Ethnomedicinal knowledge of the rural communities of Dhirkot, Azad Jammu and Kashmir, Pakistan

Asia Farooq, Muhammad Shoaib Amjad, Khalid Ahmad, Muhammad Altaf, Muhammad Umair and Arshad Mehmood Abbasi*

Abstract

Background: Being an isolated locality and having a tough mountainous terrain, strong ethnomedicinal practices still prevail in Dhirkot and its allied areas, which have been rarely explored yet. The present study was intended with the aim to document and compare the traditional knowledge of local communities on botanical taxa of Dhirkot, Azad Jammu, and Kashmir.

Methodology: Ethnomedicinal data were collected from 74 informants using a semi-structured questionnaire in addition to field observation and group discussion. Various indices were also used to evaluate the ethnomedicinal data. Furthermore, the present findings were compared with previous reports to assess data novelty.

Result: A total of 140 medicinal plant species belonging to 55 families were recorded, which are used by local communities to treat 12 disease categories. Asteraceae was dominating with 20 species, followed by Poaceae, Lamiaceae, and Rosaceae (14, 11, and 10 species, respectively). Herbs were leading with 66% contribution, whereas leaves were the most utilized plant part with 29% utilization and decoction was the common mode of administration. Viola canescens depicted the highest use value and relative frequency of citation (1.7 and 0.92, respectively). Maximum informant consensus factor (0.88) was calculated for digestive and liver disorders. Five plant species including Berberis lycium, Mentha arvensis, Pyrus malus, Taraxacum officinale, and Viola canescens had 100% fidelity level.

Conclusion: Dhirkot and its allied areas harbor rich botanical and cultural diversity because of its unique geography and diverse climatic conditions. However, mostly, traditional ethnobotanical knowledge is restricted to healers, midwives, and older people, and could be extinct in the near future. Therefore, such documentation not only conserves traditional knowledge but may also contribute significantly to novel drug resources.

Keywords: Traditional knowledge, Medicinal plants, FC, ICF, Dhirkot

Background

Medicinal plants are an important element of aboriginal curative systems. This knowledge is considered as a part of cultural assets [1]. However, many indigenous groups fail to sustain and preserve this communal knowledge [2] that is why the systematic evaluation of this knowledge in order to contribute to health care in marginalized areas has been sighted in programs of national and international organizations [3]. In developing countries, most of the local communities are still relying on plant-based medicines [4]. The use of medicinal plants is a valuable source of income for poor communities but knowledge on therapeutic plants is decreasing gradually due to the progression in the present health care system and rapid urbanization [5, 6]. Therefore, such rich tradition should be preserved through a reliable approach before it gets lost due to various anthropogenic and other causes.

There is an amazing growing interest in the alternative systems of therapeutics on a global level [7]. The factors contributing towards the potential use of herbal drugs in developing countries are accessibility, affordability, and historical and cultural background besides a holistic approach...
to health problems, safety, lack of adverse reaction, and side effects [8, 9]. The use of plants as medicine ranges from 4 to 20% in different countries and about 2500 species are traded internationally. Pakistan has about 6000 species of higher plants, and among them, 10–30% of the flora is used for medicinal purposes in various areas [10, 11]. The tradition of using medicinal plants in Pakistan for the treatment of various ailments is very mature, based predominantly on the Unani system of medicine. This traditional medicine sector has become an important source of health care, especially in rural and tribal areas of the country where it is considered as first-line treatment [12].

Azad Jammu and Kashmir (AJ&K) is characterized by its diverse habitats, climate, and soil [13–16]. It is located in North-East of Pakistan and is stuffed with natural resources particularly plant flora [17]. AJK has a wide range of mountainous ecosystems which are affluent in fauna and flora. Due to extraordinary climatic conditions, the area has three vegetation groups (deserts, alpine, and grasslands). Natural and anthropogenic stresses have a great effect on the natural environment and ecosystems of the area [18]. Previously, different researchers reported ethnomedicinal uses of plant species from other parts of AJ&K [16, 19, 20]. However, the present research area is rarely reported except in one study, which was conducted about 16 years ago [21]. We hypothesize that older people are more familiar with ethnomedicinal uses of plant species compared to younger people and formal education is not predictive of the traditional knowledge level of indigenous people. Moreover, among the local communities, having the same culture usage or importance of a plant species may vary. Therefore, the present study was designed to document the traditional knowledge of plant species and its quantitative assessment and to associate the frequency of occurrence with ethnomedicinal uses of plant species.

Materials and methods

Study area

Dhirkot is a diversity-rich mountainous area of district Bagh, Azad Jammu, & Kashmir, Pakistan. It is situated 55 km southeast of Muzaffarabad (the capital city for Azad Jammu and Kashmir) and 132 km from Islamabad. It is located on latitude 33° 57’ N and longitude 73° 36’ E (Fig. 1), covering an area of 150 km square with an altitudinal variation of 850–2200 m [22]. The climate of the study area is of a subtropical humid and moist temperate type with maximum precipitation occurring in July (95 mm) followed by August (89 mm). The weather remains pleasant in summer due to its location at high altitude. The hottest months are June and July with an average temperature of 24°C and 23°C respectively. Sometimes, the temperature rises to 29°C. The coldest months are January and February with an average temperature of 5.3°C and 6.6°C respectively. Sometimes, the temperature falls to 1.1°C, and at higher elevation, snowfall occurs (Fig. 2). The vegetation of the study area is subtropical humid and moist temperate type. The dominant tree species are Pinus roxburghii (Chir Pine) and P. wallichiana (Blue Pine). Due to the cool and humid condition, the vegetation is comprised of a wide variety of herbs, shrubs, and trees. The ground flora is composed of a number of angiosperms along with mosses and ferns.

The region embraced a diverse ethnic composition including Abbasi, Sudhans, Rajputs, and Gardazi. Among them, Abassi and Gardazi are the largest and well-settled tribes in the area. The whole population is Muslim. The majority of the population speaks the Hindko language, while Gojri and Urdu are also spoken. The major proportion of the indigenous community has very limited income sources. Majority of people are farmers, some people are job holders, some are labor, and few have their own business on a small scale. People also keep animals at their homes for livelihood. Few public health dispensaries are providing basic health facilities but people living at higher altitudes have limited access to them. They mainly depend on herbal remedies prepared at home or by traditional healers for primary health care.

Sampling and plant identification

Several field trips were made in four different seasons (from August 2017–July 2018) following the method as reported previously [23]. Each medicinal plant species was collected in triplicates from different localities during guided tours. The specimens were properly dried, pressed, and mounted on standard herbarium sheets and voucher specimens were prepared following Jain and Pandey’s method [24]. Flora of Pakistan (https://www.eflora.com) [25, 26] was used for identification. For the correct family names, the APG IV (2016) [27] was followed, while for the accurate scientific name, The Plant List (2013) [28] was used. The identified specimens were further confirmed in the AJ&K Medicinal and Aromatic Plant Herbarium PARC, Pakistan. The fully identified voucher specimens were then deposited in the herbarium of the Women University of Azad Jammu & Kashmir, Bagh.

Data collection and analysis

Ethnomedicinal data were gathered from 74 informants including male (55%) and female (45%) using semi-structured interviews, questionnaire, group discussion, and field observation. The informants were selected on a random basis via convenience sampling and sample size was determined by Kadam and Bhalerao’s method [29]. For the preparation of the questionnaire Edward et al. method was used [30]. And ethical guidelines of the International Society of Ethnobiology (http://www.ethnobiology.net/) were strictly followed. In this regard, ethical approval was taken...
from the ethical committee of the Women University of Azad Jammu & Kashmir before starting surveys, while legal permission for conducting the survey was also taken from the representative of the municipality. Prior consent was taken from all the respondents following the participatory rural appraisal (PRA) approach as mentioned in the Kyoto Protocol after explaining the possible objective consequences of the study in the local language. Informants were not subjected to any clinical trial. Informants were classified into different categories like age, education level, and professions. The correctness of the ethnobotanical data was checked through triangulation. The data was then compared with the existing literature and analyzed both quantitatively and qualitatively.

**Ethnobotanical indices**
For quantitative analysis various quantitative indices were applied including:

**Relative frequency citation**
The frequency of citation (FC) was used to identify the most used plant species by the local inhabitants of the area. It was calculated by following Tardio and Pardo-de Santayana [5] and Vitalini et al. [31], using the following formula:

\[
RFC = \frac{FC}{N}
\]

where FC is respondents citing the use of specific species and N are the total respondents.

**Use value**
The relative importance of particular plant species cited by all informants in a given area is quantitatively measured in terms of the use value. It was calculated by following Savikin et al. [32] using the following formula:

\[
UV = \frac{\sum Ui}{N}
\]

where \( Ui \) is the number of citations or used reports by each respondent for a particular plant species and \( N \) is the total respondents.
Informant consensus factor
The consensus between respondents and particular plant species used for each diseased category was tested by using informant consensus factor. It was figured out by following Vitalini et al., [5] using given formula:

\[ AICF = \frac{Nur - Nt}{Nt - 1} \]

where ‘Nur’ represents the total number of used reports in each group of diseases, and ‘Nt’ represents the total species cited by all the informants for that group of ailments.

Jaccard index
The similarity of indigenous knowledge among different communities was determined by using the Jaccard index (JI). It was calculated by following Gonzalez-Tejero et al. [33] using the given formula:

\[ JI = \frac{C \times 100}{(a + b) - c} \]

where \( a \) is the species of the study area, \( b \) is the species recorded from the allied area, and \( c \) is the common species in both areas.

Relative importance
Relative importance (RI) was figured out by following Khan et al. [34] using the given formula.

\[ RI = \frac{(RelPH + RelBS) \times 100}{MaximumPH} \]

\[ Re1PH = \frac{PH\ of\ a\ givn\ plant}{Maximum\ PH\ of\ all\ reported\ plant\ species} \]

\[ Re1BS = \frac{BS\ of\ a\ given\ plant}{Maximum\ BS\ of\ all\ reported\ plant\ species} \]

where PH is the pharmacological attribute of the selected plants and Rel PH is the relative number of pharmacological properties attributed to individual plant species.

Fidelity level
The fidelity level (FL) index was used to determine the most preferred species used to cure a particular disease as to treat the same ailment category with more than one plant species is also used. It was figured out after Friedman et al. [35], using the given formula:

\[ FL = \frac{Np}{N} \times 100 \]

where \( Np \) is the number of respondents citing the use of species for a particular ailment and \( N \) is the total number of respondents citing the plants for any illness.
Results and discussion

Medicinal plants use and knowledge variation

The data on medicinal uses of plants was collected from 12 villages. Detail demographic data is given in Table 1. The females usually avoid participating and sharing knowledge with male interviewee due to communal restriction and Islamic instruction, which is also mentioned in other studies [36–38]. However, the women hold a wider competence regarding the traditional herbal recipes (5.36% species; 8.68% uses). A similar trend was also observed in other studies from Pakistan and abroad [39–41]. The older people (age ≤ 60) have more knowledge (6.46% species; 10.82% uses), followed by middle-aged people (age ≤ 40) (6.34% species; 9.50% uses) in comparison to adolescent informants (age ≤ 19) while it is inversely proportional to the level of education (Table 1). This might be the consequence of modernization and weak beliefs of young people regarding traditional remedies and due to changing lifestyles, development in modern medication, and urbanization [42, 43]. Similar findings are reported from other areas of Pakistan [44, 45] and elsewhere [46–48]. Illiterate native people are more accustomed to the usage of ethnomedicinal plants than literate people. The reason behind this is that educated people have very less interest in learning and practicing ethnobotanical knowledge. The same result was documented by other researchers in Pakistan [20, 49–51] and abroad [52, 53].

