Quantitative ethnobotanical exploration of wild medicinal plants of Arang Valley, District Bajaur, Khyber Pakhtunkhwa, Pakistan: a mountainous region of the Hindu Kush Range

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Research

Abstract

Background. Globally, humans traditionally use plants for the treatment of a variety of diseases. To document ethnomedical knowledge and practices, the remote Arange Valley of district Bajaur is still unexplored. The current study is a contemporary assessment that established the local knowledge of medicinal plants in the area.

Methods. The area has diverse natural flora, and the local people rely on it for a variety of things, including traditional medicine. Semi-structured questionnaires were used in conjunction with direct interviews with 166 experienced persons to elicit ethnomedical information. The collected data were analyzed quantitatively for relative frequency citation (RFC), fidelity level (FL) and use value (UV).

Results. It was recorded that 77 plant species from 46 families were being used in traditional medicine to treat a wide range of diseases. Lamiaceae with 11 species, was the most frequently utilized family, followed by Fabaceae with 5 species, Asteraceae, Polygonaceae, and Rosaceae, each with 4 species, one, two, or three species were contributed by the rest of the families. The distribution of habits included herbs (62.3%), shrubs (22.1%), and trees (13%) while lianas and parasites each made up 1.3%. Among the plant parts used in the production of remedies are leaves (39%), fruits, and roots (16% each), seeds, and the entire plant (8%) as well as rhizomes and areal stems with branches (4% each). Most medications are being used orally (68.97%) and topically (24.14 %) to treat chronic illnesses such as gastrointestinal problems, pulmonary infections, diabetes, kidney stones, urogenital tract infections and nerve stimulation. The quantitative analysis showed that the *Berberis lycium* and *Sideroxylon mascatense* have maximum RFC values i.e., 0.24 and 0.19, respectively used as a tonic, while *Decaspermum blancoi* exhibits an RFC value of 0.17 which is used for digestive disorders. The highest use values were recorded (1.0) for *Sideroxylon mascatense* and (0.78) for *Berberis lycium*.

Conclusion: This study demonstrates that the area has a rich flora of medicinal plants and could be contributed to ethnobotanical knowledge. The data collected will serve as a basis for the comprehensive investigation of active molecular constituents of the medicinal flora of the area. Novel herbal medications in the field of pharmacology may soon be discovered via the investigation of these medicinal plants.

Keywords: Ethnomedicinal uses, Indigenous knowledge, Natural compounds, Bajaur

Background

The study of the interaction between people and plants in their environment is known as ethnobotany. Along with that, it discusses how people and plants interact biologically, economically, and culturally. Ethnomedicine is a branch of ethnobotany that focuses on the study of traditional medical systems, including cultural histories that have been passed down from one generation to another as well as those with documented sources like Siddha, Ayurveda, and traditional Chinese medicine (Acharya and Shrivastava 2008). A medical plant is any plant whose one or more parts contain chemical constituents that can be utilized for therapeutic purposes or the production of valuable pharmaceuticals (Sofowora, 1993). Humans need plants because they offer them commodities including medicines, food, fruits, fuel, fodder and timber (Hussain *et al*., 2018a; Haq *et al*. 2022; Jan *et al*. 2022). Traditional knowledge is the term used to describe the shared knowledge, skills, and techniques used by indigenous people to reduce disease rates and promote health. Their ideas, beliefs, and personal experiences serve as the foundation for these techniques (Fabricant and Farnsworth 2001). Information on ethnobotany can help public health and environmental policies understand the sociocultural context and analyze ethically-based disease prevention and treatment techniques (Lemieux *et al.* 2012). The study of medicinal plants is a relatively new discipline, and attempts are being made to record and use knowledge of ethnomedicinal plants (Shinwari 2010; Hussain *et al*., 2012).

According to a WHO report and estimates, 80% of people in developing countries benefited from about 50,000 medicinal plant species for their healthcare (Villena-Tejada *et al*. 2021). In underdeveloped countries, about 3.3 billion people utilize medicinal plants because they are easily accessible and have no adverse effects (Singh 2015). Utilizing medicinal plant remedies as a substitute for synthetic drugs and pharmaceuticals is easier, more affordable, and more eco-friendly (Dilshad *et al.* 2010). Moreover, 121 bioactive compounds in the active form are already in use, and it is believed that 25% of medications prescribed globally are derived from plants (Shoo *et al.* 2010). The search for natural remedies has increased in recent years. Biochemists, botanists, microbiologists, pharmacologists, and chemists of natural products evaluate medicinal plants all over the world for phytochemicals and bioactive compounds that might be utilized to treat various ailments (Acharya and Shrivastava 2008).

Pakistan has a flora of over 6000 vascular plant species, 12% of which are medicinal plants, but numerous species have declined in recent years due to over-collection (Shinwari 2010). There are 600-700 species of these medicinal plants that have active ingredients and others are under investigation (Sharif *et al*. 2018). In Pakistan, medicinal plants have a significant role in healthcare. This is primarily a result of extreme poverty, inadequate access to health services, and a shortage of healthcare professionals. Numerous studies on the ethnomedical use of plants in various regions across the country have been performed (Khan *et al*. 2015; Umair *et al*. 2017; Hussain *et al*. 2018; Farooq *et al*. 2019; Haq *et al*. 2022). Keeping in view the importance of medicinal plants, the main objective of the study was to (1) compile traditional knowledge about medicinal plants resources used to alleviate various diseases (2) quantitively analyzed the collected information for in-depth pharmacological evaluation of medicinal plants (3) review the pharmacologically active constituents of the investigated plants used in the traditional medicines.

Materials and Methods

Study area

District Bajaur is situated in northwest Pakistan. It was a federally administered area (FATA) until 2018 and was merged into the Khyber Pakhtunkhwa province of Pakistan. The land mass of the Bajaur is located between latitudes of 34°30′ to 34°58′ N and longitudes of 71°11′ to 71°48′ E (www.globalsecurity.org/military/world/pakistan/fata-bajaur.htm). Its landscape comprises diverse types of fertile lands, hills, valleys, streams, and mountains. There are eight tehsils in it, including Khar, Lovi Mamond, Wara Mamond, Barang, Salarzai, Nawagai, Chamarkand and Utman Kheil. The Valley Arang is situated in Tehsil Utman Khel southeast of Bajaur (Figure 1). Four major tribes living in the Valley are Umar Kheil, Sarkani Kheil, Serni Kheil and Mian Mula. The Pashtunwali code of conduct emphasizing hospitality, bravery and honour, is an important component of the Cultural heritage of the Arang community and is firmly ingrained in Pashtun traditions. The majority of people remain illiterate owing to a lack of educational opportunities, although, in recent years, progress has been made towards establishing educational institutions. The local population is primarily dependent on agriculture, rearing livestock, and small-scale businesses. The Valley

contains a variety of plants and other natural resources, as well as the grave of the legendary Sufi Saint Ghazi Baba (some claim that he was a Sahabi, a companion of the Prophet Muhammad S.A.W).

