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Original Article

Ethnomedicinal and traditional uses of the Ferns of Khyber Pakhtunkhwa, Pakistan

Usos etnomedicinais e tradicionais das samambaias de Khyber Pakhtunkhwa, Paquistão

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Abstract

Ferns are often used by indigenous people in Khyber Pakhtunkhwa, Pakistan. This study was designed to collect the ethnomedicinal and traditional knowledge of these locals about this group of vascular plants. Forty taxa belong to nineteen genera and ten families are used in the treatment of different diseases. The Pteridaceae was the most representative family with twelve taxa (30%), followed by Athyriaceae and Dryopteridaceae with six taxa each (30%), and Thelypteridaceae with five taxa (12.5%). Regarding the genera, *Adiantum*, *Asplenium* and *Dryopteris* ranked first with four taxa each (30%), followed by *Aleuritopteris, Diplazium, Pteris* and *Equisetum* with three taxa each (30%), followed by *Athyrium, Oeosporangium, Polystichum* and *Pseudophegopteris* with two taxa each (20%). These taxa were commonly used in the treatment of respiratory disorders i.e. asthma, bronchitis, emphysema, pneumonia; intestinal ulcer, stomach, urinary ailments and skin disorders by the methods of decoction and infusion. Traditional knowledge about ethnomedicinal plants is a valuable and essential source for the discovery of allopathic, herbal and homeopathic medicines.

Keywords: ethnomedicinal, ferns, Khyber Pakhtunkhwa, Pakistan, traditional.

Resumo

As samambaias são frequentemente usadas pelos indígenas em Khyber Pakhtunkhwa, Paquistão. Este estudo foi desenhado para coletar o conhecimento etnomedicinal e tradicional desses moradores sobre este grupo de plantas vasculares. Quarenta táxons pertencem a dezenove gêneros, e dez famílias são utilizadas no tratamento de diferentes doenças. Pteridaceae foi a família mais representativa com doze táxons (30%), seguida por Athyriaceae e Dryopteridaceae com seis táxons cada (30%), e Thelypteridaceae com cinco táxons (12,5%). Em relação aos gêneros, *Adiantum*, *Asplenium* e *Dryopteris* ficaram em primeiro lugar com quatro táxons cada (30%), seguidos por *Aleuritopteris*, *Diplazium*, *Pteris* e *Equisetum* com três táxons cada (30%), e *Athyrium*, *Oeosporangium*, *Polystichum* e *Pseudophegopteris* com dois táxons cada (20%). Estes táxons foram comumente usados no tratamento de distúrbios respiratórios, isto é, asma, bronquite, enfisema, pneumonia; úlcera intestinal, estômago, doenças urinárias e doenças da pele pelos métodos de decocção e infusão. O conhecimento tradicional sobre plantas etnomedicinais é uma fonte valiosa e essencial para a descoberta de medicamentos alopáticos, fitoterápicos e homeopáticos.

Palavras-chave: etnomedicinal, ferns, Khyber Pakhtunkhwa, Paquistão, tradicional.

1. Introduction

All living organisms depend upon food and medicines (Irfan et al., 2017a, b). Plants are ethnomedicinally used in different communities of the world since centuries ago (Irfan et al., 2018a; Ullah et al., 2018). Now a day's modern medicines are replacing the ethnomedicinal uses of the plants around the world (Iftikhar et al., 2019; Irfan et al., 2018b, 2019). Until now 70% inhabitants around the world depends upon the ethnomedicinal uses of plants (Irfan et al., 2018c). Most of the population of poor and developing countries relies upon traditional medicines (Attaullah et al., 2017; Irfan et al., 2018d; Singh and Upadhyay, 2014). In Pakistan about 700 plant species are

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medicinally used in rural and tribal areas due to high cost on modern medicines and poverty (Ahmad et al., 2016; Irfan et al., 2018e).

Worldwide there are about 11916 taxa with 337 genera, 51 families, 14 orders and two classes of ferns and lycophytes (PPG-I, 2016). A total of 168 taxa with 45 genera and 19 families are currently reported from Pakistan with greater wealth in Azad Jammu and Kashmir, Khyber Pakhtunkhwa and Gilgit-Baltistan, Pakistan (Fraser-Jenkins et al., 2016, 2018, 2020; Irfan et al., 2021d).

