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Ethnomedicinal uses of plants for the treatment of snake and scorpion bite in Northern Pakistan

Maryam Akram Butt [a], Mushtaq Ahmad [a,*], Anam Fatima [a], Shazia Sultana [a], Muhammad Zafar [a], Ghulam Yaseen [a], Muhammad Aqeel Ashraf [b], Zabta Khan Shinwari [c], Sadaf Kayani [a]

[a] Department of Plant Sciences, Quaid-i-Azam University, Islamabad 45320, Pakistan
[b] Department of Geology, Faculty of Science, University of Malaya, 50603 Kuala Lumpur, Malaysia
[c] Department of Biotechnology, Quaid-i-Azam University, Islamabad 45320, Pakistan

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ABSTRACT

Ethno-pharmacological relevance: Medicinal plants represent one of the most accessible resources available for snake and scorpion bite among the rural communities of Northern Pakistan. This first ethno-botanical study aimed to document the indigenous knowledge and practices of using plants for snake and scorpion bite disorders in Northern Pakistan.

Methods: Ethno-medicinal data is documented from 187 informants using semi-structured interviews. The data is analyzed using quantitative ethno-botanical indices of frequency citation (FC) and relative Frequency of Citation (RFC). In addition to this, the ethno-medicinal findings of this survey were compared with 10 previous published studies in order to report novel uses of medicinal plants against snake and scorpion bite disorders.

Results: In total 62 medicinal plants belonging to 40 families are reported against snake and scorpion bite in this study. Our results showed that Asteraceae is the most used family (10 species), dominant life form is herb (48.38%), leaves were the most used plants part (18 Use-reports) and the paste is most used method of administration (22 reports). The range of RFC was 0.08–0.27 about the use of documented species. Compared to previous published studies, 33.87% similarity index while 66.12% novelty index is reported. About 40 plant species are first time reported with medicinal uses against snake and scorpion bite from Northern Pakistan.

Conclusions: This study presents useful traditional knowledge of rural communities for the control of snake and scorpion bite using medicinal plants. The study mainly focused on ethno-medicinal documentation to preserve the valuable traditional knowledge that can be used in future phytochemical and pharmacological studies on medicinal plants of the area.

1. Introduction

The use of medicinal plants is the historical practice throughout the human history and this knowledge has been transferred among the rural communities from generation after generation (Perumal and Ignacimuthu, 2000; Perumal et al., 1998; Pieroni and Quave, 2005). It is still well preserved among the many native communities in all over the world (Heinrich and Gibbons, 2001; Ladio et al., 2007). This trend leads to carry out ethno-botanical surveys and ethno-pharmacological studies (Heinrich, 2008; Verpoorte et al., 2005). Even at present, many indigenous communities use herbal medicines for the treatment of various diseases (Naidu et al., 2013). Among such diseases, snake and scorpion bites are also treated by using medicinal plants (Singh et al., 2012). Thus, the studies on herbal antidotes against snake and scorpion venom are of great importance in the management of snake bite disorders (Mukherjee and Wahile, 2006).

Snake bite and scorpion sting are the main health threats that lead to high mortality and countless distress in many communities. It is a severe medical and socio-economic issue in many parts of the world, particularly in the tropical and subtropical countries. About 50,000 poisonous snake bites and scorpion stings are described in the world annually (Kunjam et al., 2013). Subsequently millions of fatalities are caused each year; with 4 million in Asia; 1 million in Africa; 300,000 in central and South America and 100,000 in other continents (Phalke et al., 2012) while many studies indicated high rate of scorpion stings ranging from 1% in adults to 20% in children (Freire-Maia et al., 1994; Majumder et al., 2014). In Asian countries, expiries by snake bites and scorpion stings have been reported and

* Corresponding author.
E-mail address: mushtaqflora@hotmail.com (M. Ahmad).

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increased every year (Harshavardhana et al., 2014). Many reports point out the frequency of scorpion stings and snake bites in Pakistan and it is thought to be increased due to deforestation and migrations of these poisonous animals towards human populations (Nasim et al., 2013). At present, use of anti-venoms from plants is reported among many indigenous communities. In spite of the widespread achievement of this therapy, there is still need to search more plant based venom inhibitors (Samy et al., 2008). As a result, a large number of plants have been documented as antidotes against snake bites and scorpion stings in various regions of the world (Usher, 1974; Makhija and Khamar, 2010).