Local health care system

Throughout history, the role of traditional health practitioners (THPs) and midwives varies with time and culture, but even today, they are contributing significantly to the primary health care system, particularly among marginalized communities. THPs are usually aged males that use plants, animals, and minerals to treat various health disorders, whereas midwives are the elders and experienced females, which are familiar with pregnancy issues of women and treat them using diverse medicinal plants. Midwives are the integral component of a community that perform their important duties and provide essential support to women during delivery [54, 55]. Data given in Table 1 revealed that most of the information on ethnomedicinal uses of plant species of the study area were shared by (THPs), and midwives. The average number of species reported by THPs and midwives was 21.5 and 12.4, while they reported about 10.4% and 7.36% uses in respective order. Most of the traditional health practitioners were males who possess extensive information about therapeutic herbs and natural treatments which they use in herbal and other remedial preparations to cure diseases [56, 57]. However, as reported previously, traditional knowledge of plant resource utilization is declining due to changing lifestyle and more dependence on allopathic medicines [20, 51, 58, 59]. And similar trends were noted in the study areas.

Diversity of ethnomedicinal flora

A total of 140 species belonging to 55 families and 93 genera were reported (Table 2). Most of the documented ethnomedicinal plants species were herbs (66%) followed by shrubs (16%), trees (14%), and climbers (4%), (Fig. 3). This is because the study area is located in a dense forest zone at higher altitude where the herbs are abundantly distributed with few trees and shrubs. The bimodal rainfall and high availability of moisture might also be the reason. These findings are consistent with other studies [62–65, 69, 75, 76]. Among 22 families representing 2–20 plant species (Fig. 4), Asteraceae was the dominant family with 14.29% contribution of the total reported taxa, followed by Poaceae (10%), Lamiaceae (7.86%), Rosaceae (7.14%), Fabaceae (4.29%), and Pteridaceae (3.57%). All other families contributed less than 5% with percentages varying from 0.71–2.86%. The dominance of Asteraceae, Poaceae, Lamiaceae, and Rosaceae might be due to suitable habitat, favorable environmental conditions for the growth of the species belonging to these families, and more interactions of local communities with them in the study area. Therefore, traditional uses of plant species of these species are well recognized by the local inhabitants [6, 36, 66, 77, 78]. Additionally, majority of plant

### Table 1

| Variables       | IC informants category | Number | ANSRI | ANURI |
|-----------------|------------------------|--------|-------|-------|
| Gender          | Male                   | 41     | 4.53  | 7.71  |
|                 | Female                 | 33     | 5.36  | 8.68  |
|                 | Total                  | 74     | 4.17  | 3.46  |
| Age-Class       | 19–40                  | 17     | 6.59  | 4.23  |
|                 | 41–60                  | 44     | 13.1  | 11.7  |
|                 | Above 60               | 13     | 6.40  | 5.70  |
| Education Level | Illiterate             | 12     | 13.7  | 6.40  |
|                 | Elementary education   | 16     | 13.1  | 6.02  |
|                 | Secondary education    | 18     | 13.1  | 6.02  |
|                 | HSE                    | 14     | 6.40  | 5.70  |
|                 | Bachelor degree        | 9      | 17.1  | 4.92  |
|                 | Higher education       | 5      | 11.5  | 6.91  |
| Professions     | THPs                   | 12     | 21.5  | 10.4  |
|                 | Midwives               | 07     | 12.4  | 7.36  |
|                 | Herders                | 05     | 10.2  | 8.33  |
|                 | Housewives             | 15     | 7.88  | 6.31  |
|                 | Teachers               | 8      | 7.29  | 8.54  |
|                 | Farmers                | 14     | 5.65  | 4.40  |
|                 | Shopkeeper             | 04     | 4.18  | 3.98  |
|                 | Students               | 06     | 4.31  | 3.04  |
|                 | Labors                 | 03     | 5.23  | 4.75  |

IC informants category, ANSRI average number of species reported by each informant, ANURI average number of use reported by each informant, HSE higher secondary education, THPs traditional health practitioners
| Sr # | Family            | Nomenclature                   | Scientific name                  | Local name | Habit     | Part used | Preparation | Application | Disease treated | Previous reports |
|------|-------------------|--------------------------------|----------------------------------|------------|-----------|-----------|-------------|--------------|----------------|-----------------|
| 1    | Acanthaceae       | *Achillea*                     | *Achillea*                       | Chenar     | H         | WP        | PD          | Internal     | *Diabetes, *Tonic | 1, 2, 6, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 21, 22 |
|      |                   |                                |                                  |            |           |           |             |              |                |                  |
| 2    | Adoxaceae         | *Amaranthus*                    | *Amaranthus*                      | Puthkanda  | H         | LE        | DE          | External     | *Toothache*    | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |                   |                                |                                  |            |           |           |             |              |                |                  |
| 3    | Amaranthaceae     | *Amaranthus*                    | *Amaranthus*                      | Ganyar     | H         | LE        | VG          | Internal     | *Constitution* | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |                   |                                |                                  |            |           |           |             |              |                |                  |
| 4    | Apocynaceae       | *Chenopodium*                   | *Chenopodium*                     | Bathu/Bathwa | H         | WP        | IN          | Internal     | *Measles, *Cough, Amenorrhea | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |                   |                                |                                  |            |           |           |             |              |                |                  |
| 5    | Averaceae         | *Hydrocotyle*                   | *Hydrocotyle*                     | Chamk wali boti | H         | LF        | EX          | Internal     | Fever, Bowel Complaints | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |                   |                                |                                  |            |           |           |             |              |                |                  |
| 6    | Asplenaceae       | *Asplenium*                     | *Asplenium*                       | Niaroi     | H         | WP        | JU          | External     | Blisters       | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |                   |                                |                                  |            |           |           |             |              |                |                  |
| 7    | Asteraceae        | *Artemisia*                     | *Artemisia*                       | Chaow      | H         | RT        | EX          | Internal     | *Regulation* | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |

Table 2 Medicinal uses of the reported taxa and their comparison with previous reports
| Sr # | Family | Nomenclature | Habit | Medicinal uses                        | Preparation | Application | Disease treated                              | Previous reports |
|------|--------|--------------|-------|--------------------------------------|-------------|-------------|----------------------------------------------|-----------------|
|      |        | Scientific name | Local name | Part used | Internal | *Cardiac problems | 7, 8, 9, 10, 11 | 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        | L. /AF-55     |        | WP | IN | 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        | Beiplant/AF-27 |        | LE | JU | Internal | *Cardiac problems | 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        | Suryaly/AF-27 |        | RT | PA | 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        | L. /AF-43     |        | WP | EX | Internal | 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        | Marchi/RT-127  |        | LE | DE | Internal | 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        | Kasni/RT-2    |        | RT | IN | Internal | 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        | Kandayara/AF-127 |        | WP | IN | Internal | 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        | Kali Buti/AF-129 |        | WP | EX | Internal | 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        | Peeli Booti/AF-73 |        | LE | DE | Internal | 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        | Gerbera/AF-27 |        | LF | PA | Internal | 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        | Bhurjali/AF-95 |        | LF | PA | Internal | 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        | Inula/AF-95   |        | WP | EX | Internal | 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        | Matricaria/AF-46 |        | RT | DE | Internal | 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        | Mynhactis/AF-65 |        | LF | PA | External | 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |

**Table 2** Medicinal uses of the reported taxa and their comparison with previous reports (Continued)
Table 2 Medicinal uses of the reported taxa and their comparison with previous reports (Continued)

| Sr # | Family | Scientific name | Local name | Habit | Medicinal uses | Preparation | Application | Disease treated | Previous reports |
|------|--------|-----------------|------------|-------|----------------|-------------|--------------|-----------------|-----------------|
| 8    | Balsaminaceae | *Impatiens* edgeworthii Hook. f./AF-105 | Tilchawli | H | LF | Internal | *Urinary tract infection* | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 |
|      |        |                 |            |      | PD | Internal | *Burns* | 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        |                 |            |      | DE | Internal | *Fever* | 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        |                 |            |      | TE | External | *Cooling effect on hands and Foot* | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
| 9    | Berberidaceae | *Berberis* lycium Royle./AF-4 | Sumbal | S | LE | PA | External | *Bleeding, Wound healing* | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |

*NOTE: Sr = Serial number, Family = Botanical family, Scientific name = Scientific name of the plant, Local name = Local name of the plant, Habit = Habit, Medicinal uses = Medicinal uses of the plant, Preparation = Preparation of the plant, Application = Application of the plant, Disease treated = Disease treated by the plant, Previous reports = Previous reports on the plant.*
Table 2 Medicinal uses of the reported taxa and their comparison with previous reports (Continued)

| Sr # | Family                  | Scientific name Local name        | Part used | Preparation | Habit   | Medicinal uses                  | Disease treated      | Previous reports |
|------|-------------------------|-----------------------------------|-----------|-------------|---------|---------------------------------|----------------------|-----------------|
| 10   | Boraginaceae            | Cynoglossum lanceolatum Churuun   | RT        | EX          | Internal| *Throat diseases               | Toothache            |                 |
|      |                         | Forsk./AF-23                      |           |             |         |                                 |                      |                 |
|      |                         |                                    | BA        | PD          | Internal| Bleeding gums                   |                      |                 |
| 11   | Brassicaceae            | Capsella bursa-pastoris (L)       | Doddipatti | H           | AP      | Diarrhea                        |                      |                 |
|      |                         | Medick./AF-94                     |           |             | VG      |                                 |                      |                 |
|      |                         |                                    | LE        | DE          | Internal| Menstrual disorders             |                      |                 |
|      |                         |                                    | WP        | JU          | Internal| *Nose bleeding                   |                      |                 |
| 12   | Buxaceae                | Sarcococca saligna (D. Don)       | Niaroi/Ndroon | S          | SH      | Joint pain                      | Gonorrea             |                 |
|      |                         | Müll. Arg./AF-64                  |           |             | EX      |                                 |                      |                 |
| 13   | Campanulaceae           | Campanula palida Wall./AF-111     | Beli Phool | H           | WP      | Dysentery, Liver disorders      |                      |                 |
| 14   | Cannabaceae             | Cannabis sativa L./AF-83          | Kamm/Bhang | H           | LE      | *Joint problems                 | Whooping cough       |                 |
|      |                         |                                    |           |             | TE      |                                 |                      |                 |
| 15   | Convolvulaceae          | Convolvulus anensis L./AF-30      | Speaker Booti | C           | WP      | Skin Diseases                   | Danduff              |                 |
|      |                         |                                    |           |             | VG      |                                 |                      |                 |
|      |                         |                                    |           |             | EX      |                                 |                      |                 |
|      |                         | Ipomoea purpurea (L) Roth./AF-76  | Eieer     | C           | SD      | Mental disorders, Constipation, Diuretic |                      |                 |
|      |                         |                                    |           |             | PD      | Syphilis                        |                      |                 |
| 16   | Cyperaceae              | Cyperus serotinus Rottb./AF-116   | Deela Ghass | H           | RT      | Tonic, Stimulant                |                      |                 |
|      |                         |                                    |           |             | EX      |                                 |                      |                 |
|      |                         | Eriophorum comosum (Wall) Nees. /AF-90 | Berbaya    | H           | WP      | Abdominal pain, Kidney pain     |                      |                 |
|      |                         |                                    |           |             | PD      |                                 |                      |                 |
| 17   | Dryopteridaceae         | Dryopteris filix-mas (L) Schott. /AF-17 | Kungi     | H           | FD      | Diabetes                        | To treat Tapeworms   |                 |
|      |                         |                                    |           |             | VG      |                                 |                      |                 |
|      |                         |                                    |           |             | EX      | Muscle pain, Paralysis, Sciatica|                      |                 |
| 18   | Ebenaceae               | Diospyros lotus L./AF-119         | Amlook     | T           | FR      | *Stomach disease, Fever         |                      |                 |
|      |                         |                                    |           |             | ET      |                                 | Toothache            |                 |
|      |                         |                                    |           |             |         | *Gums and lips coloring         |                      |                 |
| 19   | Elaeagnaceae            | Elaeagnus umbellata Thunb. /AF-77 | Kankoli    | S           | SD      | Breathing disorders, Lungs disease |                      |                 |
|      |                         |                                    |           |             | EX (Oil)|                                 | Toothache            |                 |
|      |                         |                                    |           |             |         |                                 |                      |                 |
| Sr # | Family | Scientific name       | Local name | Part used | Preparation | Application | Disease treated                                           | Previous reports |
|------|--------|-----------------------|------------|-----------|-------------|-------------|----------------------------------------------------------|-----------------|
| 20   | Euphorbiaceae | Euphorbia indica Lam. /AF-15 | Dodhale/ Dodhal | H          | WP DE       | Internal     | *Diarrhea, Dysentery*                                     | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        | Euphorbia prostrata Aiton. /AF-49 | Dodhale/Hazar Dani | H          | WP DE       | Internal     | *Dysentery, Diarrhea*                                     | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        | Ricinus communis L./ AF-57 | Hernoli S | RT EX      | Internal     | *To remove poisonous from body*                          | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
| 21   | Fabaceae | Acacia nilotica (L.) Willd. ex Delile/AF-37 | Kikar T | ST Ash (PD) | External     | *Eye Diseases*                                           | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        | Desmodium elegans DC./AF-31 | Mangkit parang | S          | WP Extract   | Internal     | *Diarrhea*                                               | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        | Indigofera heterantha Wall.ex Brandis./ AF-33 | Jand S | BR PD      | Internal     | *Whooping cough*                                         | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        | Lespedeza juncea (L. f.) Pers./AF-133 | Silky bush-clover H | SH DE | Internal     | *Dysentery, Diarrhea*                                     | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        | Medicago lupulina L./AF-132 | Sirri H | SD PD      | Internal     | *Indigestion*                                            | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        | Trifolium pratense L./AF-42 | Trapetra H | FL DE      | Internal     | *Minimize menopause symptoms*                            | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
| 22   | Fagaceae | Quercus incana W. Bartram./AF-32 | Rein T | SD DE      | Internal     | *Cancer, *Whooping Cough, *Gout disease*                  | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
| 23   | Gentianaceae | Gentianodes | Neeli Booti H | WP DE | Internal     | Jaundice, Cough                                         | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
| Sr # | Family | Nomenclature | Habit | Part used | Preparation | Application | Disease treated | Previous reports |
|------|--------|--------------|-------|-----------|-------------|-------------|-----------------|------------------|
|      |        | Scientific name | Local name |          |             |             |                 |                  |
| 24   | Hypericaceae | Hypericum perforatum L./AF-59 | Sharan Gulab | H | SH | DE | Internal | *Anxiety | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        | Plamas/jabba Wall./jari |     | WP | EX | Internal | *Malarial Fever, *Diarrhea | 1, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
| 25   | Lamiaceae | Ajuga bracteosa Wall. ex Benth./AF-20 | Thandi Jari/ Ratti Booti | H | LE | DE | Internal | Skin Infection, Stomach problem | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        | Podina | H | LF | DE | Internal | Stomach acidity, Indigestion, Vomiting | *Toothache | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        | Bareena | H | LF | DE | Internal | Digestive disorders, Abdominal disorders | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |

