichophora* trees, supports the prolific growth of lichen species such as *Parmotremanilgherrense*, *Ramalina conduplicans*, *Ramalina sinensis*, *Heterodermiadiademata*, and various *Usnea* species (Thakur et al., 2020).

Lichens of the northwestern Himalayan regions serves as an essential ingredient in the traditional medicines and their sensitivity towards the SO<sub>2</sub> makes then an essential indicator for SO<sub>2</sub> pollution. Furthermore, time to time discovery of new lichen species indicates progressing speciation and high endemism. On the whole, the northwestern Himalayan regions serve as a vital center for lichen diversity, conservation and scientific research.

## Morphological Features and Growth Forms

Lichens possess a thalloid plant body without any distinct differentiation between true root, stem and leaves. Based on the different growth forms, habit and attachment to the substratum, three major forms have been recognized.

### Crustose Lichens

These are thin, flat and crust-like in appearance and tightly adhere to the substratum like rock, bark, soil, etc. These are so tightly attached to the substratum that they cannot be removed without damage. These are mostly corticolous and saxicolous. For example, *Melasphilealentiginosa*: These were found on the bark of *Quercus leucotrichophora* at around 1700 m in Shimla, Himachal Pradesh, these species has a thin, immersed, rough thallus and carbonaceous apothecia (Prasher & Sushma, 2017). *Physconia pulverulenta*: Occurs on bark at 2680 m in Sangla, Himachal Pradesh. It has a foliose-like appearance near apothecia but is considered microlichen due to small, closely attached thalli (Prasher & Sushma, 2017).

### Foliose Lichens

These appears leaf-like with lobes and possessing a slightly flattened body. Unlike crustose lichens, these are quite loosely bound to the substratum usually through root-like structures called rhizines. For example, *Hyperphysciaadglutinata*– This lichen has small orbicular foliose thalli, greenish-grey to brownish in color, collected in forested areas of Uttarakhand, including Bajpurand Khatima (Awasthi, 1960). *Parmotrema tinctorum* and *Parmotrema austrosinense*: These corticolous lichens are with broad round lobes, soralia present, found in Sikander Dhar, Himachal Pradesh (Thakur & Chander, 2018). *Leptogiumpapillosum*: These saxicolous lichens are loosely attached with flat to ascending lobes, bluish-grey to dark-grey in appearance; found in Himachal Pradesh and reported new to India (Prasher & Sushma, 2017).

### Fruticose Lichens

Visually these are shrub-like or hair-like, often found branched with 3-dimensional appearance. These may be erect or pendant, attached to substratum at a single point. For example, *Cladonia subsquamosa* – A podetiate fruticose lichen growing on soil over rocks in alpine zones, height ranges from 10–20 mm, with secondary thallus podetia exhibiting soredia and microsquamules and this species has also been reported from Nilgiri hills in southern India, highlighting its pantropical distribution as well as Himalayan occurrence (Bhoria *et al.*, 2019). Ramalinaceae and Parmeliaceae representatives – Fruticose members like *Evernia*, *Everniastrum*, and *Parmotrema* genera are reported in temperate forests of Himachal Pradesh, Uttarakhand, and J&K, growing on the trunks of evergreen trees (Nayaka *et al.*, 2010).

### Ethnomedicinal and Traditional Uses

Ethnobiology has experienced significant growth, with scientific knowledge derived from research expeditions and traditional data on organisms increasingly utilized for medicinal applications. This has heightened researchers' awareness of bioactive substances present in organisms, facilitating the development of novel pharmaceuticals (Posey, 1992). In this context, lichens have been extensively investigated, particularly focusing on their pharmacological potential and ethno-lichenological aspects, based on survey-based studies (Sharma *et al.*, 2021). Traditional knowledge points towards the knowledge acquired over the