Ferns have been used as prophylactic measure in different respiratory, urinary and skin disorders (Mannan et al., 2008; Nair, 1959; Kaushik and Dhiman, 1995; Gul et al., 2016b). New plant taxa have been added to the Flora of Pakistan having great medicinal importance (Ali et al., 2017). First time ethnomedicinal uses of ferns were reported in Jammu and Kashmir, India (May, 1978). Sixty-six species representatives of this group of vascular plants were reported from India for the treatment of various ailments (Kumar et al., 2003). Ferns were ethnomedicinally used for the treatment of various diseases, such as ulcer, urinary infections, vomiting, hair fall, sterility, dysentery and healing of wounds (Keller et al., 2011; Keller and Prance, 2015; Liu et al., 2012; Oloyede et al., 2008; Ranil and Bussmann, 2021). Ethnomedicinal uses of different ferns species have been documented by many workers, from Western Ghats, India (Benjamin and Manickkam, 2007); Arunachal Pradesh, North Eastern, India (Benniamin, 2011); Kumaun Himalaya, Uttarakhand, India (Upreti et al., 2009); Vindhyan Region (M.P.), India (Pathak et al., 2011); Kolli hills, Namakkal District, Tamil Nadu, India (Perumal, 2010); Similipal biosphere reserve, Orissa, India (Rout et al., 2009); Kerala, South India (Kumar et al., 2003); Rajasthan, India (Parihar and Parihar, 2006); Banajalaya conserved forest area of Shimoga District, Karnataka, India (Deepa et al., 2014) and from others mainland of India (Singh and Viswanathan, 1996; Vasudev, 1999). Ferns are used as a source of food, fibers, fuel (Biplab and Subir, 2007); screen heavy metals from the soil (Deepa et al., 2014); enhance environmental beauty and reduces pollution (Ranil et al., 2015; Gul et al., 2016b); adds pleasant scenery of gardens, parks and houses (Manickam and Irudayaraj, 2003); improves environmental beauty of offices, schools and hospitals (Mittal and Bir, 2006; Pande, 1991).

The major ferns genera dominated in Khyber Pakhtunkhwa, Pakistan are *Asplenium*, *Dryopteris, Polystichum*, *Athyrium*, *Pteris*, *Adiantum*, *Aleuritopteris*, *Cystopteris, Selaginella, Diplazium, Equisetum, Oeosporangium, Onychium*, *Cryptogramma*, *Notholaena*, *Hypodematium, Pteridium, Marsilea, Anogramma, Actiniopteris, Dennstaedtia* and *Gymnocarpium* (Fraser-Jenkins, 1992, 2014; Gul et al., 2016a). Due to variable climatic, topographic, edaphic and physiographic features with highest humidity and precipitation in higher elevations Khyber Pakhtunkhwa occupies greater wealth of lycophytes and ferns (Irfan et al., 2021a, b, c).

2. Materials and Methods

Ethnomedical and traditional uses of the ferns in Khyber Pakhtunkhwa were investigated through questionnaire method from the local inhabitants; herbal practitioners, Hakeem's, medicinal plants traders, wound healers and aged women from March 2018 to August 2019. A total of 150 questionnaires were conducted from informers at different districts of Khyber Pakhtunkhwa, Pakistan, i.e. Abbottabad, Buner, Chitral, Dir Lower, Dir Upper, Khyber, Kurram, Malakand, Mansehra, Swabi, Swat, Shangla and Torghar. During field trips the potential indigenous knowledge about its use were documented. Plant specimens were collected, photographed, tagged, pressed, preserved and mounted on exsiccates and later deposited at the herbarium of Abdul Wali Khan University, Mardan, Khyber Pakhtunkhwa, Pakistan. Plant specimens were identified by Mr. C. R. Fraser-Jenkins and were classified according to (PPG-I, 2016).