*Table 2 Medicinal uses of the reported taxa and their comparison with previous reports (Continued)
| Sr # | Family | Scientific name | Local name | Part used | Preparation | Application | Disease treated | Previous reports |
|------|--------|----------------|------------|----------|-------------|-------------|----------------|-----------------|
| 26   | Lauraceae | *Prunus* L. | Kathri H | LF | DE | Internal | *Sore throat*, *Liver tonic* | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
| 27   | Liliaceae | *Allium cepa* L. | Kathra H | LF | PO | External | Wounds, Itching | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
| 28   | Lythraceae | *Salvia lanata* Roxb. | Kathra H | LF | EX | Internal | *Cough* | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
| 29   | Malvaceae | *Allium sativum* L. | Kathra H | LF | EX | Internal | *Cough* | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
| 30   | Malvaceae | *Salvia officinalis* L. | Kathra H | LF | EX | Internal | *Cough* | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
| 31   | Malvaceae | *Salvia officinalis* L. | Kathra H | LF | EX | Internal | *Cough* | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
| Sr # | Family | Scientific name | Local name | Part used | Preparation | Application | Disease treated | Previous reports |
|------|--------|----------------|------------|-----------|-------------|--------------|----------------|-----------------|
| 32   | Oleaceae | *Oxalis* grandiflorum L. | Jasmine/ Chambeli | T       | FL          | Internal      | *Sexual disorders* | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        |                |            |          |             |              | *Body weakness,* Chest Infection |                      |
| 33   | Onagraceae | *Oenothera rosea* L.Hèr.ex Alton. | Buti/ Seh Davi | H       | LF          | Internal      | Kidney disorders | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        |                |            |          | TE          | Internal      | Digestive disorders, Diabetes |                      |
| 34   | Oxalidaceae | *Plantago* corniculata L. | Khati Buti | H       | LF          | External      | Mouth infection | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        |                |            |          | CH          | External      | Digestive disorders, Dental |                      |
| 35   | Pinaceae | *Pinus roxburghii* Sarg. | Chir        | T       | LF          | Internal      | Jaundice | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        |                |            |          | DE          | Internal      | Toothache | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        |                |            |          | ET          | Internal      | Jaundice | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
| 36   | Plantaginaceae | *Plantago lanceolata* L./ AF-86 | Chamchi ptra/ Ispagol | H       | FL          | Internal      | Dysentery | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        |                |            |          | SD          | Internal      | Diarrhea | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
| 37   | Platanaceae | *Platanus orientalis* L./AF-123 | Chinar      | T       | BA          | Internal      | *Snake and *Scorpion bite | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        |                |            |          | JU          | Internal      | *Dysentery | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        |                |            |          | DE          | Internal      | *Wound healing | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
Table 2 Medicinal uses of the reported taxa and their comparison with previous reports (Continued)

| Sr # | Family | Scientific name | Local name | Habit | Medicinal uses | Preparation | Application | Disease treated | Previous reports |
|------|--------|----------------|------------|-------|----------------|-------------|-------------|-----------------|------------------|
| 38   | Poaceae| Arthraxon prionodes (Steud.) Dandy/AF-100 | Kah | H | WP | DE | Internal | *Dysentery | Liver disease, Nervous system regulator |
|      |        | Arista cyanantha Nees ex Steud./AF-122 | Common Ghass | H | WP | Ash (PD) | External | Burns, Skin infection | |
|      |        | Bromus catharticus Vahl./AF-68 | Jarun ghass | H | RT | EX | Internal | Purgative | Skin disorders |
|      |        | Chrysopogon gryllus (L.) Trin./AF-89 | BunchGrass | H | LE | DE | Internal | Fish Poisonings | |
|      |        | Cynodon dactylon (L.) Pers./AF-18 | Khabal | H | IN | PA | External | *Skin infection | |
|      |        | Doctylis glomerata L./AF-107 | Billi Ghass | H | LE | EX | Internal | Kidney problem, Bladder ailment | |
|      |        | Dichanthium annulatum (Forssk) Stapf./AF-118 | Galgen beared Ghass | H | WP | EX | Internal | *Menstrual prolonged duration, Stomach acidity | |
|      |        | Eleusine indica (L.) Gaertn./AF-131 | Madhani ghass | H | WP | PA | External | *Stop bleeding | |
|      |        | Opisiumus compositus (L.) P. Beauv./AF-130 | Running mountaingrass | H | AP | EX | External | *Asthma | |
|      |        | Pennisetum orientale Rich. /AF-35 | Siliag ghass/ Haati Gaas | H | AP | EX | External | *Snake bite | |
|      |        | Saccharum spontaneum L. /AF-101 | Kai | H | WP | JU | Internal | *Cough, *Abdominal pain | |
| Sr # | Family | Nomenclature | Scientific name | Local name | Habit | Medicinal uses | Previous reports |
|------|--------|--------------|----------------|-----------|--------|---------------|-----------------|
| 39   | Polygonaceae | Persicaria capnita | Setaria viridis (L.) P. Beauv./AF-113 | Kera Ghass | H | SD | PD | Internal | *Kidney stones |
|      |         |              |                |           |       |               | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 |
|      |         |              |                |           |       |               | 13, 14, 15, 16, 17, 18 |
|      |         |              |                |           |       |               | 19, 20, 21, 22, 23 |
|      |         |              | Sorghum halepense (L.) Pers./AF-102 | Barun ghass | H | RT | EX | Internal | Indigestion |
|      |         |              |                |           |       |               | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 |
|      |         |              |                |           |       |               | 13, 14, 15, 16, 17, 18 |
|      |         |              |                |           |       |               | 19, 20, 21, 22, 23 |
| 40   | Primulaceae | Androsace ratanilfolia | Polygonum hydropiper L./AF-38 | Knotweed/ Marsh weed | H | WP | DE | Internal | Menorrhagia |
|      |         | Hardw./AF-14 |                |           |       |               | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 |
|      |         |              |                |           |       |               | 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |         |              |                |           |       |               | 23 |
|      |         |              |                |           |       |               | 24 |
|      |         |              |                |           |       |               | 25 |
|      |         |              |                |           |       |               | 26 |
|      |         |              |                |           |       |               | 27 |
|      |         |              |                |           |       |               | 28 |
|      |         |              |                |           |       |               | 29 |
|      |         |              |                |           |       |               | 30 |

