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Ethnobotanical and pharmacological studies of pteridophytes (Ferns) from Mussoorie region, Dehradun district, Uttarakhand

Chhaya Singh[1], Neha Chauhan[2], Anju Rani[3], Kunal Kishore[4], Keerti Singh[5], Raj Singh[6*]
[1] Department of Botany, Government Degree College, Thalisain, Uttarakhand, India
[2] Department of Microbiology, College of Paramedical Sciences, SGRRU, Dehradun, Uttarakhand, India
[3] Department of Botany, Keral Verma Subharti College of Science, Swami Vivekananda Subharti University, Meerut, Uttar Pradesh, India
[4] Department of Microbiology, School of Allied Health Sciences, Sharda University, Greater Nioda, India
[5] Department of Microbiology, School of Basic and Applied Sciences, SGRRU, Dehradun, Uttarakhand, India
[6] Department of Biotechnology, Maharishi Markandeshwar University, Mullana-Ambala, Haryana, India
[*]Corresponding Author: Raj Singh

Abstract
The present paper highlights the traditional knowledge of ferns related with the use as ethno medicine. Extensive field trips were organised in order to collect the ethnobotanical information of Mussoorie region. The data related to ferns used as ethnomedicine was collected by interaction with inhabitant of the area. Information includes local name, part used, disease treated, mode of administration and methods of preparation. Total 107 species were observed during this investigation belong to 41 genera and 23 families of pteridophytes. The present article gives a brief account of 31 plants species out of 107 species reported used as herbal remedies by local people. The pteridophytes have immense pharmacological significance such as *Woodwardia biserrata* C. Presl., *Pteris vittata*L. used in the treatment of diarrhea; *Adiantum venustum* is the single species has wide specturum which is used in different disease such as cough, fever, tumour, amtimicribial activity and for wounds, *Polystichum squarrosum* (D. Don.) *Fee* and *Pteris cretica*L. Show antibacterial activities; *Athyrium pectinatum* (Wall. ex Mett) T. Moore; *Dryopteriscaroli-hopei*F Jenks.are anti-heleminthic in activity; swhile *Asplenium adiantum-nigrum* is used in eyes, jaundice, cough etc. Pteridophytes are used in Homeopathic, Ayurvedic, and Unani medicines and provided insecticides, antibiotics, food and ornamentation but due to habitat destruction by more than 10% of the 1200 fern species has become endangered. Therefore, the habitat conservation or *in-situ* conservation of fern environment to maintain ecological balance is very essential. The study will be helpful in the correct assessment regarding the extent of infra specific, morphological variation, ecological relationships and distribution of pteridophytes and finally for making conservation strategies.

Keywords: ethnomedicinal, pharmacological, homeopathic, ayurvedic, unani, pteridophytes, Mussoorie, Uttarakhand

Introduction
Pteridophytes includes ferns and fern allies which are basically lower vascular plants, also known as vascular cryptograms, who prefer shady, moist habitat with moderate temperature, and mostly found in the rain forest, both tropical and temperate but also found occuring throughout a very diverse range of habitats from high altitude and latitude to arctic -alpine situations, to the heart of tropical rain forests, and from sub -desert scrub of continental interiors to consist to rocks of the sea coast and mangrove swamps (Dixit, 1974; Singh *et al*., 2013; Singh *et al*.2017] [10, 37, 38].
This group of lower plants importantly contribute in Homeopathic, Ayurvedic, and Unani medicines and also used in insecticides, antibiotics, food and ornamentation but due to habitat destrution by more than 10% of the 1200 fern species has become endangered. The need for the hour is therefore, that the habitat conservation or *in-situ* conservation of fern life to maintain ecological balance (Pande, 2011; Singh *et al*., 2021a, b, c) [23, 36, 42, 33]. It has been found that the forest plays an important role in life and economy of the tribal people of our country. This is due of the fact that they are more dependent upon the forest flora for their livehood, collect and utilize many plants including pteridophytes for food, fuel, fiber, oils, medicines and shelter (Singh *et al*., 2020a, b, c, d, e) [34, 35, 39. 41, 43].
Mussoorie derives its name from the Mansur shrub common in the Himalayan foot – hills. It lies in the North – Western Himalaya and administratively placed in the Dehradun District of Uttarakhand State of India lying between 78^0–79^0E longitude and 30^0– 31^0 N latitude. The annual rainfall is 215 cm. The climate is warm temperate and very damp from July to September in Mussoorie (31.2^0C (max), 7.26^0C (min) in summers and 7.2^0C (max), 1.1 ^{0}C (min) in winters). The climate is tropical to sub – tropical in Dehradun and surrounding areas less than 1500 m altitude. The frequency and luxuriance of epiphytic ferns becomes less as one descends to lower altitudes. Ethnobotanical knowledge is very ancient field in India and all traditional systems of medicine had their roots in ethnobotany. Theophrastus (327-287 BC) and Dioscorides (50 AD) listed different Pteridophytes as a potential herbal formulation to cure numner of deadly disorders. However, Shushruta and Charak in their monumental contribution on the medicinal attributes of ferns have especially described the utility of

Marsileaminuta, *Adiantumcapillus-veneris*etc. Some of the recommendations were based on the belief of impression where plant of particular shapes was recommended for the cure of certain organs resembling to it. First historical attempt was made by Caius in 1935to report the medicinal uses of ferns in India, therefore get recognized as the first man to take this very initiative kind of investigations. Thus from the socio-cultural point, the district exhibits great ethnic and cultural diversity. The Studies on fern of this region have been carried out by different investigators (Beddome, 1883; Clarke, 1880; Hope, 1899; Dhir and Sood, 1981) [3, 7, 15, 9]. Because ferns are relatively little known for their economic utilization several workers have emphasized this aspect of the group (Bir et.al., 1983, Tryon and Tryon, 2012) [5, 46]. The medicinal importance of the fern and fern allies studies were made by frequent field surveys during July2008-April 2010 covering various remote localities of the district in rainy seasons. All the specimens collected from the area for medicinal use are deposited in the herbarium of Botanical Survey of India, Dehra Dun. The Fern and fern allies has an immense share in the inventory of medicinal plants and contributes an important and effective part in Ayurvedic, Homeopathic and Allopathic system of medicine

The study helps in the correct assessment regarding the extent of infra specific, morphological variation, ecological relationships and distribution of Pteridophytes and establishing conservation strategies.