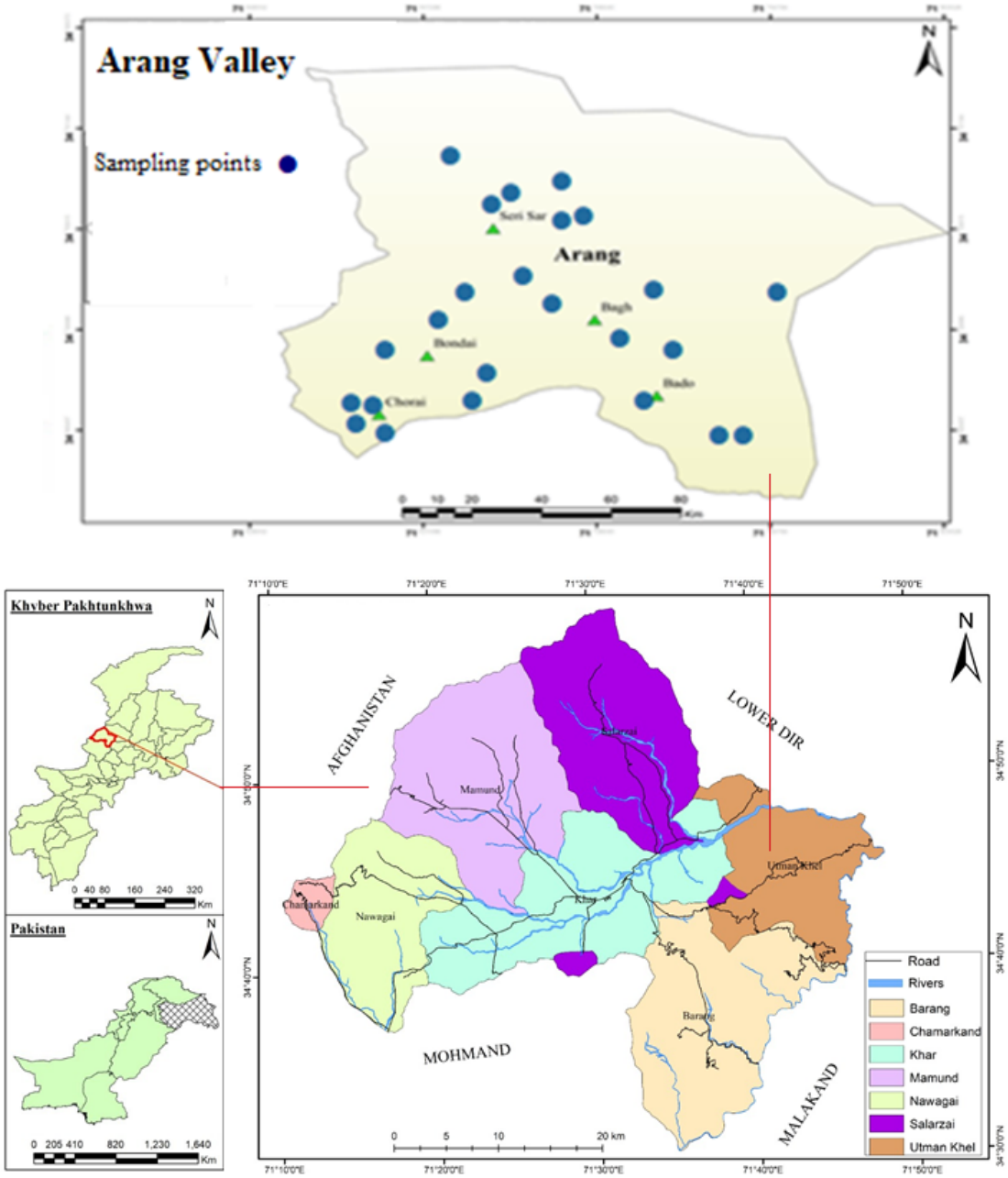


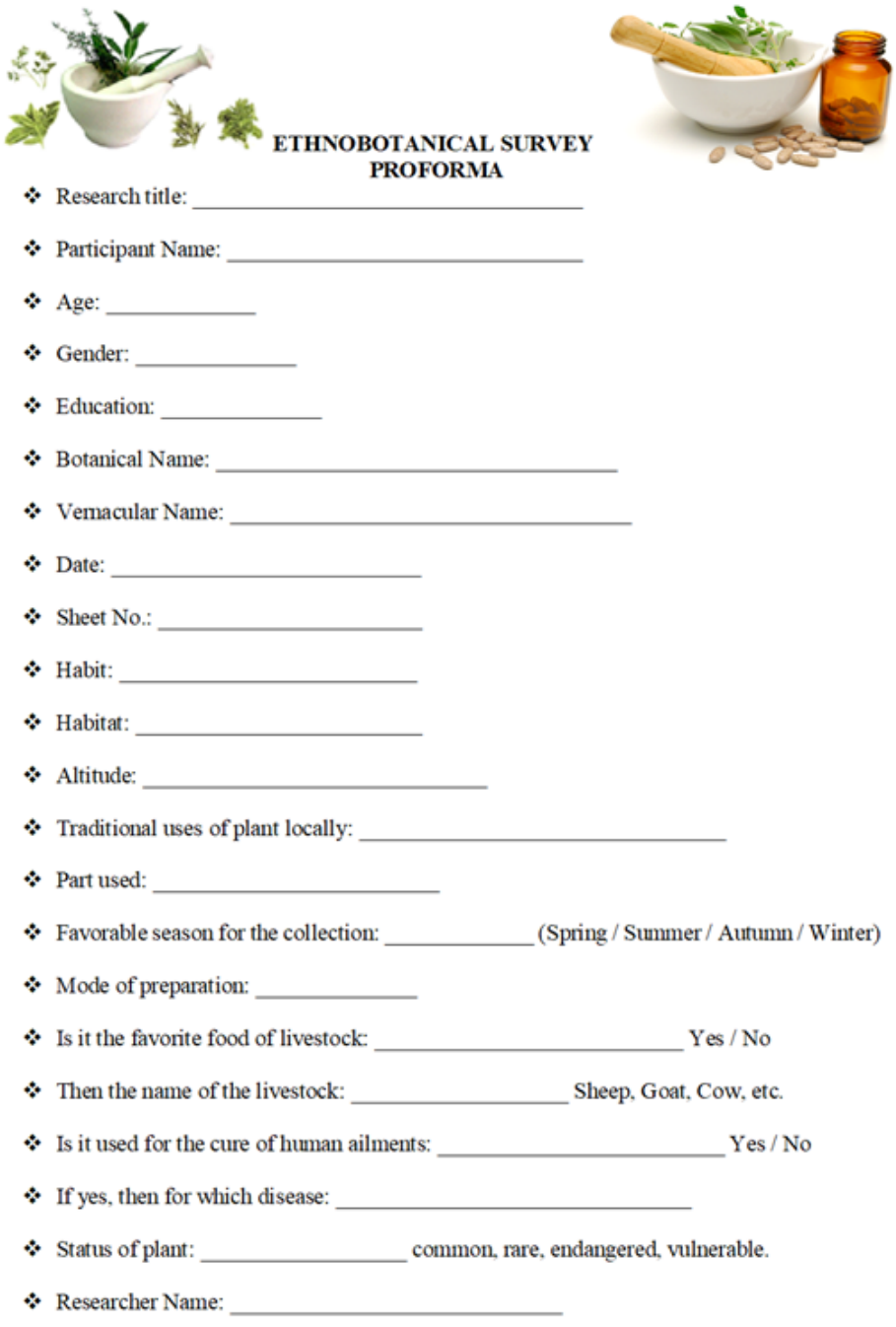
Figure 1. Map of the area

Collection of data and its documentation

During the survey, 166 inhabitants of the different villages in the valley, including Bagh, Mirwais, Mirkhan, Bado, Bondai, Chorai, Ghazi Baba, Mazdak, Pigigram and Seri Sar were interviewed through semi-structured questionnaires. The interviewed person includes semi-skilled workers, laborers, farmers, housewives and employees with age from 18 to more than 60 years old. The traditionally used plant specimens were collected, dried and pressed through the standard procedures and mount on the herbarium sheets for further study (Jain 1964). The plant specimens were identified with the Flora of Pakistan (Nasir and Ali 1971-1995; Ali and Qaiser 1995-2018) and verified with the Plants of World Online (https://powo.science.kew.org/). The specimens were given voucher numbers following the herbarium at the Department of Botany, University of Peshawar, Pakistan (PUP).

Demographic data

The ethnobotanical information was gathered through the filling of semi-structured questionnaires from the local inhabitants (Figure 2). A total of 166 informants were selected with age groups ranging from 20 to more than 60 years (Table 1). Of them, 131 were men and 35 were women. The locals were randomly asked about the plant name, part used as a remedy, mode of preparation and route of administration. The collected information was then checked and verified with the available literature (Hussain *et al.* 2018; Farooq *et al.* 2019; Kassa *et al.* 2020; Haq *et al.* 2021; Haq *et al.* 2022; Mir *et al.* 2022).



ETHNOBOTANICAL SURVEY PROFORMA

- Research title: _____
- Participant Name: _____
- Age: _____
- Gender: _____
- Education: _____
- Botanical Name: _____
- Vernacular Name: _____
- Date: _____
- Sheet No.: _____
- Habit: _____
- Habitat: _____
- Altitude: _____
- Traditional uses of plant locally: _____
- Part used: _____
- Favorable season for the collection: _____ (Spring / Summer / Autumn / Winter)
- Mode of preparation: _____
- Is it the favorite food of livestock: _____ Yes / No
- Then the name of the livestock: _____ Sheep, Goat, Cow, etc.
- Is it used for the cure of human ailments: _____ Yes / No
- If yes, then for which disease: _____
- Status of plant: _____ common, rare, endangered, vulnerable.
- Researcher Name: _____

Figure 2. Ethnobotanical survey form

Table 1. Demographic details

Factor	Categories	Bagh	Mirwais	Mir Khan	Bado	Bondai	Chorai	Ghazi Baba	Mazdak	Pigi-gram	Seri Sar	Total	%age
Gender	Male	13	18	9	13	10	11	19	5	12	21	131	78.92
	Female	2	4	3	3	3	4	4	2	3	7	35	21.08
Occupation	Govt. employees	2	3	1	1	1	0	2	0	1	1	12	7.229
	Unemployed	3	4	2	2	2	2	4	0	1	2	22	13.25
	Labors	3	7	3	5	4	5	6	3	5	13	54	32.53
	Farmer	3	4	3	5	3	4	7	2	5	5	41	24.7
	Housewives	2	4	3	3	3	4	4	2	3	7	35	21.08
	Practitioners	2	0	0	0	0	0	0	0	0	0	2	1.205
Age	<30	2	3	0	0	1	1	3	0	0	3	13	7.831
	30-40	2	4	3	4	3	3	5	1	2	5	32	19.28
	40-50	5	9	3	4	4	3	7	2	4	7	48	28.92
	50-60	3	4	3	5	3	6	5	2	7	9	47	28.31
	>60	3	2	3	3	2	2	3	2	2	4	26	15.66

Quantitative analysis of data

The relative frequency citation (RFC), use value (UV) and fidelity level (FL) for each species were determined accordingly.

Relative Frequency Citation (RFC)

The RFC value of the species was calculated using the formula (Vitalini *et al.* 2013).

$$\text{Relative Frequency Citation (RFC)} = FC/N \ (0<RFC<1)$$

Where 'FC' is the number of informants who reported the use of a particular plant species and 'N' is the total number of informants who participated in the survey. If informants describe how useful a specific plant species is, the RFC value for that species may be '1', while if no one mentions how useful a particular plant species is, the RFC value may be '0' (Medeiros *et al.* 2011).

Fidelity level (FL)

The percentage of informants that claim similar uses of the same species depends on the fidelity level. It was computed using the provided formula (Alexiades 1996).

$$\text{Fidelity level (FL)} = (Np/N) \times 100$$

Where Np is the number of informants who report using a particular plant species to treat a particular disease, and N is the total number of informants.

Use Value (UV)

The use value of each species was calculated using the formula published in the literature (Savikin *et al.* 2013).

$$\text{Use value (UV)} = \sum U/n$$

Where 'U' stands for the total number of user reports for a given species and 'n' stands for the total number of informants interviewed for a specific plant species. The UV value, which represents the usefulness of a plant species, will always be less than or almost equal to 1.

Results and Discussions

Demographic details

In the current study, the information presented is based on a semi-structured questionnaire and direct interviews with the local inhabitants of the area, who have a lot of experience in utilizing plants as medicines. In this survey, information about the therapeutic use of the collected plants was gathered from 166 persons aged 20 to over 60 years old. The majority of informants' interviewed were men (78.92%) and the low numbers of women (21.08%) were the religious restrictions that not allowed them to talk with males outside their community (Table 1). For these reasons, there was less involvement of women compared to men during the documentation of ethnomedicinal knowledge. Because of previous experience, older people have a greater understanding of medicinal plants than youngsters.

Medicinal plants diversity in the area

In the current study, 77 plants from 47 families were used by the inhabitants of the Arang Valley of Bajaur. The family Lamiaceae contributed 11 species (14%) followed by the Fabaceae with 5 species, Asteraceae, Polygonaceae and Rosaceae families with 4 species each (5%) as shown in Figure 3. Our results are consistent with the earlier studies of many academics, who also found that Lamiaceae is a dominant family of medicinal plants around the globe (Tolossa *et al.* 2013; Bano *et al.* 2014; Hussain *et al.* 2018; Jan *et al.* 2021; Mir *et al.* 2021; Haq *et al.* 2022). The details of each medicinal plant, including its scientific name, voucher number, family, local name, habit, phenology, parts used, and local uses, were presented in table 2. It also contains quantitatively analyzed data such as the frequency citation (FC), used value (UV), relative frequency citation (RFC) and fidelity level (FL).

Habit of Medicinal plants and part used

The habit-wise classification of the plants was such as herbs (62.3%), shrubs (22.1%) and trees (13%), while 1.3 % of each was from lianas and parasites (Figure 4). The percentages of plant parts used are as follows leaves 39%, fruits and roots 16% each, seeds, and whole plants 08% each, rhizome and areal stem with branches 4% each. The

rest of the parts were used less than 3% respectively (Figure 5). Data analysis shows that leaves are more useful than other plant parts, such as roots, stems and whole plants. Their extensive use of leaves in herbal medicines may be due to their easiness of collection and availability (Welz *et al.* 2018). The present findings are supported by multiple studies that claim leaves as the major used part of plants for therapeutic purposes (Akhtar *et al.* 2013; Bano *et al.* 2014; Hussain *et al.* 2018; Kassa *et al.* 2020; Islam *et al.* 2021; Haq *et al.* 2022; Jan *et al.* 2022).