**Table 2** Medicinal uses of the reported taxa and their comparison with previous reports (Continued)
| Sr # | Family | Nomenclature | Local name | Habit | Part used | Preparation | Medicinal uses | Application | Disease treated | Previous reports |
|------|--------|--------------|------------|-------|----------|-------------|----------------|-------------|----------------|-----------------|
| 42   | Ranunculaceae | Onychium japonicum (Thunb.) Kunze / AF-108 | Carrot Fern | H | WP | EX | Internal | Common cold, Dysentery, Jaundice | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        | Farooq (2019) 15:45 |                |     |         |             |                |             |                |                  |
|      |        | Bengtson and Koning 2004 |                |     |         |             |                |             |                |                  |
|      |        | Lacaita./AF-136 |                |     |         |             |                |             |                |                  |
|      |        | Takeda et al. 1989 |                |     |         |             |                |             |                |                  |
|      |        | Jungli dhaniya | Jungli dhaniya | H | WP | EX | Internal | Asthma, Arthritis, Hay fever | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        | L./AF-112 |                |     |         |             |                |             |                |                  |
|      |        | Kor kandoli | Kor kandoli | H | AP | CK | Internal | Asthma | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        | L./AF-120 |                |     |         |             |                |             |                |                  |
|      |        | Pteris vittata Cretan brake | Cretan brake | H | FD | PA | External | *Bone Fracture | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        |              |                |     |         |             |                |             |                |                  |
|      |        | Pteris vittata L./AF-45 | Nanore | H | WP | PA | External | *Bone Fracture | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        |              |                |     |         |             |                |             |                |                  |
| 43   | Rosaceae | Duchesnea indica (Andrews) Teschem./AF-39 | Budimeva/ Surkh Akhtra | H | FR | ET | Internal | *Kidney stone | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        |              |                |     |         |             |                |             |                |                  |
|      |        | Fraga ria nubicola (Hook. f) Lind.l.ex Lacaita./AF-136 | Budi meva | H | RT | PD | Internal | Urinary disorder | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        |              |                |     |         |             |                |             |                |                  |
|      |        | Fraga ria vesca L./AF-91 | Budi meva | H | LF | DE | Internal | *Mouth ulcer, *Gum inflammation | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        |              |                |     |         |             |                |             |                |                  |
|      |        | Prunus persica (L.) Batsch./AF-75 | Aru | T | LF | JU | Internal | To kill intestinal worms, Whooping cough | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        |              |                |     |         |             |                |             |                |                  |
|      |        | Pyrus malus L./AF-98 | Saib | T | FR | JU | Internal | Body weakness, Joint problems, *Heart disease Hypertension, *Gout | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        |              |                |     |         |             |                |             |                |                  |
|      |        | Pyrus pashia Bach.-Ham.ex D. Don. /AF-85 | Tangi | T | FR | ET | Internal | Dark circles around eyes | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
| Sr # | Family        | Nomenclature                          | Habit   | Medicinal uses                                      | Previous reports |
|-----|---------------|---------------------------------------|---------|----------------------------------------------------|------------------|
|     |               | Scientific name                       |         | Part used                                          |                  |
|     |               | Local name                            |         | Preparation                                      |                  |
|     |               |                                      |         | Application | Disease treated                                |                  |
| 47  | Sapindaceae   | Aesculus indica                      | IN      | Internal  | *Blood purification                              | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17 |
|     |               | L./AF-103                             |         | FL        | Constipation                                      | 18, 22           |
|     |               | Jangli Gulab/Chal                     | S       | PD        | Skin infection                                    |                  |
| 48  | Rutaceae      | Rubus fruticosus                      | EX      | Internal  | *Tonic                                            | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 |
|     |               | L./AF-54                              | S       | ET        | *Sore throat                                      | 16, 17, 18, 19, 20, 21, 22, 23 |
|     |               | Kanachi                               |         | Internal  | Dianea, *Bleeding                                 |                  |
| 49  | Solanaceae    | Solanum nigrum                       | EX/PD   | Internal  | *To remove Tapeworms                              | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16 |
|     |               | L./AF-109                             | H       | LE        | Mouth ulcer                                       |                  |
| 39  | Simaroubaceae  | Alantus altissima                     | IN      | Internal  | *Dysentery                                        | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|     |               | (Mill.) Swingle/AF-1                  |         | EX        | *Anemia                                           |                  |
|     |               |                                      |         | FR        | *Dysentery, *Bloody stools                        |                  |
|     |               | Banakhorin                           | IN      | Internal  | *Gout disease                                     |                  |
|     |               | (Wall. ex Cambess.) Hook/AF-5         |         | SD        | *Gout                                             |                  |
|     |               |                                      |         | Oil       | Dysentery, Arthritis                              |                  |
|     |               |                                      |         | FR        | Indigestion                                       |                  |
|     |               |                                      |         | PD        | To reduce pain, Fever                             |                  |
|     |               |                                      |         | LF        | Tov remove swelling                               |                  |
|     |               |                                      |         | DE        | Stomach disease, To kill intestine worms, Fever   |                  |
|     |               |                                      |         |           | *Antiviral                                        |                  |
| 50  | Solanaceae    | Solanum nigrum                       | ET      | Internal  | *To remove Tapeworms                              | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|     |               | L./AF-109                             | H       | LE        | Mouth ulcer                                       |                  |
|     |               | Kach Mach                            |         | EX/PD     | *Gout, Stomach worm                               |                  |
|     |               |                                      |         |           | Skin disorders                                    |                  |
| 44  | Rubiaceae     | Rubia cordifolia                      | IN      | Internal  | *Blood purifier                                   | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 |
|     |               | L./AF-71                             | C       | PD        | Cough                                             |                  |
|     |               | Chero                                |         | External  | *Broken Bones                                     |                  |
|     |               |                                      |         | EX        | Wound healing, *Antitumor                         |                  |
| 45  | Rutaceae      | Zanthoxylum alatum                    | IN      | Internal  | Whooping cough, Dysentery                         | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|     |               | Roxb./AF-12                          |         | TW        | Fever, *Indigestion                               |                  |
|     |               | Timbar                               |         | RB        | Fever                                             |                  |
|     |               |                                      |         | FR        | *Peptic ulcer                                     |                  |
|     |               |                                      |         | SD        | Wound healing, *Antitumor                         |                  |
| 46  | Salicaceae    | Salix nigra                          | PO      | External  | Stomach disease, To kill intestine worms, Fever   | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|     |               | Marshall/AF-96                       | T       | PD        | Dysentery, Arthritis                              |                  |
|     |               | Bees                                 |         | Internal  | *Antiviral                                        |                  |
|     |               |                                      |         |             | Tov remove swelling                               |                  |
| 47  | Sapindaceae   | Aesculus indica                      | IN      | Internal  | *Fever                                            | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|     |               | (Wall. ex Cambess.) Hook/AF-5        |         | SD        | *Gout disease                                     |                  |
|     |               | Banakhorin                           | T       | Oil       | Dysentery, Arthritis                              |                  |
|     |               |                                      |         | FR        | Indigestion                                       |                  |
| 48  | Simaroubaceae  | Alantus altissima                     | IN      | Internal  | *Anemia                                           |                  |
|     |               | (Mill.) Swingle/AF-1                  |         | EX        | *Dysentery, *Bloody stools                        |                  |
|     |               |                                      |         | FR        | *Dysentery, *Bloody stools                        |                  |
| 49  | Solanaceae    | Solanum nigrum                       | ET      | Internal  | *To remove Tapeworms                              | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|     |               | L./AF-109                             | H       | LE        | Mouth ulcer                                       |                  |
species belonging to the abovementioned families contain a variety of secondary metabolites and possess significant bioactivities, pharmacological, and organoleptic properties [79]. Floristic distribution of plant species in different families was analogous to previous reports from Pakistan and around the world [20, 36, 37, 74, 80–82].

### Plant part(s) used

Data presented in Fig. 5 revealed that local inhabitants of the study area use 15 different parts of plants in making recipes to treat various diseases. Among these, leaves were the most abundantly utilized plant parts with percentage contribution of 29%, followed by whole plants (21%) and root (13%), fruit (8%), seed (6%), and flowers (5%) contribution, whereas the use of aerial parts, bark, branches, stem, and latex etc. were less than 5%. Abundant availability and easy collection or harvesting of leaves make them highly utilized plant parts [4, 61, 72, 83]. Moreover, leaves also contain a high concentration of health-beneficial secondary metabolites, phytochemicals, and essential oils, which contribute significantly to phytotherapy or treatment of various health disorders [15, 75, 84]. Likewise, roots are storage parts of plant species also rich in bioactive constituents compared to other parts [4, 85, 86], which therefore possess more health-beneficial properties if collected in the proper time. However, previous studies revealed that majority of the researchers supported the use of leaves than roots, because eradication of roots may lead to serious

### Table 2 Medicinal uses of the reported taxa and their comparison with previous reports (Continued)

| Sr # | Family | Nomenclature | Habit | Preparation | Activity | Medicinal uses | Disease treated | Previous reports |
|------|--------|--------------|-------|-------------|----------|---------------|----------------|------------------|
| 50   | Thymelaeaceae | Daphne papyracea | Lokat Patr | RT | Internal | Intestinal complaints | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        | Wallex G. Don. /AF-53 |       | LE | External | Swelling, Tumor | 1, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        | Wikstroemia canescens Wall. ex Meisn./AF-117 | Chianthi | AP | DE | Internal | Abortifacient | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
| 51   | Urticaceae | Debregeasia salicifolia (D. Don) Rendle. /AF-99 | Sindwari | LE | Powder | External | Skin diseases | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
| 52   | Valerianaceae | Valerianella muricata (Steven ex Roem. & Schult.) W.H. Baxter./AF-47 | Cornsalad | LF | EX | Internal | Nerve complaints | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
| 53   | Verbenaceae | Verbena officinalis L./AF-138 | Neeli Booti | RT | JU | Internal | *Stomachache, *Snake bite | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        |            |       | WP | DE | Internal | *Dropy | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        |            |       | SH | PA | External | *Swellen gums | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
| 54   | Violaceae | Viola canescens Wall. /AF-81 | Banafsha | WP | JU | Internal | Antipyretic, *High Blood pressure, Asthma, Cough, *Flue, *Eye diseases, Stomachache, Liver disease | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        |            |       | FL | JU | Internal | Cough, Insomnia | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
| 55   | Vitaceae | Vitis jacquemontii R. Parker/AF-24 | Dakh/Dalore/ Jungli Angoor | FR | ET | Internal | Tonic, Constipation, Laxative | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |
|      |        |            |       | ST | JU | Internal | Internal fever | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 |

Habit: H, herbs, S shrubs, T trees, C climber, E epiphyte; 2. Part(s) used: LE leaf, FR fruit, RT Root, ST stem, AP aerial Parts, ND needles, WP whole Plant, FD fronds, SD seed, PL flower, BA bark, BL bulb, RH rhizome, IN infusion, PL pollen, TW twig, SH shoot, LX latex, LB leaf bud, GL galls, BR branches, FP floral parts, RS resin. 3. Method of preparation: PD powder, DE decoction, EX extract, PA paste, JU juice, PD poultice, IN infusion, HB hot rubbing, CH chewed, VG vegetable, TE tea, RB rubbing, ET eaten, CK cooked, HB hot beverage. * = plants with similar use; ( ) = plants with dissimilar use; ( ) = plants not reported in a previous study; Condition/ailment written in bold indicate the most preferred use for a given plant; *Plant uses, which are not reported in a previous study. 1: Ahmad et al. [20]; 2: Hussain et al. [60]; 3: Shaheen et al. [61]; 4: Amjad et al. [59]; 5: Ajaib et al. [62]; 6: Safeer et al. [63]; 7: Shabir et al. [64]; 8: Ahmad and Habib, [65]; 9: Qaseem et al. [66]; 10: Khan et al. [67]; 11: Wali et al. [68]; 12: Ijaz et al. [69]; 13: Hussain et al. [70]; 14: Aziz et al. [71]; 15: Ahmad et al. [39]; 16: Aziz et al. [50]; 17: Gulzar et al. [49]; 18: Umair et al. [36]; 19: Zahir et al. [72]; 20: Kayani et al. [38]; 21: Umair et al. [73]; 22: Fatima et al. [74]
Fig. 3 Life form distribution pattern of the reported plant species in the study area

Fig. 4 Top ranked families with number of species
conservation threats to various plant species particularly those which are highly utilized [60, 87, 88]. Moreover, it is not an easy job to collect the roots of woody and deep-rooted plants [39]. The frequent utilization of the whole plant in preparation of herbal remedies confirmed the abundant utilization of herbs in the investigated area as the whole plant can be used only in the case of herbs.

**Herbal preparation and administration**

Decoction was the widespread used method in the study area for herbal preparation with percentage contribution of 19%, followed by extract, powder, and juice used in 18, 12, and 11% preparations of traditional recipes, respectively (Fig. 6). The frequent use of decoction had also been reported previously [36, 39, 53, 73, 81, 89, 90]. This confirms that making decoction is a very simple
and easy way used for herbal preparation with more health benefits [91]. In decoction form, the efficacy of herbal remedies increases due to the maximum extraction of health-beneficial secondary metabolites and other bioactive compounds, which is accelerated on heating [92]. Taste of medicines can be adjusted by adding honey or sugar to make it more pleasant [39, 93]. Inhabitants of the study area use 63% of the herbal preparations as oral intake, whereas rest 37% were applied topically. These results were analogous to previous reports [36, 67, 68, 72, 94, 95]. Poultice, rubbing, and paste were common topical methods as reported in previous studies [51, 96]. In oral mode of administration, plant materials were mainly ingested as a decoction or in powder form with water, milk, or honey. These results are analogous to the previous findings [49, 97]. Oral intake of herbal preparation is usually effective for the treatment of internal diseases, while for external diseases, i.e., skin infections, joint pain, hemorrhoid, and stings, were treated by topical application of the drug. These observations were in agreement with previous reports [98].

**Informant consensus factor**

Different diseases reported from Dhirkot were classified into 16 categories to develop the consensus of informants on medicinal plants following WHO’s international categorization of ailments [99]. As mentioned in Fig. 7, informant consensus factor (ICF) values ranged from 0.64 to 0.88 with the highest level of 0.88 for gastrointestinal disorders and liver diseases. Prevalence of gastrointestinal disorders is mainly attributed to poor hygiene conditions, inadequate supply of pure drinking water, and consumption of contaminated food [100, 101]. *Allium cepa, Allium sativum, Mentha arvensis, Mentha longifolia, Viola canescens, Vitis jacquemontii,* and *Zanthoxylum alatum* were among the most frequently utilized plant species to treat digestive system and liver diseases in the study area. Likewise, more consumption of a high-calorie fatty diet in the local communities and changing lifestyle could be the possible reasons of liver diseases in the study area. Our data revealed that around 90 plant species with 743 used reports were used to treat liver disorders. The plant species used to treat digestive and liver diseases have been reported as a rich source of flavonoids, toxol, vitamins, and essential oils along with other bioactive phytochemicals [102, 103]. Additionally, inhabitants of the study area have traditional knowledge due to more interaction with these plant species, particularly used to treat digestive and liver disorders. Comparative assessment with previous studies exposed that many workers have also reported the highest ICF for digestive problems [61, 70, 71, 81, 104, 105].