years that has been handed down generation after generation over time. Traditionally, lichens are of utmost importance in the ethnomedicinal field. It was observed that 39% of lichen species possess both documented traditional uses and reported biological activities; 12% hold traditional significance but have yet to be investigated for biological activity; while approximately 49% have documented biological activities with no known traditional uses to date (Sutar *et al.*, 2021). Apparently far more percentage of lichens have been overlooked and still remain to be disclosed. Lichens play a major role in our lives. Local communities utilize lichens in preparing numerous traditional medicines. These medicines are used to treat multiple ailments like skin disorders, wound healing, digestive issues, etc. Cultural and medical value of lichens from Himalayan regions are far more superior to synthetic drugs. These numerous properties of lichens are due to the presence of a variety of chemical compounds within them. Basic chemical composition of lichens consist of carbohydrates (like glucans, heteropolysaccharides, cellulose-like wall materials, etc.), polyols (sugar alcohols) such as ribitol, mannitol and sorbitol (which mainly serves as carbon storage and transfer compound), proteins and amino acids from both the algal and fungal partners, lipids (fats, fatty acids, sterols), pigments such as carotenoids, chlorophyll a (in algae), phycobiliproteins (in cyanobacteria). Lichens absorb minerals directly from the air, rainwater, and their substrate, including essential macro-elements such as carbon, hydrogen, oxygen, nitrogen, phosphorus, sulfur, potassium, calcium, magnesium, and sodium. They also take up micro-elements like iron, copper, zinc, manganese, molybdenum, and boron, as well as heavy metals such as lead, cadmium, and mercury, which can accumulate within their tissues. Consequently, lichens serve as effective bioindicators of air pollution. In some regions, lichens are often boiled to make tea out of it. Lichens are especially known to produce several unique secondary metabolites, most of these are phenolic compounds synthesized by the mycobiont the fungal partner which forms around 20 % of the dry weight of lichens. These include- depsides & depsidones (e.g., atranorin, salazinic acid, norstictic acid), usnic acid which are yellow-green pigments having antibiotic, antiviral, and antifungal activity, pulvinic acid derivatives which provides orange, yellow or red pigmentation, anthraquinones (found in a few lichens and imparts red/orange hues) and in very small quantities there are also present terpenes & sterols. Lichen metabolites play a crucial role in metal homeostasis and contribute significantly to the pollution tolerance observed in lichens (Bhattacharyya *et al.*, 2016).

Thus, lichens are used as antimicrobial and antioxidant agents (Elkhateeb *et al.*, 2021) also as antiviral agent (Bhattacharyya *et al.*, 2016). Atranorin exhibits potent antioxidant and antitumor properties, demonstrating one of the highest free radical scavenging activities among lichen-derived compounds tested to date, along with exceptional reducing power and superoxide radical scavenging efficacy (Goga *et al.*, 2020). Currently, lichens are employed to treat a variety of human illnesses because of their anti-cancer, antigenotoxic, anti-inflammatory, analgesic and antipyretic activity (Nugraha *et al.*, 2019; Šeklić *et al.*, 2022). *Usnea* is considered to be the most widely used genus of lichens in traditional medicine. Due to its broad range of biological and ecological activities, atranorin is utilized in various industries, including cosmetics, deodorants, perfumery, toothpaste formulations, and medicinal ointments. Larvae of *Cleorodeslichenaria* exhibited impaired growth, increased mortality rates, and elevated concentrations of usnic acid within their tissues (Goga *et al.*, 2020). In lichens, secondary metabolite production is determined by the environmental factors including UV-exposure, temperature fluctuations, seasonal variations, etc. Due to the diverse topography in the northwestern Himalayan regions, a large variety of lichen species are thriving there, some of which has been mentioned in the table below with their few ethnomedicinal uses;

S. no.	Lichen species	Family	Substratum	Altitude(in m)	Morphological characters	Traditional uses	References
1.	<i>Alectoria sarmentosa</i> Ach.	Parmeliaceae	Tree branches	1500-3500	Fruticose thallus with pendulous and hair-like strands, highly branched, can form tangled mats, surface is smooth and slightly shiny, no soredia or isidia present, loosely attached to branches by basal holdfasts, mostly reproduce via fragmentation.	Lichens have been traditionally used for wound dressing, treating open sores, and incorporated into sanitary napkins and baby diapers due to their absorbent and antimicrobial properties. Additionally, they have been employed in the treatment of asthma, arthritis, and conditions involving excessive mucus discharge from the nose or throat.	(Jain 2016);(Rankovic 2007);(Gollapudi 1994).
2.	<i>Bryoria bicolor</i> (Hoffm.) Brodo& D. Hawksw	Parmeliaceae	Bark	1500-3500	Fruticose thallus which is hair-like, pendulous or loosely attached to branches, branches (slender, cylindrical and slightly dichotomous), no soredia or isidia, cortex is well developed, primarily reproduces through fragmentation.	It is commonly indicated for the management of general weakness, vertigo, cardiac palpitations, spontaneous ejaculation, nocturnal hyperhidrosis, urinary retention or difficulty, infectious dermatological conditions, and purulent discharge.	(Wang & Qian, 2013)

