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Traditional uses of some pteridophytes by the folks of Pithoragarh district, Uttarakhand, India

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Abstract
The Kumaun Himalayan region of Uttarakhand is known for its rich floristic diversity in India. The climatic conditions of this region support the luxuriant growth of pteridophytes. But in the present scientific scenario, lower vascular cryptogams are less reported for their economic, medicinal, and nutritional properties in comparison to higher plants. Therefore, the present study was aimed to collect the folk knowledge associated with documented ferns and fern-allies that occur in the district Pithoragarh (Uttarakhand). A total of 33 pteridophyte species (from 25 genera and 17 families) were recorded, which are used in folklore as a source of herbal medicine and food. This study may be useful for creating a database for further exploration of pteridophytic flora in the future.

Keywords: pteridophytes, cryptogams, folklore, Kumaun, Pithoragarh

Introduction
Pteridophytes are an ancient group of land plants that include ferns and fern allies with a world-wide distribution. About 12,000 species of pteridophytes have been reported throughout the world[2][3]. They are considered as the second-largest assemblage of tracheophytes after angiosperms, in terms of their contribution to Himalayan floral diversity [1]. It is a fascinating group of lower vascular land plants that lie between non-tracheophytes and tracheophytes. The characters, i.e. the presence of vascular tissue and precursors of seed-habit in pteridophytes, typically serve as models for plant evolution.
Pteridophytes reproduce by producing spores; they are flowerless and do not produce seeds, so they are known as Cryptogams. They prefer to grow abundantly in sub-tropical, tropical, and moist deciduous forests. They can be found in a wide range of habitats, but they flourish well in moist and shady habitats [12]. Anthropogenic activities leading to habitat destruction and climate change have a profound impact on their diversity and distribution. They can serve as good ecological markers of habitat quality due to their extreme vulnerability to climate change and disturbances in habitats [1].
Pteridophytes are valuable sources of traditional medicines, food, fodder, biofertilizers, landscaping, and gardening. They are rich in proteins, vitamins, fibres, and minerals, so they are utilised as vegetable and cattle feed. They contain bioactive secondary metabolites such as phenols, steroids, alkaloids, etc. due to which they exhibit antimicrobial, anti-inflammatory, anti-diabetic, and anti-septic potential [10]. The use of ferns is also mentioned in Unani medical systems and in Samhita literature by Charka and Sushruta (100 AD) [17].
The climatic and edaphic factors of the Kumaun Himalayan region support the luxuriant growth of this plant assemblage. Thus, in the present study, an attempt is made to gather folklore information about pteridophytes from the district Pithoragarh in the Kumaun division of Uttarakhand.

Material and Methods
The present study was carried out on traditional uses of pteridophytes by the folks of Pithoragarh district of Uttarakhand (Fig. 1 and 2). It is bounded by the Tibetan plateau on the north and Nepal on the east. It occupies a geographical area of 7110 km^2. It offers tranquil panoramic views of snow-capped Himalayan peaks, lush green alpine meadows, ravishing waterfalls and springs. The temperature in the study area varies with altitude. The months of December and January have the most snowfall in the district, making them the coldest months of the year. Temperature rise from March through mid-June, which is considered as the hottest season of the year in the district. It receives monsoon rainfall after mid-June. Precipitation occurs from mid-June to September. The study area has a rich ecological diversity of flora and fauna. The Kali River, which is the most important river in the district, forms the eastern boundary with Nepal and serves the purposes of irrigation and hydroelectric power generation.
Extensive field surveys were conducted in the study area between January 2021-December 2021 to collect information on folklore or traditional uses of pteridophytes. The data was gathered through a series of interviews, personal interactions, and discussions with local residents, hakims, vaidyas, farmers, and tribals. The traditional usage of pteridophytes was also validated by consulting relevant published literature and databases. The identification of plant specimen was done by available literature and regional flora [8, 9, 11].

