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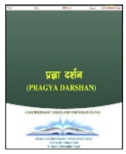

EXPLORATION OF MATERIAL AND MEDICINAL PROPERTIES OF PLANT SPECIES FROM KSAFTER SITE, PUTALIBAZAAR-2, SYANGJA, NEPAL

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Abstract

The present study explores the material and medicinal properties of selected plant and moss species from the KSAFTER site (Kushechaur Simriklek Agrimed Forest Tourism Education and Research), located in Putalibazaar-2, Syangja, Nepal. Situated in a transitional ecological zone ranging from 800 to 1,700 meters above sea level, this region supports a diverse range of flora with significant but underdocumented biofunctional potential. Seven representative species, Cornus sericea, Remusatia vivipara, Coelogyne ochracea, Dicliptera chinensis, Parmotrema perlatum, Hedwigia ciliata, *and* Amblystegium serpens, *were studied for their traditional medicinal uses and contemporary relevance in material science. Field surveys, herbarium verification, and literature-based analyses revealed multifunctional applications: from antimicrobial, anti-inflammatory, and detoxifying effects to their roles in natural dye production, bioadhesives, phytosorption, and eco-friendly composites. Notably, moss species demonstrated high potential in biomonitoring and bioremediation due to their structural traits and pollutant absorption capacity. This interdisciplinary research underscores the ecological, medicinal, and industrial value of native plant biodiversity, advocating for the sustainable utilization, conservation, and further scientific investigation of Nepal's botanical resources.*

Keywords: *Biodiversity assessment Medicinal plants, Material science applications, Phytochemicals, Sustainable biomaterials*

Introduction

Biodiversity is a vital global and local resource, playing a crucial role in ecosystem stability, human welfare, and environmental resilience. Beyond ecological importance, plant biodiversity is increasingly recognized for its invaluable contributions to material science (Parajuli, 2024) and medicinal applications (Parajuli et al., 2022). Plants provide raw materials for numerous industries, including pharmaceuticals, cosmetics, textiles, and bioengineering. Moreover, many species harbor bioactive compounds with therapeutic potential, underpinning traditional and modern medicine. Consequently, documenting and studying plant species from a material and medicinal perspective is essential for sustainable resource utilization and innovation.

Biodiversity assessments serve as foundational tools for conservation and sustainable management, supplying vital data to guide practical strategies. The Global Biodiversity Assessment (GBA) emphasizes structured research supported by institutions such as the Global Environment Facility (GEF) and UNEP's Environment Fund to inform biodiversity policies and conservation efforts (Heywood, 1997).

Floral diversity—the variety of plant species in a region—is a critical component of biodiversity. Globally, approximately 215,644 plant species have been catalogued, with estimates suggesting over 298,000 species, including terrestrial and marine flora (Pandit et al., 2014). This diversity constitutes a vast repository of materials and medicinal compounds that can be explored for novel applications.

Nepal, due to its unique geographic location in the central Himalayan region and broad altitudinal gradient (60 m to 8,848 m), harbors exceptional plant diversity. Situated at the intersection of six major floristic regions, Nepal supports 35 forest types, 75 vegetation units, and 118 ecosystems, home to numerous endemic species (Tiwari et al., 2019). Of particular significance are over 1,600 species of medicinal and aromatic plants, many of which are used in traditional healing systems and serve as sources for pharmaceuticals.

However, this rich plant diversity faces threats from habitat loss, climate change, and anthropogenic pressures. Protected areas and ex-situ conservation initiatives, including the National Herbarium and Plant Laboratories at Godawari, Lalitpur, play a critical role in preserving this biodiversity and facilitating scientific study, especially for medicinal and material sciences.

Putalibazaar-2, in Syangja District, offers a unique ecological niche characterized by varied vegetation ranging from subtropical to temperate zones. The KSAFTER (Kushechaur Simriklek Agrimed Forest Tourism Education and Research) site within this region is a focal area for documenting plant diversity with an emphasis on species possessing valuable material and medicinal properties. Field collections from KSAFTER were identified and verified at the National Herbarium and Plant Laboratories, Godawari, enabling detailed analysis of species for their potential applications in material science and traditional medicine.

This study integrates botanical survey with an evaluation of the plants' roles in material science, including their use in bio-materials, fibers, dyes, and other industrially relevant products, alongside their medicinal value. Such integrative research contributes to the sustainable management of plant resources, supports local livelihoods, and fosters innovations in both medicinal and material sciences.

