Morpho-Anatomical and Ethnobotanical Study of Common Pteridophytes of District Bannu, KPK, Pakistan

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Abstract: The present study deals with the morphological, anatomical and medicinal uses of common pteridophytes found in district Bannu, KPK, Pakistan. During the survey Morpho-anatomical and medicinal uses of 5 genera and 5 pteridophyte species were reported, which were Adiantum capillus-veneris L., (families Adiantaceae); Dryopteris affinis Lowe., (Dryopteridaceae); Equisetum arvense L., (Equisetaceae) Marsilea quadrifolia L. (Marsileaceae) and Nephrolepis exaltata (L.) Schott. (Nephrolepidiaceae). It was concluded that the local people were aware of the medicinal uses of these plants. It was reported that Adiantum was used mostly as demulcent, expectorant, diuretic, eye ointment and tonic and is effective against acute bronchitis, fever, mouth blisters, febrifuge, cough and cold.

Key words: Anatomy • Medicinal • Pteridophytes • Bannu

INTRODUCTION

The term Pteridophytes has a Greek origin. Pteron means a feather and phyton means plants. The name was originally given to those plants which has feather like fronds (leaves). They are also called Vascular cryptograms, Kryptus is a Greek word which means Hidden and Gammos means weeded (marriage), so this means that in these plants the sex organs are invisible or hidden [1]. The pteridophytes are an assemblage of flowerless, seedless and spore bearing vascular (xylem + phloem) plants. They formed a dominant part of earth vegetation in the historic past [3] hundred million years ago. Their rank is between the lower cryptograms (Thallophyta + Bryophyta) and higher vascular plants (Gymnosperm + Angiosperms) with a long geological history. They represent about 1200 taxa belonging to 204 genera. They are found all over the world and grow in varied climatic zones [2]. During past years extensive survey of different areas of Pachmarhi in India has been explored by various researchers [3, 4, 5] and in connection with pteridophytes distribution and biodiversity [6]. Khullar recorded 356 species of Pteridophytes from Western Himalaya because the Pteridophytes prefer shady, moist habitats [7]. Chowdhary published an account of pteridophytes from Upper Gangetic plains, which include parts of Uttar Pradesh, Bihar and part of Bengal [1]. Khullar (1994, 2000) in his illustrated ferns of Western Himalaya include 360 species of pteridophytes [8]. Pande and Pande reported 350 species of ferns from Kumaun Himalaya [9]. Dixit and Kumar listed 487 species and 32 specific taxa belong to 108 genera under 50 various families. Eighteen species are endemic to Uttarakhand, of these, 10 species and 2 varieties confined these distributions only to Uttarakhand state and remaining six taxa also show their occurrence in other parts of India beside Uttarakhand. About 57 species are relatively of rare occurrence being endemic, rare and endangered due to other anthropogenic factors [10].

MATERIALS AND METHODS

The present study is the result of one year critical survey of various regions of District Bannu, KPK, Pakistan. The ethano-medicinal information were collected/ noted from the local inhabitants. The taxonomical, morphological and histological study of the 5 commonly prevalent Pteridophytes belonging to 5 families found as natural flora of Bannu area was conducted in during January, 2015.

Taxonomical Study: In the taxonomical study 5 different Pteridophytic plants were collected which can be quoted as under in Table 1.
Table 1: Taxonomy of collected Pteridophyte species.

<table>
<thead>
<tr>
<th>SN.</th>
<th>Botanical Name</th>
<th>Family Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Adiantum capillus-veneris L.</td>
<td>Adiantaceae</td>
</tr>
<tr>
<td>2</td>
<td>Dryopteris affinis Lowe.</td>
<td>Dryopteridaceae</td>
</tr>
<tr>
<td>3</td>
<td>Equisetum Arvensis L.</td>
<td>Equisetaceae</td>
</tr>
<tr>
<td>4</td>
<td>Marsilea quadrifoliata L.</td>
<td>Marsileaceae</td>
</tr>
<tr>
<td>5</td>
<td>Nephrolepis exaltata (L.) Schott</td>
<td>Nephrolepidiaceae</td>
</tr>
</tbody>
</table>

For the classification and identification of the collected species of different Pteridophytes, some important instruments were used. These were Microscope, Slide, Blades, Beaker, Polythene bags, Distilled water and chemical like Safranin and digital Camera with Computer.

**Collection of Plant Species:** Five pteridophyte species were collected from Bannu. The fresh parts of plants were used for the identification and classification and to study the gross internal features of the prevalent pteridophytic species. The botanical names of pteridophytes and their concerned families were properly identified. During plant identification help was taken from available literature of Hooker & Baker [11] and Hoshizaki & Moran [12], Moran [13], & Flora of Taiwan by Devol & Shieh [14]. The properly pressed and mounted herbarium sheets of collected fern specimens were deposited in the department of Botany University of Science and Technology Bannu, as voucher specimens after pasting their voucher numbers.