The second highest ICF value viz. 0.84 was calculated for respiratory tract and throat diseases. Different factors such as sudden changes in weather, poor hygiene conditions, a high proportion of cold, moisture, germs, and spores may cause abnormalities in the respiratory track [51, 81]. *Swertia cordata, Trifolium pretense, Viola*
canescens, Elaeagnus umbellate, and Achyranthes aspera were among the commonly utilized plant species for the treatment of respiratory infections. In our study, the high ICF value for skin disease might be due to the fact that local inhabitants residing in mountains at a higher altitude are more exposed to UV radiations along with other pathogenic attacks that may lead to chronic skin diseases and infections [106–108]. The most common species used to treat skin diseases were Adiantum caudatum, Ajuga bracteosa, Achillea millefolium, Berberis lyicum, Cedrus deodara, Cynodon dactylon, Daphne papyracea, Debregeasia salicina, Ficus carica, Ficus palmate, and Gerbera gossypina.

Muscular and joint diseases are also common in the study area, which might be due to stress, minor injuries, and unhealthy food. Inhabitants of the study area use Ricinus communis, Rubia cordifolia, Salix nigra, Sarcococca saligna, and Sigesbeckia orientalis to treat joint and muscular problems. Urinary and reproductive system diseases are also common due to the unawareness and excessive use of medications. Moreover, abnormality in hormonal production, malnutrition, and environmental factor may cause reproductive disorders. The inhabitants of the study area use Saccharum spontaneum, Sarcococca saligna, Sorghum halepense, Trifolium pretense, Wikstroemia canescens, Eriophorum comosum to treat reproductive disorders. The lowest ICF value was calculated for hair problems (0.64) and 9 species including Allium cepa, Allium sativum, Melia azadarach, Olea ferruginea, and Ricinus communis were used to treat this disease with 23 use reports.

Relative importance
RI of plant species is a useful parameter to measure their adaptability. Data presented in Table 3, indicates that RI values of the reported species varied from 12.14–92.90, which were comparable with previous reports [80]. The highest RI value was calculated for Viola canescens (92.86), followed by Chenopodium ambrosioides, Pinus roxburghii, Conyza Canadensis, Jasminum grandiflorum (90.00, 82.86, 77.86, and 77.86, respectively), whereas Pyrus malus, Galinsoga parviflora, and Hydrocotyle spp. have the same RI value (70.71 each). Plants with the highest RI indicate that they are primarily used by the inhabitants of the area and possess strong pharmacological properties [59] and their importance increases when it is used to cure more infirmities [109].

Relative frequency of citation
Relative frequency of citation (RFC) indicates the native importance of each plant species with respect to informants who reported the uses of these species [5]. The RFC value of reported species ranged from 0.1 to 0.92 (Table 3). The highest RFC was calculated for Viola canescens (0.92) and, subsequently, Mentha arvensis (0.88), Berberis lyicum (0.86), Achyranthes aspera (0.85), Taraxacum officinale (0.85), Zanthoxylum alatum (0.82), Pinus roxburghii (0.80), Pyrus malus (0.80), Achillea millefolium (0.77), and Prunus persica (0.77). The high RFC value of these species indicates that inhabitants of the study area have a close association with these plant species and frequently use them to treat various diseases. The RFC data may contribute significantly to understand the importance of a plant species within an area, to conserve plant species having maximum RFC, and for biological, pharmacological, and phytochemical screening of such species. The high RFC of Viola canescens indicates that this species is commonly utilized by local communities to treat various health disorders. This leads to over-exploitation of this species in the study area indicating a high conservation threat and may lead to extension into the future if not conserved immediately. Likewise, some plants having high RFC are rare in the study area and vice versa. For example, Rauwolfia serpentina is a rare plant in the study area but had a high FC (FC-43) value.

Use value
The use value (UV) index was used to measure the ethnomedicinal uses associated with documented medicinal plant species and is ranged from 0.11–1.7 (Table 3). The highest UV was reported for Viola canescens (1.7), followed by Achyranthes aspera (1.3), Achillea millefolium (0.96), Mentha arvensis (0.96), Ajuga bracteosa (0.93), Pinus roxburghii (0.9), Pyrus pashia (0.90), Prunus persica (0.89), Punica granatum (0.89) Allium cepa (0.88), and Prunella vulgaris (0.88). The high usage of the reported species indicates a strong association and dependence of local communities on surrounding flora, specifically for the treatment of various diseases and as food and livelihoods [51]. Moreover, the plant species which are used excessively are assumed to be biologically more active; therefore these should be subjected to phytochemical and pharmacological screening to increase sustainable utilization and conservation of plant resources [110].

Fidelity level
FL identifies the most preferred plant species used by traditional healers to cure various diseases and shows the proportion of informants reporting the use of specific plant species. The FL level of reported species was ranged from 15.8–100%. Figure 8 shows some top-ranked species with FL above 90%. Among these, five plant species which include Berberis lyceum, Mentha arvensis, Pyrus malus, Taraxacum officinale, and Viola canescens (for wound healing, to treat gastrointestinal disorders, body weakness, diabetes, and cough, respectively) have 100% fidelity level, whereas Morus alba had
| Sr.# | Scientific name          | Rel. PH | Rel. BS | RI    | FC    | RFC    | UV    |
|------|--------------------------|---------|---------|-------|-------|--------|-------|
| 1    | *Acacia nilotica*        | 0.50    | 0.57    | 53.57 | 31.0  | 0.42   | 0.70  |
| 2    | *Achillea millefolium*   | 0.60    | 0.57    | 58.6  | 57.0  | 0.77   | 0.96  |
| 3    | *Achyranthes aspera*     | 0.40    | 0.57    | 48.6  | 63.0  | 0.85   | 1.30  |
| 4    | *Adiantum caudatum*      | 0.50    | 0.57    | 53.6  | 29.0  | 0.40   | 0.73  |
| 5    | *Adiantum tenerum*       | 0.50    | 0.57    | 53.6  | 22.0  | 0.30   | 0.65  |
| 6    | *Aesculus indica*        | 0.30    | 0.43    | 36.4  | 19.0  | 0.26   | 0.54  |
| 7    | *Allanthis altissima*    | 0.50    | 0.29    | 39.3  | 21.0  | 0.30   | 0.42  |
| 8    | *Ajuga bracteosa*        | 0.40    | 0.29    | 34.3  | 54.0  | 0.73   | 0.93  |
| 9    | *Ajuga parviflora*       | 0.30    | 0.43    | 36.4  | 28.0  | 0.38   | 0.55  |
| 10   | *Allium cepa*            | 0.40    | 0.43    | 41.4  | 49.0  | 0.66   | 0.88  |
| 11   | *Allium sativum*         | 0.50    | 0.29    | 60.7  | 51.0  | 0.70   | 0.82  |
| 12   | *Amaranthus viridis*     | 0.30    | 0.43    | 36.4  | 30.0  | 0.40   | 0.61  |
| 13   | *Androsace ratiundifolia*| 0.30    | 0.43    | 39.3  | 39.0  | 0.53   | 0.74  |
| 14   | *Arthroxon prionodes*    | 0.20    | 0.29    | 24.3  | 11.0  | 0.15   | 0.20  |
| 15   | *Aristida cumantha*      | 0.30    | 0.29    | 29.3  | 20.0  | 0.30   | 0.35  |
| 16   | *Artemisia vulgaris*      | 0.20    | 0.29    | 24.3  | 53.0  | 0.72   | 0.83  |
| 17   | *Asplenium dalhousiae*   | 0.40    | 0.43    | 41.4  | 29.0  | 0.40   | 0.54  |
| 18   | *Berberis lycium*        | 0.50    | 0.71    | 60.7  | 64.0  | 0.86   | 1.30  |
| 19   | *Bidens biternata*       | 0.20    | 0.14    | 17.1  | 39.0  | 0.53   | 0.65  |
| 20   | *Bromus catharticus*     | 0.20    | 0.29    | 24.3  | 10.0  | 0.13   | 0.22  |
| 21   | *Campanula pallida*      | 0.20    | 0.14    | 17.3  | 14.0  | 0.19   | 0.26  |
| 22   | *Cannabis sativa*        | 0.20    | 0.29    | 24.3  | 24.0  | 0.32   | 0.55  |
| 23   | *Capsella bursa-pastoris*| 0.30    | 0.43    | 36.4  | 33.0  | 0.44   | 0.62  |
| 24   | *Carpesium cernuum*      | 0.60    | 0.57    | 58.6  | 23.0  | 0.31   | 0.42  |
| 25   | *Cedrus deodara*         | 0.60    | 0.57    | 58.6  | 17.0  | 0.23   | 0.54  |
| 26   | *Chenopodium ambrosioides*| 0.80    | 1.00    | 90.0  | 36.0  | 0.50   | 0.72  |
| 27   | *Chrysoogonon grilus*    | 0.10    | 0.14    | 12.1  | 8.0   | 0.11   | 0.11  |
| 28   | *Cichorium intybus*      | 0.70    | 0.43    | 56.4  | 39.0  | 0.53   | 0.23  |
| 29   | *Cirsium vulgare*        | 0.30    | 0.43    | 36.4  | 19.0  | 0.26   | 0.46  |
| 30   | *Clematis grata*         | 0.20    | 0.29    | 24.3  | 23.0  | 0.39   | 0.40  |
| 31   | *Convolvulus arvensis*   | 0.20    | 0.29    | 24.3  | 15.0  | 0.20   | 0.31  |
| 32   | *Coryza canadensis*      | 0.70    | 0.86    | 77.9  | 43.0  | 0.60   | 0.70  |
| 33   | *Cymbopogon martini*     | 0.50    | 0.43    | 46.4  | 13.0  | 0.20   | 0.30  |
| 34   | *Cynodon dactylon*       | 0.50    | 0.57    | 53.6  | 37.0  | 0.50   | 0.62  |
| 35   | *Cynoglossum lanceolatum*| 0.50    | 0.29    | 39.3  | 42.0  | 0.60   | 0.76  |
| 36   | *Cyperus serotinus*      | 0.20    | 0.29    | 24.3  | 11.0  | 0.15   | 0.20  |
| 37   | *Dactylis glomerata*     | 0.50    | 0.57    | 53.6  | 23.0  | 0.31   | 0.40  |
| 38   | *Daphne papyracea*       | 0.40    | 0.57    | 48.6  | 16.0  | 0.22   | 0.32  |
| 39   | *Debregeasia salicifolia*| 0.30    | 0.29    | 29.3  | 20.0  | 0.30   | 0.44  |
| 40   | *Desmodium elegans*      | 0.60    | 0.71    | 65.7  | 26.0  | 0.35   | 0.67  |
| 41   | *Dichanthium annulatum*  | 0.30    | 0.43    | 36.4  | 12.0  | 0.20   | 0.30  |
| 42   | *Dichloptera roxburghiana*| 0.30   | 0.43    | 36.4  | 32.0  | 0.43   | 0.52  |
| 43   | *Diospyros lotus*        | 0.30    | 0.43    | 41.4  | 41.0  | 0.55   | 0.72  |
| 44   | *Dryopteris filix-mas*   | 0.50    | 0.43    | 46.4  | 25.0  | 0.34   | 0.46  |
Table 3 Quantitative analysis of ethnobotanical data (Continued)