There are some processes which are proposed in order to neutralize the effect of snake venom like the application of plant sap, chewing a plant part e.g. leaves and bark and drinking decoctions. Usually these herbal medicines are easily available in rural areas for the snake bite and scorpion sting treatment. In India and Pakistan the rural inhabitants use the plants for snakes as well as scorpion bite (Venkatraman, 2012). There are few documented reports that present the practice of herbal medicine by indigenous communities (Bhandari et al., 1996; Harsha et al., 2002, 2003). To the best of our knowledge, this is the first ethno-botanical study of plants used against snake bite and scorpion sting from Northern Pakistan. Northern Pakistan is rich in medicinal plant diversity (Ali, 2008; Nasir et al., 1972) and associated cultural communities who use these plants from generation after generation to treat diverse ailments including snake bite and scorpion sting. However, no documented statistics exist in this region regarding the use of plants for the management of snake, scorpion and other insects' bites. This first ethno-botanical study aimed to document the indigenous knowledge and practices of using plants for snake and scorpion bite disorders in Northern Pakistan. In specific, it aims to assess the valuable and frequently cited plants used against the snake bite and scorpion sting using quantitative ethno-botanical indices.

2. Materials and methods

2.1. Study area

Northern Pakistan is rich in the floristic diversity especially medicinal plants (Nasir et al., 1972). The study sites include Hazara division, Swat valley, Bannu, Mansehra and other tribal northern parts (Fig. 1). It shares border with Afghanistan in north-west; Gilgit-Baltistan in north-east; Azad Jammu and Kashmir in the east and Federally Administered Tribal Areas (FATA) in the west-south while in the south-east there is Punjab province. Its geography varies from desiccated rocky areas including Hindu Kush and Himalaya mountain ranges in the south to forests and green plains in the north. The temperature varies from 3.4 °C to 34.3 °C along with snowfall in hilly areas. The rainfall is recorded about 1200 mm in monsoon and winter (Tahir et al., 2011). There is diverse ethnic composition but the majority of races speak *Pushto* (93% of the population) while the other locally known languages are *Hindko*, *Potohari* and *Gujrati*. The area has a rural culture of old traditions and the local people have their own principles for the village life, house, family, dress, ceremonies and festivals.

2.2. Ethnobotanical data collection

Ethno-botanical data was documented from local informants and local Traditional Health Practitioners (THPs) including males and females of different age groups, education level and experience of medicinal plants utilization. During field survey, semi-structured interviews were conducted to collect information using PreInformed Consensus (PIC). First-hand traditional knowledge followed by repeated queries was made to understand their practices, experiences and methods of application of plants. Questionnaire used in the study includes two parts; first part deals with the demographic data of informants while the second part includes information about local names of the plants, parts used and mode of preparation and administration of plants against snake bite and scorpion sting. Data documented during field surveys was organized and assessed using quantitative indices. In addition, collected data was compared with previously published research papers to authenticate and highlight the plants of high value against under study disorders.

2.3. Botanical identification

All the plant specimens collected during field visits were taxonomically identified by using Flora of Pakistan (Nasir et al., 1972) in the Herbarium of Pakistan (ISL), Quaid-I-Azam University Islamabad where the voucher specimens were deposited after complete identification for future references. The correct plant names were verified from International Plant Names Index (IPNI: http://www.ipni.org).

2.4. Quantitative data analyses

2.4.1. Relative Frequency of Citation (RFC)

Indigenous knowledge is quantitatively assessed using RFC and Frequency of Citation (FC). The RFC was calculated to determine the consensus between the informants on the use of medicinal plants in this region. It is calculated using following formula (Vitalini et al., 2013):

$$RFC = FC/N \quad (0 < RFC < 1)$$

where RFC is the relative frequency citation; FC (Frequency of Citation) is the number of informants who cited the species and N is the total number of informants participated in the study. The value of RFC relies on the citing proportion of informants for that specific species (Ahmad et al., 2014; Kayani et al., 2014).

2.4.2. Informant Consensus Factor

We used the Informant Consensus Factor (ICF) as defined by Heinrich et al. (1998) to test the agreement between informants and plants used for treatment of scorpion and snake bite. It is calculated by modifying the formula that how many informants indicated the use of plants against each category for snake and scorpion bite.

The lowest ICF values indicate that plants are chosen randomly or there is no exchange of information about their use against determined category. High value is observed when there is a common selection criterion in the community and/or if traditional knowledge is exchanged frequently between the informants.

2.4.3. Use value (UV)

The use values for plants are calculated by using the formula of Phillips et al. (1994)

$$UV = \sum U/n$$

where "U" is the number of Use-reports cited by each informant for a given species and "n" refers to the total number of informants. Use value for plants provide a quantitative measure for the relative importance of species.