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RESEARCH ARTICLE

Ethnobotanical Uses of Pteridophytes in Pilibhit Tiger Reserve, Uttar Pradesh

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ABSTRACT

The protected area of Pilibhit Tiger Reserve, Uttar Pradesh, constituting the core area, spanning 73024.98 hectares, is a rich location for pteridophytes, and the remaining 12745.18 ha forms the buffer zone. A study was undertaken to collect the data on ferns and fern allies from various families. About 38 pteridophyte species have been identified, with the three most abundant groupings being Pteridaceae, Thelypteridaceae, and Ophioglossaceae. According to the study, about 30 types of ferns and their relatives have been used for various purposes, including food, fodder, medicinal use, and beautification of the houses. This study could help identifying useful and endangered species, and help in growing them for better utilization as well as in conservation of endangered plant species.

KEY WORDS : Fern-allies, Pilibhit Tiger Reserve, Uttar Pradesh, Ethnobotanical

INTRODUCTION

People in remote and rural areas rely solely on forest resources to support their daily needs, which include food, fuel, medicine, and household items. Pteridophytes have been utilized extensively in ancient homoeopathic, Ayurvedic, Unani, and other folk medical systems. Several studies have already documented the medicinal benefits of Indian ferns and their associated plants (Benniamin, 2011). Kirtikar & Basu (1935), described 27 different species of ferns with variety of therapeutic applications. About 44 species of pteridophytes with therapeutic significance have been listed by Chopra *et al*. (1956), while 11 species listed by Nadkarni (1954). About 29 medicinal ferns have been reported by Nayar (1959). A thorough analysis of the many applications for ferns was published (May, 1999), along with a list of 105 medicinal plants. Singh (1999), used ethnobotanical, pharmacological, and phytochemical research to report 160 species of beneficial pteridophytes in India. Although the therapeutic qualities of pteridophytes have been the subect of several investigations, however little is known about the medicinal potentialities of pteridophytes (Abraham *et al.,* 1962; Beddome, 1864; Benniamin *et al.,* 2008; Bir & Vasudeva, 1971). Under 204 genera, pteridophytes are represented by roughly 1200 taxa. Approximately, 17% of endemic species have been reported from India. The Eastern Himalayas and northeast India are the richest regions in terms of pteridophytes, accounting for 67% of the nation's known species, which consist of 845 taxa in 179 genera. South India comes in second with 345 taxa in 117 genera (Muttu *et al*., 2021).

Pteridophytes flourish in both temperate and moist tropical woods. Nearly 320 species of ferns and fern allies can be found in the mountain chain's perennial streams, rivers, evergreen forests, grasslands, high-altitude shoals, and many other ecosystems. Because the Western Ghats have more rainy months and higher elevations with colder climates, pteridophytes tend to proliferate in the north-south orientation. The majority of the 64 pteridophyte species found in Maharashtra are restricted to the North Western Ghats (Manickam *et al*., 2003). Observations show that, for the last two millenniaum of medical history, fresh or dried plants were the only source of medication available to humans. In addition to its potential to aid in drug development and market value, traditional medical knowledge is significant for the treatment of individuals.

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MATERIALS AND METHODS

Study Area

The PTR is located within the densely forested Indo-Nepal Sub-Himalayan Terai region of Uttar Pradesh. The PTR spans the districts of Pilibhit and Shahjahanpur in Uttar Pradesh and is located in the foothills of the Himalayas. The five ranges, Mala, Mahof, Barahi, Haripur, and Deoria, as well as a portion of the Khutar make up the Tiger Reserve. The region is administratively made up of the PTR, a single protected area. The Pilibhit district is home to PTR's headquarters. It is located along the Indo-Nepal border in the upper Gangetic Plain and is a component of the Terai Arc Landscape. The grasslands that comprise the Terai forests are home to approximately 2,100 different plant species, the majority of which are valuable for food, drink, medicine, shelter, ornaments, and other socioreligious purposes.