**Morphological Study:** The general morphological description of the characters like habit, root, stem, leaves and Spores from fresh material of the collected Pteridophytes were recorded along with their photographs [15].

**Anatomical Study:** The anatomical study of the collected species of the common pteridophytes is carried out through preparing the stained slides of the rhizome, root and petiole of the collected species which were examined under high power microscope to identify the vascular bundles, epidermis, cortex, parenchymatous cells, sclerenchyma & collenchyma cells and also pericycle, endodermis and pith [16, 17].

**RESULTS**

The present study deals with the morphological, anatomical & medicinal uses of common pteridophytes found in various parts of district Bannu. During this survey morphological, anatomical and medicinal uses of 5 genera and 5 Pteridophyte species belonging to 5 different families were reported. The detail description of each species is given below:

1. **Systematic Position of Adiantum capillus-veneris L.** (Fig. 1):
   - **Kingdom:** Plantae
   - **Division:** Filicophyta
   - **Class:** Leptosporangiopsida
   - **Order:** Filicales
   - **Family:** Polypodiaceae
   - **Local name:** Unknown
   - **Propagation:** Spores

   **Anatomical Study**
   - **Rhizome:** Epidermis is made up of thin walled or slightly thick walled cells. The cells are generally small in size. Next to epidermis lies ground tissue that may be parenchymatous or partially parenchymatous. Sclerenchymatous hypodermis is present beneath the epidermis (Fig. 2).
   - **Root:** The root boundary is also epidermis which is not covered with cuticle and it welcomes the water. The epidermis contains root hairs. Cortical region is also well developed. Pith lies in the middle (Fig. 3).
   - **Petiole:** The epidermis is single layered and the hypodermis is many layered next to which is ground tissue system (Fig. 4).

   **Medicinal Uses:** This plant is demulcent, expectorant, diuretic, tonic and is effective against acute bronchitis, fever, mouth blisters, febrifuge, cough and cold. It is also used as eye ointment.

2. **Systematic Position of Dryopteris affinis Lowe.** (Fig. 5):
   - **Botanical Name:** Dryopteris affinis Lowe.
   - **Kingdom:** Plantae
   - **Division:** Pteridophyta
   - **Class:** Polypodiopsida
   - **Order:** Dryopteridiales
   - **Family:** Polypodiaceae
   - **Sub Family:** Dryopteridoideae
   - **Genus:** Dryopteris
   - **Local name:** Unknown
   - **Propagation:** By spores
Anatomical Study:

Petiole: The epidermis is the outermost boundary of the petiole which protect the inner most tissues. The epidermis is made up of sclerenchyma cells and the cortex is parenchymatous cells. The pericycle is present outside the vascular bundles (Fig. 6).

Rhizome: The epidermis is the boundary between plant and the environment. The second layer is hypodermis which is made up of sclerenchymatous cells and the next layer is cortex which is also composed of sclerenchymatous cells. There are also present leaf bases and inside present meristeles (Fig. 7).

Root: The epidermis is single layered and beneath it parenchymatous cortex is present. Endodermis protects the inner cells and is composed of single layer of cells (Fig. 8).

Medicinal Uses: Various parts of dryopteris are used for Snake bites, rheumatism and leprosy.

3. Systematic Position of Equisetemarvense L. (Fig. 9):

<table>
<thead>
<tr>
<th>Kingdom</th>
<th>Plantae</th>
</tr>
</thead>
<tbody>
<tr>
<td>Division</td>
<td>Pteridophyta</td>
</tr>
<tr>
<td>Sub division</td>
<td>Pteropsida</td>
</tr>
<tr>
<td>Class</td>
<td>Filicophyta</td>
</tr>
<tr>
<td>Order</td>
<td>Marsileales</td>
</tr>
<tr>
<td>Family</td>
<td>Equisitaceae</td>
</tr>
<tr>
<td>Genus</td>
<td>Equisetum</td>
</tr>
<tr>
<td>Local name</td>
<td>Bandikai</td>
</tr>
<tr>
<td>Common Names</td>
<td>Horsetail</td>
</tr>
</tbody>
</table>

Anatomical Study

Stem: Epidermis is a single layered tissue i.e. uniserriate. Their walls are cuticularised and covered with rods or grains of silica. Cortex can be divided into two parts outer and inner cortex. The outer cortex consists of parrenchymatous and chlorenchymatous cells and the inner cortex consists of a few layers ofparrenchyma cells traversed by a ring of large air spaces which are called vallecular canals. Endodermis is present both outside as well as inside the bundles. Pith is hollow (Fig. 10).

Rhizome: There are no stomata on the epidermis and chlorenchyma is absent. The endodermis encircles the vascular bundles. The endodermal layer encircles the stellar region externally (Fig. 11).

Root: The epidermis is composed of single layer of cells isuniserriate epidermis and beneath is present hypodermis which is totally parrenchymatous also the cortex is composed of parenchymatous cells (Fig. 12).