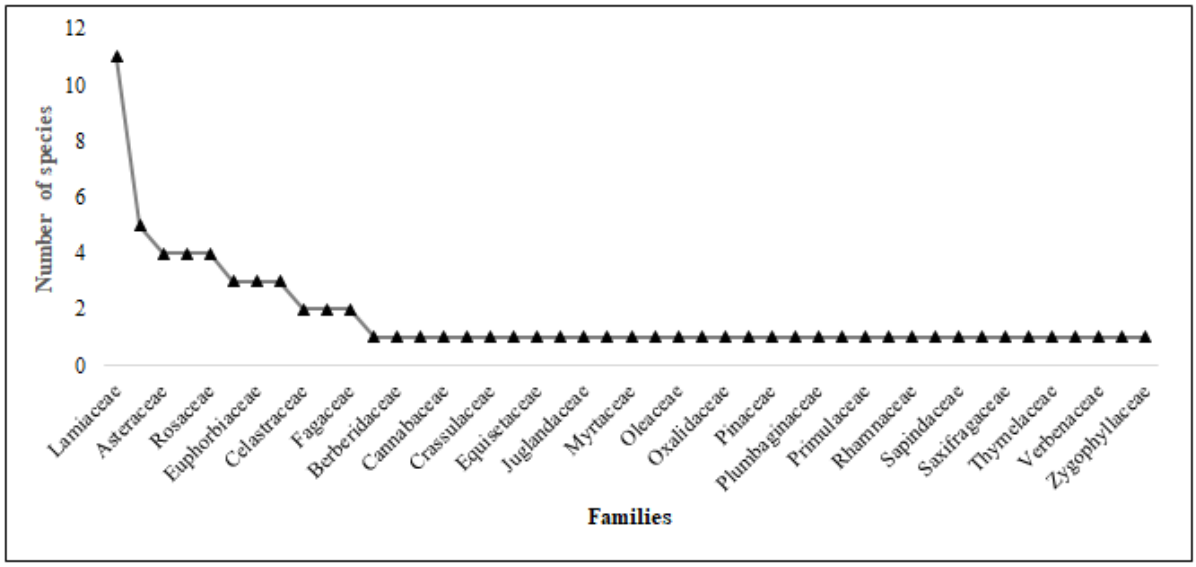


Figure 3. Percentage contribution of families of medicinal plants

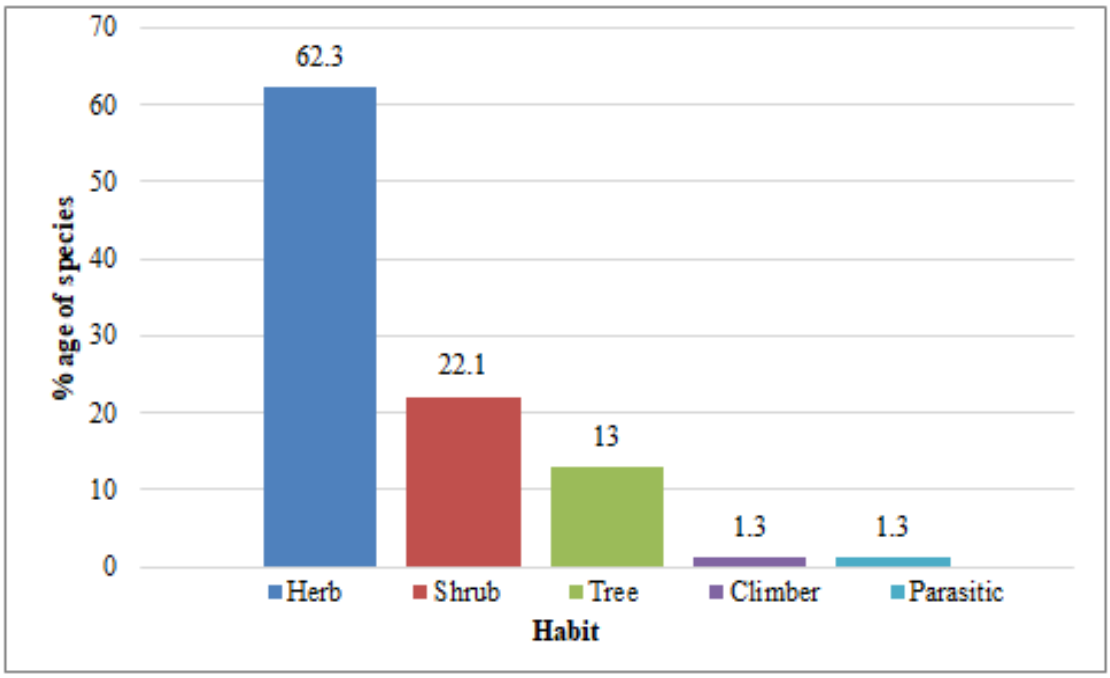


Figure 4. Habit of plants

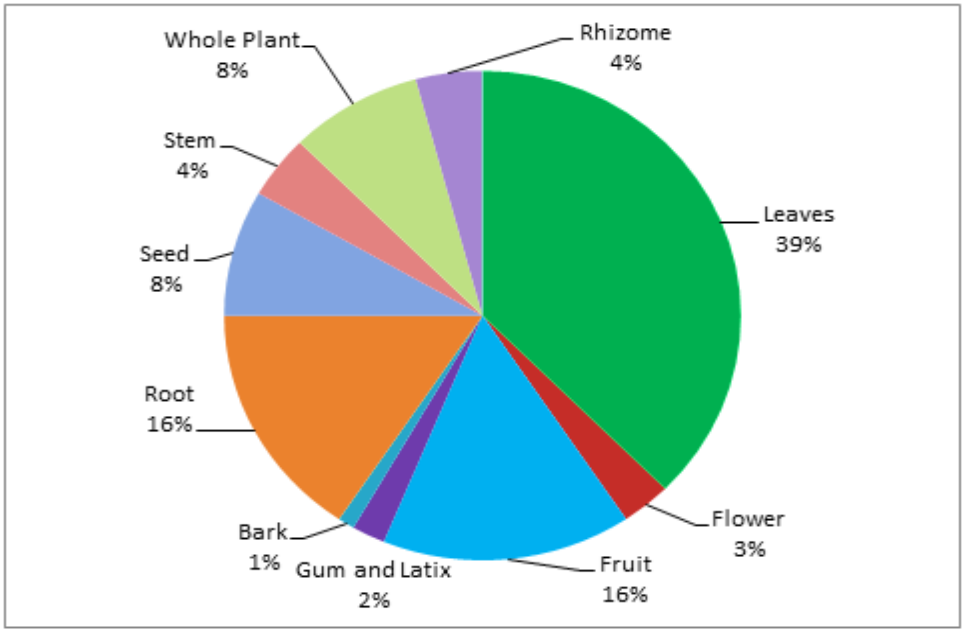


Figure 5. Plants parts used in remedies preparation

Application, formulation and route of administration of medicinal plants

The use of medicinal plants, their mode of preparation and administration routes are given in table 2. The application and formation methods are greatly different depending upon the utilization and symptom of the disease treated. According to reports from respondents, the majority of the informants in the study area dispensed medicinal plant remedies orally and topically. Exact, powder, decoction, paste and direct uses of the described plant parts are the recommended therapeutic procedures. In ethnobotanical investigations, various researchers have reported the use of these procedures (Gairola *et al.* 2014; Ridvan *et al.* 2015; Hussain *et al.* 2018; Farooq *et al.* 2019; Islam *et al.* 2021; Haq *et al.* 2022). Although this study shows significant differences in the use of plant parts, remedies preparation methods and utilization from the other regions.

Relative frequency citation (RFC)

The most widely used species in the area was *Berberis lycium*, which had the highest RFC value (0.24) for the treatment of ulcers, followed by *Sideroxylon mascatense* (0.19) as a tonic and *Decaspermum blancoi* (0.17) for a digestive disorder. *Teucrium stocksianum* had an RFC value of 0.16 used for jaundice*, Sageretia thea* (0.14) was used as body tonic and *Solanum nigrum* (0.14) for jaundice and kidney stone removal (Table 2). The three plants with the lowest RFC values were *Xanthium strumarium, Cephalanthera longifolia* and *Astragalus multiceps* each with an RFC value (0.07). Chemical analysis of plant species with the highest RFC values may be helpful for the development of novel medications (Molares and Ladio 2009).

Use Value (UV)

The UV index shows the relative importance of particular plants and families for a population to treat different types of diseases (Vendruscolo and Mentz, 2006). In the present study, maximum UV values were reported for *Berberis lycium* (1.0), *Sideroxylon mascatense* (0.78), *Decaspermum blancoi* (0.70), *Teucrium stocksianum* (0.68) and *Sageretia thea* (0.60), while the lowest for *Xanthium strumarium*, *Cephalanthera longifolia* and *Astragalus multiceps* (0.28) are each shown in table 2. The highest use value of a species might be attributed to its wide range of distribution and the awareness of local inhabitants for treating a disease. The higher use value indicates a species' greater significance; however, it cannot determine whether a plant is used for a single purpose or a broad range of purposes (Musa *et al.* 2011). Some plants were highly poisonous, such as *Calotropis procera, Euphorbia helioscopia, Ricinus communis,* if their parts are consumed in high amounts which lead to even death of a person. The medicinal plants were becoming extinct in the area because of overgrazing and deforestation.

Table 2. Medicinal plant species in Arang Valley, District Bajaur , Khyber Pakhtunkhwa, Pakistan

Species name, family	Voucher number	Local name	Habit	Parts used	FC	UV	RFC	FL	Local uses	Active constituents	References
Adiantum capillus-veneris L., **Pteridaceae**	Haq.Bot.02 (PUP)	Batosana	H	Frond	15	0.38	0.09	33.3	The leaf extract is used to treat bronchitis, dry cough and throat infections.	Flavonoids, phenylpropanoids, alicyclics, triterpenoids, carotenoids and carbohydrates	Al-Snafi (2015)
Ajuga integrifolia Buch.-Ham. ex D.Don., **Lamiaceae**	Haq.Bot.115(PUP)	Ghotti	H	Leaves and shoots	20	0.5	0.12	44.4	Leaves and stem decoction is used to cure abdominal pain and ulcer.	Alkaloids, flavonoids, steroids, phenols, tannins, saponins, quinones, glycosides diterpenes, carbohydrates and amino acids	Waqas *et al.* (2021)
Androsace umbellata (Lour.) Merr., **Primulaceae**	Haq.Bot.176 (PUP)	Gul-e-pensa	H	Leaves and rhizome	12	0.3	0.07	26.7	The leaf extract is used to treat stomach disorders, and the roots one for the cure of eye diseases.	Alkaloids, flavonoids, saponins, tannins, triterpenes and carbohydrates	Alam *et al.* (2017)
Astragalus graveolens Benth., **Fabaceae**	Haq.Bot.152(PUP)	Ghwarakai	H	Roots	14	0.35	0.08	31.1	The powder of root is used for the treatment of diabetes and jaundice	Flavonoids, terpenoids, glycosides polysaccharides, saponins, amino acids and proteins	Li *et al.* (2014)
Astragalus multiceps Benth., **Fabaceae**	Haq.Bot.151(PUP)	Ghwarakai	H	Fruit	11	0.28	0.07	24.4	Fruit powder is used to treat respiratory infections and diabetes.	Flavonoids, terpenoids, glycosides, saponins, proteins, amino acids and polysaccharides	Li *et al.* (2014)
Berberis lycium Royle, **Berberidaceae**	Haq.Bot.74(PUP)	Kwaray	S	Fruit and roots	40	1	0.24	88.9	Fruit is used for the treatment of jaundice and liver disorder. The root powder is used for stomach ulcers.	Alkaloids, saponins, tannins, carbohydrates, proteins, fats and vitamin C	Ahmed *et al.* (2017)
Bergenia ciliata (Royle) A.Braun ex Engl., **Saxifragaceae**	Haq.Bot.198(PUP)	Kamar panra	H	Whole plant	14	0.35	0.08	31.1	Whole plant decoction is used to treat pulmonary and urinary infections.	Phenolic-glycosides polyphenols, tannins, terpenes, sterols, lactones and quinones	Koul *et al.* (2020)

Bukiniczia cabulica (Boiss.) Lincz. **Plumbaginaceae**	Haq.Bot.167(PUP)	Ghutyalai	H	Leaves	13	0.33	0.08	28.9	Leaves extract is used to treat respiratory infections.		
Calotropis procera (Aiton) W.T.Aiton., **Asclepiadaceae**	Haq.Bot.47(PUP)	Spulmay	S	Leaves	18	0.45	0.11	40	Crushed fresh leaves are combined with Gur and made into a paste that is applied to dog bites. Its leaves reduce sugar levels when kept in shoes for at least 6hrs/day.	Alkaloids, flavonoids, phenols, terpenoids, saponins, glycoside, tannins sugars and steroids	Batool *et al.* (2020)
Cannabis sativa L., **Cannabaceae**	Haq.Bot.88(PUP)	Bhang	H	Leaves	18	0.45	0.11	40	The leaf extract is used to make "Tandai" a drink that produces pleasant excitement.	Alkaloids, flavonoids, terpenes, cannabinoids and phenolics	Radwan *et al.* (2021)
Celtis eriocarpa Decne., **Ulmaceae**	Haq.Bot.211(PUP)	Tagha	T	Fruit and leaves	19	0.48	0.11	42.2	Fruit is edible, and used as an astringent. Leaves are used in pustule eruption.	Flavonoid, phenolics, tannins, saponins and terpenoids	Ahmed *et al.* (2018)
Cephalanthera longifolia (L.) Fritsch., **Orchidaceae**	Haq.Bot.146(PUP)		H	Rhizome	11	0.28	0.07	24.4	Powder of rhizomes is mixed with milk and is given to lactating women.	Alkaloids and glycosides	Teoh (2016)
Chenopodium album L., **Amaranthaceae**	Haq.Bot.97(PUP)	Sarmay	H	Leaves and roots	20	0.5	0.12	44.4	Leaf extract is used as an anti-helminthic and laxative. Jaundice and urinary infections are treated with root powder extract.	Phenols, terpens, saponins, sterols, amids and vitamins	Kokanova-Nedialkova *et al.* (2009)
Cirsium arvense (L.) Scop., **Asteraceae**	Haq.Bot.56(PUP)	Ghana	H	Roots	13	0.33	0.08	28.9	The root extract is used as an anti-helminthic.	Luteolin, tracin, scopoletin, apigenin, acacetin, ciryneol C, hispidulin, pectolinarigenin and citronellol	Aggarwal *et al.* (2022)

Cotoneaster nummularius Fisch. & C.A.Mey.**, Rosaceae**	Haq.Bot.183(PUP)	Kharawa	S	Fruit	13	0.33	0.08	28.9	Fruit is edible, and used for coughing and stomachache.	Flavonoids, procyanidins, phenolic acids, cotonefurans, cyanogenic glycosides, triterpenes, sterols, fatty acids, volatile substances and carbohydrates	Kicel (2020)
Cuscuta cassytorres Nees ex Engelm., **Cuscutaceae**	Haq.Bot.103(PUP)	Mecha Bootae	P	Whole plant	15	0.38	0.09	33.3	The whole plant extract is used for the treatment of diarrhea, constipation, and hepatitis.	Flavonoids, coumarins, triterpenoids, phenylpropanoids and cardiac glycosides	Noureen *et al.* (2019)
Daphne mucronata Royle., **Thymelaceae**	Haq.Bot.210(PUP)	Laghonai	S	Fruit and roots	12	0.3	0.07	26.7	The paste is made from the fruit used for pimples, and freckle removal from the face.	Flavonoids, coumarins, triterpenoids, lignin, coumarinolignans, glucosides, daphnecin, aquillochin, daphnine, and umbelliferone	Zaidi *et al.* (2015)
Decaspermum blancoi S.Vidal., **Myrtaceae**	Haq.Bot.142(PUP)	Manroo	S	Leaves	28	0.7	0.17	62.2	The extract of leaves is used for abdominal pain and the control of diarrhea.	Flavonoids, phenolics, terpenoids, tannins, fatty acid, citric acid, malic acid and carbohydrates	Jinous and Arefeh (2015)
Dicliptera bupleuroides Nees., **Acanthaceae**	Haq.Bot.32(PUP)	Tura panra	H	Whole plant	13	0.33	0.08	28.9	The plant's decoction can be used as a tonic and to heal stomach ulcers.	Alkaloids, flavonoids, phenolics, cardiac glycosides terpenes, tannins, saponins and sugars	Riaz *et al.* (2012)
Dodonaea viscosa Jacq., **Sapindaceae**	Haq.Bot.196(PUP)	Ghoraskay	S	Leaves	18	0.45	0.11	40	Leaves powder is used for the treatment of burnt wounds.	Alkaloids, flavonoids, lipids, steroids, tannins, saponins, phenolics, mucilages, gums, glycosides and carbohydrates	Al-Snafi (2017)
Dysphania botrys (L.) Mosyakin & Clemants, **Amaranthaceae**	Haq.Bot.98(PUP)	Sakha bootai	H	Leaves	13	0.33	0.08	28.9	Leaves are used for pus discharge and wound healing. Additionally, it is utilized to decrease hyperacidity.	Phenols, terpenes, saponins, sterols, amides and vitamins	Kokanova-Nedialkova *et al.* (2009)

