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Ethno-Medicinal Uses of Pteridophytes of Dehradun and Adjoining Areas

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Abstract

Pteridophytes are a group of plants that reproduce via spores rather than seeds and include ferns, horsetails, and club mosses. However, recent scientific investigations have revealed that pteridophytes hold a significant place in traditional medicine systems and can provide a range of therapeutic benefits. This study aims to bridge this gap by examining the medicinal potential of pteridophytes and identifying ethnomedicinal pteridophytes thriving in the Dehradun region and its surrounding areas. In addition to learning more about pteridophytes, we identified 28 plants that are traditionally used as medicines in the Dehradun region and its surrounding areas. We researched 28 medicinal plants that fall under 15 different families, representing a wide variety of species, all with special healing abilities. The Pteridaceae family, which also includes the two plants Pteris cretica and Aleuritopteris bicolor, and five species of Adiantum, is the most widespread and dominant one. The remaining 21 plants that are studied in the analyzed region belong to other families. These plants are categorized into Pteridaceae, Dryopteridaceae, Lygodiaceae, Polypodiaceae, Ophioglossaceae, Thelypteridaceae, Equisetaceae, Arecaceae, Hypodematiaceae, Aspleniaceae, Tectariaceae, Adiantaceae, Oleandraceae, and Lindsaeaceae. Every plant has economic worth in terms of nutritional, aesthetic, or medicinal value. Pteridophytes are rich in phytochemicals, such as tannins, alkaloids, flavonoids, carbohydrates, and proteins. These plants exhibit a wide variety of healing methods that the native people used on their own survival, most notably antibacterial, antioxidant, and anti-inflammatory capabilities. Additionally, plants are used to treat lots of skin infections and respiratory conditions, including cuts, burns, and wounds. In conclusion, our study emphasizes the importance of preserving both the ecological integrity of the Dehradun region and the cultural heritage embedded in the traditional uses of these pteridophytes.

Keywords: Pteridophyte, *Pteridaceae*, phytochemicals, *Adiantum* species, antibacterial, anti-inflammatory, Dehradun region

INTRODUCTION

Pteridophytes, which include ferns and their allies, are essentially lower vascular plants, also referred to as cryptograms. They prefer shaded, moist environments with moderate temperatures and are primarily found in tropical and temperate rainforests, but they can also be found in a wide variety of habitats from high altitudes to latitudes.

In a broad sense, ethnomedicine refers to traditional medical practices that focus on how different cultures understand illnesses and diseases and how to treat them. Additional secondary metabolites are produced by plants that they need for life and reproduction. These secondary metabolites are species-specific and vary greatly in structure and bioactivity. They are classified as phenolics, terpenoids, alkaloids, proteins, peptides, etc. These noxious, toxic substances are primarily

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generated as defensive tools against infections and predators.

About 2.5% of the world's landmass, or 9% of all pteridophytes, are found in India. The second largest group of plants in Indian flora are ferns and fern allies, which are represented by 3 families, 130 genera, and 1267 species. 70 species are endemic to India (Botanical Survey of India) [1].

HISTORY AND ORIGIN

The non-flowering vascular plants are called pteridophytes (from the Greek: pteron, feather, phyton, plant).

About 400 genera and 10,500 species, including both living and extinct plants, serve as their representation.

They are the earliest known vascular plants, having developed throughout the Devonian to Permian periods (400 million to 400 million years ago) and emerging as the planet's predominant flora.

The successful colonizers of land habitat are pteridophytes. They had developed a few distinguishing traits throughout the early geological era, which aided in their successful adaptation to life on land. Pteridophytes emerged during the Silurian period and then underwent diversification in the Lower Devonian [2].

DISTRIBUTION

Pteridophytes can develop in a variety of environments. They mostly have terrestrial traits and do best in cool, damp, and shady conditions. Water is necessary for the transportation of male gamete to the female gamete in all pteridophytes to complete sexual reproduction.