Collection of specimens

To cover the large amount of fern diversity and diverse tribal/local indigenous communities, thorough field visits and ethnobotanical surveys of all ferns in the Pilibhit area of Uttar Pradesh were carried out. The collected specimens were identified and documented by recording their habitat and morphological characteristics in the field notebook. Each species' voucher specimens were obtained from the herbaria. Questionnaires were used to gather plant information such as regional names, portion sizes, and cooking methods. 11 male and 4 females informants were selected based on their knowledge of plant usage, whether for self-medication or for treating others. Informants were invited to the field to locate and identify the plants. The species described by the informants were taxonomically identified which, Aboriginal people have been traditionally using these plants for ethnobotanical purposes and justifying this practice.

RESULTS AND DISCUSSION

A total of 38 ferns and fern allies belonging to 12 families under 20 genera have been identified from various parts of the study sites, and the most dominant species were observed in Pteridaceae, Thelypteridaceae, and Ophioglossaceae families (Table 1), with 30 species being widely used by both ethnic and common peoples (Table 2).

Table 1: Pteridophyte species recorded in Pilibhit Tiger Reserve.

S.No.	Family	Plants name	No. of species
1.	Selaginellaceae	*Selaginella bisulcata* Spring.	1
2.	Equisetaceae	*Equisetum diffusum* D. Don *Equisetum ramosissimum* (Roxb. Ex Vaucher) debile Hauke	2
3.	Psilotaceae	*Psilotum nudum*(L.) P. Beauv.	1
4.	Ophioglossaceae	*Helminthostachyszeylanica* (L.) Hook. *Ophioglossumcostatum* R. Br. *Ophioglossumpetiolatum* Hook. *Ophioglossumreticulatum* L. *Ophioglossumvulgatum* L.	5
5.	Lygodiaceae	*Lygodium flexuosum* (L.) Sw. *Lygodium japonicum*(Thunb.) Sw. *Lygodium microphyllum*(Cav.) R. Br.	3
6.	Marsileaceae	*Marsileam inuta* L. *Marsileaqua drifolia* L.	2
7.	Salviniaceae	*Azolla pinnata* R. Br. *Salvinia cucullata* Roxb. ex Borey *Salvinia natans*(L.) All.	3
8.	Pteridaceae	*Adiantum aethiopicum* L. *Adiantum capillus-veneris* L. *Adiantum edgeworthii*Hook. *Adiantum incisum*Forsk. *Adiantum philippense* L. *Cheilanthes farinose*(Forsk.) Kaulf	10

		Ceratopteristha lictroides(L.) Ad.Brongn. *Pterisa spericaulis*Wall ex Agardh. *Pteris biaurita* L. *Pteris vittata* L.	
9.	Dennstaedtiaceae	*Dennstaedtiascabra*(Wall ex Hook.) Moore *Microlepiaspeluncae* (L.) Moore	2
10.	Thelypteridaceae	*Ampelopterisprolifera*(Retz.) Copel. *Christellaarida*(D. Don.) Holtt. *Christellaleboeufii*(Bak.) Holtt. *Christellaparasitica*(L.) Lev. *Christellasubpubescens*(Bl.) Holtt. *Pseudophegopterisaurita*(Hook.) Ching.	6
11.	Athyriaceae	*Diplaziumdilatatum*Bl. *Diplaziumesculentum*(Retz.) Sw.	2
12.	*Cystopteridaceae*	*Gymnocarpiumdryopteris*(L.) Newman	1
		Total plants	38

Table 2: Ethnobotany of pteridophytic plant species in Pilibhit Tiger Reserve.

