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Research Article

Ethnobotanical Survey of Medicinal Plants Traditionally Used in Khunjerab National Park, Pakistan

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ABSTRACT

An ethnobotanical survey was conducted in ten selected Nallahs of Khunjerab National Park, Pakistan to document the distribution and record of indigenous knowledge about medicinal plants. Field visits were conducted during the period of June-July and Aug-Sept. Ecological information about medicinal plants was collected by using purposeful sampling. The ethnobotanical information was collected from 50 knowledgeable local people and health practitioners by using semi-structured interviews and questionnaires.

A total of 59 species belonging to 45 genera and 31 families have been found to be used by the local people for curing various diseases. The most important medicinal plants of the study area belong to the family *Asteraceae*, followed by *Rosaceae, Brassicaceae* and *Polygonaceae*. About 30 types of ailments were treated with various parts of the 59 medicinal plant species. For treating ailments, the use of the aerial part was highest (52.54%), followed by leaves (11.86%) and flowers and roots (10.16%). Due to poor collection and storage, overgrazing and anthropogenic activities, medicinal plants of this area are on the verge of extinction. Thus, there is an urgent need to provide awareness regarding the sustainable utilization and management of medicinal plants, with a special focus on those that are used widely and traded outside the region. Overall, this study provides useful baseline information on medicinal plant distribution and traditional knowledge, which could play a vital role in the conservation of medicinal plants and for sustaining ecosystem functioning. Further study on phyto-chemicals of the medicinal plants will promote their use for wider purposes.

Keywords: Ethnobotany; Indigenous knowledge; Inventory; Khunjerab National park; Medicinal plants; Pakistan

INTRODUCTION

The use of traditional medicinal plants is reported as one of the common practice in many rural communities of the world, including Pakistan. In Pakistan, at least 12% of flora are reported to be of medicinal importance. However, most of these species are experiencing tremendous pressure due to over-and illegal exploitation. In particular, most of the mountain communities in Pakistan still rely on medicinal plants due to difficult terrain, lack of modern medicine and lack of access to health care services. Documenting the indigenous knowledge through ethnobotanical studies is vital to safeguard these medicinal plants and the associated knowledge from further loss and for the conservation and utilization of biological resources [1].

Despite several studies carried out on the medicinal use of plants in various regions of Pakistan, a large number of medicinal plants and associated indigenous knowledge still need appropriate documentation. In addition, research concerning medicinal plant distribution is basically lacking, with most of the available ethnobotanical information based on qualitative approaches. Resource inventory is important to understand the natural distribution of medicinal plants, which helps in formulating their conservation strategies [2].

The Hindu Kush Karakoram Pamir Landscape (HKPL) is a transboundary landscape shared by Afghanistan, China, Pakistan and Tajikistan.

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The HKPL lies at the convergence of several important biogeographical regions and possesses a unique and rich assemblage of floral and faunal diversity. The landscape is inhabited by nine indigenous ethnic groups. The region's entire population lives below the poverty line. Given these factors, the fragile desert landscape is remote and offers limited natural bio-resources, so the local people have a strong dependency on the limited natural resources for their livelihoods. Khunjerab National Park is one of the six physically connected protected areas of HKPL and is located at the junction of the Himalaya, Karakoram and Pamir mountain ranges. Furthermore, due to the intense commercialization, opening and expansion of Karakoram highway for trade in recent years, excessive pressure has been created on the floristic biodiversity, especially on the medicinal plants of the area. Within the Khunjerab National Park, the herbal practitioners have an extended history of using local herbs to meet their daily needs, but this knowledge is not well documented and very little is known about their distribution. Bearing this in mind, the present study was initiated to explore the natural resources of Khunjerab National Park with special reference to medicinal plants distribution at various elevation zones across an altitudinal range of 3,100 m-4,800 m from the selected nallahs of Khunjerab National Park, Gilgit-Baltistan. The study principally explores the folk knowledge regarding various plants' efficacy when used as a medication and in the treatment of several diseases and records their distribution [3].