The majority are epiphytic (*Lycopodium phlegmaria, Selaginella oregana, Ophioglossum vulgatum,* ferns like *Polypodium, Drynaria, Pleopeltis,* etc.), while some are aquatic (e.g., *Azolla, Isoetes, Marsilea, Salvinia*) or *Xerophytic* (*Selaginella lepidophylla, S. rupestris, Equisetum arvense*). Pteridophytes include small annual herbaceous plants like *Azolla* as well as big perennial trees like *Alsophila* and *Cyathea*. Pteridophytes are often herbaceous in nature [3].

Characteristics of Plant Bodies

i. A sporophyte, which is made up of roots, stems, and leaves, is the primary plant body. It is nutritionally independent. Some primitive members, like *Rhynia, Cooksonia,* and *Psilotum,* do not actually have roots or leaves.
ii. The diploid (2n) zygote gives rise to the sporophyte. The adventitious roots eventually take the place of the transient primary roots.
iii. The stem typically has dichotomous or monopodial branches.
iv. The leaves might be simple, tiny and sessile (like those of the ferns *Pteris species*), scale-like (like *Equisetum species*), or compound, big and petiolate.

Adaptation of Pteridophytes Plants

Pteridophyte spores are surrounded by two concentric wall layers, the outer of which is thick and acid-resistant and the inner of which is thin and acid degradable. The spores can defend themselves against harmful environmental conditions like desiccation or acid treatment. This desiccation-resistant spore was a crucial development that made it possible for plant life to spread across terrestrial surfaces. All exposed areas of land vascular plants have a surface cuticle. The cuticle's primary function is to regulate transpiration [4, 5].

Additionally, it has resistance to microbiological attack, chemical compounds, gas exchange, abrasion, and mechanical harm.

Terrestrial plants have evolved stomata, which regulate the movement of gas and water based on the needs of the plants, because the cuticle prevents gaseous exchange.

Fern allies have variously included the lycopods (*Lycopodium*, and *Selaginella*), horsetails (*Equisetum*), whisk ferns (*Psilotum* and, *Ophioglossaceae*), water ferns (*Marsileaceae*,) and sometimes even members of *Schizaeaceae* and *Gleicheniaceae (Figure 1) [6, 7]*.

- Humans use pteridophytes, like ferns, for a variety of purposes, including food, fiber, crafts, abrasives, decorations, materials, and medications. Tribal groups treat a variety of human illnesses with stem, rhizome, spores, fronds, and pinnae.
- Vegetables include the young fern leaf tips, *Circinate ptyxis*, and *chroziers*. Young *Ampelopteris prolifera* fronds are sold as "dheki shaak" in India.
- In the United States and Canada, the croziers of *Matteuccia struthiopters* are offered as spring vegetables in canned or frozen form. *Marsilea* leaves, also known as "shushni," are consumed as a vegetable.
- Many ferns, including *Pteris*, have starch-rich rhizomes that are used as food.
- Pigs, ducks, and other animals eat the corm (modified stems) of the *Isoetes* plant.
- Many ferns' dry fronds serve as the cattles livestock. *Marsilea's* quadrified lamina, which resembles a clover (*Trifolium*), has been utilized as an alternative to clover as animal feed.