S.N.	Plants name	Used parts	Ethnobotanical uses
1.	*Equisetum diffusum* D. Don	Whole plant	Used in Bone fractures, kidney trouble, and as an Antibacterial.
2.	*Equisetum ramosissimum* (Roxb. Ex Vaucher) debile Hauke	Whole plant	It is advised to mix powder with cold water twice a day for seven to eight days. For kidney issues, it is thought to be helpful. Gonorrhea cooling drugs, hemostatic, hemopoietic, antirheumatic, antifungal, and antiviral drugs, and promoting female fertility.
3.	*Psilotum nudum* (L.) P. Beauv.	Whole plant	Whole plant parts are soaked in water to heal wounds for an hour. The resulting decoction is then combined with turmeric and applied to the affected areas, and spores are used as an antidiarrhoeal.
4.	*Helminthostachyszeylanica* (L.) Hook.	Fronds	The fronds are used as an aphrodisiac, while the rhizome treats impotence, whooping cough, and intoxicants.
5.	*Ophioglossumcostatum* R.Br.	Fronds	Used to treat wounds and inflammations and as a cooling agent. Fronds have styptic and tonic properties. Powdered dried tubers are applied to skin conditions.
6.	*Ophioglossumpetiolatum* Hook.	Whole plant	The paste of the plant is applied to burns and inflammations as a cooling agent. To treat women's menstrualproblems.
7.	*Ophioglossumreticulatum* L.	Whole sporophyll and young fronds	Fronds that have been partially boiled are used as salad and vegetables. Applying leaf and rhizome paste on burns helps them calm down. The tonic is made from the extracts of the fronds. To relieve headaches, the leaf paste is applied to the forehead.
8.	*Ophioglossumvulgatum* L.	Whole sporophyll	Used in the production of fritters. It is used on wounds to stop bleeding because it contains an antibiotic.
9.	*Lygodiumflexuosum* (L.) Sw.	Young fronds	Ground into a fine powder and dried, then used as herbal tea. It is advised to boil fresh roots in mustard oil for rheumatism. Jaundice, spermatorrhea, dysmenorrhea, and skin disorders such as eczema, scabies, rheumatism, cuts, and sores.
10.	*Lygodiumjaponicum* (Thunb.) Sw.	Young fronds	Young fronds are consumed as vegetables. It is used as a diuretic, antispasmodic, and also used in the treatment of rheumatism and diseases of the lungs and kidneys.
11.	*Lygodiummicrophyllum* (Cav.) R.Br.	Young fronds	Roasted scales are considered a great delicacy. The baked or boiled roots were also a good source of starch in the diet. Leaf decoction is given in dysentery.