3.	<i>Buelliasubrosiroides</i> S. Singh & D.D. Awasthi	Buellaceae	Rocks	1500-3500	Crustose lichen, tightly attached to rock surface, smooth to slightly cracked surface, reproduce through spores, apothecia present, compact medulla, well developed cortex.	A paste derived from the thalli is traditionally applied for decorative purposes, such as creating henna-like tattoos on the palms and lips.	(Jain, 2016)
4.	<i>Bulbothrixsetschwanaensis</i> (Zahlbr.) Hale	Parmeliaceae	Barks	500-2000	Foliose thallus, closely attached to substratum with narrow lobes and smooth texture, bulbate cilia are present along the lobe margin, reproduction primarily vegetative.	It is utilized as a culinary spice in Northern India and also serves as a source of natural dye.	(Behera BC 2002);(Fernandez 2016);(Tiwari 2011);(Maurya 2018).
5.	<i>Cetraria islandica</i> (L) Ach.	Parmeliaceae	Rocks and soil	2000-3800	Foliose thallus, forms cushion-like mats, lobes are broad, flattened, often with a wrinkled surface, thick medulla.	It is employed as a tonic in the treatment of pulmonary tuberculosis, hemoptysis, asthma, chronic respiratory congestion, and also functions as a laxative. Additionally, it is used to manage indigestion, dysentery, uterine cysts, nephrolithiasis, and urinary tract infections. Furthermore, it serves as a winter forage for reindeer.	(Crawford, 2015);(Ingolfsdottir, 2000); (Turk et al., 2003); (Gülçin, 2002);(Ogbaji, 2014); (Haraldsdottir et al., 2004).
6.	<i>Cladoniafruticulos</i> aKremp.	Cladoniaceae	Wood	1990	Fruticose thallus forming shrub-like structures, primary thallus is squamulose, dichotomous	It is traditionally used in the treatment of bacterial skin infections,	(Wang & Qian, 2013).

					branching.	vertigo, epistaxis, infectious dermatological conditions, and conjunctivitis.	
7.	<i>Everniastrumnepalense</i> (Taylor) Hale ex Sipman	Parmeliaceae	Barks and branches	1800-3400	Foliose thallus, loosely attached to substratum, lobes are broad, flat and dichotomously branched, well developed upper cortex protecting the photobiont layer.	The thalli are consumed as a vegetable after boiling or frying and are also utilized in the traditional treatment of toothache and sore throat.	(Shah, 2014);(Maharjan, 2013);(Tiwari, 2011);(Sinha, 2005).
8.	<i>Lobariapindarensis</i> Räsänen	Peltigeraceae	Tress and shrubs in subalpine forests	~2000-4150	Foliose thallus, reproduce by both sexual spores (disk shaped fruiting body called apothecia) and vegetative propagules (isidia, lobules, thallus fragments).	Used as spices in some regions	(Yang et al.,2022); (Yang et al.,2021).
9.	<i>Lobariaisidiosa</i> (Müll. Arg.) Vainio	Peltigeraceae	Bark, Mosses & Rock	~1500-3500	Foliose and leathery thallus, broad flattened lobes usually overlapping, isidiate thallus surface, with whitish & loose medulla.	Utilized in the management of dyspepsia, the alleviation of inflammation and pain, the treatment of burns and scalds, as well as the reduction of oedema associated with renal inflammation.	(Crawford, 2015).
10.	<i>Parmelia saxatilis</i> (L.) Ach	Parmeliaceae	bark	1200-3000	Foliose thallus tightly attached to substratum, lobes are slightly lobulate or crenate, upper surface is smooth and slightly wrinkled with pseudocyphellae scattered on	Employed in the treatment of visual disturbances, uterine hemorrhage, external bleeding due to injury, chronic dermatitis, as well as	(Wang & Qian, 2013);(Thadhani & Karunaratne, 2017);(Kosanić et al., 2012a);(Ćilerdžić,2016);(Huang, 2014);(Wei et al., 2008);(Karagöz,2009).

					upper surface, lower cortex are with simple rhizines for attachment.	persistent sores and inflammatory swelling.	
11.	<i>Parmotremahababanum</i> (Gyeln.) Hale	Parmeliaceae	Barks and rocks	1500-3200	Foliose thallus, broad, rounded, often overlapping lobes, lower surface is black with simple or branched rhizines for attachment, loosely packed medulla.	Traditionally used as a culinary spice and in the management of renal disorders, venereal diseases, and various dermatological conditions. The fresh plant is burned, and the resulting ash is combined with mustard or linseed oil to prepare a topical remedy for ringworm and similar skin infections	(Upreti et al., 2005);(Ganesan, 2016).
12.	<i>Usnea orientalis</i> Motyka	Parmeliaceae	Bark, wood, rarely on rocks	2000-3200	Fruticose thallus which is pendulous, hair-like to stringy, extensively dichotomously branched, central cord is visible when thallus is broken, sensitive to air pollution.	Traditionally utilized as a culinary spice in the regional cuisines of Uttaranchal, Uttar Pradesh, and Himachal Pradesh.	(Upreti et al., 2005);(Pathak, 2016b); (Wei et al., 2008).
13.	<i>Usnea aciculifera</i> Vain.	Parmeliaceae	Branches and twigs of trees	2000-3500	Fruticose thallus, central axis is elastic, basal holdfasts present, lacks soredia or isidia.	It is employed in the treatment of bladder infections, dysuria, urinary retention, and edema associated with cardiac and renal conditions. Additionally, it is used to manage external	(Jain,2016); (Nayaka et al. 2002B); (Srivastava et al., 2004B).