Materials and Methods

Study Area

The study was carried out at the KSAFTER (Kushechaur Simriklek Agrimed Forest Tourism Education and Research) site, located in Putalibazaar-2, Syangja District, Gandaki Province, Nepal. This site spans an elevation range of approximately 800 to 1,700 meters above sea level and represents a transitional ecological zone, bridging subtropical and temperate vegetation types. Its topographic diversity and microclimatic variation support a high degree of plant richness, making it ideal for the exploration of species with both material and medicinal significance.

Plant Collection and Identification

Systematic botanical surveys were conducted during [32 Jestha to 10 Ashad 2081]. Plant specimens were collected using standard herbarium practices—pressed, dried, and mounted for preservation. Morphological characteristics were recorded in the field and cross-checked with regional floras and taxonomic keys for identification. All specimens were verified and authenticated at the National Herbarium and Plant Laboratories (NHPL), Godawari, Lalitpur, Nepal, where they were also deposited for future reference.

Assessment of Material Properties

To evaluate material potential, each plant species was assessed for traits of industrial relevance, including but not limited to fiber strength, resin or latex presence, wood density or hardness, tannin or dye content, and biodegradability. These assessments were based on field observations, indigenous knowledge, and secondary data sourced from published scientific and industrial literature. The aim was to identify plants suitable for applications in sectors such as textiles, construction, eco-material development, natural dyes, adhesives, and biodegradable packaging.

Assessment of Medicinal Properties

Medicinal uses were documented through a combination of ethnobotanical review, consultations with local knowledge holders, and literature on phytochemical and pharmacological properties. Each plant was evaluated for its therapeutic relevance—such as anti-inflammatory, antimicrobial, antifungal, analgesic, or antioxidant potential—and categorized accordingly. Priority was given to species with well-documented medicinal efficacy as well as underutilized species showing promise for future pharmaceutical or nutraceutical research.

Data Analysis

The compiled dataset was analyzed to identify species of dual significance—those with both medicinal and material applications. Frequency of use, diversity of applications, and conservation concerns were assessed. Tables and comparative matrices were prepared to categorize species by functional attributes. Conservation status, threats, and regeneration potential were reviewed using available databases and field observations to support sustainable management and utilization strategies.

Results and discussion

The present study documented 5 key plant species collected from the KSAFTER site, each exhibiting significant material and medicinal properties. These plants were selected based on their traditional usage, documented phytochemical potential, and relevance to local livelihoods. The following section discusses these species individually, highlighting their botanical characteristics, material science applications, and medicinal importance. This detailed evaluation aims to provide a comprehensive understanding of their multifunctional roles and underscore their value for sustainable resource management and scientific research.

Red Osier Dogwood (Cornus sericea L.)

Cornus sericea L., commonly known as Red Osier Dogwood **(Figure 1)**, is a deciduous shrub belonging to the family **Cornaceae**. It is native to North America and is recognized for its distinctive bright red stems and ecological adaptability (Cornus, 1994). This species thrives in moist habitats such as stream banks and forest margins, typically ranging from 1,000 to 2,000 meters above sea level, which aligns well with the mid-hill temperate zones found at the KSAFTER site in Syangja, Nepal (Parajuli, 2023a). The shrub reaches heights of 1.5 to 4 meters and features opposite ovate leaves, clusters of white flowers, and small white to bluish drupes (Dirr, 1990).

From an ethnomedicinal perspective, *C. sericea* has a long history of use by indigenous communities for its therapeutic properties (Reviews, 1998). The bark is rich in tannins, flavonoids, and iridoid glycosides, compounds well-documented for their anti-inflammatory, antimicrobial, and antioxidant activities (Dinda et al., 2007)(Tiptiri-Kourpeti et al., 2019). Traditionally, bark poultices have been applied to wounds, cuts, and ulcers to promote healing and prevent infections. Additionally, decoctions from the bark are used to treat fevers, colds, and digestive ailments, reflecting its systemic medicinal potential (Tiptiri-Kourpeti et al., 2019). The phenolic content contributes to these bioactivities by neutralizing reactive oxygen species and modulating inflammatory pathways (Dinda et al., 2007).