12.	*Marsileaminuta* L.	Young fronds	Young fronds are consumed as green leafy vegetables by various tribal communities. The plant is used in cough, spastic conditions of leg muscles, sedation and insomnia.
13.	*Marsileaquadrifolia* L.	Fronds	Consumed as a vegetable. Plant extracts are used in couples to improve fertility. A handful of leaves is mixed with pepper and garlic and ground into a paste. The paste is taken orally to treat colds and coughs. The paste is mixed with turmeric and applied over the affected places to cure skin diseases.
14.	*Azollapinnata* R. Br.	Whole plant	It is used as a diuretic. The whole plant is used as a food supplement or fodder in fresh, dried, or silage form for a variety of domestic animals. A biofertiliser in rice fields.
15.	*Salviniacucullata* Roxb. ex Borey	Whole plant	The whole plant is used as poultry and cattle feed, to increase the fertility of rice fields, and as an antibacterial and insecticide.
16.	*Salvinianatans*(L.) All.	Whole plant	Crushed into fine powder after drying and used as an herbal tea. No other medicinal uses.
17.	*Adiantumcapillus-veneris* L.	Whole plant	The whole plant is made into a paste along with aloe gel and applied externally in the affected places to treat cuts and wounds. The paste is also used as a hair tonic applied to the head.
18.	*Adiantumedgeworthii* Hook.	Fronds and rhizomes	Decoction of fronds and rhizomes is used for fever and cough.
19.	*Adiantumincisum* Forsk.	Fronds	The leaf powder is mixed with butter and used to control the internal burning of the body. Also used in cough, diabetes, fever, and skin diseases.
20.	*Adiantumphilippense* L.	Fronds and rhizomes	It is used for cough, asthma, fever, leprosy, and hair falling. Useful in the treatment of throat swellings in cattle; the paste of the rhizome is applied to the swelling of the throat.
21.	*Cheilanthesfarinose* (Forsk.) Kaulf	Fronds	Curing discharge of yellow urine; curing eczema and stomach-ache.
22.	*Ceratopteristhalictroides* (L.) Ad. Brongn.	Young fronds	Young fronds are consumed as a vegetable. The leaves are used in a poultice for dermis diseases. They are reported to be used as a tonic and styptic.
23.	*Pterisaspericaulis* Wall ex Agardh.	Rhizome	Rhizome paste is used to take out the pus and for very fast recovery from inflammation.
24.	*Pterisbiaurita* L.	Rhizome	Chronic disorders. The rhizome is ground into a paste and applied over the affected places to get relief from body pain.
25.	*Pterisvittata* L.	Whole plant	The whole plant parts are ground into a paste and applied over the affected places for wound healing. The paste is mixed with pepper and taken orally to get relief from cold, cough, and fever.
26.	*Microlepiaspeluncae* (L.) Moore	Fronds	The decoction of plants is useful against various eye diseases.
27.	*Ampelopterisprolifera* (Retz.) Copel.	Young fronds	Fresh fronds are consumed as vegetables. It is used for constipation.
28.	*Christellaparasitica* (L.) Lev.	Whole plant	The decoction is orally used to treat swellings, spermatorrhea, and rheumatism.
29.	*Diplaziumdilatatum* Bl.	Young croziers	Croziers are consumed as vegetables. It is used as a diuretic.
30.	*Diplaziumesculentum* (Retz.) Sw.	Frond, Young croziers, tender stem, and rhizome	Stems, rhizomes, leaves, and croziers are used to make pickles and are eaten as green vegetables in salads. Leaf juice is regarded as an effective remedy for cough, asthma, and jaundice, while leaf extracts are used to treat scabies. Pregnant ladies also eat fronds to protect themselves from a rough delivery. Young fronds are prepared and consumed as food to enhance overall well-being.