Materials and Methods

The Present work was carried out by following certain procedures, which are as follows-

Survey and Collection

Short duration survey tours were undertaken in August to October of every year from 2013 to different localities, *viz*. Doiwala, Robber's cave, Premnagar, Cloud end's, Hathipaua, forest, etc. of the district Dehradun, Uttarakhand. Since the ferns are flourish well with developed sori and spores in these months. Different altitudinal zones and forest types were selected randomly for collecting the wide range and variety of specimens. In field, mature specimens, i.e. whole plant with developed sori and spores were collected in the polythene bags and then carried to base camp for further study.

Preservation

In the base camp, all the collected specimens were pressed in the blotting sheets in open air under direct sunlight or artificial fire place in case of moist weather. Larger specimens were folded in the shape of 'V' or 'M' alphabets then pressed. These blotting sheets were changed as required till the species gets completely dried.

Once dried completely, the specimens were brought to the BSI laboratories, where they were poisoned by standard methods as suggested by Jain and Rao (1977) [16]. After poisoning the specimens were mounted on herbarium sheets (42cm × 28cm) with the help of fevicol and get stitched. These herbarium sheets are properly labelled with name of species, full details of locality, habitat, date, collection no, collector.

All the collections have been deposited in the herbarium of Botanical Survey of India, Northern Regional Centre, Dehradun (BSD).

Identification

The identification of taxa has been done with the help of protologues, taxonomic revisions, monographs and relevant floristic account. The herbarium specimens available in different herbaria, *viz*. Botanical Survey of India, Dehradun, Herbarium (BSD); Forest Research Institute, Herbarium (DD), National Botanical Research Institute, Herbarium (LWG) and H.N.B. Garhwal University, Herbarium (GUH), were also studied for authentication of plant samples.

Presentation

In the systematic treatment of the taxa, the families have been arranged according to classification of Pichi-Sermolli (1977) [26], with some modification based on Ching (1978) [6].

However, the genera within each family and species within a genus is arranged alphabetically.

Results

Total 107 ferns have been reported from the Mussoorie region and the table 1 provide detail information about the family, botanical name, locality, habitat and altitude of the different ferns of the given area. Out of which 66 ferns found as terrestrial (T), 20 epiphytic (E) and 14lithophytic (L) in their habitat. About 7 ferns show both epiphytic and lithophytic (E/L) occurrence.

Table 1: List of ferns observed during the investigation from different places of mussoorie area

S. No	Name of Family and Taxa	Place of collections/ Locality	Habitat	Altitude (in m)
	Botrychiaceae			
1.	*Botrychium multifidum* (Gmelin) Rupr.	Near Woodstock school, Mussoorie	T	2800-3000m
	Ophioglossaceae			
2	*Ophioglossum. Petiolatum*Hook.	Mussoorie, below Caineville School	T	2200m
3	*O. reticulatum*L.	Mussoorie, Park tank; Spring Road	T	2000m
	Loxogrammaceae			
4	*Loxogramme involuta* (D.Don) C.Presl.	Hathipaua, Company garden, Mossy falls, Mussoorie	L	1800-2700m
	Polypodiaceae			
5	*Arthromeris wallichiana* (Spreng.) Ching	Jabberkhet, Laltibba,Mussoorie	E	2000m
6	*Drynaria mollis*Bedd.	Hathipaua forest, Company garden, Cloudend forest, Mussorie	E	2000m
7	*Drynaria propniqua*(Wall. ex Mett.) Smith	Mussoorie; Chur valley	E	2500m
8	*Lepisorus nudus*(Hook.) Ching	Mussoorie	E/ L	1000-2800m
9	*L. pseudonudus*Ching	Mussorie park	E	1500-3000m
10.	*Microsorum membranaecum* (D.Don) Ching	Mussorie,; Jabberkhet, Camel's back	E	1000-1500m
11.	*Pichisermollia ebenipes*Hook.	Mussoorie	E	1800-2500m
12.	*Pichisermollia malacodon Hook.*	Mussoorie	E	2800m
13.	*Selliguea oxyloba*(Wall. et Kuntze)	Mussorie,; Jabberkhet	E	2800m
14	*Pichisermollia stewarti*(Bedd.) Pic-Ser.	Mussoorie; park	E/ L	Above 2800m