Fidelity level (FL) was calculated according to Equation 1 (Alexiades, 1996).

$$FL(\%) = Ip/Iu\,100 \quad (1)$$

The fidelity level is the percentage of respondents mentioning the uses of a specific plant to treat particular disease. Ip is the number of informants independently suggested the use of various taxa for a specific disorder, while Iu is the total number of informants suggested various taxa for the ethnomedicinal purpose.

Use value (UV) was calculated according to Equation 2 (Phillips et al., 1994).

$$\mathbf{UVi} = \Sigma \mathbf{Ui} / \mathbf{Ni} \quad (2)$$

Use value (UV) is a numerical method that proves the relative importance regarding medicinal uses of plant species; UV is the number of individual use species, Ui is the number of uses recorded for each species and Ni is the total number of informants. Use value reflects the relative importance of reported plant species in an area. High use value shows that plant species have many use reports and is important in the region, whereas low use value (approach to 0) shows that species have few use reports related to its use. However, use report is not meaningful to differentiate whether a plant species is used for single or manifold purposes (Kayani et al., 2014).

Relative frequency was calculated according to Equation 3 (Ali-Shtayeh et al., 2016).

$$\mathbf{RFC} = \mathbf{FC} / \mathbf{N}(\mathbf{0} < \mathbf{RFC} < \mathbf{1}) \quad (3)$$

Relative frequency of citation (RFC) presents the local importance of each species in a study area. To calculate RFC, number of respondents citing a useful species (FC) is divided by total number of respondents in the field survey (N). RFC value varies from 1 (when all the respondents refer to a plant as a useful one) to 0 (when nobody refers to a plant as a valuable species). FC is the number of informants using the plant species, N is the total number of informants (Ahmad et al., 2014).

Jaccard index (JI) was calculated according to Equation 4 (González-Tejero et al., 2008).

$$JI = c \times 100 \div (a + b - c) \quad (4)$$

"a" is the total number of taxa used in Khyber Pakhtunkhwa, Pakistan, "b" is the total number of taxa previously published in each article from India, while "c" is the total number of taxa common to both A and B.

The similarity of knowledge between different communities was determined by comparing the findings of the current study with already published articles from India by applying Jaccard index. The studies conducted on the areas with similar, vegetation, climatic condition, and culture was considered for comparison.

3. Results

The current research found 40 taxa of ferns belongs to 19 genera and 10 families with ethnomedicinal and traditional used in the prophylaxis of different ailments (Table 1). Amongst 10 ferns plant families Pteridaceae was

Table 1. Ethnomedicinal and traditional uses of the ferns of Khyber Pakhtunkhwa, Pakistan.

Taxon	Family	Vernacular name	Part /s used	Method of application and Disease cured	UV	FL	RFC
Asplenium adiantum-nigrum L. subsp. *adiantum-nigrum*	Aspleniaceae	Sumbal	Yl	Ten grams extract of young leaves used orally for treatment of chest infections, i.e. asthma, bronchitis and pneumonia.	0.1	0.13	0.35
Asplenium ceterach L. subsp. *ceterach*	Aspleniaceae	Naroky	Yl, R	Young leaves extract used against enema in children. Women use rhizome decoction against miscarriage and infertility.	0.06	0.4	0.29
Asplenium dalhousiae Hook.	Aspleniaceae	Naroky	Yl	Decoction of young leaves used orally for ten days against hepatitis having anti-viral effects.	0.09	0.6	0.21
Asplenium trichomanes L. subsp. *trichomanes*	Aspleniaceae	Jenabil	Yl	Fifty grams leaves boiled mixed with coconut oil applied on skin for treatment of skin infections, i.e. leukoderma and psoriasis.	0.15	0.26	0.25
Athyrium atkinsonii Bedd.	Athyriaceae	Mangeti	Yl	Decoction of leaves mixed with gum *Acacia* powder used as an herbal tonic against body weakness.	0.9	0.5	0.21
Athyrium schimperi Moug. ex Fée subsp. *biserrulatum* (Christ) Fraser-Jenk.	Athyriaceae	Mangeti	Yl	Ten ml young leaves extract used to prevent ulcer and intestinal disorders.	0.3	0.1	0.25
Cystopteris fragilis (L.) Bernh. subsp. *fragilis*	Athyriaceae	Kandad	Yl	Paste of young leaves mixed with mustard oil applied on hairs against dandruff, hair fall and maintains hair shine.	0.1	0.3	0.29
Diplazium esculentum (Retz.) Sw	Athyriaceae	Kunji saag	Yl	Young leaves palatable used as vegetable enriched with iron reduces iron deficiency and is diuretic.	0.4	0.6	0.32
Diplazium longifolium (D.Don) T.Moore	Athyriaceae	Kunji saag	Yl	Young leaves palatable used as vegetable enriched with iron and is purgative.	0.6	0.5	0.5
Diplazium maximum (D.Don) C.Chr.	Athyriaceae	Kunji	R	Decoction of rhizome used empty stomach removes intestinal worms.	0.6	0.33	0.6
Woodwardia unigemmata (Makino) Nakai	Blechnaceae	Banjasa	R, Yf	Decoction of rhizome used orally at night after meal causes expulsion of intestinal worms. Infusion of young frond used to relieve stomach cramps and increase urine flow.	0.2	0.2	0.1