Equisetum arvense L., **Equisetaceae**	Haq.Bot.01(PUP)	Bandakai	H	Shoots	17	0.43	0.1	37.8	Shoot extract is combined with mustard oil and applied to the hair as a restorative. Kidney stones are also removed with the aqueous extract.	Alkaloids, phenol, tannin, flavonoids, saponins, phenol, tannin, triterpenoids, carbohydrates, proteins, amino acids, sterols, ascorbic acid, silicic acid and volatile oils	Makia *et al.* (2022)
Euphorbia helioscopia L., **Euphorbiaceae**	Haq.Bot.104(PUP)	Arbai	H	Roots	18	0.45	0.11	40	The powder of root is used as an anthelminthic.	Flavonoids, tannins, terpenes, polyphenols, glycosides, lipids, fatty acids, waxes and hydrocarbons	Abou-El-Hamd *et al.* (2012)
Ferula jaeschkeana Vatke., **Celastraceae**	Haq.Bot.41(PUP)	Skhwara	H	Rhizome	21	0.53	0.13	46.7	The rhizomatic powder is used for the regulation of the menstrual cycle and as an aphrodisiac.	Alkaloids, flavonoids, terpenoids, saponins, glycosides, phenolics, tannins, phlobotannins, anthraquinones, phytosterols, steroids, coumarins, quinones, triterpenoids, xanthoproteins, carbohydrates, resins, proteins, amino acids and oxalate	Yaqoob *et al.* (2016)
Fragaria nubicola (Lindl. ex Hook.f.) Lacaita **Rosaceae**	Haq.Bot.185(PUP)	Balmangai	H	Fruit and leaves	19	0.48	0.11	42.2	The leaves and fruit are laxatives and are used to prevent constipation.	Flavonoids, tannins, phenolics, flavonols, proanthocynidins, ellagic acid glycosides, and benzyl derivatives	Bahukhandi *et al.* (2023)
Gymnosporia royleana Wall. ex M.A.Lawson **Celastraceae**	Haq.Bot.96(PUP)	Soor azghay	S	Roots	17	0.43	0.1	37.8	The powder is made from the roots and is used for stomach problems.	Alkaloids, flavonoids, phenols, tannins, saponins, cardiac glycosides, anthraquinone terpenoids and sterols	Arshad *et al.* (2019)

Hypericum perforatum L., **Hypericaeae**	Haq.Bot.113(PUP)	Kashne	H	Leaves and shoots	13	0.33	0.08	28.9	The leaves and shoots extract are used for the treatment of trauma.	Hyperforin, adhyperforin, hypericin, rutin, quercetin, quercitrin hydrate, hyperoside, biapigenin, and chlorogenic acid	Alahmad *et al.* (2022)
Incarvillea emodi (Royle ex Lindl.) Chatterjee, **Bignoniaceae**	Haq.Bot.75(PUP)	Gul-e-barq	H	Whole plant	13	0.33	0.08	28.9	For the treatment of malaria and diabetes, plant root decoction is recommended.	Alkaloids, flavonoids, phenol, saponin, tannin, polysterol, glycoside, amino acids and carbohydrates	Huzafa *et al.* (2020)
Indigofera heterantha Wall. ex Brandis, **Fabaceae**	Haq.Bot.155(PUP)	Ghorega	S	Roots	18	0.45	0.11	40	The root powder is used to cure chest pain.	Alkaloids, flavonoids, triterpenoids, steroids, fatty acids and lignins	Rahman *et al.* (2018)
Isodon rugosus Wall. ex Benth., **Lamiaceae**	Haq.Bot.116(PUP)	Karechay	S	Leaves and branches	18	0.45	0.11	40	The decoction of leaves and branches is used as an antiseptic.	Alkaloids, flavonoids, glycosides, terpenoids, tannins, anthraquinones, saponins, oils, steroids, β-cyanin, coumarins, carbohydrates, diterpenoids, rugosinin, effusanin-A, effusanin-B, effusanin-E,lasiokaurin, oridonin,triterpenoids, plectranthoicacid A and B, acetyl plectranthoic acid and plectranthadiol	Hussain *et al.* (2017)
Juglans regia L., **Juglandaceae**	Haq.Bot.114(PUP)	Ghoz	T	Fruit, leaves and bark	20	0.5	0.12	44.4	Fruit is edible, and used as a brain tonic. Leaves and bark are used for the prevention of gum bleeding.	Flavonoids, phenolic acids, stilbenes and tannins	Hayes *et al.* (2016)
Mallotus philippensis (Lam.) Müll.Arg., **Euphorbiaceae**	Haq.Bot.107(PUP)	Kambela	H	Fruit and leaves	14	0.35	0.08	31.1	Fruit is used to treat parasite infestations. As an appetizer leaves powder is utilized.	Flavonoids, phenolics, saponins, tannins, terpenoids, carbohydrates, gum, resins, oil, steroids, proteins and amino acids	Velanganni *et al.* (2011)

Marrubium vulgare L., **Lamiaceae**	Haq.Bot.118(PUP)	Khaar bootai	H	Leaves	12	0.3	0.07	26.7	Leaves extract is used for the cure of dry cough and hypertension.	Flavonoids, tannins, saponins, terpenoids, steroids and volatile oils	Lodhi *et al.* (2017)
Medicago minima (L.) Bartal., **Fabaceae**	Haq.Bot.158(PUP)	Shapeshtare i	H	Whole plant	13	0.33	0.08		The plant extract is used for gallbladder infections and prostate problems.	Alkaloids, phenolic compounds, isoflavonoids, saponins, tannins, lignin, triterpene glycosides, flavones, carotenoids, sterols, phytoestrogens, proteins and carbohydrates	Al-Snafi *et al.* (2021)
Melia azedarach L., **Meliaceae**	Haq.Bot.135(PUP)	Tora bakana	T	Fruit and seeds	18	0.45	0.11	40	For the treatment of hypertension, fruit and seeds are used.	Alkaloids, flavonoids, saponins, tannins terpenoids, steroids, amino acids and anthraquinones	Sharma and Paul (2013)
Mentha longifolia (L.) L., **Lamiaceae**	Haq.Bot.120(PUP)	Eelanay	H	Leaves	23	0.58	0.14	51.1	For constipation, dried leaf powder is recommended.	Flavonoids, phenolic acids, terpenes, terpenoids, ceramides, cinnamates and sesquiterpenes	Farzaei *et al.* (2017)
Nasturtium officinale W.T.Aiton., **Brassicaceae**	Haq.Bot.85(PUP)	Termera	H	Leaves and stem	15	0.38	0.09	33.3	Fresh leaves and stems are used for the relief of abdominal pain and stomach trouble.	Alkaloids, flavonoids, saponins, tannins, terpenoids, steroids, glycosides, folic acid, vitamins, protein, volatile oils and elements	Al-Snafi (2020)
Olea europaea subsp. *cuspidata* (Wall. & G.Don) Cif., **Oleaceae**	Haq.Bot.144(PUP)	Khona	T	Leaves, fruit and seeds	18	0.45	0.11	40	Chewing on leaves can relieve a sore throat. Fruits can effectively deter diabetes. Its seed oil can be consumed.	Alkaloids, flavonoids, tannins, saponins, glycosides and terpenoids anthraquinines and carbohydrates	Rafique (2010)
Oxalis corniculata L., **Oxalidaceae**	Haq.Bot.147(PUP)	Trewakay	H	Leaves and stem	15	0.38	0.09	33.3	Young stems and leaves are used as an anti-acid for digestive issues.	Alkaloids, flavonoids, terpenoids, glycosides, saponins, phlobatannins and steroids	Sarfraz *et al.* (2022)

Papaver rhoeas L., **Papaveraceae**	Haq.Bot.149(PUP)	Redai	H	Leaves	13	0.33	0.08	28.9	The extract of dried leaves is used for cough and chest infections.	Alkaloids, phenolics, tannins, sesquiterpenes and steroids	Nikolaos *et al.* (2013)
Periploca aphylla Decne., **Asclepiadaceae**	Haq.Bot.48(PUP)	Barara	S	Latex	15	0.38	0.09	33.3	Plant latex is used for the removal of warts as well as for the treatment of constipation.	Alkaloids, flavonoids, phenols. tannins, saponins, lipids and carbohydrates	Mushtaq *et al.* (2021)
Phlomidoschema parviflorum (Benth.) Vved., **Lamiaceae**	Haq.Bot.128(PUP)	Kharr bootai	H	Leaves	17	0.43	0.1	37.8	Leaves are used for the healing of the wound.	Terpenoids, flavone glycosides, sterols and steroidal saponin.	Arshad (2006)
Pinus roxburghii Sarg., **Pinaceae**	Haq.Bot.04(PUP)	Nakhtar	T	Leaves	15	0.38	0.09	33.3	The leaves' ash is used for the healing of wounds.	Flavonoid, α-pinene, abietic acid, quercetin, xanthone and resin	Kaushik *et al.* (2013)
Plantago lanceolata L., **Plantaginaceae**	Haq.Bot.164(PUP)	Alam	H	Seeds	20	0.5	0.12	44.4	The seeds extract is used as a laxative and also for the control of obesity.	Alkaloids, flavonoids, tannins, terpenoids, polyphenols, glycosides, fatty acids and polysaccharides	Abate *et al.* (2022)
Polygonatum verticillatum (L.) All., **Lamiaceae**	Haq.Bot.14(PUP)	Nor-e-Alam	H	Rhizome	13	0.33	0.08	28.9	The rhizomatic powder is used as an aphrodisiac.	Alkaloids, flavonoids, phenols, tannins, saponins, sitosterol, santonin, amino acids and carbohydrates	Saboon *et al.* (2016)
Polygonum aviculare L., **Polygonaceae**	Haq.Bot.169(PUP)	Bandakai	H	Whole plant	12	0.3	0.07	26.7	The plant extract is used to cure dysentery, hemorrhoid, and pulmonary infections.	Alkaloids, flavonoids, saponins, tannins and sesquiterpenes	Yu *et al.* (2022)
Portulaca oleracea L., **Portulaceae**	Haq.Bot.174(PUP)	Warkharei	H	Stem	18	0.45	0.11	40	The stem extract is used for the treatment of urogenital infections.	Alkaloids, flavonoids, terpenoids, sterols, carbohydrates, proteins, fatty acids, vitamins and minerals.	Zhou *et al.* (2015)
Quercus floribunda Lindl. ex A.Camus., **Fagaceae**	Haq.Bot.110(PUP)	Wara serai	T	Nuts and seeds	16	0.4	0.1	35.6	The nuts and seeds are edible and used for indigestion.	Flavonoids, phenolic acids, tannins, glycosides, terpenoids, fatty acids and sterols	Taib *et al.* (2020)