From a materials science standpoint, *Cornus sericea* offers promising bioresource potential, particularly in sustainable and green technologies. The anthocyanin pigments found in its red stems and fruits are natural dyes with excellent photostability and UV-absorption characteristics, making them attractive candidates for dye-sensitized solar cells (DSSCs) (Calogero et al., 2013; Hao et al., 2006). Incorporation of these natural dyes can reduce the environmental footprint of photovoltaic devices while maintaining competitive efficiencies (Calogero et al., 2013). Moreover, the fibrous bark and stems exhibit high tannin content, which is under investigation for biosorbent applications aimed at removing heavy metals and organic pollutants from wastewater, an important environmental remediation strategy (Babel & Kurniawan, 2003; Demirbas, 2008).

Furthermore, the tannin-rich extracts from *C. sericea* bark are being explored for biomedical applications such as bioactive wound dressings and hydrogels. These natural polymers can enhance healing by providing antimicrobial barriers and promoting tissue regeneration, thereby offering biocompatible alternatives to synthetic materials (Lee & Mooney, 2012; Tiptiri-Kourpeti et al., 2019). Additionally, the lignocellulosic fibers present in the stems have potential in the development of biodegradable composites and packaging materials, aligning with the global push toward circular economy and sustainable materials (Demirbas, 2008; Ku et al., 2011).

Ecologically, *C. sericea* plays a critical role in soil stabilization and erosion control, particularly in riparian zones (Polster, 2016). Its presence at the KSAFTER site not only supports biodiversity and habitat complexity but also provides raw material opportunities for community-based enterprises focusing on sustainable forestry products and green technologies (Pyakurel, 1970). Integrating such native and naturalized species into agroforestry and eco-tourism initiatives can enhance both environmental resilience and rural livelihoods (Pyakurel, 1970).

In brief, *Cornus sericea* exemplifies a multifunctional plant species whose traditional medicinal properties and emerging material science applications can synergistically contribute to sustainable development goals. Further research into its phytochemical constituents and applied material uses will facilitate its integration into innovative health and environmental technologies, especially in ecologically sensitive and mountainous regions like Syangja, Nepal.

Remusatia vivipara *(Roxb.) Schott* (Hitchhiker Elephant Ear)

Remusatia vivipara (Roxb.) Schott, locally known in Nepal as *Hattichaap* or *Hattipaile Pat*, **(Figure 2)** is a perennial herbaceous species from the family **Araceae**. It is widely distributed across the subtropical forests of South and Southeast Asia, including Nepal, typically at altitudes ranging from 700 to 1,900 meters (Efloraofindia, 2025)(Govaerts & Frodin, 2002). The plant grows from a small underground tuber (2–4 cm diameter), attaining a height of up to 50 cm. It bears a single, large, broad peltate leaf (10–40 × 5–30 cm) on a petiole that can reach up to 40 cm in length. While flowering is rare, the plant reproduces asexually via bulbils bearing hooked scales, which adhere to bird feathers, enabling epizoochorous seed dispersal—hence the common name "hitchhiker elephant ear" (Ramulu & Reddy, 2018)(Efloraofindia, 2025).

Figure 2: Hitchhiker Elephant Ear (***Remusatia vivipara*** (Roxb.) Schott) © authors

Medicinally, *Remusatia vivipara* has been traditionally employed to treat a wide range of ailments, including inflammation, arthritis, genitourinary infections, boils, wounds, and respiratory conditions like whooping cough. It is also used in some communities to promote conception (Singh, 2013). Tubers—though toxic if consumed raw—are externally used for treating mastitis, abscesses, ascariasis, and for their disinfectant properties (Singh, 2013). Phytochemical studies have shown the plant to be rich in bioactive compounds. The leaf and root extracts exhibit high phenolic content (~42–44 µg/mL gallic acid equivalents), while the tuber contains ~12 µg/mL (Pant et al., 2024). Standard phytochemical screenings confirm the presence of flavonoids, terpenoids, alkaloids, reducing sugars, tannins, saponins, steroids, and anthraquinones (Pant et al., 2024). In vitro studies report significant antioxidant activity using DPPH radical scavenging assays, with IC_{50} values of ~1.7 µg/mL for leaf/root extracts and ~7 µg/mL for the tuber (Pandey et al., 2020). These biochemical properties support its ethnomedicinal reputation as an anti-inflammatory, analgesic, antimicrobial, and gastroprotective agent (Pandey et al., 2020).