15	*P. quasidivaricata*(Hayata)	Landour, Mussoorie	E / L	Above 2800
16	*Polypodiumdiastrum argutum*(Wall ex. Hook.) Ching	Mussorie; Castle hill estate	E/L	1500-2000m
17.	*Polypodiode samonea* (Wall.exMett.) Ching	Hathipaua forest, Company garden, Cloudend forest, Mussorie	E	2000m
18	*P. lachnopus*(Wall.ex Hook.) Ching	Mussorie; Camel;s back' Mossy falls	E	1000-1500m
19.	*P. microrhizoma* (C.B.Clarke ex Baker) Ching	Company garden, Cloudend forest, Mussorie	E	1700m
20.	*P. subamonea*(C.B.Clarke)Ching	Mussoorie,	E	2000-2500m
21.	*Pyrrosia costata*(Wall. ex C.Presl) Tagawa et K.Iwat.	Mussoorie below Benog	E	800-1500m
22	*P. flocculosa* (D.Don) Ching	Mossy falls Mussoorie	E	1000m
23.	*P. porosa* (C.Presl.) Hovenk.	Hathipaua forest, Company garden, Mussoorie,	E	2000m
		Lygodiaceae		
24	*Lygodium flexuosum* (L.) Sw.	Mossy falls Mussoorie	T	1000m
25	*Lygodium japonicum* (Thunb.) Sw.	Mussoorie	T	1000-1500m
		Sinopteridaceae		
26	*Aleuritopteris anceps*Blanf.	Mussoorie; Landour near Woodstock school	T	1000-18000m
27.	*A. dubia*(Hope) Ching	Mussoorie	T	1000m
28.	*A. leptolepis*(Fraser-Jenk.)	Mussoorie	T	2000-2300m
29.	*A. grisea*(Blanf.) Panigrahi	Mussoorie, Laltibba	T	2800-3000m
30.	*A. rufa*(D.Don) Ching	Mussoorie; Cart road	T	3000m
31.	*A. subvillosa* (Hook.) Ching	Mussoorie	T	2500-3000m
		Cryptogrammaceae		
32.	*Onychium cryptogrammoides*H.Christ	Mussorie; laltibba, Jabbherkhet	T	2000m
33.	*O. japonicum*(Thunb.) Kunze.	Mussoorie	T	2500m
		Hypolepidaceae		
34.	*Hypolepis polypodiodes* (Bl.) Nakai	Musoorie;nearBhatuli	T	1800m
		Pteridaceae		
35	*Pteris aspercularis*Wall.ex J. Agardh	Camel's back, Company garden, Cloudend forest, Mussorie	T	2000-2500m
36	*P. cretica* L.	Company garden, Mossy falls, Mussoorie	T	1200-1800m
37	*P. excelsa* Gaud.	Dhobhighat, Mussorie	T	2000m
38	*P. stenophylla*Wall.ex Hook	Mossy falls, Mussoorie	T	2500m-3000m
39	*P.vittata*L.	Mussoorie	T	900m
		Adiantaceae		
40	*Adiantum edgeworthii* Hook.	Mussoorie	L	900-1000m
41	*A.incisum*Forssk	Mussoorie	L	900-1000m
42.	*A. venustum*D.Don	Mossy falls,Mussoorie	L	1500-2000m
		Hemionitidaceae		
43.	*Annogramma reichsteinii*Fraser.-Jenk.	Camel;s back road, near Woodstock School Mussoorie	L	1600-1800m
44.	*Coniogrammae fraxinea*(D.Don.) Fee ex Diels	Jhabbherkhet, Cloud end forest, Mussoorie	T	1800m
45.	*C. serrulata* (Bl.) Fee	Jabberkhet forest, Mussoorie	T	3000m
46.	*Gymnopteris vestita* (Wall. Ex T.Moore) Underw. 21	Mussoorie	L	2500m
		Vittaraceae		
47.	*Vittaria flexuosa* Fee	Landour forest, Mussoorie	L	1800-2500m
		Hymenophyllaceae		
48.	*Crepidomanes late-alatum*(v.d. Bosch) Copel	Company garden, Mussoorie	E	2200-2500m
		Dennstaedtiaceae		
49.	*Dennstaedtia scabra*Wall. ex T.Moore	Mussoorie	T	1500m
		Lindsaeaceae		
50.	*Odontosoria chinensis*(L.) J. Sm.	Landour forest, Mussoorie,	T	2200m
		Aspleniaceae		
51.	*Asplenium adiantum-nigrum* L.	Mussoorie	T	3000
52.	*A.capillies*Makino.	Mussoorie	L	3000m
53.	*A. dalhousiae* Hook.	Camel's back, Mussoorie	L	1000m
54.	*A. ensiforme*Wall. ex Hook.et Grev.	Landour near Savoy hotel	L/E	1500m
55.	*A. indicum*Sledge	Mussoorie	L/E	1800-2500m
56.	*A.lacinatum*D.Don	Mussoorie	L	1800-2200m
57.	*A. tenuifolium*D.Don	Landour, Mussoorie	E	2000m
58.	*A. trichomanes* L.	Mussorie	L	1800m
59.	*A. unilaterale*Lamk.	Jhabbherkhet, Mussoorie	L	2400m
60.	*A.yunnanense*Franch	Camel's Back, Mussoorie	E	2500m
		Athyriaceae		
61.	*Athyrium aniospterum*H.Christ.	Mossy falls, Mussoorie	T	2800m
62.	*A. falcatum*Bedd.	Mussoorie	T	2800m
63.	*A.foliolosum*(Wall.) T.Moore ex Sim.	Mussoorie	T	2000-2500m
64.	*A. pectinatum*(Wall.exMett.) T.Moore.	Dhobhighat, NalotaKhala	T	1800-2500m
65.	*A. rupicola* (Edgew.ex C. Hope) C.Chr	Jhabherkhet forest, Mussoorie,	T	2000m
66.	*A. schimperi*Moug.ex Fee	Mussorie	T	1800m
67.	*A. setiferum*C.Chr	Mussoorie- Chakrata way	T	2800m
68.	*A. strigillosum*(E.J. Lowe) Moore ex Salom	Mussoorie	T	1800-2200m
69.	*Deparia allantodiodes* (Bedd.) M.Kato	Mussoorie	T	2200m
70.	*D. boryana*(Willd.) M.Kato	Jharipani, Mussoorie	T	3000m
71.	*D. japonica* (Thunb.exMurr.) M.Kato	Bhatauli,Mussoorie	T	1800-2400m
72.	*D. petersenii*(Kunze) M. Kato	Landour, Mussoorie	T	2000-2800m
73.	*Diplazium esculentum* (Retz.) Sw.	Bhatauli,Mussoorie	T	900m
74.	*D.longifolium*T.Moore	Jabbarkhet, Mussoorie	T	2300m
75.	*D. maximum* (D.Don) C.Chr	Dhobhighat, Landour;Mussoorie	T	1000m