Key for part used: C: Cones; R: Rhizome; WP: Whole plant; Yf: Young frond; Yl: Young leaves.

Table 1. Continued...

Taxon	Family	Vernacular name	Part /s used	Method of application and Disease cured	UV	FL	RFC
Dryopteris blanfordii (C.Hope) C.Chr. subsp. *blanfordii*	Dryopteridaceae	Mangeti	Yf	Paste of whole plant applied on skin against snake, scorpion and insect bites.	0.04	0.2	0.5
Dryopteris nigropaleacea (Fraser-Jenk.) Fraser-Jenk.	Dryopteridaceae	Ratanjot	Yf, Yl	Fronds removes ghosts and unseen evils, leaves extract mixed with coconut oil applied on body to cure skin disorders, i.e. urticaria and sarcoma.	0.06	0.66	0.29
Dryopteris redactopinnata S.K.Basu & Panigrahi	Dryopteridaceae	Mangeti	R	Paste of rhizome mixed with olive oil used to cure eczema and stomachache.	0.08	0.46	0.41
Dryopteris stewartii Fraser-Jenk.	Dryopteridaceae	Mangeti	R	Decoction of rhizome used for twenty days orally against rheumatism.	0.09	0.33	0.61
Polystichum piceopaleaceum Tagawa	Dryopteridaceae	Kunji	Yf	Rhizome powder mixed with coconut oil and sugar used orally for healing of wounds.	0.1	0.53	0.15
Polystichum squarrosum (D.Don) Fée	Dryopteridaceae	Kunji	Yl	Fresh paste of young leaves used for curing of fire burns and skin disorders.	0.1	0.46	0.3
Equisetum arvense L. subsp. *arvense*	Equisetaceae	Bandaky	C	Decoction of strobilus used for seven days against bones weakness, arthritis, osteoporosis, osteomalacia and vitamin-D deficiency.	0.8	0.93	0.46
Equisetum arvense L. subsp. *diffusum* (D.Don) Frser-Jenk.	Equisetaceae	Bandaky	Wp	Whole Plant powder mixed with cow's butter and sugar used as an incense to keep off fear in children.	0.6	0.96	
Equisetum ramosissimum Desf.	Equisetaceae	Bandaky	C	Ten grams Strobilus powder mixed with 100 ml olive oil used in the treatment of stomach and intestinal disorders, i.e. ulcer.	0.8	0.32	0.68
Hypodematium crenatum (Forssk.) Kuhn subsp. *Crenatum*	Hypodematiaceae	Kunji	R	Rhizome decoction used for one month orally against women infertility and menstrual disorders.	0.08	0.2	0.16
Marsilea minuta L.	Marsileaceae	Yah boty	Yl	Leaf poultice used as emollient for treatment of skin problems, i.e. swelling, irritation, inflammation, itching and scabies.	0.09	0.93	0.38
Adiantum capillus-veneris L.	Pteridaceae	Parshu shah	Yl	Ten grams of young leaves powder mixed with 100 grams of rice and sugar made into a cake, used against women sterility.	0.1	0.4	0.46
Adiantum incisum Forssk. subsp. *incisum*	Pteridaceae	Bishushah	Yf	Young frond 10 ml extract mixed with 100 ml mustard oil used against dandruff, hairs falling,baldness, i.e. alopecia areata and alopecia.	0.1	0.8	0.46
Adiantum tibeticum Ching	Pteridaceae	Parshushah	Yl	Ten ml young leaves extract mixed with boiled rice made into a cake used orally against gastroesophageal reflux, Celiac disease and gallstones.	0.12	0.6	0.19