Quercus incana W.Bartram., **Fagaceae**	Haq.Bot.109(PUP)	Serai	T	Nuts and seeds	15	0.38	0.09	33.3	The nut and seeds are edible, and diuretic.	Flavonoids, phenolic, tannins, terpenoids, glycosides, fatty acids and sterols	Taib *et al.* (2020)
Rheum australe D.Don., **Polygonaceae**	Haq.Bot.173(PUP)	Chutyal	H	Roots	13	0.33	0.08	28.9	To relieve constipation, root powder is used as a laxative.	Anthraquinone rhein, chrysophanol, aloe-emodin, emodin, physcion and glycosides	Rehman *et al.* (2014)
Ricinus communis L., **Euphorbiaceae**	Haq.Bot.108(PUP)	Aranda	S	Seeds	15	0.38	0.09	33.3	Asthma and constipation are both treated with oil made from seeds.	Alkaloids, ricinoleic acid, stearic, palmitic acid, linoleic acid, sitosterol, squalene tocopherols and stearic acid	Tyagi *et al.* (2013)
Rosa brunonii Lindl., **Rosaceae**	Haq.Bot.191(PUP)	Khurach	S	Flowers	17	0.43	0.1	37.8	The flower petals extract is used for the treatment of eye diseases.	Flavonoids, tannins, phenolic acids, triterpenes, fatty acids, carotenoids, organic acids, polysaccharides and vitamins	Wang *et al.* (2022)
Rosa Webbiana Wall. ex. Royle., **Rosaceae**	Haq.Bot.192(PUP)	Zangali gulab	S	Flowers and fruit	20	0.5	0.12	44.4	In Gul Kand and Arq-e-Gulab, flower petals are used. Asthma is cured with a decoction of the fruit.	Flavonoids, tannins, phenolic acids, triterpenes, fatty acids, organic acids, carotenoids, polysaccharides and vitamins	Wang *et al.* (2022)
Rosularia adenotricha (Wall. ex Edgew.) C.-A.Jansson **Crassulaceae**	Haq.Bot.102(PUP)	Gut gulae	H	Roots	13	0.33	0.08	28.9	Roots can be ground into a fine powder and used as a pain reliever and aphrodisiac.	Flavonoids, phenolic and glycosides	Naz *et al.* (2020)
Rumex dentatus L., **Polygonaceae**	Haq.Bot.171(PUP)	Tarookay	H	Leaves and roots	13	0.33	0.08	28.9	Leaf decoction is used to alleviate muscle pain, and root decoction is used to treat constipation.	Alkaloids, flavonoids, tannins, saponins, terpenoids, glycosides and anthraquinones	Nisa *et al.* (2013)
Rumex hastatus D. Don., **Polygonaceae**	Haq.Bot.172(PUP)	Tarookay	H	Leaves and shoots	21	0.53	0.13	46.7	The fresh leaves and young shoots are used as an appetizer.	Alkaloids, flavonoids, saponins, protein, carbohydrates, fats, vitamins and minerals	Ahmad *et al.* (2019)

Rydingia limbata (Benth.) Scheen & V.A.Albert., **Lamiaceae**	Haq.Bot.123(PUP)	Spin azghay	S	Leaves	19	0.48	0.11	42.2	For the treatment of wounds, dried leaves powder is blended with butter.	Flavonoids, terpenes and glycosides	Khan and Syed, (2013)
Sageretia thea (Osbeck) M.C.Johnst., **Rhamnaceae**	Haq.Bot.181(PUP)	Mammana	S	Leaves and roots	24	0.6	0.14	53.3	For the purification of blood and to treat hepatitis, leaves and roots are infused to form decoction.	Alkaloids, flavonoids, tannins, triterpenes, saponins phytosterols and glycosides	Shah *et al.* (2013)
Salvia moorcroftiana Wall. ex Benth., **Lamiaceae**	Haq.Bot.126(PUP)	Khardag	H	Leaves	18	0.45	0.11	40	Leaves are used for wound healing. The root extract is used for colds and coughs.	Alkaloids, flavonoids saponins, tannins and terpenoids	Irfan and Qadir, (2017)
Scutellaria linearis Benth., **Lamiaceae**	Haq.Bot.127(PUP)	Kamar gulae	H	Leaves	14	0.35	0.08	31.1	For the treatment of diabetes and hepatitis, the leaf extract is recommended.	Alkaloids, flavonoids, phenols, terpenoids scutellarin, baicalin, tannins, saponins, glycosides and carbohydrates	Mubin *et al.* (2022)
Senegalia modesta (Wall.) P.J.H.Hurter., **Fabaceae**	Haq.Bot.136(PUP)	Palosa	T	Gum	22	0.55	0.13	48.9	Stem gum is used as a tonic. It is also used to treat dysentery and weakness.	Alkaloids, flavonoids, terpenoids and tannins	Sarwar (2016)
Sideroxylon mascatense (A.DC.) T.D.Penn., **Sapotaceae**	Haq.Bot.197(PUP)	Gurgora	T	Fruit	31	0.78	0.19	68.9	Fruit is edible and used as a tonic.	Flavanoids, terpenoids, tannins, saponins, glycosides anthraquinones and carbohydrates	Rehman *et al.* (2013)
Solanum nigrum L., **Solanaceae**	Haq.Bot.207(PUP)	Kachmachu	H	Fruit	24	0.6	0.14	53.3	The fruit can be used to treat jaundice and get rid of kidney stones.	Alkaloids, flavonoids, phenylpropanoids , Steroids, phenols, saponins, organic acids, glycosides and polysaccharides	Chen *et al.* (2022)
Solanum virginianum L., **Solanaceae**	Haq.Bot.208(PUP)	Maraghony	H	Fruit	20	0.5	0.12	44.4	The powder of ripened fruit is used for diabetes and the removal of abdominal fat.	Alkaloids, flavonoids, tannins, saponins, triterpenoids, steroids and glycosides	Tekuri *et al.* (2019)

Sonchus oleraceus L., **Asteraceae**	Haq.Bot.70(PUP)	Zaer gulae	H	Leaves and roots	12	0.3	0.07	26.7	Constipation, abdominal pain, and diarrhea are all treated with extracts from the leaves and roots.	Flavonoids, sesquiterpene lactone, quininic acid esters, phenolics, glycerate, triterpenes, steroids, coumarins and saccharides	Li and Yang (2018)
Taraxacum officinale F.H. Wigg., **Asteraceae**	Haq.Bot.72(PUP)	Shodafi	H	Leaves and roots	14	0.35	0.08	31.1	Leaves and roots decoction is used to cure both hepatitis and constipation.	Flavonoids, phenolic acids, phytosterols, sesquiterpene and lactones	Choi *et al.* (2018)
Teucrium stocksianum Boiss., **Lamiaceae**	Haq.Bot.130(PUP)	Akandas	H	Whole plant	27	0.68	0.16		Diabetes, jaundice, and sore throat symptoms can be treated with a whole plant decoction.	Alkaloids, flavonoid, tannins, phenolics and essential oils	Shah *et al.* (2012)
Thymus linearis Benth., **Lamiaceae**	Haq.Bot.131(PUP)	Khashmalay	H	Whole plant	12	0.3	0.07	26.7	The plant extract is used as an expectorant and antispasmodic.	Alkaloids, flavonoids, terpenoids, glucoside and polyphenols	Leal *et al.* (2017)
Tribulus terrestris L., **Zygophyllaceae**	Haq.Bot.218(PUP)	Malkonday	H	Leaves, fruit and seeds	14	0.35	0.08	31.1	Kidney stone removal and urogenital tract infection are treated using extracts from leaves, fruit, and seeds.	Alkaloids, flavonoids, flavonol, tannins, saponins, glycosides and steroidal	Chhatre *et al.* (2014)
Verbascum thapsus L., **Scrophulariaceae**	Haq.Bot.199(PUP)	Kharghwag	H	Leaves and flowers	17	0.43	0.1	37.8	The leaves and flowers are turned into a paste that is administered for cough. Muscle aches can be treated with warmed leaves.	Flavonoids, saponins, iridoid, glycosides, phenylethanoid, phenylpropanoid vitamin C and minerals	Gupta *et al.* (2022)
Viburnum cotinifolium D. Don., **Caprifoliaceae**	Haq.Bot.90(PUP)	Tora	S	Fruit	16	0.4	0.1	35.6	Stomach and abdominal pain are treated with ripened fruit decoction.	Flavonoids, iridoids glycosides, sesquiterpenes, vibsane diterpenes and triterpenes	Shah *et al.* (2014)

Vincetoxicum arnottianum (Wight) Wight., **Asclepiadaceae**	Haq.Bot.49(PUP)	Laram bootai	H	Leaves	12	0.3	0.07	26.7	Leaf extract is used to alleviate symptoms of diarrhea, vomiting, and stomach pain.	Polyphenolics; rutin, gallic acid, caffeic acid, apigenin, myricetin and quercetin	Zahra *et al.* (2020)
Vitex negundo L., **Verbenaceae**	Haq.Bot.214(PUP)	Marwandai	S	Leaves	20	0.5	0.12	44.4	Abdominal pain, diarrhea, and vomiting are treated with leaf extract.	Alkaloids, flavonoids, terpenoids, glycosides and lignans	Khan *et al.* (2017)
Vitis jacquemontii Parker., **Vitaceae**	Haq.Bot.217(PUP)	Zangali kowar	L	Fruit	16	0.4	0.1	35.6	Fruit is edible and used as a laxative.	Phenols, glucoside, fatty acids, steroids, and vitamin C	
Withania somnifera (L.) Dunal., **Solanaceae**	Haq.Bot.209(PUP)	Kotelal	H	Leaves and roots	21	0.53	0.13	46.7	Asthma and arthritis are treated with leaves and root powder.	Alkaloids, flavonoids, terpenoids and phenolic acids	Munir *et al.* (2022)
Xanthium strumarium L., **Asteraceae**	Haq.Bot.73(PUP)	Jeshkai	H	Leaves	11	0.28	0.07	24.2	Fresh leaves are used for the treatment of leukoderma (Baris) disease. Roots powder is used for kidney disease.	Flavonoids, glycosides, steroids, sesquiterpenoids, phenylpropenoids, lignanoids, coumarins, thiazides, anthraquinones and naphthoquinones	Fan *et al.* (2019)
Zanthoxylum capense (Thunb.) Harv., **Rutaceae**	Haq.Bot.195(PUP)	Dambara	T	Braches and seeds	22	0.55	0.13	48.9	In Chatny, the seeds powder is used for flavor. A toothbrush can be made from branches.	Alkaloids, flavonoids, terpenoids, phenolic acids, glycosides coumarins and lignins	Singh *et al.* (2011)

Key: H- Herb, S- Shrub, T- Tree, L- Liana, P - Parasite, FC- Frequency of citation, RFC- Relative frequency of citation, UV- Use value, FL- Fidelity level

Fidelity Level (FL)

The fidelity level determined the species that the locals preferred to cure specific ailments. For a particular ailment, there were significant differences in the fidelity levels of the recorded species. Among the reported species, *Berberis lycium* depicted the highest FL (88.9%) used for the treatment of stomach pain and ulcer followed by *Decaspermum blancoi* (62.2%) for diarrhea and abdominal pain, *Sageretia thea* and *Solanum nigrum* each with FL (53.3%) for blood purification and hepatitis, *Mentha logifolia* (51.1%) for constipation, *Senegalia modesta* for curing dysentery and *Zanthoxylum capense* for food taste with (48.9%) are given in table 2. However, the *Xanthium strumarium, Cephalanthera longifolia* and *Astagalus grahamianus* showed the lowest fidelity level. The highest FL value for medicinal plants reveals the local inhabitants' choice of a specific plant species for the treatment of a certain disease (Bibi *et al.* 2014; Islam *et al.* 2014). Although the residents have access to pharmaceutical drugs, there is a greater propensity for the usage of medicinal plants in the area.

Complaint treatment and remedies preparation

The inhabitants of the area typically used the plant or its parts to treat a variety of ailments. Of the total species that have been documented, 13 species have been used for respiratory infections, 10 for gastrointestinal issues, 9 for jaundice and liver disorders, 8 for stomach pain and ulcers, and 6 each for constipation and diabetes. A single plant species may be used for the treatment of more than one disease. The remedies were prepared from the whole plant and its parts in the forms of decoction, powder, extract and paste that was mostly administrated orally and topically (Table 3).

The gum of *Senegalia modesta*, seed oil of *Ricinus communis* and decoction of roots of *Withania somnifera* uses for arthritis and rheumatism. The most frequently used plants for gastrointestinal issues (abdominal pain, gastric ulcer, diarrhea, dysentery, cholera, vomiting, dyspepsia and constipation) were *Berberis lycium, Chenopodium album, Mentha longifolia*, *Decaspermum blancoi Nasturtium officinale, Oxalis corniculata, Quercus incana, Solanum nigrum, Sonchus oleraceus, Viburnum cotinifolium* and *Gymnosporia royleana*. For the treatment of diarrhoea, constipation, and hepatitis, *Cuscuta cassytorres* whole plant extract was administered. In traditional medicine, *Cuscuta* species are used as purgatives, diaphoretics, anthelmintics, diuretics, and tonics in addition to treating itching and bilious disorders (Noureen *et al.* 2019). The whole plant of *C. reflexa* can be used to treat conjunctivitis, respiratory diseases, piles, ulcers, and stomach problems (Singh and Sharma 2017). Similar to this, *Olea europaea, Astragalus multiceps, Bukiniczia cabulica, Polygonum aviculare* and *Bergenia ciliata* were the most often utilized plants for pulmonary infractions such as coughing, tonsillitis, sore throat, influenza and asthma.