76.	*D.spectabile*(Wall.exMett) Ching	Mossy falls.Mussoorie	T	1000-1500m
	Thelypteridaceae			
77.	*Thelypteris appendiculata*(C.Presl) Holtt.	Jabbarkhet, Mussoorie	T	1000-1500m
78.	*Thelypteris. papilio*(Hope) Holtt	Nagtibba;Mussoorie	T	1000-1500m
79.	*T.auriculata*(J.Smith) Ching	Jabbarkhet forest, Mussoorie	T	1300-2000m
80.	*T. erubescens*(Wall.ex Hook.) Ching	Company Khud, Mussorie	T	1500-2000m
81	*Pronephrium nudatum*(Roxb.) Holtt.	Near Magra, Mussoorie	T	1500-2000m
82.	*P.penanginaum* (Hook.) Holtt	Cloudend forest, Mussorie,	T	1800m
83.	*Pseudocyclosorus canus*(Baker) Holtt.	Mossy falls,Mussoorie	T	1200-1800m
84.	*P. tylodes*(Kunze) Ching	Jabbarkhetkhud, Mussoorie	T	1000-1500m
85.	*P. pyrrhorachis*ssp. *Distans*Fraser.Jenk	Mossy falls, Mussoorie	T	2000-2500m
86.	*Stenogramma mollissima*(Kunze)	Mussoorie	T	1500-2500m
	Dryopteridaceae			
87	*Cyrtomium caryotideum* (Wall.ex Hook.et Greville) C.Presl	Kimoinforest,Company garden, Mussorie	T	2800m
88.	*Dryopteris caroli-hopei*F.Jenks	Library bazar, Mussoorie	T	1000-2000m
89.	*D. chrysocoma* (H.Christ) C.Chr	Lal tibba, Mussoorie	T	1800-2100m
90.	*D. cochleata*(Ham.exD.Don) C.Chr	Mussoorie	T	1200-1500m
91.	*D. juxtaposita*H.Christ	Mussoorie	T	1700-2500m
92.	*D. nigropaleacea* (F.Jenks) F.Jenks	Mussoorie	T	1800-2000m
93.	*D. ramosa* (C.Hope) C.Chr	Near Woodstock school, Mussoorie	T	2500m
94.	*D. sparsa*(Ham. ex D.Don)C.Chr*	Landour, Mussoorie	T	2900m
95.	*Polystichum discretum* (D.Don) Smith	Cloudend, Mussoorie	T	2000-2500m
96	*P. longipaleatum*H.Christ	Camel's back road, Mussoorie	T	2000-2800m
97.	*P.mehrae*F.Jenks*et*Khullar	Cloud end forest, Mussoorie	L	1800-2400m
98.	*P.nepalense*(Spreng.) C.Chr	Mussoorie	T	1900-2500m
99.	*P. obliquum*(D.Don)T. Moore	Mossy falls,Mussoorie	T	2200m
100.	*P. piceo-paleaceum*Tagawa	Mossy falls,Mussoorie	T	2500m
101.	*P. stimulans* (Kunze ex Mett.) Bedd.	Mussoorie	L	1500-2000m
102.	*P. squuarosum* (D.Don) Fee	Hathipaua, Cloudend, Mussoorie	T	1800-2500m
	Tectariaceae			
103.	*Tectaria coadunata* (Smith) C.Chr	Mossy falls, Bhatta falls,Mussoorie	T	1000-1200m
	Oleandraceae			
104.	*Oleandra wallichi* (Hook.) C.Presl	Bhadraj forest, Mussoorie	E	2500m
	Davalliaceae			
105.	*Araoistegia pseudocystopteris*(Kunze) Copel	Hathipaua, Company garden,Mussoorie	E	1800m-2500m.
106.	*Leucostegia truncate* (D. Don)	Mossy falls,Jabbherkhet,Mussoorie	E/L	1500-2000m
	Blechnaceae			
107.	*Woodwardia biserrata*C.Presl	Jabberkhet, Companygarden, Cloudend forest, Mussorie	T	1500-2200m

T= terrestrial, E=epiphytic, L=lith ophytic after Khullar (2000) [17]

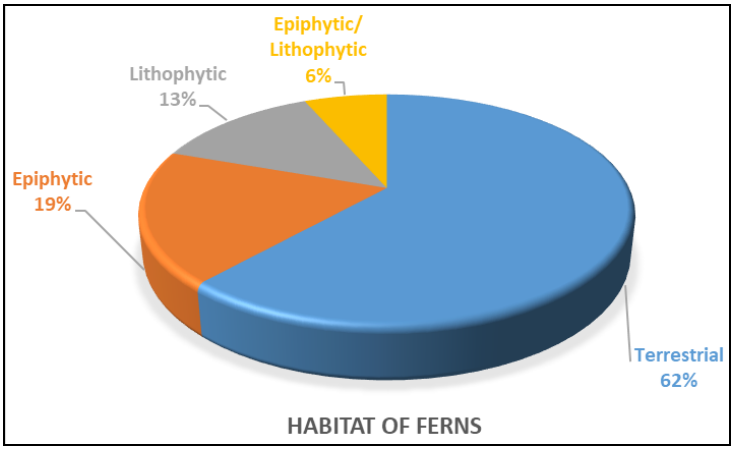

Fig 1: Occurrence of habitat in ferns

Out of the total 107, number of ferns reported from the area have medicinal uses. Thus species of pharmacological significance are enlisted based on interaction with inhabitant of the area and confirmation was also done in consultation with the literature *viz*. Gaur and Painuli 1993a, b; Pande et.al 2000; Rout *et al*., 2009., Singh and Rawat, 2011,Singh *et al*., 2013 [13, 14, 24, 27, 32, 37] (Table 3).