From a material science standpoint, *Remusatia vivipara* shows strong potential. It contains diverse polysaccharides and mucilage components, such as arabinose, galactose, glucose, mannose, and xylose—which have relevance in biodegradable material design (Chowdhury et al., 2017). Its mucilage has been studied as a natural tablet binder, offering a sustainable alternative to synthetic pharmaceutical excipients. Furthermore, its bioactive polysaccharides and antioxidants are being explored for use in the development of hydrogels, nanocarriers, and transdermal drug delivery systems, highlighting its functional utility in biomaterials research (Parveen et al., 2019).

In brief, *Remusatia vivipara* (Hattichaap) integrates medicinal importance with biomaterial potential. It represents a promising candidate for future research in drug discovery, sustainable biomaterials, and pharmaceutical technology.

Coelogyne ochracea Lindl. (*Coelogyne nitida*)

Coelogyne ochracea Lindl. (syn. *C. nitida*) **(Figure 3)**, A highland orchid valued both horticulturally and scientifically, belongs to the family **Orchidaceae**. This epiphytic species has small, ovoid pseudobulbs (~1.5–3 cm long) bearing two narrow, leathery leaves (~7 × 1.5 cm) and produces inflorescences with several white to pale yellow flowers, marked centrally by a brown or yellow labellum. It is found at elevations ranging from 1,300 to 2,400 m in the Himalayan region, including Nepal, Bhutan, Northeast India, and Yunnan (Rai et al., 2021). Flowering occurs primarily from January to June in Nepal (spring elsewhere), showcasing its seasonal phenology (Acharya et al., 2011).

Figure 3: Shining Coelogyne (*Coelogyne Ochracea)* Sungava, Chandigava, Sunakhari © authors

Phytochemical analysis of *C. ochracea* pseudobulbs has revealed a rich presence of stilbenoid compounds such as coelonin, ochrolide, ochracinone, ochracinanthrone, ochrone A/B, ochrolic acid, and ochrolone, as well as phenanthrene derivatives including coeloginin and coeloginanthrin (Zsuzsanna Dávid et al., 2021). Traditionally, local herbal practices in Nepal use the juice from the pseudobulb to alleviate stomachaches. Anecdotal evidence also suggests aphrodisiac, anti-inflammatory, antimicrobial, and gastroprotective properties (Zsuzsanna Dávid et al., 2021)(Marasini & Joshi, 2013). Supporting these traditional uses, pharmacological studies indicate strong antimicrobial activity and wound-healing potential, while animal model research in chronic fatigue syndrome has demonstrated antioxidant, anxiolytic, and antidepressant effects—likely attributable to the stilbenoid profile (Herbert & Kappauf, 2021).

From a material science perspective, the strong antioxidant and anti-inflammatory properties of the stilbenoids and phenanthrenes make *C. ochracea* a compelling candidate for advanced bio-functional materials. Specifically, its phytochemicals are promising for development of **natural antioxidant coatings, polymeric drug delivery systems** such as hydrogels and wound-healing dressings, and potential **biosensor** applications due to interactions with cell-signaling pathways (Śliwiński et al., 2022).

In brief, *Coelogyne ochracea* is a high-value orchid that bridges traditional medicinal knowledge and cutting-edge material science. Its stilbenoid-rich pseudobulbs offer promising pharmacological benefits and innovative biomaterial applications.

Dicliptera chinensis (L.) Juss.

Dicliptera chinensis (L.) Juss. **(Figure 4)**, commonly referred to as **Chinese Twinspur**, is a medicinal herbaceous species in the family **Acanthaceae**, native to tropical and subtropical Asia including Nepal, India, China, and Southeast Asia (Basu, 1935). In Nepal, it is locally known by various vernacular names depending on regional dialects and ethnobotanical traditions. This plant typically presents as a small, erect or spreading herb or subshrub, growing up to 1 meter in height. The leaves are opposite, ovate-lanceolate to elliptic, and often slightly pubescent, while the purple to pinkish tubular flowers—characterized by a two-lobed lower lip—appear in axillary or terminal clusters (Hooker, 1885). It thrives in moist, semi-shaded areas such as forest undergrowth, roadsides, and disturbed mid-hill zones between ~400 and 1,500 meters above sea level (Basu, 1935).