Key for part used: C: Cones; R: Rhizome; WP: Whole plant; Yf: Young frond; Yl: Young leaves.

Table 1. Continued...

Taxon	Family	Vernacular name	Part /s used	Method of application and Disease cured	UV	FL	RFC
Adiantum venustum D.Don	Pteridaceae	Sunrah	Y l	*Ten grams Young leaves grinded powder mixed with sugar used orally for one week against common cold, Pertussis and seasonal influenza.*	0.09	0.4	0.06
Aleuritopteris albomarginata (C.B.Clarke) Ching	Pteridaceae	Jenabil	Yl	Ten ml young leaves extract mixed with hot milk used once a day for three weeks to cure chronic fatigue syndrome, fibromyalgia and dystonia.	0.08	0.94	0.07
Aleuritopteris formosana (Hayata) Tagawa	Pteridaceae	Jenabil	Yl	Young leaves extract mixed with honey used orally against body weakness and used as a herbal tonic.	0.07	0.9	0.21
Aleuritopteris grisea (Blanf.) Panigrahi	Pteridaceae	Jenabil	Yl	Ten grams young leaves extract mixed with cow butter, sugar used to enhance bones strength and reduce body weakness.	0.06	0.8	0.45
Oeosporangium nitidulum (Hook.) Fraser-Jenk.	Pteridaceae	Jenbil	Yl	Leaves extract used for treatment of cough, disorders of lungs, i.e. Bronchitis, Asthma and Pneumonia.	0.07	0.6	0.45
Oeosporangium subvillosum (Hook.) Fraser-Jenk. & Pariyar	Pteridaceae	Jenabil	Yl	Ten ml young leaves extract mixed with 100 ml olive oil used orally as herbal tonic.	0.1	0.53	0.26
Pteris cretica L. subsp. *cretica*	Pteridaceae	Thandi boty	Yf	Leaf poultice applied on skin for skin disorders, swelling, irritation and inflammation.	0.5	0.3	0.4
Pteris vittata L. subsp. *emodi* Fraser Jenk.	Pteridaceae	Ghwar boty	Yl	Young leaves extract mixed with 100 grams of black cow butter used orally once a day for one month against epilepsy.	0.6	0.13	0.35
Pteris vittata L. subsp. *vittata*	Pteridaceae	Zbarg boty	Yl	Young leaves paste used for treatment of body wounds and fire burns.	0.8	0.5	0.5
Ampelopteris prolifera (Retz.) Copel.	Thelypteridaceae	Banjabsa	Yf	Ten grams young frond extract mixed with yoghurt used for treatment of crohn's disease, ulcerative colitis and irritable bowel syndrome.	0.05	0.6	0.39
Christella dentata (Forssk.) Brownsey & Jermy	Thelypteridaceae	Kunji	R	Rhizome grinded powder mixed with coconut oil and sugar used orally against female infertility.	0.9	0.2	0.45
Phegopteris connectilis (Michaux) Watt	Thelypteridaceae	Banjasa	R	Young leaves extract mixed with two drops of honey and applied in nostrils twice a day effective in migraine.	0.05	0.4	0.2
Pseudophegopteris levingei (C.B.Clarke) Ching	Thelypteridaceae	Konji	R	Rhizome decoction mixed with olive oil and applied on ear and nose jewelries wounds healing.	0.2	0.4	0.4
Pseudophegopteris microstegia subsp. *laterepens* (E.W. Trotter) Fraser-Jenk.	Thelypteridaceae	Jenabil	Yl	Leaf extract mixed with *Memordica* extract used against diabetes mellitus.	0.1	0.35	0.16

Key for part used: C: Cones; R: Rhizome; WP: Whole plant; Yf: Young frond; Yl: Young leaves.