MATERIALS AND METHODS

Study area description

The study area represents Khunjerab National Park (KNP), which is situated in Gojal Tehsil, Hunza-Nagar district, in Gilgit-Baltistan Province in the extreme north of Pakistan. It is the only national park in the world which is unique by virtue of its altitude and elevation characteristics. More than half of the park lies above 4,000 masl. It has an extent of about 4,455 km^2 and borders China's Taxkorgan nature reserve in the north. The area has relatively severe winters but mild autumns and pleasant summers, with the mean extreme temperature reaching 27°C in May and descending below 0°C in November and onward. Yearly precipitation ranges from 200 mm to 900 mm. Due to the vertical zonation, the vegetation types in KNP can be classified into four types. Most of the area can be categorized as dry alpine scrub-type vegetation with species like *Artemesia* spp, *Juniper* spp, *Rosa webbiana* and *Polygonum* spp. on the dry slopes and *Myricaria germanica* and *Hippophae rhamnoides* along the stream beds. Broadleaved species mainly consist of *Salix* spp and *Betula utilis*, which can be found in moist places. Juniper woodland is mixed with grasslands at high altitude. The Park comprises three main valleys-Khunjerab, Ghujerab and Shimshal. The Khunjerab river flows from the watershed of the Pakistan-China border. Many small tributaries join it until it joins the Hunza river. However, for the inventory of medicinal plants, different nullahs in Khunjerab valley were considered, including Dhee Nallah, Qarchenai Nallah left, Qarchenai right, Toghroqin, Barkhun, Ferzindur, Koksil, Arbobkuk, Kooz and Zero Point.

The study area lies in between longitude 74°55' E to 75°57' E and latitude 36°01' N to 37°02' N, with altitude ranging from 3,100 m-4,800 m [4].

Data collection

The study was conducted during June and September 2014. During the field visits, plant specimens and ethnobotanical data were collected. The plant specimens and their photographs were used to identify the plants and collect information on the medicinal uses of parts of plants to treat human diseases. The collected plant specimens were dried and mounted on standard herbarium sheets, and their scientific names were determined with the help of flora of Pakistan. The specimens were deposited in the department of biological science herbarium, Karakoram International University Gilgit, Pakistan. Most of the plants were collected from the alpine zone, but some were collected from sub-alpine and lower elevations [5].

Five group discussions were conducted with local people to identify the vernacular names of the plants and to collect information on local threats to these plants and measures for conserving them. Semi-structured interviews were conducted with 50 herbal practitioners to learn about their traditional uses. A Global Positioning System (GPS-Arc GIS 10.2) was used for plotting readings to locate the position of plant specimens collected at different localities of KNP [6].

RESULTS AND DISCUSSION

Distribution of medicinal plants across elevation and study sites

Khunjerab National Park is a gateway between China and Pakistan. The transboundary flora has much similarity on adjacent plateaus, as well as great diversity at different elevations and in different ecological zones of the region. The buffer zone communities are directly and indirectly dependent on the natural resources of the area. The main streams of Khunjerab valley were thoroughly studied during the consecutive field visits. During the field survey, the lowest altitude record was 3,245 meters at Dhee nullah and the highest elevation where medicinal plants were reported was 4,771 meters at Zero point. A total of 59 identified medicinal flora were collected from these ten nullahs. Out of these, about 48 species have been found growing in the altitudinal range of 3,200 m-3,999 m, while 20 species were identified in the 4,000 to 4,800 meter range. The highest percentage of medicinal plants was found in Barkhun (25 species), followed by Dhee nullah (16 species) and Fezindor (14 species). Qarchenai left hosted 13 species, Koksil and Zero point hosted 10 species, Qarchenai right hosted eight species, Arbobkuk hosted seven species, Kooz hosted six species. The fewest medicinal plants were found in Toghroqin, with just one species. The relative frequency of *Ephedra intermedia* was high (60%), followed by *Allium carolinianum, Artemisia brevifolium, Sissymbrium irio, Juniperus excela, Dracocephalum stamineum, Salix denticulate* (40%) (Table 1). The distribution of *Hippophae rhamnoides* L. was confined to a single location, which could be due to over-utilization and the lack of community awareness about its sustainability [7].

Table 1: Relative frequency of medicinal plants.

Species	Relative frequency (%)
Ephedra intermedia	60
Allium carolinianum	40
Artemisia brevifolium	40
Sissymbrium irio	40
Juniperus excela	40
Dracocephalum stamineum	40
Salix denticulate	40

Diversity

A total of 59 plant species belonging to 45 genera and 31 families have been found to be used by the local people for curing various diseases. Angiosperm was dominant with 54 species belonging to 29 families. The most dominant families with the highest number of medicinal plants used were *Asteraceae* (11 species), followed by *Rosaceae* (five species), *Polygonaceae* (four species) and *Ephederaceae* (three species). Our results are in line with other studies carried out in similar eco-regions, where *Asteraceae* was reported as predominant with the highest number of medicinal species. Only five species of gymnosperm belonging to two families, *Ephederaceaee* and *Cupressaceae*, were reported to have medicinal use. Habit analysis shows that herbs, shrubs and trees are represented by 66.10%, 28.81% and 5.08% of species, respectively. This proportion was similar to other studies on medicinal plants carried out in Gilgit Baltistan [8].