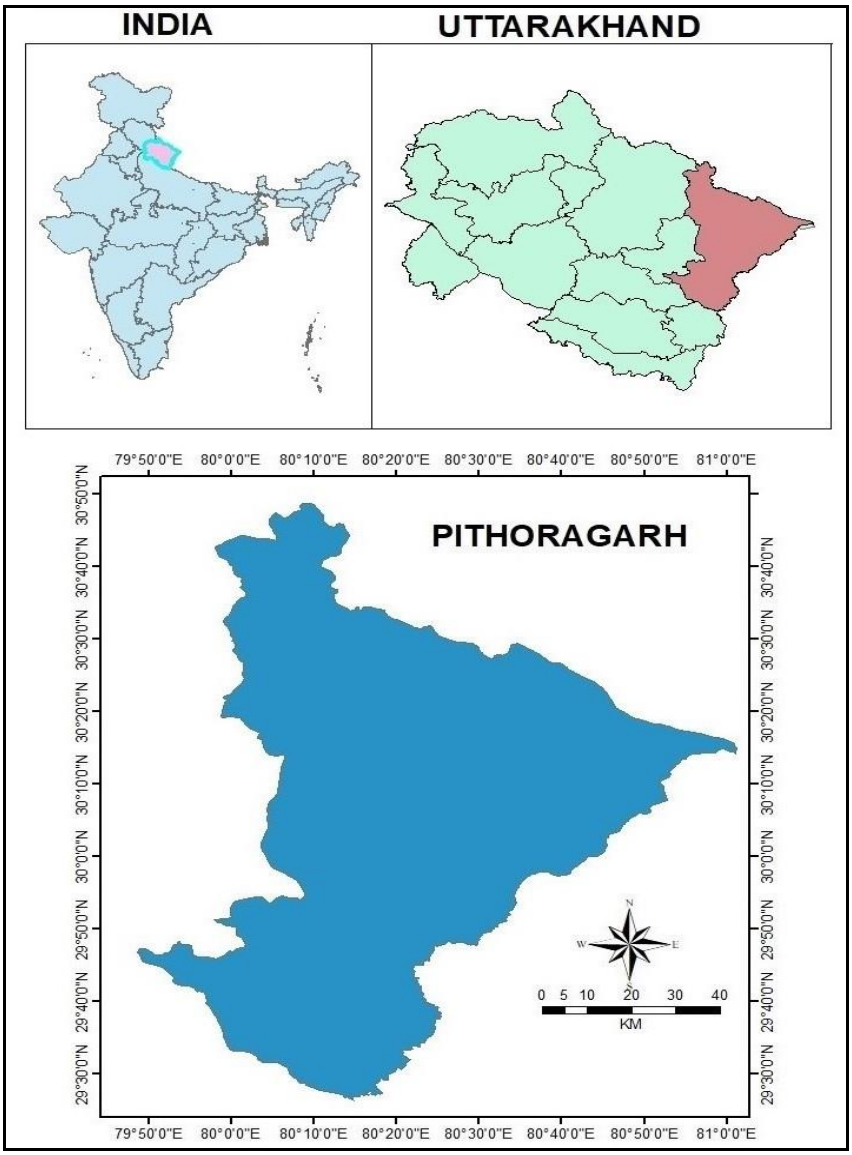

Fig 1: Location map of the study area

Fig. 2 (A-D): Views of study area

Results and Discussions

In the present study, 33 pteridophyte species (from 25 genera and 17 families) were recorded from the district Pithoragarh, which are used in folklore as a source of herbal medicine and food. A comprehensive list of documented pteridophyte species along with their common name, family, plant part used and folk uses is represented in Table 1.

Out of the recorded pteridophyte species, *Botrychium lanuginosum*, *Ceratopteris thalictroides*, *Dicranopteris linearis*, *Diplazium maximum*, *Diplazium polypodioides*, *Dryopteris wallichiana*, *Lygodium japonicum*, *Nephrolepis cordifolia*, and *Polystichum squarrosum* are edible species and consumed as vegetable by the local inhabitants. Species of *Diplazium* are available in the markets and support the livelihood of rural people[10].

A significant percentage (85%) of pteridophyte species have medicinal potential, used in treatment of cough, fever, dysentery, indigestion, skin diseases, cuts, wounds, bronchial infections, rheumatism, etc. and this findings coincides with other studies on ethnomedicinal uses of pteridophytes i.e. Gaur and Bhatt, 1994 [4]; Upreti et al., 2009 [14]; Sathiyaraj et al., 2015 [13]; Wani et al., 2016 [17]; Verma and Kanwar, 2020 [16], etc.

Pteridophytes are considered to have high economic value due to their medicinal, aesthetic and nutritional importance [15]. Steroids, terpenoids, phenolic acids, flavonoids and other phytochemicals found in them increases their worth. Goswami et al., 2016 [6] isolated polyphenols from ferns and documented their bioactivities viz., antimicrobial, antiviral, anti-inflammatory, etc. Giri et al., 2021[5] described the application of pteridophytes by the ethnic and local communities of India for the cure of various chronic diseases. Ferns are used to cure wounds, ulcers, dysentery, and as a protective remedy for women after childbirth [7]. Therefore, the present study was conducted to explore the uses of ferns and fern-allies, especially in traditional systems of medicine and food markets.

Conclusion

It was concluded from the present study that pteridophytes can be used as an alternative source of food and medicine by local people in the hills and hence reduce the burden on angiospermic plant communities. The nutritional value of edible pteridophyte species should be studied to meet the needs during scarcity. The secondary metabolites present in the pteridophytes are potent source of herbal medicine, which can be extracted to prepare drugs by pharmaceutical companies. The documentation of folk uses of pteridophytes is crucial to preserve the traditional knowledge of their usage for future generations.