Cardiovascular problems such as hypertension and increased cholesterol levels were commonly treated with *Marrubium valgare, Melia azedarach* and *Sageretia thea.* The medicinal herb *Sageretia thea* has been used in Korea and China to treat fevers and hepatitis, and researchers have also discovered that it possesses anticancer properties (Kim *et al.* 2019). For skeletal and muscular complaints and healing of the wound, the plants like *Verbascum thapsus* and *Rumex dentatus* were administered. Hesperidin and coumarin are the two important compounds that are used to treat wounds and are found in the leaves of the *verbascum thapsus* (Gupta *et al.* 2022). Plants such as *Tribulus terrestris*, *Bergenia ciliata*, *Chenopodium album*, *Equisetum arvens*e, *Solanum nigrum* and *Xanthium strumarium* were frequently primarily used to treat kidney stones and other urogenital disorders. *Tribulus terrestris* is used individually as a single therapeutic agent or as a prime or subordinate component in numerous medicine formulations and food supplements. It is used in traditional medicine as a tonic, aphrodisiac, palliative, astringent, stomachic, antihypertensive, diuretic, lithotriptic, and urinary disinfectant (Chhatre *et al.* 2014). While it has been found that some plants, like *Dodonaea viscosa, Rydingia limbata, Salvia moorcroftiana, Phlomidoschema parviflorum* and *Pinus roxburghii* have the potential to treat burns and wounds. *Teucrium stocksianum, Melia azedarach, Solanum virginianum, Incarvillea emodi* and *Astragalus graveolens* were used to lower blood sugar levels. *Teucrium stocksianum* is an important medicinal plant used in traditional medicine to treat abdominal pain, diarrhea, coughing, and jaundice. Additionally, it has cytoprotective effects on the gastrointestinal tract and hepatoprotective effects (Shah *et al.* 2012). Due to the presence of numerous phytoconstituents such as alkaloids, terpenoids, saponins, steroids, and flavonoids, the bark, leaves, roots, and fruits of *Solanum virginianum* are widely utilized in traditional medicine (Tekuri *et al.* 2019).

Table 3. Medicinal plants application as well as their formulation and route of administration

Name of Disease	No. of Plants used	Method of remedies formation	Route of administration
Abdominal pain	10	Dec, Pow, Ext.	O
Appetite	2	Pow.	O
Arthritis	2	Pow, Ext	O, T
Asthma	2	Dec, Pow	O
Blood pressure	4	Dir, Ext	O
Constipation	9	Dec, Dir, Ext, Lat, Pow	O
Diabetes	6	Dec, Ext, Pow	O
Diarrhea	5	Ext	O
Dysentery	2	Gum, Ext	O
Eye diseases	1	Ext	T
Gum bleeding	2	Dir	O
Hemorrhoid	1	Ext	O
Healing of wound	1	Pes	T
Hepatitis and Liver disorder	3	Dec, Dir, Ext	O
Kidney stones	2	Ext, Pow,	O
Leukoderma	1	Pas	T
Malaria	1	Dec	O
Muscular pain	3	Dec, Dir, Ext	O, T
Obesity	1	Ext	O
Parasitic worms	4	Ext, Pow	O
Pimples	1	Dec	T
Pustule eruption	4	Dir, Pes	T
Respiratory infections	13	Dec, Dir, Ext, Lat, Pow	O
Sexual disorder	3	Pow	O
Stomach Pain and Ulcer	8	Dec, Ext, Pow	O
Trauma	3	Pest	T
Urogenital infection	4	Dec, Ext, Pow	O
Vomiting	2	Ext	O

Legend: Dec = Ru = Rubbing, T = Topical

Berberis lycium, Chenopodium album and *Solanum nigrum* were among the species frequently used to treat jaundice. Since ancient times, the *Chenopodium album* has been used as a diuretic, dysentery, laxative, sedative, hepatoprotective, and anti-parasitic medication (Kokanova-Nedialkova *et al.* 2009). Similarly, the infusions of *Dysphania botrys* were made and utilized as medicines having diuretic, antispasmodic, carminative, and antidiarrheal effects (Kokanova-Nedialkova *et al.* 2009). Similarly, *S. nigrum* has been utilized for blood purification, mouth ulcers, skin eczema, urinary tract infections, dysentery, prostate, and bronchitis since ancient times (Chen *et al.* 2022). *Zanthoxylum capense,* locally known as "Dambara" dried fruit and seeds powder is used to enhance the flavor of foodstuff and is also employed in yogurt drinks during the summer season. Similarly, *Vitis jacquemontii* fruits are used in milk drink juice as a body coolant. The nuts of *Juglans regia*, fruits of *Sideroxylon mascatense* and gum of *Senegalia modesta* were used as body tonic. Patients prefer using herbal medicines over synthetic and standardized medications because they are easy to use and can be administered by themselves (Burnetti *et al.* 2020). The use of a plant's leaves, stem, bark, roots, flowers, fruits, and seeds in herbal medicine used since ancient

times to cure a variety of illnesses (Kong *et al.* 2003), because having more active biological compounds (Rehman *et al.* 2015). For the sustainable uses of medicinal plants, the use of leaves, and up ground parts are safer (Giday *et al.* 2003), than the regular use of roots, fruit, seeds and whole plant which reduces the population and overall growth of the medicinal plants (Ghimire *et al.* 2008).

Breastfeeding mothers are given *Cephalanthera longifolia* rhizome powder mixed with milk to enhance milk production for the infants. An early study by Shah *et al.* (2015) reported that when the crushed rhizome of *Cephalanthera longifolia* is put into a glass of Lassi (whey milk), which is made by churning curd, enhanced the milk production of lactating women. A tonic made from roots and rhizomes of *Cephalanthera longifolia* is used to improve lactation (Haq 2012). The roots of *Cirsium arvense* have hepatoprotective, diuretic, astringent, and antiphlogistic properties. Children with worm infections have traditionally been treated with a *Cirsium* root decoction (Agarwal *et al.* 2022). The ripe fruits of *Cotoneaster nummularius* are used as an expectorant, the fruiting twigs of this species have a long tradition of usage as an antipyretic, and the roots of this plant are used to treat rheumatic complaints (Kicel 2020). The presence of terpenes and volatile oil in the fresh shoots of *Isodon rugosus* are kept in bedrooms to repel bedbugs, fleas and other insects while sleeping. *Daphne mucronata* fruit poultice is used to treat acne and freckles on the face, and plant extract is thought to be effective in treating allergies and disorders of the skin (Zaidi *et al.* 2015). Traditionally, *Dodonaea viscosa* was used in the treatment of rheumatism, skin infections, diarrheas, stomachaches, pains of hepatic or splenic origin, uterine colic and other disorders involving smooth muscles, antipruritic in skin rashes, dermatitis, hemorrhoids and sore throat. The infusion of leaves was used to treat rheumatism, gout, hemorrhoids, fractures and snake bites (Al-Snafi 2017). *Ajuga integrifolia* locally knowns as "Ghoti" in the region, has demonstrated promise in the treatment of diabetes, cancer, fungal infection, and worm infestation. Its leaves' extracts are used to treat skin diseases, combat malaria, and purify the blood while roots can be used to make antidotes for snake bites (Waqas *et al.* 2021).

The use of certain plant parts as a medicine suggests that the tissues of the specified part have strong therapeutic properties, needing biochemical study as well as pharmacological screening to confirm local information. Utilizing plants for traditional purposes has a long history in human culture (Hussain *et al.* 2018b; Ikram *et al.* 2015). Currently, 80% of the world's population uses herbal medicines to treat their illnesses because of no adverse effects and easy accessibility to impoverished people (WHO 2015). However, the traditional usage of medicinal herbs is dwindling as a result of modernity and improvement in various domains of life. Many ethnic societies rely on plants for several necessities including food, fuel, and fodder as well as medicines to alleviate diseases (Hussain *et al.* 2018; Farooq *et al.* 2019). The current study's results are consistent with those of Getaneh and Girma (2014) study, in which they reported 83 plants from Ethiopia whose vegetative and reproductive parts were utilized for the treatment of various ailments. Similarly, Islam *et al.* (2014) from Bangladesh, Naghibi *et al.* (2014) from Iran, and Mustapha (2014) from Nigeria reported the use of plants for the same purposes. From different parts of Pakistan, similar types of investigations have been documented by different research workers such as Ahmad *et al.* (2014), Rehman *et al.* (2015), Hussain *et al.* (2018), Farooq *et al.* (2019) and Islam *et al.* (2021) which supported the current findings. For the first time, information on *Xanthium strumarium* leaves was documented to treat leucoderma, also known as Baris (Baragai) locally, which appears to be an incurable skin disease.

The bioactive constituents in the plants are extracted from the plants and used in pharmaceutical medication preparation. The main chemical constituents in medicinal plants are alkaloids, flavonoids, terpenoids, terpenes, saponins, glycosides, phenolics, tannins, phlobotannins, anthraquinones, phytosterols, steroids, coumarins, quinones, triterpenoids, xanthoproteins, carbohydrates, resins, proteins, amino acids and oxalate (Yaqoob *et al.* 2016). Due to the presence of these bioactive chemical compounds, medicinal plants reputed therapeutic value. These chemical compounds support the body's capacity for carrying out normal physiological processes. Flavonoids and phenols are effective sources for combating germs, scavenging free radicals, reducing inflammation and relieving pain. Similarly, alkaloids are recognized to play a significant role in metabolism (Mubin *et al.* 2022). Many medicinal plants with phytoconstituents have been primarily used to treat diseases including diabetes, cancer, gastrointestinal problems, cardiovascular problems, and urological problems (Koul *et al.* 2020). Further study is required on these plants to extract the compounds and confirm the results of the current analysis. Pharmacologists and herbalists will be able to use this data to improve their further research.

Conclusion

To document ethnomedical knowledge and practices, the remote Arange Valley of District Bajaur is still unexplored. The present study is a contemporary evaluation that recorded local knowledge of medicinal plants in the area. The area has diverse natural flora, and the local people rely on it for a variety of things, including traditional medicine.

Semi-structured questionnaires were used in conjunction with direct interviews with 166 experienced persons to elicit ethnomedical information. It was recorded that 77 plant species from 46 families were being used in traditional medicine to treat a wide range of diseases. Most medications are being used orally (68.97%) and topically (24.14 %) to treat chronic illnesses. The quantitative analysis showed that the *Berberis lycium* and *Sideroxylon mascatense* have maximum RFC values i.e. 0.24 and 0.19, respectively used as a tonic, while *Decaspermum blancoi* exhibits an RFC value of 0.17 which is used for digestive disorders. The highest use values were recorded (1.0) for *Sideroxylon mascatense* and (0.78) for *Berberis lycium*. This study demonstrates that the area has a rich flora of medicinal plants and could be contributed to ethnobotanical knowledge. The data collected will serve as a basis for the comprehensive investigation of active molecular constituents of the medicinal flora of the area. Novel herbal medications in the field of pharmacology may soon be discovered via the investigation of these medicinal plants.

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Literature cited

Abate L, Bachheti RK, Tadesse MG, Bachheti A. 2022. Ethnobotanical uses, chemical constituents, and application of *Plantago lanceolata* L. Journal of Chemistry 2022:1-29.

Abou-El-Hamd EM, Mohamed-Elamir FH, Moustafa MF. 2012. *Euphorbia helioscopia*: chemical constituents and biological activities. International Journal of Phytopharmacology 3(1):78-90.

Acharya D, Shrivastava K. 2008. Indigenous Herbal Medicines: Tribal Formulations and Traditional Herbal Practices, Aavishkar Publishers Distributor, Jaipur- India. Pp.440.

Aggarwal G, Kaur G, Bhardwaj G, Mutreja V, Sohal HS, Nayik GA, Sharma A. 2022. Traditional uses, phytochemical composition, pharmacological properties, and the biodiscovery potential of the Genus *Cirsium*. Chemistry 4(4):1161-1192.

Ahmad S, Ullah F, Ayaz M, Ahmad A, Sadiq A, Mohani SNUH. 2019. Nutritional and medicinal aspects of *Rumex hastatus* D. Don along with in vitro anti-diabetic activity. International Journal of Food Properties 22(1):1733-1748.

Ahmed E, Arshad M, Bibi Y, Ahmed MS. 2018. Phytochemical and antioxidant potential of crude methanolic extract and fractions of *Celtis eriocarpa* Decne. leaves from lesser Himalaya Region of Pakistan. Pakistan Journal of Botany 50(1):279-285.

Ahmed S, Shuaib M, Ali K, Ali S, Hussain F. 2017. Evaluation of different parts of *Berberis lycium* and their biological activities: a review. Pure and Applied Biology (PAB) 6(3):897-907.

Alahmad A, Alghoraibi I, Zein R, Kraft S, Dräger G, Walter JG, Scheper, T. 2022. Identification of major constituents of *Hypericum perforatum* L. extracts in Syria by development of a rapid, simple, and Reproducible HPLC-ESI-Q-TOF MS analysis and their antioxidant activities. ACS omega 7(16):13475-13493.

Alam F, Afsar N, Saqib QNU. 2017. Antioxidant Activity, A-glucosidase inhibition and antidiabetic potential of *Androsace Rotundifolia* Hardw in diabetic model. Pakistan Journal of Pharmacology 34 (1 & 2):31-38.