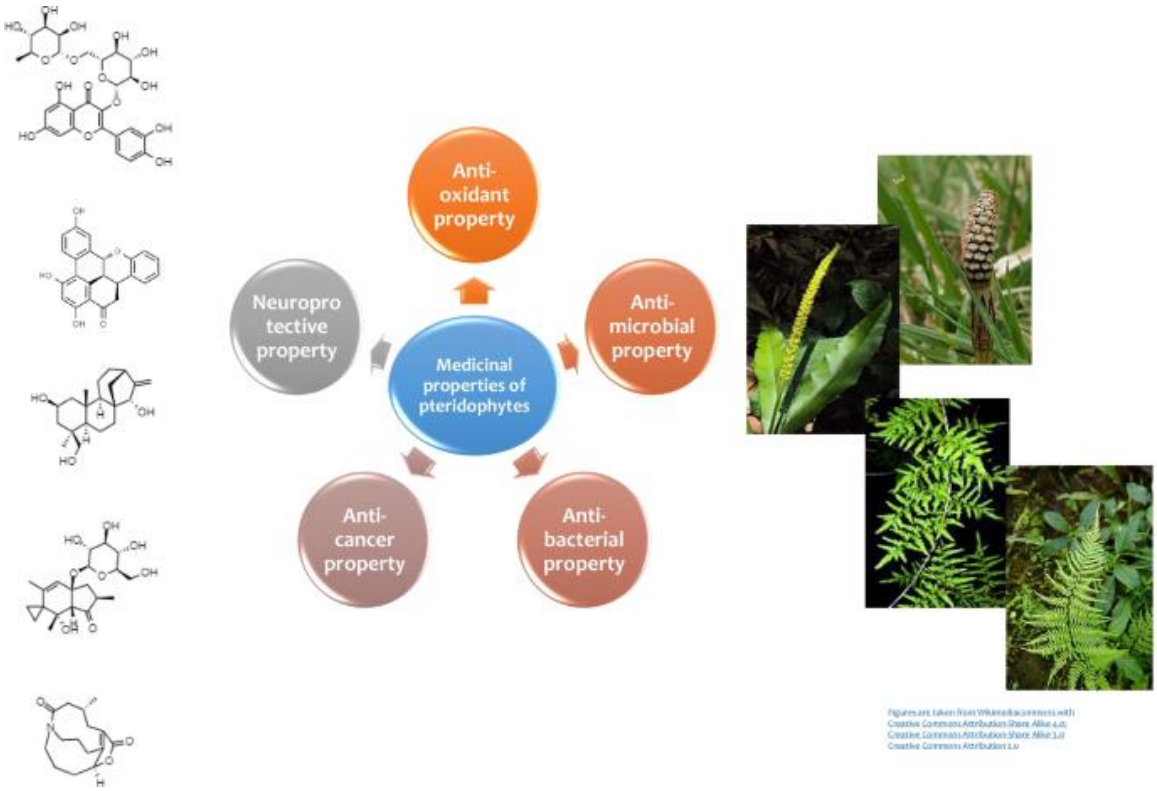

Figure 1. Medicinal properties of pteridophytes (Bandyopadhyay and Dey, 2022).

Purpose

The study aims to offer valuable insight into the medicinal potential of pteridophytes found in the Dehradun district and its surrounding areas, including Chakrata forests and Mussoorie hills, as well as their role in the contribution and use of natural therapeutic agents for improving human welfare [8].

Problem Statement

The problem statement behind the search revolves around the exploration and documentation of these plants in medicinal practices, as well as their cultural significance in indigenous communities

and their role in maintaining cultural habitats generally. Documentation of the ethnomedicinal pteridophytes addresses a complex interaction of conservation, traditional knowledge, modern science, and cultural preservation [9, 10].

The Objective Includes

- To find out the uses of different plant parts of the pteridophytes in the Dehradun region.
- To find out the different ethno-medicinal properties in the pteridophyte plants studied.
- To signify and highlight the pteridophytes for use in the field of medicine and to improve the knowledge of plants in human welfare.

REVIEW LITERATURE

Himalaya is one of the most important biodiversity areas, accounting for more than half of the Indian subcontinent's vegetational resources. Within the Himalayan region, the Garhwal Himalaya has lush and diverse vegetation. Almost every plant has economic worth in terms of nutritional, aesthetic, or medicinal value.

Folk medicine has been used for ferns for ancient times and has been passed down verbally from generation to generation or documented in old texts of traditional pharmacopoeia. Data gathered from various nations describe ethnopharmacological studies on therapeutic plant usage, such as those of ferns and allies, which date back to ancient times. Different fern species have grown all over the world and are used to treat a variety of ailments.