Table 1. Continued...

Taxon	Family	Vernacular name	Part /s used	Method of application and Disease cured	UV	FL	RFC
Woodsia glabella R.Br. ex Richardson	Woodsiaceae	Manji boty	Yl	Young leaves extract used orally in cough & cold disorders of lungs, chest, i.e. Asthma and bronchitis.	0.1	0.2	0.2

Key for part used: C: Cones; R: Rhizome; WP: Whole plant; Yf: Young frond; Yl: Young leaves.

largest with 12 taxa (30%), followed by Athyriaceae and Dryopteridaceae with 6 taxa each (30%), Thelypteridaceae with five (12.5%), followed by Aspleniaceae presenting 4 (10%) and Equisetaceae with 3 taxa (7.5%). Blechnaceae, Hypodematiaceae, Marsileaceae and Woodsiaceae presented 1 taxon each (10%) (Figure 1, Table 1). *Adiantun*, *Asplenium* and *Dryopteris* were the most representative genera with 4 taxa each (30%), followed by *Aleuritopteris*, *Diplazium*, *Pteris* and *Equisetum* were second with 3 taxa each (30%), *Athyrium*, *Oeosporangium*, *Polystichum* and *Pseudophegopteris* with 2 taxa each (20%), and *Ampelopteris*, *Christella*, *Cystopteris, Hypodematium, Marsilea, Phegopteris*, *Woodsia* and *Woodwardia* with 1 taxon each (20%) (Figure 2, Table 1). All of these taxa were used in the treatment of different diseases, i.e. healing of wounds, general tonic, asthma, bronchitis, pneumonia, skin infections, ulcer, sterility in women, diabetes, hepatitis, gonorrhea, common cold, as an anthelmintic, rheumatism, epilepsy and osteoporosis while two taxa of *Diplazium* were used as a vegetable. Different parts of ferns were used by local inhabitants, i.e. young leaves of twenty one taxa (52.5%), rhizome of nine taxa (22.5%), young frond of seven taxa (17.5%), cones of two taxa (5%), while whole plant of only one taxa (2.5%) were used. Seven taxa was used for skin infections (17.5%), followed by female sterility and general tonic with 4 taxa each (20%), followed by intestinal disorders and wound healings with 3 taxa each (15%), lungs, bones, stomach disorders have 2 taxa each (15%), while remaining disorders, i.e. antivenom, rheumatism, migraine, diabetes, epilepsy and as an expectorant etc have only 1 taxon each (32.5%) were used for treating them (Table 1). The effectiveness of the treatments described has not been tested, as the present study aimed to rescue and record the knowledge contained in traditional populations regarding ferns and how they are used by these inhabitants. Frequency and percentage of different ethnic groups in the area resulted that Pashto was the dominant language (98%) followed by Gujars (2%). Gender wise men had more information about vernacular names and uses of taxa (70%) followed by women (30%). Hakims, wound healers, medicinal plant traders and farmers presented more information on the use of these taxa. Locality wise rural and hilly areas (81.33%) people have more knowledge about the ethnomedicinal uses of taxa, followed by suburban and urban areas (19.67%).

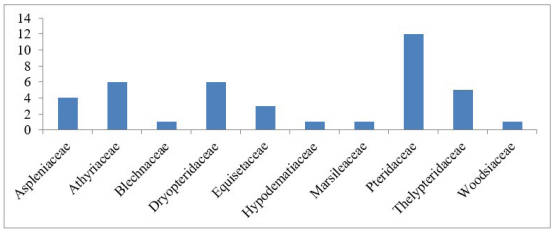

Figure 1. Representation of ethnomedicinal and traditional uses of the ferns families of Khyber Pakhtunkhwa, Pakistan.