Plant part used

The plant parts used for treating different ailments were aerial parts (*i.e.,* everything above ground), berries, branches, flowers, fruits, leaves, seeds, stem bark and underground parts such as roots, root bark and bulbs. For one species (*Carduus edelbergii*), the whole plant was reported to be used for medicinal purpose. The aboveground parts, including aerial parts, were the most frequently utilized, with 31 out of 59 identified species, followed by leaves and flowers. Using leaves to make herbal medicine preparations is a common practice in many communities in Pakistan. For underground parts, the root was the most extensively used plant part for preparing traditional medicine (six species). In a few studies from the region, roots were the most common plant parts used in herbal medicine preparations [9].

Traditional use

The inhabitants of the Khunjerab National Park use medicinal plant species to treat more than 30 ailments. The greatest diversity of medicinal plant species used were for ailments such as digestive problems, fever, respiratory disease, cough and cold,joint pain, bone fracture and allergies.

Almost half of the species were found to have more than one and up to four medicinal uses [10].

Comparison of reported uses

Most of the medicinal plant species collected and identified in this study were also used medicinally in other parts of Gilgit Baltistan and Pakistan. When we compared our list with the only available paper related to ethnobotany in the Khunjerab National Park, we found that out of the 43 medicinal plants reported from the Khunjerab National Park, 13 species are reported in the study, with 12 species having similar documentation of medicinal properties. This study is the first time that more than half of the medicinal plant species from Gilgit Baltistan were reported regarding their use. Interestingly, indigenous knowledge of plants and their uses changes with respect to geographic area and ethnic group. For instance, a plant decoction of *Artemesia japonica* is used against malaria, but in Khunjerab National Park it is used for cough, fever and especially to treat digestive problems. *Rosa webinnia* processed flowers are used in respiratory problems, while bark is used in the healing of wounds, but in Khunjerab National Park, fresh fruits are used in preparing carminative and are good for digestive problems, while in old age, stem bark is used for tea making. *Juniperus excelsa* is used for eye diseases and chest-related problems such as cough and asthma, whereas in Khunjerab National Park, the fresh or dry berries are used after decoction or in powder form for problems related to kidney and urinary tract infections [11].

Management of medicinal plants

During the group discussions, over collection and overgrazing were reported as major threats to these medicinal plants. These findings were very similar to other studies, which reported overgrazing as one of the major threats to medicinal plants in Gilgit Baltistan, Pakistan. Recently, there have been efforts to reduce the population size of livestock, introduce rotational grazing systems and declare a “no grazing” zone in Dhee and Qarchenai to control grazing.

The local communities were hopeful that these efforts will have positive effects on the growth of medicinal plants. A majority of the herbal practitioners perceived a gradual decline in availability of the plants [12]. One of the main causes of plant population decline could be due to over collection. *Ephedra gerardiana* medicinal species reported from the National Park are endemic to the Himalaya and therefore special attention should be given to them in order to ensure sustainable use; *in vitro* cultivation of the species is recommended to obtain quick benefits. *Dactylorhiza hatagirea* is listed on the Convention on International Trade in Endangered Species of wild fauna and flora (CITES) appendix II and is strictly banned for collection, utilization and sale. *Hippophae rhamnoides*, which is extensively used to cure heart diseases and kidney problems and is used as an anti-cancer drug, must be cultivated and harvested sustainably in its natural habitats [13].

CONCLUSION

This study revealed that traditional medicinal plants play an important role in health care in the region around the Khunjerab National Park, as the area lies in the alpine belt, far from settlements. The study showed that local people still have a treasure trove of knowledge about medicinal plants and their uses. However, these important resources have been declining continuously because of overgrazing and exploitation. There have been efforts in only a few areas to conserve these medicinal plants. Therefore, there is an urgent need to implement practices that control overgrazing and exploitation of the medicinal plants, including raising awareness of the implications of unsustainable harvest, as well as capacity-building for commercial cultivation and marketing and sustainable harvest, utilization and management of medicinal plants. There is a need for studies on the economic contribution of medicinal plants to the national and local economy and on existing marketing and management systems to increase the benefits to local livelihoods. Further study on the phyto-chemicals of the medicinal plants will promote their use for wider purposes.

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DECLARATION

The views and interpretations in this publication are those of the authors and they are not necessarily attributable to their organizations.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF DATA AND MATERIALS

Please contact author for data requests.

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COMPETING INTERESTS

The authors declare that they have no competing interests.

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