| Sr.# | Scientific name          | Rel. PH | Rel. BS | RI  | FC  | RFC | UV  |
|------|---------------------------|---------|---------|-----|-----|-----|-----|
| 45   | Duchesnea indica          | 0.30    | 0.43    | 36.4| 29.0| 0.40| 0.54|
| 46   | Elaeagnus umbellata       | 0.40    | 0.29    | 34.3| 44.0| 0.60| 0.80|
| 47   | Eleusine indica           | 0.30    | 0.43    | 36.4| 10.0| 0.13| 0.20|
| 48   | Eriophorum comosum        | 0.20    | 0.29    | 24.3| 8.0 | 0.10| 0.14|
| 49   | Euphorbia indica          | 0.50    | 0.43    | 46.4| 26.0| 0.35| 0.63|
| 50   | Euphorbia prostrata       | 0.40    | 0.29    | 34.3| 19.0| 0.26| 0.50|
| 51   | Ficus carica              | 0.60    | 0.71    | 65.7| 48.0| 0.65| 0.78|
| 52   | Ficus palmata             | 0.50    | 0.43    | 46.4| 53.0| 0.72| 0.85|
| 53   | Fragaria nubicola         | 0.40    | 0.57    | 48.6| 27.0| 0.36| 0.53|
| 54   | Fragaria vesca            | 0.40    | 0.43    | 41.4| 33.0| 0.44| 0.55|
| 55   | Galinsoga parviflora      | 0.70    | 0.71    | 70.7| 22.0| 0.30| 0.61|
| 56   | Gentianodes olivieri      | 0.30    | 0.43    | 36.4| 12.0| 0.16| 0.23|
| 57   | Gerbera gossypina         | 0.30    | 0.29    | 29.3| 29.0| 0.40| 0.63|
| 58   | Hedera nepalensis         | 0.30    | 0.29    | 29.3| 32.0| 0.43| 0.51|
| 59   | Hydrocotyle spp.          | 0.70    | 0.71    | 70.7| 26.0| 0.35| 0.55|
| 60   | Hypericum perforatum      | 0.70    | 0.43    | 56.4| 37.0| 0.50| 0.62|
| 61   | Impatiens edgeworthii     | 0.30    | 0.43    | 36.4| 11.0| 0.15| 0.34|
| 62   | Impatiens glandulifera    | 0.30    | 0.43    | 36.4| 19.0| 0.26| 0.42|
| 63   | Indigofera heterantha     | 0.20    | 0.29    | 24.3| 19.0| 0.26| 0.42|
| 64   | Inula spp.                | 0.40    | 0.57    | 48.6| 21.0| 0.29| 0.46|
| 65   | Ipomoea purpurea          | 0.60    | 0.57    | 58.6| 34.0| 0.46| 0.55|
| 66   | Isodon rugosus            | 0.50    | 0.29    | 39.3| 40.0| 0.54| 0.70|
| 67   | Jasminum grandiflorum     | 0.70    | 0.86    | 77.9| 54.0| 0.73| 0.82|
| 68   | Justicia vahlii           | 0.10    | 0.14    | 12.1| 9.0 | 0.12| 0.15|
| 69   | Lespedeza juncea          | 0.40    | 0.43    | 41.4| 22.0| 0.30| 0.40|
| 70   | Machilus odoratissimus    | 0.30    | 0.43    | 36.4| 16.0| 0.23| 0.34|
| 71   | Malva parviflora          | 0.40    | 0.57    | 48.6| 44.0| 0.60| 0.76|
| 72   | Maticaria matricariaoides | 0.50    | 0.43    | 46.4| 23.0| 0.31| 0.40|
| 73   | Medicago lupulina         | 0.20    | 0.29    | 24.3| 34.0| 0.46| 0.54|
| 74   | Melia azedarach           | 0.50    | 0.71    | 60.7| 50.0| 0.70| 0.76|
| 75   | Mentha arvensis           | 0.50    | 0.14    | 32.1| 65.0| 0.88| 0.96|
| 76   | Mentha longifolia         | 0.40    | 0.29    | 34.3| 53.0| 0.72| 0.82|
| 77   | Micromeria biflora        | 0.30    | 0.43    | 36.4| 20.0| 0.30| 0.35|
| 78   | Morus alba                | 0.30    | 0.43    | 36.4| 38.0| 0.51| 0.62|
| 79   | Myriactis wallichii       | 0.10    | 0.14    | 12.1| 11.0| 0.15| 0.20|
| 80   | Myrsine africana          | 0.40    | 0.43    | 41.4| 53.0| 0.72| 0.82|
| 81   | Nepeta laevigata          | 0.30    | 0.43    | 36.4| 20.0| 0.30| 0.31|
| 82   | Nerium oleander          | 0.30    | 0.43    | 36.4| 43.0| 0.60| 0.81|
| 83   | Oenothera rosea           | 0.20    | 0.29    | 24.3| 36.0| 0.50| 0.60|
| 84   | Olea ferruginea          | 0.40    | 0.57    | 48.6| 52.0| 0.76| 0.82|
| 85   | Onychium japonicum       | 0.40    | 0.43    | 41.4| 18.0| 0.24| 0.42|
| 86   | Oplismenus compositus     | 0.10    | 0.14    | 12.1| 15.0| 0.20| 0.26|
| 87   | Origanum vulgare          | 0.40    | 0.57    | 48.6| 28.0| 0.40| 0.50|
| 88   | Oxalis corniculata        | 0.40    | 0.43    | 41.4| 48.0| 0.65| 0.74|
Table 3 Quantitative analysis of ethnobotanical data (Continued)

| Sr.# | Scientific name               | Rel. PH | Rel. BS | RI   | FC  | RFC | UV  |
|------|-------------------------------|---------|---------|------|-----|-----|-----|
| 89   | Parthenium hysterophorus      | 0.60    | 0.71    | 65.7 | 37.0| 0.50| 0.61|
| 90   | Pennisetum orientale         | 0.10    | 0.14    | 12.1 | 17.0| 0.23| 0.30|
| 91   | Persicaria capitata           | 0.60    | 0.71    | 65.7 | 21.0| 0.30| 0.40|
| 92   | Phagnalon rupestre            | 0.40    | 0.43    | 41.4 | 28.0| 0.38| 0.44|
| 93   | Pinus roxburghii              | 0.80    | 0.86    | 82.9 | 57.0| 0.80| 0.90|
| 94   | Pinus wallichina              | 0.50    | 0.57    | 53.6 | 51.0| 0.70| 0.82|
| 95   | Plantago lanceolata           | 0.40    | 0.29    | 34.3 | 43.0| 0.60| 0.76|
| 96   | Planatus orientalis           | 0.50    | 0.57    | 53.6 | 30.0| 0.40| 0.55|
| 97   | Plectranthus rugosus          | 0.20    | 0.29    | 24.3 | 37.0| 0.50| 0.62|
| 98   |Polygonum hydropiper          | 0.60    | 0.71    | 65.7 | 29.0| 0.40| 0.50|
| 99   | Prenanthes brunoniana        | 0.20    | 0.14    | 17.1 | 19.1| 0.26| 0.32|
| 100  | Prunella vulgaris             | 0.40    | 0.57    | 48.6 | 48.0| 0.65| 0.88|
| 101  | Prunus persica                | 0.50    | 0.57    | 53.6 | 57.0| 0.77| 0.89|
| 102  | Pteracanthus articulifolius   | 0.50    | 0.71    | 60.7 | 26.0| 0.35| 0.45|
| 103  | Pteris cretica                | 0.20    | 0.29    | 24.3 | 8.0 | 0.10| 0.15|
| 104  | Pteris vittata                | 0.40    | 0.43    | 41.4 | 13.0| 0.17| 0.26|
| 105  | Punica granatum               | 0.40    | 0.43    | 41.4 | 55.0| 0.74| 0.89|
| 106  | Pyrus malus                   | 0.70    | 0.86    | 77.9 | 58.0| 0.80| 0.87|
| 107  | Pyrus pashia                  | 0.20    | 0.29    | 24.3 | 53.0| 0.72| 0.90|
| 108  | Quercus incana                | 0.50    | 0.71    | 60.7 | 55.0| 0.74| 0.86|
| 109  | Ranunculus arvensis           | 0.50    | 0.71    | 60.7 | 21.0| 0.28| 0.34|
| 110  | Ranunculus muricatus          | 0.30    | 0.43    | 36.4 | 12.0| 0.22| 0.18|
| 111  | Ricinus communis              | 0.60    | 0.71    | 65.7 | 36.0| 0.49| 0.65|
| 112  | Rosa brunonii                 | 0.30    | 0.43    | 36.4 | 45.0| 0.61| 0.77|
| 113  | Rubia cordifolia              | 0.60    | 0.71    | 65.7 | 39.0| 0.53| 0.62|
| 114  | Rubus fruticosus              | 0.40    | 0.57    | 48.6 | 50.0| 0.68| 0.84|
| 115  | Rubus ellipticus              | 0.40    | 0.57    | 48.6 | 42.0| 0.56| 0.62|
| 116  | Rubus niveus                  | 0.50    | 0.71    | 60.7 | 28.0| 0.38| 0.52|
| 117  | Rumex dentatus                | 0.30    | 0.43    | 22.1 | 45.0| 0.61| 0.62|
| 118  | Rumex hastatus                | 0.20    | 0.29    | 24.3 | 40.0| 0.54| 0.69|
| 119  | Saccharum spontaneum          | 0.60    | 0.57    | 58.6 | 24.0| 0.32| 0.43|
| 120  | Salix nigra                   | 0.50    | 0.71    | 60.7 | 30.0| 0.40| 0.49|
| 121  | Salvia lanata                 | 0.50    | 0.43    | 46.4 | 21.0| 0.30| 0.44|
| 122  | Sarcococca saligna            | 0.30    | 0.43    | 36.4 | 18.0| 0.24| 0.31|
| 123  | Setaria viridis               | 0.30    | 0.43    | 36.4 | 15.0| 0.20| 0.26|
| 124  | Sigesbeckia orientalis        | 0.60    | 0.57    | 58.6 | 33.0| 0.44| 0.54|
| 125  | Solanum nigrum                | 0.60    | 0.71    | 65.7 | 54.0| 0.73| 0.85|
| 126  | Sonchus arvensis              | 0.40    | 0.71    | 60.7 | 49.0| 0.70| 0.84|
| 127  | Sonchus oleracicus            | 0.60    | 0.43    | 51.4 | 29.0| 0.40| 0.44|
| 128  | Sorghum halepense             | 0.50    | 0.57    | 53.6 | 12.0| 0.16| 0.20|
| 129  | Swertia cordata               | 0.50    | 0.71    | 60.7 | 49.0| 0.70| 0.84|
| 130  | Swertia paniculata            | 0.30    | 0.43    | 36.4 | 24.0| 0.32| 0.42|
| 131  | Tagetes minuta                | 0.40    | 0.43    | 41.4 | 40.0| 0.54| 0.78|
| 132  | Taraxacum officinale          | 0.50    | 0.29    | 39.3 | 63.0| 0.85| 0.86|
the lowest FL (15.8%) and was used to treat body weakness. These findings elucidate the dominance of specific ailments in the area that are cured with different plant species, particularly having high FL [81]. Plant species having high FL values are extensively used in the area compared to those with less FL values and similar findings have already been reported [35]. These plants are used to cure different ailments since ancient times in combination with other plants or ingredients and could be considered as model plants for pharmacological screening [38]. Despite the fact that modern health facilities are accessible in the study area, local communities especially in the mountainous parts of this region still rely on medicinal plants and possess significant traditional knowledge on plant resource utilization.

**Novel uses**

The comparison of indigenous knowledge on medicinal plants is helpful to determine the difference between region arising due to ecological [111], historical [112], organoleptic and phytochemical differences [71, 113]. The Jaccard index (JI) is a quantitative index used to compare the ethnobotanical data with previous reports, specifically from adjoining areas. In this study, the data was compared with 22 previously published articles. The similarity percentage with the allied area ranges from 2.08–14.9, whereas our findings were dissimilar up to 41.8 from previous data (Table 4). The highest JI value (48.4) was with data reported previous [64] from Devi Galli Azad Kashmir, Pakistan. This similarity was due to the fact that both areas have the same type of vegetation and geography along with a similarity in culture and

---

**Table 3** Quantitative analysis of ethnobotanical data (Continued)

| Sr.# | Scientific name     | Rel. PH | Rel. BS | RI  | FC  | RFC | UV  |
|------|---------------------|---------|---------|-----|-----|-----|-----|
| 133  | *Trifolium pratense* | 0.50    | 0.57    | 53.6| 36.0| 0.49| 0.57|
| 134  | *Valerianella muriaca* | 0.10    | 0.14    | 12.1| 11.0| 0.15| 0.17|
| 135  | *Verbena officinalis* | 0.40    | 0.57    | 48.6| 27.0| 0.36| 0.42|
| 136  | *Viburnum grandiflorum* | 0.20    | 0.14    | 17.1| 22.0| 0.30| 0.34|
| 137  | *Viola canescens*    | 1.00    | 0.86    | 92.9| 68.0| 0.92| 1.70|
| 138  | *Vitis jacquemontii* | 0.40    | 0.43    | 41.4| 16.0| 0.22| 0.31|
| 139  | *Wikstroemia canescens* | 0.10    | 0.14    | 12.1| 9.0 | 0.12| 0.15|
| 140  | *Zanthoxylum alatum* | 0.80    | 0.57    | 68.6| 61.0| 0.82| 0.89|

*Rel. PH* relative number of pharmacological properties attributed to a single plant, *Rel. BS* relative number of body systems treated by a single species, *RI* relative importance, *FC* frequency of citation, *RFC* relative frequency of citation, *UV* use value.