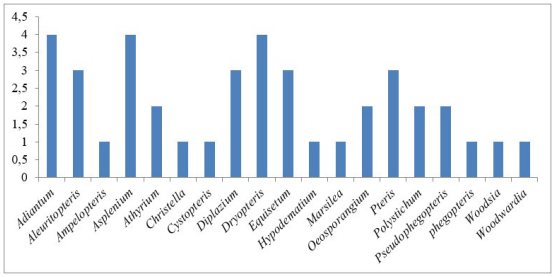

Figure 2. Representation of ethnomedicinal and traditional uses of the ferns genera of Khyber Pakhtunkhwa, Pakistan.

3.1. Use value (UV)

Use value is used to identify the plant species which was used extensively amongst indigenous communities for various ailments. In present study use value of ferns species ranges from (0.90) to (0.04); the highest use value reported were of *Athyrium atkinsoni* and *Christella dentata* (0.90) each, followed by *Equisetum arvense* subsp. *arvense*, *E. ramossimum* and *Pteris vittata* subsp. *vittata* with (0.80) each, *Diplazium longifolium*, *D. maximum*, *Equisetum arvense* subsp. *diffusum* and *Pteris vittata* subsp. *emodi* (0.60) each, *Pteris cretica* subsp. *cretica* (0.50), *Diplazium esculentum* (0.40), *Pseudophegopteris levingei* and *woodwardia unigemata* (0.20) each, *Asplenium trichomanes* subsp. *trichomanes* (0.15) and *Adiantum tibeticum* with (0.12). The species with lowest use value were *Dryopteris blandfordi* subsp. *blanfordi* (0.04), *Ampelopteris prolifera*, *Phegopteris connectalis* (0.05) each, *Aleuritopteris grisea*, *Asplenium ceterach* subsp. *ceterach* and *Dryopteris nigropalacea* (0.06) each, *Aleuritopteris formosana*, *Oeosporangium nitidulum* (0.07) each, *Aleuritopteris albomarginata*, *Hypodematium crenatum* subsp. *crenatum* and *Dryopteris redactopinnata* (0.08) each (Table 1).

3.2. Fidelity level (FL)

The fidelity level (FL) of ferns species ranged from 0.96 to 0.10 with highest fidelity level (FL) were *Equisetum arvense* subsp. *diffusum* (0.96), followed by *Aleuritopteris albomarginata* (0.94), *Equisetum arvense* subsp. *arvense*,

and *Marsilea minuta* (0.93) each, *Aleuritopteris formosana* (0.90) and *Adiantum incisum* subsp. *incisum* (0.80) while species with lowest fidelity level (FL) were *Athyrium schimperi* (0.10), *Asplenium adiantum-nigrum* subsp. *adiantum-nigrum*, *Pteris vittata* subsp. *emodi* (0.13) each, *Woodwardia unigemata*, *Dryopteris blandfordi* subsp. *blanfordi*, *Hypodematium crenatum* subsp. *crenatum*, *Christella dentata* and *Woodsia cycloba* (0.20) each, *Asplenium trichomanes* subsp. *trichomanes* (0.26), *Pteris cretica* subsp. *cretica* (0.30) and *Equisetum ramossimum* (0.08) (Table 1).

3.3. Relative frequency of citation (RFC)

In present study the relative frequency of citation (RFC) ranged from 0.68 to 0.06 with highest value were of *Equisetum ramossimum* (0.68) followed by *Dryopteris stewartii* (0.61), *Diplazium maximum* (0.60), *Diplazium longifolium* (0.50) and *Equisetum arvense* subsp. *arvense*, *Adiantum capillus-veneris* and *Adiantum incisum* subsp. *incisum* (0.46) each; while species with lowest relative frequency of citation (RFC) were *Adiantum venusetum* (0.06) followed by *Aleuritopteris albomarginata* (0.07), *Woodwardia unigemata* (0.10), *Polystichum piceopalaceum* (0.15), *Hypodematium crenatum* subsp. *crenatum* and *Pseudophegopteris microstegia* subsp. *laterpens* with (0.16) each (Table 1).