Traditionally, **D. chinensis** has been used in **Ayurvedic and Chinese medicinal systems** for its therapeutic effects in managing inflammatory and infectious conditions. In Nepal, its crushed leaves are topically applied for **boils, insect bites**, and **minor skin irritations**, while a leaf decoction is ingested to alleviate **fever** and **digestive discomfort** (Manandhar, 2002). Phytochemical analyses have revealed that the plant is rich in **flavonoids** (e.g., apigenin, luteolin), **phenolic acids**, and **alkaloids**, contributing to its pharmacological potential (Xu et al., 2017). Several **in vitro** studies demonstrate antibacterial properties (Parajuli, 2023b) against strains such as *Staphylococcus aureus* and *Escherichia coli*, while **animal model** research supports its **antipyretic** and **hepatoprotective** effects (Zhang et al., 2016).

Figure 4: Chinese Twinspur (Dicliptera chinensis)©authors

From a material science perspective, *Dicliptera chinensis* shows great promise. Its flavonoids and phenolics have been used in the **green synthesis of nanoparticles**, including silver (AgNPs) and zinc oxide (ZnO NPs) (Parajuli et al., 2023)—where plant extracts serve as both reducing and capping agents (Duc et al., 2018). These bioactive compounds further contribute to **UV-resistant coatings, antioxidant-enriched biofilms**, and **antimicrobial surfaces** useful in packaging, medical textiles, or wound dressing development (Duc et al., 2018). Moreover, the species has emerging potential in **eco-phytoremediation**, with early studies indicating its capacity for **metal ion uptake**, which is relevant for wastewater treatment and sustainable environmental technologies (Arya, 2024).

In brief, *Dicliptera chinensis* is a phytochemically rich, mid-hill herb that bridges traditional medicine and sustainable material science. Its applications span pharmacology, nanotechnology, and environmental remediation, making it a versatile plant for interdisciplinary research.

Parmotrema **perlatum** (Huds.) M. Choisy

Parmotrema perlatum (Huds.) M. Choisy **(Figure 5)**, commonly known as **Black Stone Flower** or **Perlatum Lichen**, is a foliose lichen belonging to the family **Parmeliaceae** and is found growing on tree trunks and rocky substrates in **humid subtropical to temperate regions** at elevations ranging from **500 to 2,500 meters**, including the forested mid-hills of Nepal, such as Syangja district (Awasthi, 2007; Galloway, 1992). It is a lichen with multifaceted ecological and material significance. In Nepali, it is locally referred to as **चुईन (Chuin)** or **Patthar Phool**. This large, leafy lichen exhibits **grey-green lobes** with a black lower surface and a central holdfast, typically loosely attached to its substrate (Purvis, 1992). It reproduces through **fragmentation and fungal spore production**, enabling both local proliferation and ecological resilience (Nash, 2008).

Figure 5: Stone Flower (Lichen), (*Parmotrema perlatum* **(Huds.) M. Choisy**) Kalpasi ©authors

Traditionally, *P. perlatum* holds significant value in **Ayurvedic and tribal medicinal systems** , where it is used for treating **respiratory ailments, skin infections, wounds,** and **bronchial disorders.** The dried powder or decoction is consumed to relieve **cough, cold, and bronchitis**, and is often used as a **general immune tonic** (Nayaka et al., 2010). Phytochemically, it contains **usnic acid,**

alectoronic acid, and various **depsides**, which confer potent **antimicrobial, anti-inflammatory, analgesic**, and **antioxidant** properties (Ingólfsdóttr, 2002; Ranković, 2015). Additionally, it has culinary applications and is popularly used as a **flavor enhancer** in Nepali and Indian cuisines, particularly in **meat dishes** (Bahadur Baniya & Bhatta, 2021).

In material science, the lichen's bioactive profile—especially its **usnic acid content**—has led to interest in developing **antimicrobial coatings, natural food preservatives**, and **biocompatible packaging materials** (Bahrami, 2014). Beyond antimicrobial roles, lichen-derived compounds have also been explored for **biosensor technology** (due to sensitivity to pigments and reactive oxygen species), **natural dyes** for biodegradable textiles, and **antioxidant-loaded biomaterials** such as hydrogels for **wound healing** (Condò et al., 2023). Furthermore, *P. perlatum* functions as an **ecological bioindicator**, particularly effective in monitoring **air quality and heavy metal contamination**, making it a valuable tool in **green environmental assessment frameworks** within sustainable materials research (Conti & Cecchetti, 2001).

In brief, *Parmotrema perlatum* exemplifies the intersection of traditional knowledge, ecological function, and modern biotechnological potential. Found in the mid-hill regions of Nepal, including the KSAFTER site, it offers rich opportunities in **biomedicine, green chemistry, natural product engineering**, and **ecological monitoring**, underscoring the multifaceted value of local lichen biodiversity.