Alexiades M. 1996. Collecting ethnobotanical data. An introduction to basic concepts and techniques. In: Selected Guidelines for ethnobotanical research: A field manual. The New York Botanical Garden Press. New York, USA. Pp.58-94.

Ali SI, Qaisar M. 1993-2018. "Flora of Pakistan". Department of Botany, University of Karachi. 194-222.

Al-Snafi A. E. 2017. A review on *Dodonaea viscosa*: A potential medicinal plant. IOSR Journal of Pharmacy 7(2):10-21.

Al-Snafi AE. 2015. The chemical constituents and pharmacological effects of *Adiantum capillus-veneris*-A review. Asian Journal of Pharmaceutical Science and Technology 5(2):106-111.

Al-Snafi AE. 2020. A review on *Nasturtium officinale*: A potential medicinal plant. IOSR Journal of Pharmacy 10(9):33-43.

Arshad M, Ahmad MS, Mashwani ZUR. 2019. Fermentation enhances redox protective activities of *Gymnosporia royleana* Wall. ex Lawson extracts. Iranian Journal of Science and Technology, Transactions A: Science 43(1):15-23.

Arshad S. 2006. Chemical Constituents of *Stachys Parviflora* (Doctoral dissertation, University of Karachi).

Asgarpanah J, Ariamanesh A. 2015. Phytochemistry and pharmacological properties of *Myrtus communis* L. Indiaan Journal of Traditional Knowledge 1 (1):82-87

Bahukhandi A, Attri DC, Mehra T, Bhatt ID. 2023. *Fragaria* spp.(*Fragaria indica*, *Fragaria nubicola)*. In Himalayan Fruits and Berries (pp. 183-196). Academic Press.

Bano A, Ahmad M, Hadda TB, Saboor A, Sultana S, Zafar M, Khan MP, Arshad M, Ashraf MA. 2014. Quantitative ethnomedicinal study of plants used in the Skardu Valley at high altitude of Karakoram-Himalayan range, Pakistan. Journal of Ethnobiology and Ethnomedicine 10(1):1-17.

Batool H, Hussain M, Hameed M, Ahmad R. 2020. A review on *Calotropis procera* its phytochemistry and traditional uses. Big Data in Agriculture 2:29-31.

Bibi T, Ahmad M, Tareen RB, Tareen NM, Jabeen R, Rehman SU, Sultana S, Zafar M, Yaseen G. 2014. Ethnobotany of medicinal plants in District Mastung of Baluchistan Province-Pakistan. Journal of Ethnopharmacology 157:79-89.

Brunetti P, Pichini S, Pacifici R, Busardò FP, del Rio A. 2020. Herbal preparations of medical cannabis: A vademecum for prescribing doctors. Medicina, 56(5):237.

Chen X, Dai X, Liu Y, Yang Y, Yuan L, He X, Gong G. 2022. *Solanum nigrum* L.: An insight into current research on traditional uses, phytochemistry and pharmacology. Frontiers in Pharmacology 13:1-32.

Chhatre S, Nesari T, Somani G, Kanchan D, Sathaye S. 2014. Phytopharmacological overview of *Tribulus terrestris*. Pharmacognosy Reviews 8(15):45-51.

Fabricant DS, Farnsworth NR. 2001. The value of plants used in traditional medicine for drug discovery. Environmental health perspectives 109(1):69-75.

Fan W, Fan L, Peng C, Zhang Q, Wang L, Li L, Wang J, Zhang D, Peng W, Wu C. 2019. Traditional uses, botany, phytochemistry, pharmacology, pharmacokinetics and toxicology of *Xanthium strumarium* L.: A review. Molecules 24(2):1-40.

Farooq A, Amjad MS, Ahmad K, Altaf M, Umair M, Abbasi AM. 2019. Ethnomedicinal knowledge of the rural communities of Dhirkot, Azad Jammu and Kashmir, Pakistan. Journal of Ethnobiology and Ethnomedicine 15(1):1-30.

Farzaei MH, Bahramsoltani R, Ghobadi A, Farzaei F, Najafi F. 2017. Pharmacological activity of *Mentha longifolia* and its phytoconstituents. Journal of Traditional Chinese Medicine 37(5):710-720.

Gairola S, Sharma J, Bedi YS. 2014. A cross-cultural analysis of Jammu, Kashmir and Ladakh (India) medicinal plant use. Journal of Ethnopharmacology 155(2):925-86.

Getaneh S, Girma Z. 2014. An ethnobotanical study of medicinal plants in Debre Libanos Wereda, Central Ethiopia. African Journal of Plant Science 8(7):366-379.

Ghimire SK, Gimenez O, Pradel R, McKey D, Aumeeruddy-Thomas Y. 2008. Demographic variation and population viability in a threatened Himalayan J. Med. Aromat. herb *Nardostachys grandiflora*: matrix modelling of harvesting effects in two contrasting habitats. Journal of Applied Ecology 45(1):41-51.

Giday M, Asfaw Z, Elmqvist T, Woldu Z. 2003. An ethnobotanical study of medicinal plants used by the Zay people in Ethiopia. Journal of Ethnopharmacology 85(1):43-52.

Gupta A, Atkinson AN, Pandey AK, Bishayee A. 2022. Health-promoting and disease-mitigating potential of *Verbascum thapsus* L. (common mullein): A review. Phytotherapy Research 36(4):1507-1522.

Haq A, Badsha L, Ali A, Ullah A, Khan S M, Ullah I. 2022. Ethnobotanical study of medicinal plants of Pashat Valley, Bajaur, along Pakistan–Afghanistan border: a mountainous region of the Hindu Kush Range. Nordic Journal of Botany e03580.

Haq F. 2012. The ethnobotanical uses of medicinal plants of Allai Valley, Western Himalaya Pakistan. Inter. Journal of Plant Research 2(1):21-34.

Haq SM, Hassan M, Bussmann RW, Calixto ES, Rahman IU, , Sakhi S, Ijaz F, Hashem A, Al-Arjani ABF, Almutairi KF, Abd_Allah EF. 2022. A cross-cultural analysis of plant resources among five ethnic groups in the Western Himalayan region of Jammu and Kashmir. Biology, 11(4):1-38.

Haq SM, Yaqoob U, Calixto ES, Rahman IU, Hashem A, Abd_Allah EF, Alakeel MA, Alqarawi AA, Abdalla M, Hassan M, Bussmann RW. 2021. Plant resources utilization among different ethnic groups of Ladakh in Trans-Himalayan Region. Biology, 10(9):p.827.

Hayes D, Angove MJ, Tucci J, Dennis C. 2016. Walnuts (*Juglans regia*) chemical composition and research in human health. Critical reviews in food science and nutrition 56(8):1231-1241.

Hussain I, Khan AU, Ullah R, Alsaid MS, Salman S, Iftikhar S, Marwat GA, Sadique M, Jan S, Adnan M, Tariq A. 2017. Chemical composition, antioxidant and anti-bacterial potential of essential oil of medicinal plant *Isodon rugosus*. Journal of Essential Oil Bearing Plants. 2;20(6):1607-13.

Hussain W, Badshah L, Ullah M, Ali M, Ali A, Hussain F. 2018a. Quantitative study of medicinal plants used by the communities residing in Koh-e-Safaid Range, northern Pakistani-Afghan borders. Journal of Ethnobiology and Ethnomedicine 14:1-18.

Hussain W, Hussain J, Ali R, khan Shinwari Z, Nascimento IA, Lope WA. 2012. Tradable and Conservation Status of Medicinal Plants of KurramValley, Parachinar, Pakistan. Journal of Applied Pharmaceutical Science 2(10):066-070.

Hussain W, Ullah M, Dastagir G, Badshah L. 2018b. Quantitative ethnobotanicalappraisal of medicinal plants used by inhabitants of lower Kurram, Kurram agency, Pakistan. Avicenna Journal of Phytomedicine 8(4):313.

Huzafa M, Jamal Z, Ahmed A. 2020. Qualitative phytochemical analysis of *Incarvillea emodi* (Royle ex Lindl.) Chatterjee and *Malva neglecta* (Wallr.). Ukrainian Journal of Ecology 10(4):93-95.

Ikram EHK, Stanley R, Netzel M, Fanning K. 2015. Phytochemicals of papaya and its traditional health and culinary uses–A review. Journal of Food Composition and Analysis 41:201-211.

Irfan M, Qadir MI. 2017. Analgesic, anti-inflammatory and antipyretic activity of *Salvia moorcroftiana*. Pakistan Journal of Pharmacy Science 30(2):481-486.

Islam MK, Saha S, Mahmud I, Mohamad K, Awang K, Uddin SJ, Rahman MM, Shilpi JA. 2014. An ethnobotanical study of medicinal plants used by tribal and native people of Madhupur forest area, Bangladesh. Journal of Ethnopharmacology 151:921-930.

Islam T, Pieroni A, Uddin SB, Faruque MO. 2021. Medical ethnobotany of the Marma community of Rangamati district of Bangladesh. Nordic Journal of Botany 39(12):1-42.

Jain SK. 1964. The role of botanist in folklore research. Folklore 5:145-150.

Jan M, Khare RK, Mir TA. 2021. Medicinal plants used during Pregnancy and Childbirth in Baramulla District of Jammu and Kashmir, India. Ethnobotany Research and Applications 22:1-19.

Jan M, Mir TA, Khare RK. 2022. Traditional use of medicinal plants among the indigenous communities in Baramulla district, Jammu and Kashmir, India. Nordic Journal of Botany 6:e03387.

Kassa Z, Asfaw Z, Demissew S. 2020. An ethnobotanical study of medicinal plants in Sheka Zone of Southern Nations Nationalities and Peoples Regional State, Ethiopia. Journal of Ethnobiology and Ethnomedicine 16:1-15.

Kaushik P, Kaushik D, Khokra SL. 2013. Ethnobotany and phytopharmacology of *Pinus roxburghii* Sargent: a plant review. Journal of Integrative Medicine 11(6):371-376.

Khan A, Naz S, Farooq U, Shahid M, Ullah I, Ali I, Mabkhot YN. 2017. Bioactive chromone constituents from *Vitex negundo* alleviate pain and inflammation. Journal of pain Research:95-102.

Khan S, Syed F. 2013. Bioactive constituents from genus *Otostegia*. SARJ of Physical Science 1:15-25.

Khan SM, Uddin N, Ilyas M, Sohail URI. 2015. Ethnobotanical study of some medicinal plants of Tehsil Kabal, District Swat, KP, Pakistan. *Journal of Medicinal and Aromatic Plants* 4(189):1-4.

Kicel A. 2020. An overview of the genus *Cotoneaster* (Rosaceae): phytochemistry, biological activity, and toxicology. *Antioxidants* 9(10):1-26.

Kim HN, Park GH, Park SB, Kim JD, Eo HJ, Son HJ, Song JH, Jeong JB. 2019. Extracts from *Sageretia thea* reduce cell viability through inducing cyclin D1 proteasomal degradation and HO-1 expression in human colorectal cancer cells. BMC Complementary and Alternative Medicine 19(1):1-11.

Kokanova-Nedialkova Z, Nedialkov P, Nikolov S. 2009. The genus *Chenopodium*: phytochemistry, ethnopharmacology and pharmacology. Pharmacognosy Reviews 3(6):280-306.

Kong JM, Goh NK, Chia LS, Chia TF. 2003. Recent advances in traditional plant drugs and orchids. *Acta Pharmacologica* Sinica 24:7-21.

Koul B, Kumar A, Yadav D, Jin JO. 2020. *Bergenia* genus: Traditional uses, phytochemistry and pharmacology. Molecules 25(23):1-19.

Leal F, Taghouti M, Nunes F, Silva A, Coelho AC, Matos M. 2017. *Thymus* Plants: A review—Micropropagation, molecular and antifungal activity. Active Ingredients from Aromatic and Medicinal Plants:107-126.

Lemieux CJ, Eagles PF, Slocombe DS, Doherty ST, Elliott SJ, Mock SE. 2012. Human health and well-being motivations and benefits associated with protected area experiences: An opportunity for transforming policy and management in Canada. Parks. 18(1):71-85.

Li X, Qu L, Dong Y, Han L., Liu E, Fang S, Wang T. 2014. A review of recent research progress on the *Astragalus* genus. Molecules,19(11):18850-18880.

Li XM, Yang PL. 2018. Research progress of *Sonchus* species. International Journal of Food Properties 21(1):147-157.

Lodhi S, Vadnere GP, Sharma VK, Usman MR. 2017. *Marrubium vulgare* L.: A review on phytochemical and pharmacological aspects. Journal of Intercultural Ethnopharmacology 6(4):429-452.

Makia R, Al-Halbosiy MM, Al-Mashhadani MH. 2022. Phytochemistry of the Genus *Equisetum* (Equisetum arvense). *G*SC Biological and Pharmaceutical Sciences 18(2):283-289.