Table 1: Folk uses of pteridophytes in district Pithoragarh, Uttarakhand

Botanical Name	Common name	Family	Part used	Folk uses
Adiantum capillus-veneris L.	Maidenhair fern	Pteridaceae	Fronds	Cold, cough, bronchial disease
Adiantum caudatum L.	Mayurshikha	Pteridaceae	Fronds, Rhizome	Wounds, cough, fever
Adiantum incisum Forsk.	Hanspadi	Pteridaceae	Fronds	Skin diseases
Adiantum lunulatum Burm.	Hamsapadi	Pteridaceae	Whole plant	Cough, indigestion, fever
Arthromeris wallichiana (Spr.) Ching	Banoo	Polypodiaceae	Rhizome	Dysentery
Asplenium dalhousiae Hook.	Spleenworts	Aspleniaceae	Fronds	Fever, skin diseases
Athyrium pectinatum (Wall.) Presl.	Lady fern	Athyriaceae	Rhizome	Anthelminthic
Botrychium lanuginosum Wall	Moonworts	Botrychiaceae	Young fronds	Edible (vegetable)
Ceratopteris thalictroides (L.) Brongn.	Indian fern	Pteridaceae	Tender shoots	Edible (vegetable)
Christella dentata (Forssk.) Brownsey & Jermy	Downy wood fern	Thelypteridaceae	Fronds	Skin diseases
Dicranopteris linearis (Burm. f.) Und.	Forked fern	Gleichinaceae	Rachis; Fronds	Rachis edible; laxative, asthma (fronds)
Diplazium maximum (D. Don) C. Chr.	Lingura	Athyriaceae	Young fronds	Edible (vegetable)
Diplazium polypodioides Blume	Lingra	Athyriaceae	Young fronds	Edible (vegetable)
Drynaria propinqua (Wall. ex Mett.) Sm.		Polypodiaceae	Rhizome	Backache, headache, bone fracture
Dryopteris wallichiana (Spreng.) Hyl.	Mountain food fern	Dryopteridaceae	Young fronds	Edible (vegetable), dysentery
Equisetum diffusum D. Don	Himalayan horsetail	Equisetaceae	Rhizome	Diuretic
Equisetum ramosissimum Desf.	Evergreen horsetail	Equisetaceae	Whole plant	Bone fracture
Glaphyropteridopsis erubescens (Wall. ex Hook.) Ching	Ryun ghas	Thelypteridaceae	Rhizome	Gonorrhea, leucorrhea
Hypodematium crenatum (Forssk.)	Bhoot kesari	Hypodematiacea	Fronds	Cuts, insect bites

Kuhn		e		
Lepisorus bicolor Ching	Ribbon fern	Polypodiaceae	Fronds	Rheumatism
Lygodium flexuosum (L.) Sw.	Climbing fern	Lygodiaceae	Rhizome; Fronds	Eczema, cuts, rheumatism
Lygodium japonicum (L.) Sw.	Japanese climbing fern	Lygodiaceae	Young fronds	Edible (vegetable); wounds and cuts
Microsorium membranaceum (D. Don) Ching	Ban gakdum	Polypodiaceae	Rhizome	Cough, cold, dysentery
Nephrolepis cordifolia (L.) Presl.	Ladder fern	Nephrolepidacea e	Tuber; Fronds	Edible; Cough
Ophioglossum vulgatum L.	Adders tongue fern	Ophioglossaceae	Rhizome	Antiseptic, wounds
Osmunda sp.		Osmundaceae	Whole plant	Cuts and wounds
Polystichum squarrosum (D.Don) Fee		Dryopteridaceae	Tender shoots	Edible (vegetable)
Pteris biaurita L.	Thinleaf brake	Pteridaceae	Rhizome; Fronds	Chronic disease
Pteris vittata L.	Ladder brake	Pteridaceae	Rhizome; Fronds	Wound healing
Pteris wallichiana Agardh		Pteridaceae	Fronds	Dysentery, astringent, skin infection
Selaginella chrysocaulos (Hook. & Grev.) Spr.	Spikemoss	Selaginellaceae	Whole plant	Fever
Sphenomeris chinensis (L.) Maxon	Lace fern	Lindsaeaceae	Whole plant	Sprain, swelling
Tectaria coadunata (Smith) C. Chr.	Halberd fern	Tectariaceae	Rhizome	Stomache

Fig 3: A) *Adiantum incisum* Forsk.; B) *Adiantum capillus-veneris* L.; C) *Adiantum caudatum* L.; D) *Nephrolepis cordifolia* (L.) Presl.; E) *Pteris biaurita* L.; F) *Pteris vittata* L.

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