Table 2: List of ferns having pharmacological significance from mussoorie area

S. No	Name of The Plant	Family	English Name	Local Name	Part Used	Medicinal uses
1.	*Adiantum edgeworthii* L	Adiantaceae	Walking black maiden hair fern	Hansraj	Frond	use in mouth blisters
2.	*Adiantum incisum* L	Adiantaceae	Walking fern	Hansraj, Mayrshikha	Frond, leaves.	Infusion of young leaves

3.	*Adiantum venustum* D. Don	Adiantaceae	Evergreen maidenhair	Hansraj	Whole plant	The plant is used for healing of wounds, cough, tumors, fever, asthma and inflammatory disease of chest. It also shows antimicrobial activity (Pandey & Bhargava (1980).
4.	*Araoistegia pseudocystopteris* (Kunze) Copel.	Davilliaceae	Maiden –hair fern	Hansraj	Frond.	It is used for vermifuge.
5.	*Asplenium adiantum – nigrum* L.	Aspleniaceae	Spleenwort		Fronds, Leaves and Rhizome	The extract of frond mixed with honey is used for eye problems. The fronds are diuretic, laxative. Jaundice and problem relating to spleen can be treated by the use of leaves and rhizome. The decoction of leaves helps in cough
6.	*Asplenium dalhousiae*Hook.	Aspleniaceae	Maiden –hair fern	Vishkanya	Frond.	It is used for mastitis.
7.	*Asplenium trichomanes*L.	Aspleniaceae	Maidenhair Spleenwort		Whole plant.	Smoked leaves are useful for cold, in head and chest, also used as expectorant and also as laxative.
8.	*Athyrium pectinatum (Wall. ex Mett)* T. Moore.	Athyriaceae	.		Leaves, Rhizome, Young frond.	The Rhizome has antiheleminthic property.
9.	*Diplazium esculentum* (Retz.) Sw.	Athyriaceae	Vegetable fen	Lingrhi	Rhizome, stipe	The rhizome is used in treatment of tuberculosis. For the relive in constipation frond can be used. Extract of rhizome and stipe is found effective against cuts and burns. To cure spermatorrhea. fresh root (boiled) along with honey is used.
10.	*Drynaria mollis* Bedd	Polypodiaceae			Rhizome	Backaches can be treated by using a paste of rhizome. In animals, it is used to wash areas around dislocated bones to relieve pain.
11.	*Dryopteris caroli-hopei* F Jenks.	Dryopterideaceae			Rhizome	Rhizome is used as antihelminthic
12.	*Dryopteris chrysocoma*(H. Christ) C. Chr	Dryopterideaceae	Cliff fern		Lamina, rhizome	Extract of the rhizome can be applied to cut and wounds. Crushed Lamina works as antihelminthic
13.	*Dryopteris cochleata* (Ham. ex D. Don) C. Chr	Dryopterideaceae			rhizome and Young fronds	The rhizome is found useful for diarrhea and vomiting and eczema, also as antiheleminthic. In snake bite whole plant extract is given during treatment. In gonorrhea aqueous rhizome extract is used. In sprains, scabies and ulcers rhizome boiled with mustard oil is used.
14.	*Dryopteris juxtaposita* H. Christ	Dryopterideaceae			Fronds	The digestion can be enhanced by fronds.
15.	*Hypolepis polypodiodes* (Bl.) Nakai.	Hyplolepidaceae			Fronds	In poultice boils fronds are used.
16.	*Lygodium flexosum* (L.) Sw.	Lygodiaceae	Climbing fern		Rhizome, Fronds, Leaves	Memory in children can be enhanced by leaf powder mixed with milk. Fractured bone can be fixed by leaf paste. Aqueous rhizome extract is used for treatment of gonorrhea. The plant is also used in treatment of rheumatism sprains, jaundice, and scabies.
17.	*Lygodium japonicum* (Thunb.) Sw.	Lygodiaceae	Climbing fern		Rhizome, Fronds, Lamina	Rhizome powder is found effective as antibacterial, antispasmodic along with cows urine. It is also used for disease of lungs rheumatism, and kidney.
18.	*Leucostegia truncata*(D. Don) Fraser-Jenk	Davalliaceae			Rhizome	The constipation can be treated by the use of rhizome and also has antibacterial property.
19.	*Microsorum membranecum* (D. Don) Ching	Polypodiaceae			Rhizome	The plant rhizome is found useful for Ulcer, haematuria, dysuria, sore boil, swelling. Diarrhea and dysentery can be cured by. decoction of rhizome.
20.	*Oleandra wallichii* (Hook.) C. Presl	Oleandraceae			Rhizome	The Rhizome of plant shows rejuvenating properties as a health tonic and antidote. For the treatment of headache and dislocation of bones the paste of rhizome is used.
21.	*Onychium siliculosum* (Desv.) C. Chr	Cryptogrammaceae			Fronds	The decoction made of fronds helps to cure dysentery
22.	*Ophioglossum*	Ophioglossaceae	Adder's	Ban Palak	Leaves,	The paste made of fresh leaf act as coolant on

	*reticulatum*L.		tongue fern/ Snake-tongued Fern		fronds	burns and in cures wounds and inflammation. Fronds are also found useful as tonic and styptic
23.	*Ophioglossum petiolatum* Hook.	Ophioglossaceae	Stalked adder's tongue		Rhizome, Tuber	Hair fall control can be done through fresh rhizome and tuber paste.
24.	*Polypodium lachnopus* (Wall. ex Hook.) Ching	Polypodiaceae			Rhizome	Rhizome is found laxative in nature.
25.	*Polystichum squarrosum* (D. Don.)Fee	Dryopteridaceae	Basket fern		Sporophyll, Rhizome.	The extract of sporophyll is found to be anti antibacterial agent. pyloric disease can be cured by rhizome decoction.
26.	*Pronephrium penangianum* (Hook.) Haltt.	Thelypterideace	Crescent fern plant		Rhizome.	The Rhizome is used as styptic detoxifier, in control of dysentery, red eyes, acute conjunctivitis.
27.	*Pteris aspercularis* L.	Pteridaceae	Frond, Rhizome	Ribbon Fern.	Frond, Rhizome	The extract of frond is applied on cuts and bruises. Brewof rhizome and frond is given in chronic disorder
28.	*Pteris cretica* L.	Pteridaceae	Ribbon Fern.		Frond, Whole plant	The paste of fronds helps in healing of wounds and possesses antibacterial properties. It also found useful in leprosy.
29.	*Pteris vittata* L.	Pteridaceae	Ladder brake fern		Rhizome leaves and plant	The paste made out of leaves and fresh rhizome is found effective against glandular swelling.Plant extract is used as antiviral and antibacterial (Pandey & Bhargava, 1980).The leaves extarct helps in diarrhea and dysentery. Fern of Pterisvittata also possesss carcinogenic activity (Siman *et al*., 2000; Somvanshi and Sharma, 1999).
30.	*Odontosoria chinensis* (L.) J. Sm	Lindsaeaceae			Fronds, Pinnae and Leaves	Young leaves relives toothache. Fronds provide relief in chronic enteritis
31.	*Woodwardia biserrata* C. Presl.	Blechnaceae			Rhizome, Stipe and Lamina	In dysentery fronds are used.