Table 1: Plants with chemical compounds used in medicinal activies

S.N.	Plants name	Activity	Chemical compound
1.	*Equisetum diffusum* D. Don	Antibacterial	Apigenin, Ascorbic acid, Benzoic acid, Caffeic acid, Cinnamic acid, ferulic acid, gallic acid, Isoquercitrin, Kaempferol, Lauric acid, Luteolin, Naringenin, p- coumaric acid, Procyanidin, rutin, Salicylic acid, tannic acid, vanillic acid
2.	*Equisetum ramosissimum* (Roxb. *Ex* Vaucher) debile Hauke	Antifungal, astringent, Diuretic and antiviral	Phenols, Ascorbic acid, Isoquercitrin, Equisetonin, gallic acid, Salicylic acid, quercitrin, Zinc, p- coumaric acid
3.	*Psilotum nudum* (L.) P. Beauv.	Antiseptic, Antidiarrheal	Psilotin, apigenin, acacetin, genkwanin, amentoflavone, hinokiflavone, psilotic acid, gibberellin, GA36, desmethylsterols, alkanetriols
4.	*Helminthostachyszeylanica* (L.) Hook.	Anti-pyretic, anti-inflammatory, intoxicant	Stigmasterol, fucosterol, dulcitol
5.	*Ophioglossumcostatum* R.Br.	Antibacterial	Apigenin, Ascorbic acid, Benzoic acid, Caffeic acid, Cinnamic acid, ferulic acid, gallic acid, Isoquercitrin, Kaempferol, Lauric acid, Luteolin, Naringenin, p- coumaric acid, Procyanidin, rutin, Salicylic acid, tannic acid, vanillic acid
6.	*Ophioglossumpetiolatum* Hook.	Anti-inflammatory	Apigenin, Ascorbic acid, beta-sitosterol, Caffeic acid, Cinnamic acid
7.	*Ophioglossumvulgatum* L.	Anticancer, antiseptic	Flavonoid, triglycoside
8.	*Lygodiumflexuosum* (L.) Sw.	Antibacterial, antirheumatic	Apigenin, Ascorbic acid, Benzoic acid, Caffeic acid, Cinnamic acid, ferulic acid, gallic acid, Isoquercitrin, Kaempferol, Lauric acid, Luteolin, Naringenin, p- coumaric acid, Procyanidin, rutin, Salicylic acid, tannic acid, vanillic acid
9.	*Lygodiumjaponicum* (Thunb.) Sw.	Diuretic, anthelmintic	Arsenic, Calcium, Cupper, Iron, Zinc, Ascorbic acid, Isoquercitrin
10.	*Lygodiummicrophyllum* (Cav.) R.Br.	Antidysentric	Tannin
11.	*Marsileaminuta* L.	Antifungal, antibacterial, Diuretic	Beta-carotene, sodium, potassium, calcium, marsiline, Ascorbic acid, Isoquercitrin, gallic acid
12.	*Marsileaquadrifolia* L.	Antiviral	Isoquercitrin, gallic acid, carotinoids, Salicylic acid, tannic acid, Kaempferol
13.	*Azollapinnata* R.Br.	Antifungal, antibacterial, diuretic	Ascorbic acid, Isoquercitrin, gallic acid, carotinoids, Salicylic acid, tannic acid
14.	*Salviniacucullata* Roxb. ex Borey	antibacterial, insecticide	Cinnamic acid, ferulic acid, gallic acid, Isoquercitrin, Kaempferol, Lauric acid, Luteolin, Naringenin, p- coumaric acid, Procyanidin, rutin, Salicylic acid, tannic acid
15.	*Salvinianatans*(L.) All.	antioxidant	Apigenin, beta-carotene, caffeic acid, Kaempferol, Isoquercitrin
16.	*Adiantumcapillus-veneris* L.	Anticancer, antibacterial, antifungal, antiviral	Tanin,Kaempferol, qeuercetol, astragalin, luteolol, rutin, triterpenoid, Isoquercitrin, nicotiflorin, querciturone, flavonoids, naringenin, hesperidin, sulphuretin and genistein
17.	*Adiantumedgeworthii* Hook.	Antibacterial	Apigenin, Ascorbic acid, Benzoic acid, Caffeic acid, Cinnamic acid, ferulic acid, gallic acid, Isoquercitrin, Kaempferol, Lauric acid, Luteolin, Naringenin, p- coumaric acid, Procyanidin, rutin, Salicylic acid, tannic acid, vanillic acid
18.	*Adiantumincisum* Forsk.	Astringent, anticancer, antibacterial, anti-diabetic, anti-pyretic	Adiantone, isoadiantone, fernane, hentriacontane, hentriacontanone, beta- sitosterol, Cinnamic acid, ferulic acid, gallic acid, Isoquercitrin, Kaempferol, Lauric acid, Luteolin, Naringenin, p- coumaric acid, Procyanidin, rutin, Salicylic acid, tannic acid