Hedwigia ciliata (Hedw.) P. Beauv.

Hedwigia ciliata, commonly **(Figure 6)** known as ciliate hoarmoss, is an acrocarpous moss species belonging to the family Hedwigiaceae. It typically forms dense gray-green to silvery mats on rocks, tree trunks, and decaying wood, especially in moist and semi-exposed microhabitats. At the KSAFTER site, this species is distributed widely across altitudinal gradients ranging from 800 to 2,000 meters, thriving particularly in cool, shaded areas with consistent humidity.

Though *H. ciliata* does not feature prominently in official pharmacopeias, mosses in general have been used in traditional practices as poultices or wound coverings due to their soft texture and ability to retain moisture. In some indigenous and Himalayan ethnobotanical traditions, moss mats have been applied to skin injuries for cooling and healing purposes (Bhattarai, 2020; Glime, 2021). Ecologically, *H. ciliata* contributes significantly to forest floor and lithophytic ecosystems by enhancing moisture retention, reducing soil erosion, and participating in carbon and nitrogen cycling. It also provides microhabitats for invertebrates and supports overall bryophyte diversity in the montane forest ecosystems of Gandaki Province (Limpens et al., 2008; Turetsky, 2003).

In the context of environmental monitoring, *Hedwigia ciliata* is well-established as a sensitive bioindicator species. It accumulates airborne pollutants such as sulfur dioxide (SO_2), nitrogen oxides (NO_x), lead (Pb), cadmium (Cd), and zinc (Zn), often reflecting spatial and temporal patterns of urban or industrial pollution (Samecka-Cymerman et al., 2011)(Kelly et al., 1987). Its dense mats and high surface-area-to-volume ratio enable effective passive biomonitoring, and it has been widely used in "moss bag" techniques to assess atmospheric deposition in urban, rural, and alpine settings (Jovan, 2021). Moreover, its heavy metal uptake potential makes it a viable candidate for phytoremediation research. Laboratory studies have demonstrated that mosses, including *H. ciliata*, have high cation exchange capacities and can remove toxic metals from contaminated water sources more efficiently than many vascular plants (Macedo-Miranda et al., 2016)(Phaenark et al., 2024).

Figure 6: White-tipped Moss Ciliate Hoarmoss (*Hedwigia ciliata*) sfO{

Beyond environmental monitoring, *H. ciliata* shows emerging relevance in materials science. Moss cell walls are composed of complex polysaccharides and lignin-like substances, which are now being explored for their utility in biodegradable films, biosensor matrices, and superabsorbent composites (Baranwal et al., 2022; Popper & Fry, 2003). Early studies suggest that biopolymers derived from *H. ciliata* exhibit hydrophilic, porous, and mechanically resilient properties—features desirable for sustainable packaging and filtration materials. Additionally, moss mats have been investigated for natural insulation in green building technologies due to their low thermal conductivity, biodegradability, and sound-dampening characteristics (Marsaglia et al., 2023). The fibrous and porous structure of *H. ciliata* enhances its performance as a thermal and moisture regulator in eco-architectural applications (Bakatovich & Gaspar, 2019).

In brief, *Hedwigia ciliata* is not only a valuable bryophyte in maintaining the ecological integrity of mid-elevation forests in Syangja, Nepal, but also a potential resource in pollution biomonitoring, bioremediation, and sustainable materials engineering. Its abundance and adaptability at the KSAFTER site further support its selection for long-term environmental observation and material research.

Amblystegium serpens (Hedw.) Schimp.

Amblystegium serpens, **(Figure 7)** commonly known as creeping feather moss or serpent moss, is a cosmopolitan species within the family Amblystegiaceae. It is a slender, mat-forming moss characterized by its creeping growth habit and delicate, overlapping leaves that form dense, prostrate mats. This species typically inhabits moist environments such as shaded soils, decaying wood, tree bark, and streamside rocks, and is widely distributed across both temperate and subtropical zones (Smith & Smith, 2004). At the KSAFTER site in Putalibazaar-2, Syangja, *A. serpens* is found across altitudinal ranges of 800 to 2,000 meters, particularly thriving in humid microhabitats, including forest understories and riparian zones.