3.4. Jaccard index (JI)

Comparison of our study with the previously published articles from India jaccard index (JI) ranged from 5.5 to minus 0.10. The highest Jaccard index (JI) value 5.5, 5.0, 3.33, 3.14 and 2.57 were reported from Rajasthan, India (Parihar and Parihar, 2006); Kolli Hills, Namakkal District,Tamil Nadu, India (Perumal, 2010); Similipal Biosphere Reserve, Orissa, India (Rout et al., 2009) and Vindhyan Region (M.P.) India (Pathak et al., 2011) respectively; while lowest Jaccard index (JI) were -1.0, 0.31, 0.69 and 0.79 were reported from the studies of different parts of India (Kumar et al., 2003); Western Ghats, India (Benjamin and Manickkam, 2007); Banajalaya conserved forest of Shimoga District, Karnataka, India (Deepa et al., 2014) and Arunachal Pradesh, North eastern India (Benniamin, 2011) respectively. Overall the percentage of similar uses ranges from 0.07 to 40.0% and percentage of dissimilar uses ranges from 0 to 12.50% (Table 2).

4. Discussion

Comparison of our results with previously published articles have highest similarity use index with Kolli hills, Namakkal District, Tamil Nadu, India (Perumal, 2010); Rajasthan, India (Parihar and Parihar, 2006); Kerala, South India (Kumar et al., 2003); Vindhyan Region (M.P.), India (Pathak et al., 2011); Similipal Biosphere Reserve, Orissa,

Table 2. Comparison of given data with previously published articles.

Reported areas	Total no. of taxa	Taxa with same uses	Taxa with different uses	Taxa common in both areas	% of taxa with same uses	% of taxa with different uses	JI	Citation
Kumaun Himalaya, Uttarakhand, India	30	04	02	06	13.33	6.66	2.57	Upreti et al. (2009)
Different parts of India	66	13	05	18	19.70	7.57	-1.0	Kumar et al. (2003)
Rajasthan India	16	05	02	07	31.25	12.50	5.50	Parihar and Parihar (2006)
Similipal Biosphere Reserve, Orissa, India	33	06	03	09	18.18	9.09	3.33	Rout et al. (2009)
Arunachal pardesh, North eastern india	51	06	02	08	11.76	3.92	0.79	Benniamin (2011)
Vindhyan Region (M.P.) India	16	03	01	04	18.75	6.25	3.14	Pathak et al. (2011)
Western Ghats, India	57	07	03	10	12.28	5.26	0.31	Benjamin and Manickkam (2007)
Kolli Hills, Namakkal District,Tamil Nadu, India	10	04	01	05	40	10	5.0	Perumal (2010)
Banajalaya conserved forest area of Shimoga District, Karnataka, India	19	01	00	01	5.26	00	0.69	(Deepa et al., 2014)

JI: Jaccard index.

India (Rout et al., 2009); Kumaun Himalaya, Uttarakhand, India (Upreti et al., 2009); Western Ghats, India (Benjamin and Manickkam, 2007); Arunachal Pradesh, North Eastern, India (Benniamin, 2011) and Banajalaya conserved forest area of Shimoga District, Karnataka, India (Deepa et al., 2014), while the lowest JI values were resulted with Kerala, South India (Kumar et al., 2003); Banajalaya conserved forest area of Shimoga District, Karnataka, India (Deepa et al., 2014); Arunachal Pradesh, North Eastern, India (Benniamin, 2011); Kumaun Himalaya, Uttarakhand, India (Upreti et al., 2009); Rajasthan, India (Parihar and Parihar, 2006); Similipal Biosphere Reserve, Orissa, India (Rout et al., 2009) and Kolli hills, Namakkal District, Tamil Nadu, India (Perumal, 2010) respectively (Table 2).

5. Conclusion

Ethnomedicinally ferns taxa were utilized by the local inhabitants in the curing of various ailments, i.e. diabetes, hepatitis, hair loss, bones disorders, female infertility, stomach, urinary and intestinal disorders, bronchial disorders, wound healings, general tonic, epilepsy, hair care, inflammation of skin, antivenom, anthelmintic, and fair complexion to treat skin problems with strong potential. These taxa may be utilized commercially for drug discovery, keeping in view of their availability and sustainable supply. Cultivation of these taxa for medicine and ornamental purpose is highly needed. Education plays a key role in awareness about the uses of medicinal plants at scientific basis which can leads to drug discovery.

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