---

**Fig. 8** Top-ranked plant species with above 90% fidelity level
cross-cultural exchange of traditional knowledge among communities. Conversely, our data depicted the lowest similarity (JI = 2.08) with reported ethnomedicinal uses of plant species from Central Punjab, Pakistan [7]. These variations might be due to cultural diversity, geo-climatic conditions, habitat structure, and change on vegetation types of bath areas. More specifically, the origin and culture of local communities have a significant influence on ethno-ecological knowledge.

Comparative analysis of present findings with reported literature revealed some new uses of plant species, which have rarely been documented so far from this region, such as the stem ash of *A. nilotica* is used to treat eye infections. Leaves of *A. bracteosa*, *A. rotundifolia*, *B. lycium*, *I. rugosus*, *P. roxburghii*, and *T. officinale* are used to cure stomach disorders, menstrual problems, and flu and to heal wounds in the form of different formulations (decoction, extract, paste, and powder). Likewise, inhabitants of the study area use fruits of *F. nubicola*, *M. azedarach*, *M. africana*, *O. ferruginea*, and *S. nigrum* for the treatment of diabetes and mouth infections, to remove intestinal worms, and for hair growth (Table 2). Consequently, documenting and comparing such information reflects the considerable intensity of knowledge among local communities, which can provide a novel source of remedial preparation [114] and indicates the high degree of ethnomedicinal novelty in the study area [20, 36].

**Conclusions**

Due to its unique geography and diverse climatic conditions, Dhirkot and its allied areas harbor rich botanical and cultural diversity. Though inhabitants of this area

| Sr. no. | Study area                          | SY | Np | NRP | NPSU | NPDU | TSCBA | SEASA0-18 | SEASA140-18 | PPSU 3/50 x 100 | PPSU 15/50 x 100 | JI  | C |
|---------|-------------------------------------|----|----|-----|------|------|-------|------------|-------------|-----------------|------------------|-----|---|
| A       | Comparison with articles from AJK    |    |    |     |      |      |       |            |             |                 |                  |     |   |
| 1       | Neelum (AJK), Pakistan              | 2017 | 20 | 50 | 3 | 15 | 18 | 32 | 122 | 6.00 | 30.0 | 13.2 | 20 |
| 2       | Bhimber (AJK), Pakistan             | 2013 | 97 | 5 | 20 | 25 | 72 | 115 | 5.15 | 20.62 | 15.4 | 60 |
| 3       | Rawalakot, (AJK), Pakistan          | 2017 | 64 | 136 | 16 | 27 | 43 | 93 | 97 | 11.8 | 19.85 | 29.3 | 61 |
| 4       | Toli Peer National Park, (AJK), Pakistan | 2017 | 64 | 121 | 18 | 24 | 42 | 79 | 98 | 14.9 | 19.8 | 31.1 | 59 |
| 5       | Darguti, Tehsil khuiratta, AJK, Pakistan | 2015 | 100 | 6 | 28 | 34 | 66 | 106 | 6.00 | 28 | 24.6 | 62 |
| 6       | Bagh, (AJK), Pakistan               | 2017 | 34 | 3 | 13 | 16 | 18 | 124 | 8.8 | 38.2 | 12.7 | 63 |
| 7       | Devi Galli Azad Kashmir             | 2017 | 135 | 98 | 6 | 41 | 47 | 51 | 93 | 6.12 | 41.8 | 48.4 | 64 |
| 8       | Neelum, (AJK), Pakistan             | 2014 | 100 | 59 | 2 | 19 | 21 | 38 | 119 | 3.4 | 32.2 | 15.4 | 65 |
| 9       | District Kotli, (AJK), Pakistan     | 2019 | 112 | 80 | 7 | 21 | 28 | 52 | 112 | 8.75 | 26.25 | 20.6 | 66 |
| B       | Comparison with articles from Northern Pakistan |    |    |     |      |      |       |            |             |                 |                  |     |   |
| 10      | Dir Lower, Pakistan                 | 2018 | 87 | 50 | 2 | 20 | 22 | 28 | 118 | 4 | 40 | 17.7 | 67 |
| 11      | Gilgit Baltistan, Pakistan          | 2019 | 146 | 90 | 2 | 14 | 16 | 74 | 124 | 2.2 | 15.5 | 8.80 | 68 |
| 12      | Sarban Hills, Abbottabad, Pakistan  | 2016 | 134 | 74 | 4 | 17 | 21 | 53 | 119 | 5.4 | 22.9 | 13.9 | 69 |
| 13      | Northern Pakistan Afghan borders    | 2018 | 108 | 92 | 2 | 23 | 25 | 67 | 115 | 2.8 | 25 | 16.0 | 70 |
| 14      | Bajaur Agency, Pakistan             | 2017 | 108 | 79 | 5 | 18 | 23 | 55 | 116 | 6.33 | 22.8 | 15.5 | 71 |
| 15      | Chail Valley, District Swat, Pakistan | 2014 | 142 | 50 | 7 | 10 | 17 | 33 | 123 | 14 | 20 | 12.2 | 39 |
| 16      | South Waziristan agency, Pakistan   | 2016 | 113 | 82 | 4 | 17 | 21 | 61 | 119 | 4.88 | 20.7 | 13.2 | 50 |
| 17      | Malakand, KPK, Pakistan             | 2019 | 50 | 3 | 14 | 17 | 33 | 123 | 6 | 28 | 12.2 | 45 |
| C       | Comparison with articles from whole Pakistan |    |    |     |      |      |       |            |             |                 |                  |     |   |
| 18      | Hafizabad district, Punjab, Pakistan | 2017 | 166 | 85 | 7 | 11 | 18 | 67 | 122 | 8.2 | 12.9 | 10.5 | 36 |
| 19      | District Sheikupura, Pakistan       | 2017 | 400 | 96 | 2 | 13 | 15 | 81 | 125 | 2.08 | 13.54 | 7.85 | 72 |
| 20      | Alpine and Sub-alpine regions of Pakistan | 2015 | 290 | 125 | 3 | 12 | 15 | 110 | 125 | 2.4 | 9.6 | 6.80 | 38 |
| 21      | Chenab riverine, Punjab province Pakistan | 2019 | 321 | 129 | 7 | 13 | 20 | 109 | 120 | 5.4 | 10.1 | 9.60 | 73 |
| 22      | Central Punjab-Pakistan             | 2017 | 197 | 72 | 2 | 7 | 9 | 63 | 131 | 2.8 | 9.7 | 4.90 | 74 |

**Table 4** Jaccard index comparing the present study with previous articles

SY study year, Np number of participants, NRP number of reported plant species, NPSU number of planst with similar uses, NPDU number of plants with different uses, TSCBA total species common in both area, SEASA species enlisted in aligned areas, SEASA species enlisted only in study area, PPSU percentage of plant with similar uses, PPDU percentage of plant with different uses, JI Jaccard index, C citation
have a strong association with surrounding flora and fauna, ethnomedical knowledge is at an extreme risk of extinction as it is mainly restricted to traditional healers, midwives, and older people. Consequently, there is a dire need to avoid the extinction of this ethnobotanical heritage that could be attained by the involvement of concerned authorities, conservation managers, and academia. Furthermore, high-value medicinal plant species of this area not only could contribute significantly in the livelihood of the future generations, particularly of this region, but also be a rich source of biomass supply for pharmaceutical industries.

Acknowledgements
Local inhabitants of the study area are gratefully acknowledged for sharing valuable information.

Declaration
Ethnomedical and cultural practices of mammals and birds in the vicinity of river Chenab, Punjab-Pakistan.

Authors’ contributions
AF designed the study and conducted field survey; MSA supervised the project; KA, MA, MU helped in data analysis, interpretation, and preparation/correction of the final draft. All the authors critically read this article and approved it as the final manuscript.

Funding
This paper is a part of a master’s thesis by student Miss Asia Farooq (first author). However, no funding was provided by any source to conduct this survey.

Availability of data and materials
All data have already been included in the manuscript.

Ethics approval and consent to participate
The present study is purely based on a field survey instead of human or animal trails. Therefore, ethical approval and consent to participate is not applicable. However, formal consent was received from informants regarding data collection and publication; then, the Participatory rural appraisal (PRA) approach as mentioned in the Kyoto Protocol was applied with the consent of the informant. Ethical guidelines of the International Society of Ethnobiology (http://www.ethnobiology.net/) were strictly followed.

Consent for publication
The present paper does not contain any individual person’s data; therefore, this section is not applicable to our study.

Competing interests
The authors declare that they have no competing interests.

Author details
1Department of Botany, Women University of Azad Jammu & Kashmir, Bagh, Pakistan. 2Department of Environment Sciences, COMSAT University Islamabad, Abbottabad Campus 22660, Pakistan. 3Department of Zoology, Women University of Azad Jammu & Kashmir, Bagh, Pakistan. 4School of Agriculture and Biology, Shanghai Jiao Tong University, Shanghai 200240, China.