						hemorrhage, relieve pain, and treat hematochezia. Furthermore, it is utilized as a traditional remedy for pulmonary disorders, internal bleeding, and asthma.	
14.	<i>Xanthoparmeliac onspersa</i> (Ach.) Hale	Parmeliaceae	Exposed rocky surface	1200-3000	Foliose thallus, tightly attached to rocks, broad, flat, often overlapping lobes, well developed protective upper cortex with white and dense medulla.	Traditionally, it is applied topically as a therapeutic intervention for snake bites and utilized in the treatment of syphilis	(Nayaka, 2010);(Karaahmet et al., 2019);(Sokmen, 2018).

## Discussion

From the data documented in the table above, it can be concluded that there is predominance of foliose lichens in ethnomedicinal practices which may be ascribed to their relatively larger surface area that aids collection and large number of unique secondary metabolites production. It can be also drafted that mostly the lichens found at higher altitudes are being used in ethnomedicinal fields which may be due to the great topographical and climatic variations. Moreover, different tribal communities reside in the landscapes of northwestern Himalayan regions like Gaddi, Gujjars, etc. From generations they have used lichens for the treatment of various diseases. For example, *Usnea*, as believed to have antibacterial properties is often used to treat wound and cuts. *Parmelia* is used to treat various skin diseases and coughs. Our study recorded 70 lichen species, encompassing 29 genera and 15 families, across eight different localities in the Mandi district of Himachal Pradesh, as reported in the referenced research paper “An Assessment of Lichens Diversity from Mandi District, Himachal Pradesh, India” by (Thakur et al., 2020). Their documentation reported that among the primary localities in Mandi district, Himachal Pradesh, the Sikandra Dhar area exhibited the highest lichen diversity with 19 species. Other localities, including Balh Valley, Barot, and Mandi city, recorded 18, 17, and 16 species, respectively. They also noted that lichen species belonging to the genera *Ramalina*, *Parmotrema*, and *Caloplaca* were exclusively found in the pollution-free zones of the inner reserve forest. The study conducted by Bajpai et al., (2022) reported 714 lichen species, representing 189 genera and 49 families, across 12 representative districts of Himachal Pradesh. In their research it was found that among the 12 districts studied only Kullu and Shimla were characterized by a large number of species (425 and 304 species respectively) as both had almost similar habitats. Their study further revealed that the districts of Una, Hamirpur, and Bilaspur exhibited the lowest lichen species diversity, with 10, 39, and 66 species recorded respectively. According to their findings, lichens belonging to Parmeliaceae family were reported in dominance. The study by Chander et al., (2019) reported the collection of sixty lichen species from Balh Valley in the

Mandi district of Himachal Pradesh. Their documentation recorded *Usnea longissima* for the first time from the Mandi district of Himachal Pradesh.

### Conclusion

Based on the findings of these studies, it can be concluded that the Northwestern Himalayan region possess remarkable lichen diversity, with a wide range of growth forms and species adapted to different habitat and environmental conditions. These lichens are not only recognized ecologically important but also play an impactful role in the traditional medicine practices of local communities. For generations, indigenous people including tribal communities have used various lichen species to treat several medical urgencies like wounds, skin diseases, coughs, and other common illnesses. Some of these traditional uses are now being supported by modern scientific research, especially for species like *Usnea* and *Parmelia*. However, even though they are so much important, lichens are encountering severe threats from overharvesting, pollution, and climate change. At the same time, the traditional knowledge related to their medicinal use is gradually vanishing from existence as younger generations are moving away from these practices. Thus, there is an urgent need to document this knowledge, so that lichen habitats can be protected, to carry out even more scientific practices to bring out their full potential in medicinal fields. By combining traditional wisdom with modern research, new and fascinating world of lichens can be brought into light and help to conserve both biodiversity and cultural heritage for future generations.

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