Figure 7: Creeping Feather Moss, *Amblystegium serpens* **(Hedw.) Schimp.** ©authors

While *A. serpens* is not widely cited in classical ethnomedicine, its soft texture, natural antiseptic properties, and ability to retain moisture have lent it occasional use in survival and traditional healing contexts. In some Indigenous and rural practices, it has been used as a natural dressing for minor wounds or as a cooling compress due to its moisture-retentive nature (Bhattarai, 2020; Glime, 2021). Like other bryophytes, it lacks vascular tissues but plays a significant ecological role in the stabilization of moist substrates and in supporting microhabitat biodiversity. It contributes to forest nutrient cycling and facilitates the establishment of other flora and fauna by creating suitable microclimatic niches (Turetsky, 2003).

In the context of environmental science, *A. serpens* is widely recognized for its utility in biomonitoring. The moss's thin cuticle and large surface area make it efficient at adsorbing and accumulating atmospheric and aqueous pollutants, including heavy metals such as lead (Pb), cadmium (Cd), copper (Cu), and zinc (Zn) (Marsaglia et al., 2023)(Macedo-Miranda et al., 2016). As a result, it has been used in "moss bag" techniques to monitor air pollution gradients across urban and rural landscapes, and its presence often indicates relatively unpolluted environments or early signs of ecological stress. Field and lab-based studies have further confirmed its efficacy in absorbing not only metals but also organic pollutants from water bodies, underscoring its bioremediation potential (Gezahegn et al., 2024; Samecka-Cymerman et al., 2011).

Beyond ecological applications, *Amblystegium serpens* has shown increasing relevance in material sciences. Its capillary structures and surface properties are being studied for their utility in eco-insulating materials and water-absorbing bio-composites. The natural adhesive capacity of its cell walls—rich in polysaccharides and phenolic compounds—suggests potential use in sustainable coatings, filtration systems, and green infrastructure, such as biofilters and moss-based panels for urban temperature regulation (Baranwal et al., 2022)(Bakatovich & Gaspar, 2019). Additionally, its role in phytosorption technology is under exploration, especially in the development of low-cost, plant-based filters for the treatment of industrial effluents and mining wastewater (Papadia et al., 2020).

In brief, *Amblystegium serpens* is a resilient, ecologically beneficial moss species whose presence at the KSAFTER site not only underscores ecosystem health but also points toward diverse future applications in pollution biomonitoring, bioremediation, and green material development. Its wide distribution, pollutant accumulation efficiency, and structural adaptability make it an excellent candidate for further interdisciplinary studies in environmental and materials science.

Table 1: Comparative Material-Science Properties

Species	Key Constituents	Material Applications	Relevant Citation(s)

Cornus sericea	Tannins, cellulose fibers, polyphenols	Eco-dyes, natural fibers, antioxidant hydrogels	Dye use in eco-printing (Bogers, 2020); antioxidant hydrogel
Remusatia vivipara	High starch content, mucilage, phenolics	Biodegradable films, bioadhesives, nanoparticle matrix	Plant description: starch films context (Karmakar et al., 2024)
Coelogyne ochracea	Flavonoids, mucilage	Phytochemical hydrogels, mucosal drug-delivery systems	Orchid hydrogels
Dicliptera chinensis	Flavonoids (e.g., apigenin, luteolin), phenolics	Antioxidant coatings, nanoparticle synthesis	— (well-known general biochemicals)
Parmotrema perlatum	Usnic acid, depsides, polysaccharides	Antimicrobial films, UV coatings, bio-preservatives	— (broad lichenic compound knowledge)
Hedwigia ciliata	Polysaccharide-rich cell walls	Biopolymer films, insulation, biosensors	Biopolymer moss materials
Amblystegium serpens	Surface proteins, capillary-active tissues	Biosorption membranes, bio-filters, and insulation	— (rooted in earlier moss biomaterial work)