Table 3: The percentage occurrence of recovered genus and species of different plant families.

S. No.	Name of family	Genus (%) 41	Species (%) 107	S.No.	Name of family	Genus (%)	Species (%)
1.	Botrychiaceae	2.43	0.93	13.	Hymenophyllaceae	2.43	0.93
2.	Ophioglossaceae	2.43	1.86	14.	Dennstaedtiaceae	2.43	0.93
3.	Loxogrammaceae	2.43	0.93	15.	Lindsaeaceae	2.43	0.93
4.	Polypodiaceae	21.95	17.75	16.	Aspleniaceae	2.43	9.3
5.	Lygodiaceae	2.43	1.86	17.	Athyriaceae	2.8	14.95
6.	Sinopteridaceae	2.43	5.6	18.	Thelypteridaceae	9.7	9.3
7.	Cryptogrammaceae	2.43	1.86	19.	Dryopteridaceae	7.3	14.95
8.	Hypolepidaceae	2.43	0.93	20.	Tectariaceae	2.43	0.93
9.	Pteridaceae	2.43	4.6	21.	Oleandraceae	2.43	0.93
10.	Adiantaceae	2.43	2.8	22.	Davalliaceae	4.8	1.86
11.	Hemionitidaceae	7.3	3.7	23.	Blechnaceae	2.43	0.93
12.	Vittaraceae	2.43	0.93				

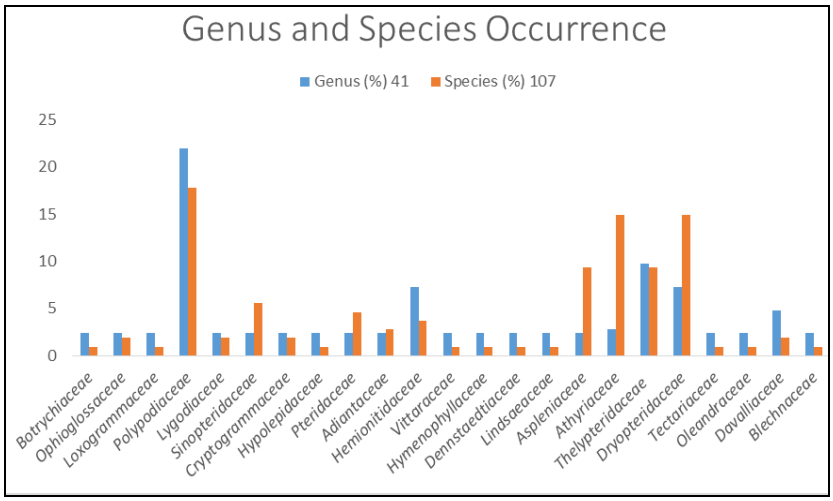

Fig 2: Percentage occurrence of recovered genus and species of different plant families.

Discussion

Ferns plays an important role in the earth's plant diversity. They form a significant sometimes, dominants component of many plant communities (Tryon, 1986; Benniamin, 2011) [4, 45]. Human environment interactions can be easily understood through different tools such as the ethnobiological knowledge of people and listing of plants of particular region (Gangwar *et al*., 2010; Sheokand *et al*., 2019; Agarwal *et al.,* 2020; Devi *et al.,* 2020; Sharma *et al.,* 2020; Agarwal *et al.,* 2021; Doharey *et al.,* 2021; Kumar *et al*., 2021 a, b, c, d, e) [12, 30, 2, 8, 29, 1, 11, 19, 20, 21 22, 18]. The present study focusses on medicinal ferns of Mussoorie region. The fern collected from area and the litreature consulted Khullar ferns of western Himalayas (2001) as documented is 107,out of which 34 are found to be of medicinal use. Since the area is a tourist spot the ferns are under the threat. The data collected shows that ferns need to be conserve as they have many important medicinal properties as they can be used in the fields of clinical research for making medicines, alsoin treatment of common ailments like stomach ache, diarrhea, dysentery skin problems etc. The plant parts used by the inhabitant in different form such as juice, extract, decotion and paste etc. The *Adiantum venustum* is the single species has wide specturum which is used in different disease such ascough, fever, tumour, amtimicribial activity and for wounds, similarly *Dryopteris cochleata* is used in Diarrohea, anthelminthic activity and snake bite. While *Asplenium adiantum-nigrum*is used in eyes, jaundice, cough. Due to the increase in deforestation for the development of tourist spots present number of taxa in ferns and fern allies species have been eradicated from Mussoorie. First historical effort was made by Caius in 1935 to describe the medicinal uses of ferns in India, therefore get recognized as the first man to take this very initiative kind of investigations. Thus from the socio-cultural point, the district exhibits great ethnic and cultural diversity. Important contribution on studies of ferns in this region have been carried out by several investigators (Beddome, 1883; Clarke, 1880; Hope, 1899) [3, 7, 15]. Ferns are lesser known for their economic utilization and not much documented several workers have emphasized this aspect of the group (Bir et.al., 1983, Tryon and Tryon 2012) [5, 46].