Received: 7 May 2019 Accepted: 6 August 2019
Published online: 30 August 2019

References
1. Heinrich M, Ankli A, Frei B, Weimann C, Sticher O. Medicinal plants in Mexico: healers’ consensus and cultural importance. Soc Sci Med. 1998;47(11):1859–71.
2. Panyapah K, Van On T, Sirira-Ard P, Sirisa-Nga P, ChansaKoow S, Nathakarmkitkul S. Medicinal plants of the mien (Yao) in northern Thailand and their potential value in the primary healthcare of postpartum women. J Ethnopharmacol. 2011;135(2):226–37.
3. Heinrich M. Ethnobotany and its role in drug development. Phytother Res. 2000;14(7):479–88.
4. Srithi K, Babile H, Wangpakapattanawong P, Srisanga P, Trisonthi C. Medicinal plant knowledge and its erosion among the mien (Yao) in northern Thailand. J Ethnopharmacol. 2009;123(2):335–42.
5. Vitalini S, Inti M, Punicelli C, Cuchi D, Segale A, Fico G. Traditional knowledge on medicinal and food plants used in Val san Giacomo (Sondrio, Italy)—an alpine ethnobotanical study. J Ethnopharmacol. 2013;145(2):517–29.
6. Baydoun S, Chalak L, Dalleh H, Arnold N. Ethnopharmacological survey of medicinal plants used in traditional medicine by the communities of mount Hermon, Lebanon. J Ethnopharmacol. 2015;173:139–56.
7. Organization WH. Traditional medicine-growing needs and potential. WHO policy perspectives on medicine, no. 2. In: WHO/EBW/2002. Geneva: WHO; 2002.
8. Haq I. Safety of medicinal plants. Pak J Med Res. 2004;43(4):203–10.
9. Shaikh BT, Hatcher J. Complementary and alternative medicine in Pakistan: prospects and limitations. Evid Based Complement Alternat Med. 2005;2:139–42.
10. Schippmann U, Leaman DJ, Cunningham A. Impact of cultivation and gathering of medicinal plants on biodiversity: global trends and issues. Biodiversity and the ecosystem approach in agriculture, forestry and fisheries. 2002.
11. Shinwari ZK. Medicinal plants research in Pakistan. J Med Plants Res. 2010;4(161):76.
12. Shaikh SH, Malik F, James H, Abdul H. Trends in the use of complementary and alternative medicine in Pakistan: a population-based survey. J Altern Complement Med. 2009;15(5):545–50.
13. Amjad MS, Arshad M. Ethnobotanical inventory and medicinal uses of some important woody plant species of Kotli, Azad Kashmir, Pakistan. Asian Pac J Trop Biomed. 2014;4(1):952–8.
14. Quave CL, Pieroni A. A reservoir of ethnobotanical knowledge informs resilient food security and health strategies in the Balkans. Nature Plants. 2015;1(2):401–9.
15. Amjad MS, Arshad M, Qureshi R. Ethnobotanical inventory and folk uses of indigenous plants from Pir Nasoora National Park, Azad Jammu and Kashmir. Asian Pac. J Trop Biomed. 2015;5(3):234–41.
16. Khan M, Khan MA, Muktaba G, Hussain M. Ethnobotanical study about medicinal plants of Poonch valley Azad Kashmir. J animal plant Sci. 2012;2493–500.
17. Iqtiqam CM, Khan M, Hanif W. An ethnomedicinal inventory of plants used for family planning and sex diseases treatment in Samahni valley (AK) Pakistan. Pak J Biol Sci. 2006;9(14):2546–55.
18. Aklar K. Potential impacts of climate change on plant diversity of hilly areas of Azad Kashmir and their mitigation: a review. J Mt Area Res. 2017;2:37–44.
19. Ajab M, Khan Z, Khan N, Wahab M. Ethnobotanical studies on useful shrubs of district Kotli, Azad Jammu & Kashmir, Pakistan. Pak J Bot. 2010;42(3):1407–15.
20. Ahmad KS, Hamid A, Nawaz F, Jengi A, Afzal N, Wasarat A, MastroS. Ethnopharmacological studies of indigenous plants in Kel village, Neelum Valley, Azad Kashmir, Pakistan. J Ethnobiol Ethnomed. 2017;13(1):18.
21. Goni M, Shahzad R. Medicinal uses of plants with particular reference to the people of Dhirkot, Azad Jammu and Kashmir. Asian Journal of Plant Sciences. 2002.22949–500.
22. Khan RN. Distribution and habitat preference of small mammals in Dhirkot, AJK. M.Sc. Thesis. University of AJK, Muzaffarabad. Muzaffarabad: University of AJK; 2002.
23. Heinrich M, Edwards S, Moerman DE, Leonti M. Ethnopharmacological field studies: a critical assessment of their conceptual basis and methods. J Ethnopharmacol. 2009;124(1):1–17.
24. Jain SK, Rao RR. A handbook of field and herbarium methods. New Delhi: today and tomorrow’s Printers and Publishers; 1977.157p–illus General (KR, 197700062) 1977.
25. Nasir E, Ali S. Flora of West Pakistan Department of Botany. Botany of Karachi, Karachi 1971, 2007:112–115.
26. Ali S, Quaiser M. Flora of Pakistan 194–210. Karachi: Department of Botany, University of Karachi; 1993.
27. Chase MW, Christenusz H, Fay M, Byng J, Judd WS, Soltis D, Mabberley D, Sennikov A, Soltis PS, Stevens PF. An update of the angiosperm phylogeny group classification for the orders and families of flowering plants: APG IV. Bot J Linn Soc. 2016;181(1):1–20.
28. Gardens RB, Kew MBG. The Plant List, Version 1.1. Recuperado el 2013, 2.
29. Kadam P, Bhalerao S. Sample size calculation. Int J Ayurveda Res. 2010;1(1):55–61.
30. Gardens RB, Kew MBG: The Plant List, Version 1.1. Recuperado el 2013, 2.
31. Vijayakumar S, Yabesh JM, Prabhu S, Manikandan R, Muralidharan B. Quantitative ethnomedicinal study of plants used in the Nelliyampathy hills of Kerala, India. J Ethnopharmacol. 2015;161:238–54.
77. Mouterde P, New Flora of Lebanon and Syria Beirut. Catholic Printing. 1983.
78. Zia-Ul-Haq M, Cavar S, Qayyum M, Iman I, Feco VD. Compositional studies: antioxidant and antiatlectic activities of Capparis decidua (Forsk.) Edgew. Int J Mol Sci. 2011;12(2):8846–61.
79. Lulebak E, Kibessu E, Bekele T, Yiniger H. An ethnobotanical study of medicinal plants in Mana Angetu District, southeastern Ethiopia. J Ethnobiol Ethnomed. 2008;4(1):10.
80. Faruque MO, Uddin SB, Barlow JW, Hu S, Dong S, Cai Q, Li X, Hu X. Quantitative ethnobotany of medicinal plants used by indigenous communities in the Bandarban District of Bangladesh. Front Pharmacol. 2018;9:40.
81. Bibi T, Ahmad M, Tareen RB, Tareen NM, Jabeen R, Rehman SU, Sultana S, Zafar M. Gy: ethnobotany of medicinal plants in district Mastung of Balochistan province-Pakistan. J Ethnopharmacol. 2014;147:79–80.
82. Aganal K. RV: some ethnomedical plants of Bhopal district used for treating stone diseases. Int J Pharm Life Sci. 2012;3(3):56–62.
83. Yemele M, Telefo P, Liouo E, Goufo E, Gobeh C, Lembefack M. Moundipa F. Ethnobotanical survey of medicinal plants used for pregnant women’s health conditions in Memoua division-West Cameroon. J Ethnopharmacol. 2015;160:14–31.
84. Bano A, Ahmad M, Hadda TB, Saboor A, Sultana S, Zafar M, Khan MPZ, Arshad M. Ashraf MA. Quantitative ethnomedicinal study of plants used in the skardu valley at high altitude of Karakoram-Himalayan range, Pakistan. J Ethnobiol Ethnomed. 2014;10(1):43.
85. Basualdo I, Zardini EM, Ortz M. Medicinal plants of Paraguay: underground organs, II. Econ Botany. 1995;49(4):387–94.
86. Noctor G, Foyer CH. Ascorbate and glutathione: keeping active oxygen under control. Annu Rev Plant Biol. 1998;49(4):249–79.
87. Bekele G, Reddy PR. Ethnobotanical study of medicinal plants used to treat human ailments by Guji Oromo tribes in Abaya District, Borana, Oromia, Ethiopia. Univ J Plant Sci. 2015;3(1):1–8.
88. Pascaline J, Charles M, George O, Lukohia C. An inventory of medicinal plants that the people of Nandi use to treat malaria. J Anim Plant Sci. 2013;11(192–200).
89. Nondo RS, Zofou D, Mochi ML, Erasto P, Warji S, Nwemgeny MN, Tantanji VP, Kidukuli AW, Masimba PJ. Ethnobotanical survey and in vitro antiplasmodial activity of medicinal plants used to treat malaria in Kagera and Lindi regions, Tanzania. J Med Plants Res. 2015;9(6):179–92.
90. Gürdal B, Kütürc Ş. An ethnobotanical study of medicinal plants in Marmaris (Muğla, Turkey). J Ethnopharmacol. 2013;146(1):113–26.
91. El Amri J, El Badaoui K, Zair T, Bouharb H, Chakir S, Alaoui T. Ethnobotanical study of medicinal plants in the region El Hajeb (Central Morocco). J Res Biol. 2015;4(8):1568–80.
92. Li W-F, Jiang J-G, Chen J. Chinese medicine and its modernization. Organ-mac-mayan ethnic groups. J Ethnopharmacol. 2003;88:119–200.
93. Luitel DR, Rokaya MB, Timsina B, Münzbergová Z. Medicinal plants used by indigenous and tribal people in Rangamati, Bangladesh. J Ethnobiol Ethnomed. 2014;10(1):5.
94. Tuliraj K, Kidukuli AW, Masimba PJ. Ethnobotanical survey and in vitro antiplasmodial activity of medicinal plants used to treat malaria in Kagera and Lindi regions, Tanzania. J Med Plants Res. 2015;9(6):179–92.
95. Gürdal B, Kültür Ş. An ethnobotanical study of medicinal plants in Marmaris (Muğla, Turkey). J Ethnopharmacol. 2013;146(1):113–26.
96. El Amri J, El Badaoui K, Zair T, Bouharb H, Chakir S, Alaoui T. Ethnobotanical study of medicinal plants in the region El Hajeb (Central Morocco). J Res Biol. 2015;4(8):1568–80.
97. Li W-F, Jiang J-G, Chen J. Chinese medicine and its modernization. Organ-mac-mayan ethnic groups. J Ethnopharmacol. 2003;88:119–200.
98. Noctor G, Foyer CH. Ascorbate and glutathione: keeping active oxygen under control. Annu Rev Plant Biol. 1998;49(4):249–79.
99. Bekele G, Reddy PR. Ethnobotanical study of medicinal plants used to treat human ailments by Guji Oromo tribes in Abaya District, Borana, Oromia, Ethiopia. Univ J Plant Sci. 2015;3(1):1–8.
100. Pascaline J, Charles M, George O, Lukohia C. An inventory of medicinal plants that the people of Nandi use to treat malaria. J Anim Plant Sci. 2013;11(192–200).
101. Nondo RS, Zofou O, Mochi M, Erasto P, Warji S, Nwemgeny M, Tantanji V, Kidukuli A, Masimba P. J Ethnobotanical survey and in vitro antiplasmodial activity of medicinal plants used to treat malaria in Kagera and Lindi regions, Tanzania. J Med Plants Res. 2015;9(6):179–92.
102. Gürdal B, Kültür Ş. An ethnobotanical study of medicinal plants in Marmaris (Muğla, Turkey). J Ethnopharmacol. 2013;146(1):113–26.
103. El Amri J, El Badaoui K, Zair T, Bouharb H, Chakir S, Alaoui T. Ethnobotanical study of medicinal plants in the region El Hajeb (Central Morocco). J Res Biol. 2015;4(8):1568–80.
104. Li W-F, Jiang J-G, Chen J. Chinese medicine and its modernization. Organ-mac-mayan ethnic groups. J Ethnopharmacol. 2003;88:119–200.
105. Luitel DR, Rokaya MB, Timsina B, Münzbergová Z. Medicinal plants used by indigenous and tribal people in Rangamati, Bangladesh. J Ethnobiol Ethnomed. 2014;10(1):5.
106. Tuliraj K, Kidukuli AW, Masimba PJ. Ethnobotanical survey and in vitro antiplasmodial activity of medicinal plants used to treat malaria in Kagera and Lindi regions, Tanzania. J Med Plants Res. 2015;9(6):179–92.
107. Gürdal B, Kültür Ş. An ethnobotanical study of medicinal plants in Marmaris (Muğla, Turkey). J Ethnopharmacol. 2013;146(1):113–26.
108. El Amri J, El Badaoui K, Zair T, Bouharb H, Chakir S, Alaoui T. Ethnobotanical study of medicinal plants in the region El Hajeb (Central Morocco). J Res Biol. 2015;4(8):1568–80.
109. Li W-F, Jiang J-G, Chen J. Chinese medicine and its modernization. Organ-mac-mayan ethnic groups. J Ethnopharmacol. 2003;88:119–200.
110. Luitel DR, Rokaya MB, Timsina B, Münzbergová Z. Medicinal plants used by indigenous and tribal people in Rangamati, Bangladesh. J Ethnobiol Ethnomed. 2014;10(1):5.
111. Gürdal B, Kültür Ş. An ethnobotanical study of medicinal plants in Marmaris (Muğla, Turkey). J Ethnopharmacol. 2013;146(1):113–26.
112. El Amri J, El Badaoui K, Zair T, Bouharb H, Chakir S, Alaoui T. Ethnobotanical study of medicinal plants in the region El Hajeb (Central Morocco). J Res Biol. 2015;4(8):1568–80.
113. Li W-F, Jiang J-G, Chen J. Chinese medicine and its modernization. Organ-mac-mayan ethnic groups. J Ethnopharmacol. 2003;88:119–200.
114. Luitel DR, Rokaya MB, Timsina B, Münzbergová Z. Medicinal plants used by indigenous and tribal people in Rangamati, Bangladesh. J Ethnobiol Ethnomed. 2014;10(1):5.
115. Gürdal B, Kültür Ş. An ethnobotanical study of medicinal plants in Marmaris (Muğla, Turkey). J Ethnopharmacol. 2013;146(1):113–26.