19.	*Adiantumphilippense* L.	Anti-pyretic	Methyl-salicylate, Ascorbic acid, Salicylic acid, Apigenin, rutin
20.	*Cheilanthesfarinose* (Forsk.) Kaulf	Antibacterial, anti-pyretic, antiseptic	Cheilanthatriol, Cheilarinosin, Kaempferol, quercitrin, flavonoid,Naringenin, dehydro-quercitrin, phenols, Cinnamic acid, ferulic acid, p- coumaric acid, Procyanidin, rutin, Salicylic acid, tannic acid
21.	*Pterisaspericaulis* Wall ex Agardh.	Anti-inflammatory	Apigenin, ascorbic acid, beta- sitosterol, Cinnamic acid, Caffeic acid
22.	*Pterisbiaurita* L.	Antibacterial	Kaempferol, quercitrin, flavonoid,Naringenin, dehydro-quercitrin, phenols, Cinnamic acid, ferulic acid, p- coumaric acid, Procyanidin, rutin, Salicylic acid, tannic acid
23.	*Pterisvittata* L.	Demulcent, hypotensive	Phenols
24.	*Microlepiaspeluncae* (L.) Moore	Anti-pyretic	Methyl-salicylate, Ascorbic acid, Salicylic acid, Apigenin, rutin
25.	*Ampelopterisprolifera*(Retz.)Copel.	Antiviral, antibacterial	Triterpenoids, flavones, flavonoids, steroid, gallic acid, Isoquercitrin, Kaempferol, Lauric acid, Luteolin, Naringenin, p- coumaric acid, Procyanidin, rutin, Salicylic acid, tannic acid
26.	*Christellaparasitica* (L.) Lev.	Antirheumatics, anti-inflammatory	Apigenin, ascorbic acid, beta-sitosterol, Cinnamic acid, Caffeic acid, Zinc
27.	*Diplaziumdilatatum*Bl.	Diuretic	Isoquercitrin, Kaempferol, Ascorbic acid
28.	*Diplaziumesculentum* (Retz.) Sw.	Antimalarial, anti-diarrhoeal, anthelminitic	Triterpenoids, flavones, flavonoids, steroids, iron, calcium, phosphorus, vitamin B

Because of Indians' knowledge of the usefulness of plants, PTR in particular, and Uttar Pradesh in general, are making rapid ethnobotanical progress. A list of ethnobotanical fern species used for various applications by various ethnic groups in Uttar Pradesh's Pilibhit region, as served by PTR. The most prevalent of these families is Pteridaceae, which includes 10 species. Thelypteridaceae and Ophioglossaceae contain 6 and 5 species, respectively. A recent study found that around 25 applications from 30 species offer therapeutic potential for treating a variety of ailments and other purposes (Table 2). Several common pteridophytes are used to treat common medical conditions like fevers, colds, gonorrhoea, dental and cardiac issues, burning wounds, mental health issues, stomach ulcers and acidity, jaundice, and abdominal disorders. The various ethnic communities in this area, also use them to decorate their homes. The local community uses pteridophytes for food, medicine (*Marsilea quadrifolia* cough and cold), fodder, and other multifunctional purposes. Fern fronds can be used to decorate homes for a variety of events. The plant parts that were most frequently utilised in herbal remedies were the fronds of 16 species; *Diplazium esculentum*, *Ceratopteris thalictroides, Adiantum incisum,* and *Lygodium flexuosum,* the whole plant of 10 species *Psilotum nudum*, *Adiantum capillus-veneris,* and *Christella parasitica*; and the rhizome are 5 species: *Pteris aspericaulis* and *Pteris biaurita,* which contain spores, which were used less frequently. *Diplazium esculentum, Ceratopteris thalictroides, Marsilea minuta*, *Ophioglossum petiolatum*, *Ophioglossum reticulatum*, and *Lygodium japonicum* are typical green vegetables that can be found in local markets. *Salvinia natans* and *Azolla pinnata* are two examples of pteridophytes that are used as ethnoveterinary (poultry feed).

CONCLUSION

The ethnobotanical usage of plants by Aboriginal people is not new, but it is currently being documented and supported by scientific evidence. Tribal populations and their medicinal practices are linked to the forest environment. Culture, traditions, languages, and conventions are all connected to this trait, either directly or indirectly. Rice fields have recently made extensive use of *Azolla pinnata* as a biofertilizer. Many of them, including the Thelypteridaceae family, are used as ornaments by ethnic communities, according to sources. In this region, just a few of the water bodies have aquatic plants and ferns. Thus, the habitat and environment of the protected area, which is predominantly terrestrial with a

few marine species (*Azolla pinnata*), support the diversification of ferns and fern allies. A efforts to make public awareness programs need to be initiated to cultivate medicinal pteridophytes. This would encourage conservation of ethnobotanical diversity and have a comprehensive positive impact on the environment and society as a whole and will be recognised, valued, and utilized effectively.

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