Conclusion

From the above study it can be concluded that Mussoorie is found rich in wild ferns due to its geographical position and the tribal communities in remote areas are still dependent on indigenous knowledge for health care. The ongoing deforestation and habit fragmentation would pose a serious threat to the growth of wild plants. It is the need of the time to take proper steps and efforts to conserve them in nature so that they can be used for the benefit of human welfare and ecological balance of the area is maintained. For the conservation of fern it is stressed that there should be good field stations just within the outer region of reserved forests with large green houses which function as 'Fernariums/ Mossariums/ and/or Lichenariums' to conserve and maintain rare, endangered and medicinally superlative species found in those areas/forests.

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Conflict Of Interest

The authors declared no conflict of interest.

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Refrences

1. Aggarwal D, Upadhyay SK, Singh R, Tuli HS. Pharmacokinetics and Recent Patents on Therapeutic Activities of Xanthohumol: A PrenylatedChalconoid from Hops (*Humuluslupulus* L.). Pharmaceutical patent analyst,2021:10(1):37-49.
2. Aggarwal D, Upadhyay SK, Singh R, Sehrawat N, Yadav M, Singh M *et al*. Tissue culture propagation of *Bacopamonnieri* (L.) Pennell: An important medicinal plant. Advances in Bioresearch,2020:11(5):97-103.
3. Beddome RH. A Handbook to the Ferns of British India, Ceylon and Malaya Peninsula, Supplement. Thacker Spink & Co., Calcutta, 1883.
4. Benniamin A. Botanical Survey of India Arunachal Pradesh, Medicinal ferns of North Eastern India with special reference to Arunachal Pradesh, IJTK,2011:10(3):516-522
5. Bir SS. Pteridophytic flora of Garhwal Himalaya (Mussoorie, Dehradun, Chakrata, and adjoining hills): an annotated catalogue of the recorded species, their ecology, distribution in the region, and common synonyms. P.K. Rastogi for Jugal Kishore, Dehradun, 1983.
6. Ching RC. The Chinese fern families and genera: Systematic arrangement and historical origin. Acta Phytotaxonomica Sinica,1978:16:1-19, 16-3.
7. Clarke CB. A review of the ferns of Northen India. Trans. Linn. Soc. London II Bot,1880:1:425-611.
8. Devi A, Dahiya VS, Upadhyay SK, Singh R. Antimicrobial Acitivity and Phytochemical constituents present in *Syziumcumini* (L) Seed, Leaves and Bark extract. Plant Archives,2020:20(2):7787-7790.
9. Dhir KK, Sood A. Fern flora of Mussoorie hills. Bibliotheca Pterdologica. J.Cramer, Vaduz (Germany),1981:2:1-99.
10. Dixit RD. Ferns- a much neglected group of medicinal plants III, Indian Journal of Medical Research,1974:(4):59-68.
11. Doharey V, Kumar M, Upadhyay SK, Singh R, Kumari B. Pharmacognostical, physicochemical and pharmaceutical paradigm of ash gourd, *Benincasahispida* (Thunb.) fruit. Plant Archives,2021:21(1 Jan.):249-252.
12. Gangwar KK, Deepali, Gangwar RS. Ethnomedicinal Plant Diversity in Kumaun Himalaya of Uttarakhand, India.Nature and Science,2010:8(5):66-78.
13. Gaur RD, Painuli P. Some little known Pteridophytes from Garhwal Himalaya. Indian J. For.,1993a:16(1):88-90.
14. Gaur RD, Painuli P. Some new records of Pteridophytes from Garhwal Himalaya. Journal of the Bombay Natural History Society,1993b:90:318-320.
15. Hope CW. The ferns of North Western India including Afganistan, the Trans Indus protected states and Kashmir, Journal of the Bombay Natural History Society 12: 315-325, 527-538,621-633, 1899; 13: 26-