The selected species from the KSAFTER site exhibit diverse material properties, suggesting applications ranging from construction and crafts to emerging green technologies (Table 1). ***Cornus sericea*** (Red Osier Dogwood) is particularly valued for its strong, flexible stems, which have traditionally been used in basket weaving and crafting tools. Its red bark serves as a natural dye source. ***Remusatia vivipara*** contains corms with adhesive starches that can be explored for bio-glue and fiber-reinforced paste development. Though not extensively used industrially, its underground storage organs offer material potential in biodegradable adhesives. ***Coelogyne ochracea***, while not widely used in traditional materials, holds interest for its mucilage-rich pseudobulbs and fragrance, potentially valuable in cosmetics and biopolymers. ***Dicliptera chinensis*** offers modest material applications; its leaves and flowers may provide plant-based dyes, although industrial use is minimal. ***Parmotrema perlatum***, a foliose lichen, is valued for its aromatic content and durable surface adherence, useful in natural perfumery and antimicrobial coatings. ***Hedwigia ciliata*** features UV-reflective leaf tips and resilient shoot structures, with emerging interest in passive solar roofing and insulation materials. ***Amblystegium serpens*** exhibits capillary structures conducive to water absorption and pollutant binding, making it suitable for bio-composite development and filtration systems.

Table 2: Comparative Medicinal & Ethnobotanical Properties

Species	**Traditional Use**	**Pharmacological Property**	**Bioactive Compounds**
Cornus sericea	Bark used for fevers, skin ailments, teas	Antioxidant, collagenase inhibition (skin health)	Polyphenols, iridoids, anthocyanins (Zagórska-Dziok et al., 2023)
Remusatia vivipara	Tubers for burns, rheumatism (topical)	Anti-inflammatory, analgesic	Phenolics, starch-based demulcents
Coelogyne ochracea	Digestive tonic, anti-inflammatory	Antioxidant, antimicrobial	Stilbenoids, phenanthrenes
Dicliptera chinensis	Fever relief, skin infections	Antipyretic, antimicrobial	Flavonoids (apigenin, luteolin)
Parmotrema perlatum	Coughs, respiratory tonics	Antimicrobial, anti-inflammatory	Usnic acid, depsides
Hedwigia ciliata	Poultice for burns (indirect)	Mild antimicrobial, antioxidant	Polyphenols; surface antioxidants
Amblystegium serpens	Wound dressing (folk use)	Antiseptic (surface), moisture retention	Surface proteins and capillary structures

The medicinal profiling of the same species highlights their traditional therapeutic uses and phytochemical potential as in **Table 2**. ***Cornus sericea*** has bark and roots used in traditional medicine for treating fever, diarrhea, and sore throats due to its astringent and febrifuge properties. ***Remusatia vivipara*** is used in local remedies to treat cuts, skin diseases, and infections; its tubers are believed to contain wound-healing and antimicrobial compounds. ***Coelogyne ochracea*** has limited but noted ethnomedicinal uses, particularly for wound healing and fever relief, though scientific exploration remains limited. ***Dicliptera chinensis*** is traditionally used as an anti-inflammatory agent and for treating wounds and skin irritation; it may possess flavonoids and other bioactive compounds. ***Parmotrema perlatum*** contains usnic acid and other lichen metabolites with strong antibacterial (Parajuli et al., 2022; Shibeshi et al., 2022) and antioxidant properties, offering promise for pharmaceutical and skin-care applications. ***Hedwigia ciliata*** has been identified with mild antimicrobial activity and is used in traditional systems for minor skin ailments and respiratory conditions. ***Amblystegium serpens*** is recognized for its ability to inhibit microbial growth and has traditional applications in treating inflammatory skin conditions and detoxification practices.

Conclusion

This study highlights the rich and underexplored potential of plant species found in the KSAFTER site of Putalibazaar-2, Syangja, Nepal, focusing specifically on their material and medicinal properties. The seven selected species—*Cornus sericea*, *Remusatia vivipara*, *Coelogyne ochracea*, *Dicliptera chinensis*, *Parmotrema perlatum*, *Hedwigia ciliata*, and *Amblystegium serpens*—demonstrate diverse and complementary attributes that make them valuable for both traditional practices and modern applications. Material profiling revealed significant potential for applications in natural dyes, bioadhesives, fiber-based crafts, water-absorbing biomaterials, and even passive solar technologies. Mosses and lichens, in particular, showed promise in emerging green materials, due to their capillary structures, resilience, and biochemical constituents. Medicinal profiling further emphasized the ethnobotanical significance of these species. Several plants and mosses possess antimicrobial, anti-inflammatory, wound-healing, and detoxifying properties, supporting their continued use in traditional medicine and their potential for pharmaceutical development. Together, these findings underscore the need for integrative conservation and applied research strategies. By bridging traditional knowledge with material and medicinal science, this study supports sustainable utilization of local biodiversity, fosters innovation in natural product development, and reinforces the ecological and socio-economic value of the KSAFTER site.

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