Medicinal Uses: The plants parts (root, stem and leaves) are used to cure scabies, skin infections and itches. This is considered to be very useful against kidney troubles and stomach disorders.

4. Systematic Position of Marsileaquadrifoliata L. (Fig. 13):

<table>
<thead>
<tr>
<th>Kingdom</th>
<th>Plantae</th>
</tr>
</thead>
<tbody>
<tr>
<td>Division</td>
<td>Pteridophyta</td>
</tr>
<tr>
<td>Sub division</td>
<td>Pteropsida</td>
</tr>
<tr>
<td>Class</td>
<td>Filicophyta</td>
</tr>
<tr>
<td>Order</td>
<td>Marsileales</td>
</tr>
<tr>
<td>Family</td>
<td>Marsiliaceae</td>
</tr>
<tr>
<td>Local name</td>
<td>Unknown</td>
</tr>
<tr>
<td>Propagation</td>
<td>By spores</td>
</tr>
</tbody>
</table>

Anatomical Study

Rhizome: The epidermis forms the outermost boundary and is made up of continuous single layer of cells. The cells are thick and compactly arranged. The cortex is divided into 3 parts outer, middle and inner cortex made up of parenchymatous cells. The vascular bundles are in a ring form. The pith is limited by inner endodermis (Fig. 14).

Petiole: There is a single layered epidermis which is made up of rectangular cells. Beneath it are a few layers of thin walled outer cortex which is followed by middle inner aerenchymatous cortex, which consists of a ring of air chambers. The inner cortex is a solid and compact structure. The inner cortex is delimited by a single layered endodermis. Within the endodermis is the stele which is somewhat triangular in outline. It lies in the centre and has vascular bundles (Fig. 15).

Root: The epidermis is uniserriate i.e. composed of single layer of cells. The cortex is parenchymatous and having air chambers. The endodermis is present outside the vascular bundles (Fig. 16).

Medicinal Uses: Rhizome is very useful for Cough, spastic conditions of leg muscles, sedation and insomnia.
5. Systematic Position of *Nephrolepis exaltata* (L.) Schott

(Fig. 17):

**Kingdom:** Plantae  
**Division:** Pteridophyta  
**Class:** Polypodiopsida  
**Order:** Polypodiales  
**Family:** Nephrolepidaceae  
**Genus:** Nephrolepis  
**Local name:** Fern  
**Common Names:** Boston fern  
**Propagation:** Spores

**Anatomical Study**

**Rhizome:** The epidermis is composed of single layer of cells and the outer cortex is sclerenchymatous and the inner cortex is parenchymatous. The endodermis is present outside the vascular bundles (Fig. 18).

**Root:** The epidermis is composed of single layer of cells i.e. uniserriate and the cortex is parenchymatous. Also root hairs are present on the epidermis (Fig. 19).

**Petiole:** The epidermis is uniserriate and is sclerenchymatous. The cortex is parenchymatous and the endodermis is present outside the vascular bundles (Fig. 20).

**Medicinal Uses:** This is very attractive ornamental plant and is effective for cleaning indoor air. It is also considered to be a good source of new antimicrobial chemicals.

**DISCUSSION**

The present study resulted in exploration of valuable variations in the configuration of foliar epidermal, root and stem anatomy of pteridophytes that can be used as an important taxonomic tool for the identification and differentiation of different species of wild plants. Anatomical studies revealed clear cut differences in size, shapes of epidermal cells, vascular bundles, stomata and trichomes etc. anatomical characteristics have an important role in taxonomy and determining the number of plant genera and species [18, 19].
The epidermis possesses a number of important diagnostic character that offer valuable clues for identification, like size, shape and orientation of stomata, guard cells and subsidiary cells, structural peculiarities of epidermal cell walls, distinctive or specialized form of trichomes [20]. Leaf epidermal features like shape of epidermal cells, stomata and trichomes are useful anatomical tools. Vascular bundles, cortex, pericycle, pith, length and width of epidermal cells is a useful aid in distinguishing varieties [21, 22]. The plant epidermis consists of three main cell types: epidermal cells, guard cells and their subsidiary cells that surround the stomata and trichomes, otherwise known as leaf hairs. The present study confined to leaf epidermal, stem and root anatomical features of same important species of wild plants. Some species have been investigated first time for anatomical characters that might be useful for plant biologist for the identification of important wild plants at global level. Stomatal guard cells are essential to keep one particular component inside the plant that is, water. However, they must also allow the gaseous exchange essential for photosynthetic activity. Stomata and associated epidermal cells are an important source of taxonomic characters. The pattern and frequency of stomata on any leaf surface are under conservative genetic control, but may be modified by environmental parameters such as the availability of CO\(_2\) [23, 24]. Different types of stomata were observed in all the examined species of wild plants. These types comprises of Anomocytic, Paracytic and Anisocytic [25, 26]. In all these collected species stomata are present mostly on abaxial surface and a very few species possess stomata on both surfaces.

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REFERENCES