Medeiros MFT, Silva O, Albuquerque U. 2011. Quantification in ethnobotanical research: an overview of indices used from 1995 to 2009. *Sitientibus* Série Ciências Biológicas 11:211-230.

Mir, T. A., M. Jan, R. K. Khare. 2021. Ethnomedicinal application of plants in Doodhganga forest range of district Budgam, Jammu and Kashmir, India. European Journal of Integrative Medicine 46:101366.

Molares S, Ladio A. 2009. Ethnobotanical review of the Mapuche medicinal flora: use patterns on a regional scale. Journal of Ethnopharmacology 122:251-260.

Mubin S, Rehman NU, Murad W, Shah M, Al-Harrasi A, Afza, R. 2022. *Scutellaria petiolata* Hemsl. ex Lace & Prain (Lamiaceae).: A New Insight in Biomedical Therapies. Antioxidants 11(8):1-21.

Munir N, Mahmood Z, Shahid M, Afzal MN, Jahangir M, Ali Shah SM, Tahir IM, Riaz M, Hussain S, Akram M, Yousaf F. 2022. *Withania somnifera* chemical constituents' In vitro antioxidant potential and their response on spermatozoa parameters. Dose-Response, 20(1):15593258221074936.

Musa SM, Fathelrhman EA, Elsheikh AE, Lubna AA, Abdel LEM, Sakina MY. 2011. Ethnobotanical study of medicinal plants in the Blue Nile State, South-eastern Sudan. Journal of Medicinal Plants Research, 5(17):4287-4297.

Mushtaq M, Peerzada S, Ishtiaq S. 2021. Pharmacognostic features, preliminary phytochemical screening and in vitro antioxidant studies of indigenous plant of Lahore. International Journal of Advanced Biological and Biomedical Research 9(2):190-201.

Mustapha AA. 2014. Ethnobotanical field survey of medicinal plants used by traditional medicine practitioners to manage HIV/AIDS opportunistic infections and their prophylaxis in Keffi Metropolis, Nigeria. Asian Journal Plants Science Research 4:7-14.

Naghibi F, Esmaeili S, Malekmohammadi M, Hassanpour A, Mosaddegh M. 2014. Ethnobotanical survey of medicinal plants used traditionally in two villages of Hamedan, Iran. *Research Journal of Pharmacognosy* 1(3):7-14

Nasir E, Ali SI. 1971-1995. Flora of Pakistan. Pakistan Agriculture Research Council, Islamabad.

Naz D, Muhammad A, Zeb A. 2020. Evaluation of antioxidant, analgesic and anti-inflammatory properties of *Sedum Adenotrichum*. Acta Poloniae Pharmaceutica 77(5):737-744.

Nikolaos S, Christodoulakis NS, Tsiarta M, Fasseas C. 2013. Leaf structure and histochemical investigation in *Papaver rhoeas* L. (Corn poppy, field poppy). Journal of Herbs Spices and Medicinal Plants 19:119-131.

Nisa H, Kamili AN, Bandh SA, Lone BA, Parray JA. 2013. Phytochemical screening, antimicrobial and antioxidant efficacy of different extracts of *Rumex dentatus* L.–a locally used medicinal herb of Kashmir Himalaya. Asian Pacific Journal of Tropical Disease 3(6):434-440.

Noureen S, Noreen S, Ghumman SA, Batool F, Bukhari SNA. 2019. The genus *Cuscuta* (Convolvolaceac): An updated review on indigenous uses, phytochemistry, and pharmacology. Iranian Journal of Basic Medical Sciences 22(11):1225-1252.

Radwan MM, Chandra S, Gul S, ElSohly MA. 2021. Cannabinoids, phenolics, terpenes and alkaloids of *Cannabis*. Molecules, 26(9):2774.

Rafique R. 2010. Ethnopharmacological studies of *Isminum sambac (*L.) *Aition, Olea Europae* L. and *Olea Ferruginea* Royal (Doctoral dissertation, GC University Lahore

Rahman TU, Zeb MA, Liaqat W, Sajid M, Hussain S, Choudhary MI. 2018. Phytochemistry and pharmacology of genus *Indigofera*: A review. Records of Natural Products 12(1):1-13.

Rehman H, Begum W, Anjum F, Tabasum H. 2014. *Rheum emodi* (Rhubarb): A fascinating herb. Journal of Pharmacognosy and Phytochemistry 3(2):89-94.

Rehman J, Khan IU, Farid S, Kamal S, Aslam N. 2013. Phytochemical screening and evaluation of in-vitro antioxidant potential of *Monotheca buxifolia*. Journal of Biotechnology and Pharmacy Research 4(4):54-60.

Rehman K, Khan MA, Ullah Z, Chaudhary HJ. 2015. An ethnobotanical perspective of traditional medicinal plants from the Khattak tribe of Chonthra Karak, Pakistan. Journal of Ethnopharmacology 165:251-259.

Riaz T, Abbasi MA, Rehman A, Shahzadi U, Qureshi MZ, Ajaib M. 2012. *Dicliptera bupleuroides*: an imperative source for protection from oxidative stress. Journal of the Chemical Society of Pakistan 34(2):326-332.

Ridvan P, Ugur C, Kaan K, Denizhan UM, Zafer T. 2015. An ethnobotanical study on medicinal plants in Espiye and its surrounding (Giresun-Turkey). Journal of Ethnopharmacology 163:1-11.

Saboon BY, Arshad M, Sabir S, Amjad MS, Ahmed E, Chaudhari SK. 2016. Pharmacology and biochemistry of Polygonatum verticillatum:a review. Journal of Coastal Life Medicine 4(5):406-415.

Sarfraz I, Rasul A, Hussain G, Shah MA, Nageen B, Jabeen F, Adem S. 2022. A review on phyto-pharmacology of *Oxalis corniculata*. Combinatorial Chemistry & High Throughput Screening 25(7):1181-1186.

Sarwar W. 2016. Pharmacological and phytochemical studies on *Acacia modesta* wall; a review. JPHYTO 5:160-166.

Savikin K, Zdunic G, Menkovic N, Zivkovi CJ, Cuji CN, Teres cenko M, Bigovic D. 2013. Ethnobotanical study on traditional use of medicinal plants in South-western Serbia, Zlatibor district. Journal of Ethnopharmacology 146:803-810.

Shah A, Bharati KA, Ahmad J, Sharma MP. 2015. New ethnomedicinal claims from Gujjar and Bakerwals tribes of Rajouri and Poonch districts of Jammu and Kashmir, India. Journal of Ethnopharmacology 166:119-128.

Shah S, Siraj-ud-Din, Rehmanullah. 2013. Pharmacognostic standardization and FT-IR analysis of various parts of *Sageretia thea.* International Journal of Bioscience 3(3):108-114.

Shah SMM, Ullah F, Shah SMH, Zahoor M, Sadiq A. 2012. Analysis of chemical constituents and antinociceptive potential of essential oil of T*eucrium stocksianum* Bioss collected from the North West of Pakistan. BMC Complementary and Alternative Medicine 12(1):1-6.

Shah Z, Ali F, Ullah H, Khan D, Khan S, Khan R, Ali I. 2014. Biological screening and chemical constituents of *Viburnum grandiflorum. Journal of the Chemical Society of Pakistan* 36(1):113-118.

Sharif A, Asif H, Younis W, Riaz H, Bukhari IA, Assiri AM. 2018. Indigenous medicinal plants of Pakistan used to treat skin diseases: a review. Chinese Medicine 13(1):1-26.

Sharma D, Paul Y. 2013. Preliminary and pharmacological profile of *Melia azedarach* L.: An overview. Journal of Applied Pharmaceutical Science 3(12):133-138.

Shinwari ZK. 2010. Medicinal plants research in Pakistan. Journal of Medicinal Plants Research 4(3):161-176.

Singh R. 2015. Medicinal plants: A review. Journal of Plant Sciences 3(1-1):50-55.

Singh TP, Okram MS. 2011. Phytochemical and pharmacological profile of *Zanthoxylum armatum* DC.-An overview.

Sofowora A. 1993. Medicinal plants and traditional medicine in Africa. Spectrum books limited: Ibadan

Taib M, Rezzak Y, Bouyazza L, Lyoussi B. 2020. Medicinal uses, phytochemistry, and pharmacological activities of *Quercus* species. Evidence-Based Complementary and Alternative Medicine, 2020:1-20.

Tekuri SK, Pasupuleti SK, Konidala KK, Amuru SR, Bassaiahgari P, Pabbaraju N. 2019. Phytochemical and pharmacological activities of *Solanum surattense* Burm. f.–A review. Journal of Applied Pharmaceutical Science 9(3):126-136.

Teoh ES. 2016. Genus: Calanthe to Cyrtosia. In Medicinal Orchids of Asia (pp. 171-250). Springer, Cham.

Tolossa K, Debela E, Athanasiadou S, Tolera A, Ganga G, Houdijk JG. 2013. Ethnomedicinal study of plants used for treatment of human and livestock ailments by traditional healers in South Omo, Southern Ethiopia. Journal of Ethnobiology and Ethnomedicine 9(1):32-38.

Tyagi K, Sharma S, Rashmi R, Kumar S. 2013. Study of phytochemical constituents of *Ricinus communis* Linn. under the influence of industrial effluent. Journal of Pharmacy Research 6(8):870-873.

Umair M, Altaf M, Bussmann RW, Abbasi AM. 2019. Ethnomedicinal uses of the local flora in Chenab riverine area, Punjab province Pakistan. Journal of Ethnobiology and Ethnomedicine 15(1):1-31.

Velanganni J, Kadamban D, Tangavelou AC. 2011. Phytochemical screening and antimicrobial activity of the stem of *Mallotus philippensis* (Lam.) Muell. Arg. var. *philippensis* (Euphorbiaceae). International Journal Pharmacy and Pharmaceutical Science 3(Suppl 2):160-163.

Vendruscolo G, Mentz A. 2006. Ethnobotanical survey of the medicinal plants used by the community of Ponta Grossa neighborhood, Porto Alegre, Rio Grande do Sul, Brazil. Iherigia Série Botânica. 61:83-103.

Villena-Tejada M, Vera-Ferchau I, Cardona-Rivero A, Zamalloa-Cornejo R, Quispe-Florez M, Frisancho-Triveño Z, Yañez JA. 2021. Use of medicinal plants for COVID-19 prevention and respiratory symptom treatment during the pandemic in Cusco, Peru: A cross-sectional survey. PloS one, 16(9):e0257165.

Vitalini S, Iriti M, Puricelli C, Ciuchi D, Segale A, Fico G. 2013. Traditional knowledge on medicinal and food plants used in Val San Giacomo (Sondrio, Italy) – an alpine ethnobotanical study. Journal of Ethnopharmacology 145:517-529.

Wang Y, Zhao Y, Liu X, Li J, Zhang J, Liu D. 2022. Chemical constituents and pharmacological activities of medicinal plants from Rosa genus. Chinese Herbal Medicines 14(2):187-209.

Waqas M, Ghous T, Akram B. 2021. Comparative study of biological activities of different extracts of root and whole plant materials of *Ajuga bracteosa* from Bhimber Azad Kashmir Pakistan. Pure and Applied Biology (PAB) 10(4):1303-1311.

Welz AN, Emberger-Klein A, Menrad K. 2018. Why people use herbal medicine: insights from a focus-group study in Germany. BMC Complementary and Alternative Medicine 18(1):1-9.

WHO. 2015. Traditional Medicine, Fact Sheet: http:/www.who.int/mediacentre/ factsheets/fs134/en/ (Accessed on: 12.12.2015).

Yaqoob U, Nawchoo IA, Ahmad M. 2016. Phytochemical evaluation of various solvent extracts of the leaves, fruits and shoots of *Ferula jaeschkeana* Vatke. Herbal Medicine 2(3):2472-0151.

Yu Y, Liu G, Piao M, Lang M, Wang Y, Jin M, Zheng M. 2022. Chemical constituents of *Polygonum aviculare* L. and their chemotaxonomic significance. Biochemical Systematics and Ecology 105:104529.

Zahra Z, Khan MR, Shah SA, Maryam S, Majid M, Younis T, Sajid M. 2020. *Vincetoxicum arnottianum* ameliorate inflammation by suppressing oxidative stress and pro-inflammatory mediators in rat. Journal of Ethnopharmacology 252:112565.

Zaidi A, Bukhari SM, Khan FA, Noor T, Iqbal N. 2015. Ethnobotanical, phytochemical and pharmacological aspects of *Daphne mucronata* (Thymeleaceae). Tropical Journal of Pharmaceutical Research 14(8):1517-1523.

Zhou YX, Xin HL, Rahman K, Wang SJ, Peng C, Zhang H. 2015. *Portulaca oleracea* L.: a review of phytochemistry and pharmacological effects. BioMed Research International 2015:1-11.