56% of the ferns in the Dehradun district's overall fern flora, which is found in a variety of habits, are categorized as terrestrial ferns. Most terrestrially grown fronds are small, triangular, and sterile. Most terrestrial ferns are located on well-sloped, well-drained soil [11–13].

The first method in the ancient Indian medical system known as "Ayurveda" dates back thousands of years, and it involves the selective use of basic plant extracts.

It is extensively recorded that bryophyte, lichens, lycophytes, and ferns were used in the herbal treatment of native Chinese and Indian peoples.

Ethnomedicinal research has proved useful in understanding the possible therapeutic elements of traditional herbal therapy. Caius first investigated pteridophytes in India for their therapeutic potential. It has been found that the spores and rhizomes of sporophytes possess medicinal advantages. The plant extracts of pteridophytes have the ability to treat a wide range of illnesses.

In tropical regions, plants like ferns are used as food and fodder; dried fern biomass is utilized as a powerful insulator against severe temperatures and as an efficient absorber of urinal excreta in cattle farms in addition to being a supplement feeding source.

The simplest way to use medicinal plants is by eating them, and numerous studies have shown that various kinds of edible ferns are present in the wild and have significant therapeutic potential. Examples include *Ampelopteris, Dryopteris,* and many more, and their young fronds and leaves can be used as vegetables, tea, or other foods.

Pteridophytes are cosmopolitan in nature. Pteridophytes are traditionally used for medicine, ornamentation, food, and phytoremediation [14]. The main unique characteristics of pteridophytes is that they are seedless vascular plants and show true alternation of generations. Lycophytes species of pteridophytes plants are found to be a very superior grade of medicinal herb.

Pteridophytes are found rich in phytochemicals, such as tannins, alkaloids, flavonoids, carbohydrates, and proteins, which are effective in various diseases and ailments. It has been shown

that the existence of antibiotic activity in extracts of over 200 pteridophyte species has significant medical implications between 1975 and 2015.

The ferns of the *Adiantum* group are especially effective against gram-positive bacteria. In addition to bacteria, *D. cochleata* proved effective against fungus. Five other *Dryopteris* species show exceptional antibacterial activity. Its ethanolic extract contains antioxidants and has the ability to lower the levels of inflammatory cytokines.

Pteridophytes are also used as phytoremediation. It is an environmentally friendly process in which plants are used to remove unsafe pollutants from contaminated sites, such as *Equisetum diffusum* commonly known as Himalayan horsetail, an aquatic macrophyte used for detoxification.

Selaginella bryopteris often known as "Sanjeevani" is a very significant pteridophyte from an ancient perspective because of its medicinal value. Its aqueous extract has some growth promoting activity and effective and protective against stress-induced cell death [15, 16].

According to several ethnomedicinal studies, ferns are consumed as vegetables in many communities across the world. Their popularity is increasing because of their high nutritional value, which includes some nourishing substances. *Diplazium* species contain a good amount of vitamin C and some essential elements for a nutritious diet.

Kanchan Upereti and others illustrated their research on ethnomedicinal pteridophytes in the Kumaon Himalayas, which included the 30 species of pteridophytes they discovered that were growing there and were being used by the locals to treat a variety of illnesses.

CONCLUSIONS

Furthermore, it is crucial to protect these plant species. The degradation of their habitat and overexploitation are serious dangers to their survival.

Understanding the challenges these ethnomedical plants face is essential. Climate change, overexploitation, and habitat destruction are threats that require immediate response. Conservation efforts must be prioritized to ensure the survival of these significant plant species.

In addition to expanding our understanding of the region's diverse flora, the documentation of ethnomedicinal pteridophytes opens new avenues for the creation of herbal and pharmaceutical treatments. As the world looks for natural and sustainable healthcare solutions, these pteridophytes could help progress medical research and development.

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