36, 236-251, 1990; 443-461, 657-671, 1901; 14: 119-127,252-266, 458-480, 1902; 720-749, 1903; 15: 67-111, 415-429, 1904. Reprint: Periodical Expert Book Agency, Delhi; International Book Distributors, Dehra Dun; Bishen Singh Mahendra Pal Singh, Dehra Dun, 1976, 1-306.
16. Jain SK, Rao RR. Handbook of field and Herbarium Methods, New Delhi, 1976.
17. Khullar SP. An illustrated fern flora of the West Himalaya. International Book Distributors, Dehradun, 2000, 2.
18. Kumar M, Kaur H, Verma R, Negi R, Sharma I, Upadhyay SK *et al*. Taxonomical Diversity, Socioeconomic and Ethnomedicinal Significance of *Bambusa*Schreber 1789 (Poaceae: Bambusoideae) in Forest Research Institute (FRI), Dehradun (Uttarakhand), India. Asian Journal of Biological and Life sciences,2021e:10(2):346-351.
19. Kumar M, Sharma I, Verma PK, Singh BJ, Singh R. Upadhyay SK. A study on diversity and distribution of *Ficus* L. (Dicotyledonae: Moraceae) species at Forest Research Insti-tute (FRI), Dehradun (Uttarakhand), India. Journal of Applied and Natural Science,2021a:13(2):552-560.
20. Kumar M, Singh R, Sharma I. Integrated Management for Post-Harvest Diseases of Fruits and Vegetables. Bio-Science Research Bulletin,2021b:37(1):17-22.
21. Kumar M, Upadhyay SK, Negi R, Sharma I, Singh R. Phytodiversity, Socioeconomic and Ethnomedicinal Study of Bamboos *Dendrocalamus* Nees in New Forest of Forest Research Institute (FRI), Dehradun (Uttarakhand), India. International Journal of Botany Studies,2021c:6(3):412-416.
22. Kumar M, Upadhyay SK, Verma PK, Sharma I, Singh R. Taxonomical and Ethnomedicinal Studies of *Ficuskrishnae* L. (Dicotyledonae: Moraceae). Bulletin of Pure and Applied Sciences (Botany),2021d:40B(1):24-29.
23. Pande HC. Ecological observations on the fern flora of Uttarakhand. Phytotaxonomy,2011:11:86-102.
24. Pande HC, Datt B, Pande PC. Notes on the Ethnomedicinal aspect of some common Pteridophytes of Almora district of KumaonHimal. (Uttaranchal), Ethnobotany, 2000, 56-59.
25. Pandey AK, Bhargava KS. Antiviral activity of crude extracts of some pteridophytes. Indian Fern Journal,1980:3:32-133.
26. Pichi-Sermolli REG. Tentamen Pteridophytorum genera in taxonomicum ordinem redigendi, Webbia,1977:31(2):313-512.
27. Rout SD, Panda T, Mishra N. Ethnomedicinal studies on some Pteridophytes of Simplipal Biosphere Reserve, Orissa, India. International Journal of Medical Sciences,1977:1(5):192-97.
28. Shah H, Naseer A, Gupta N, Patil SM, Upadhyay SK, Singh R. Proximate Analysis and Phytochemical Screening of different Plant Parts of *Myricaesculenta* Linn. Extracts. Plant Cell Biotechnology and Molecular Biology,2021:22(55-56):90-102.
29. Sharma AK, Sharma V, Sharma V, Sharma JK, Singh R. Multifaceted Potential of *Eichhorniacrassipes* (Water Hyacinth) ladened with numerous value aided and therapeutic properties. Plant Archives,2020:20(SUPPL.2):2059-2065.
30. Sheokand N, Sharma I, Singh R, Kamboj P. Antimicrobial Activity and Phytochemical Analysis of Catharanthusroseus (L).Bio-Science Research Bulletin,2019:35(2):53-57.
31. Siman SE, Povey AC, Ward, TH, Margison GP, Sheffield, E. Fern spore extracts can damage DNA. British Journal of Cancer,2000:83(1):69-73.
32. Singh G, Rawat GS. Ethnomedicinal Survey of Kedarnath Wildlife Sanctuary in Western Himalaya, India Indian Journal of Fundamental and Applied Life Sciences,2011:1(1):35-46.
33. Singh R, Gupta M, Singhal P, Goyal S. Upadhyay SK. *In vitro* antimicrobial activities of vegetables (Potato, Cucumber, Sweet Potato and Ginger) peel wastes for ecofriendly microbial management. International Journal of Botany Studies,2021c:6(4):134-137.
34. Singh C, Chauhan N, Rani A, Singh R. Restoration of World Heritage Site Nanda Devi Biosphere Reserve, Uttarakhand. Journal of Agriculture and Forest Meteorology Research,2020a:3(5):405-408.
35. Singh C, Chauhan N, Upadhyay SK, Singh R. Phytochemistry and Ethnopharmacological study of *Adiantumcapillus-veneris* L. (Maidenhair fern). Plant Archives,2020b:20(2):3391-3398.
36. Singh C, Chauhan N, Upadhyay SK, Singh R. Rani A. The Himalayan natural resources: Challenges and conservation for sustainable development. Journal of Pharmacognosy and Phytochemistry,2021a:10(1):1643-1648.
37. Singh C, Garkoti S, Pande HC. An Assessment of Ethno botanically Important Ferns from Dehradun district of Uttarakhand. Research Journal of Social and Life Sciences,2013:14(1):271-280.
38. Singh C, Kumar B, Rani A, Dhyani K, Singh R. Biodiversity and conservation ferns diversity in different forests of Dehradun district. International Journal of Pharmaceutical Research,2017:3:34-39.
39. Singh R, Upadhyay SK, Rani A, Kumar P, Kumar A. Ethanobotanical study of Subhartipuram, Meerut, Uttar Pradesh, India. II. Diversity and Pharmacological Significance of Shrubs and Climbers. International Journal of Pharmaceutical Research,2020c:12(2):383-393.
40. Singh R, Upadhyay SK, Rani A, Kumar P, Kumar A, Sharma P. Ethanobotanical Study of Subhartipuram, Meerut, Uttar Pradesh, India. I. Diversity and Pharmacological Significance of Trees. International Journal of Pharmaceutical Research,2019:11(4):782-794.
41. Singh R, Upadhyay SK, Rani A, Kumar P, Sharma P, Sharma I *et al*. Ethnobotanical Study of Weed Flora at District Ambala, Haryana, India: Comprehensive Medicinal and Pharmacological Aspects of Plant Resources. International Journal of Pharmaceutical Research, Jan.-June,2020d:12(Spl.)1:1941-1956.
42. Singh R, Upadhyay SK, Singh BJ, Verma R, Sharma I, Sharma P *et al*. Allelopathic Effect of Eucalyptus *(Eucalyptus camaldulensis Dehnh)* on the Growth of Aloe vera. Plant Cell Biotechnology and Molecular Biology,2021b:22(21&22):94-100.
43. Singh R, Upadhyay SK, Tuli HS, Singh M, Kumar V, Yadav M *et al*. Ethnobotany and Herbal Medicine: Some Local Plants with Anticancer Activity. Bulletin of

Pure and Applied Sciences Sec. B –Botany (Plant Sciences),39B:2020e:(1):57-64.
44. Somvanshi R, Kataria M, Sharma AK. Comparative clinical, biochemical and pathological evaluation of bracken, Polystichum and Dryopteris ferns in rabbits. Indian Journal of Veterinary Medicine,1999:23:177-184.
45. Tryon RM. The Biogeography of species with special reference to ferns. The Botanical Review,1986:52(2):117-156.
46. Tryon RM, Tryon AF. Ferns and allied plants: with special reference to tropical America. Springer Science & Business Media, 2012.