Ethnobotanical Significance of Medicinal flora in Tangi Dara indigenous Communities, Lower Dir, Khyber Pakhtunkhwa, Pakistan

Kalim Ullah [1], Lal Badshah [2], Muhammad Zubair [3*], Shazma Azim [4], Muhammad Zamir [5], Muhammad Nabi [6], Seemab Ali Khan [7], Nadia Faqir [8]

[1-2, 4] Department of Botany, University of Peshawar, Khyber Pakhtunkhwa, Pakistan
[3, 7] Department of Botany, University of Science and Technology Bannu, Khyber Pakhtunkhwa, 28100 Pakistan
[5] Department of Botany, GPGC Timergara Dir Lower, Khyber Pakhtunkhwa, Pakistan
[6] Institute of Pharmaceutical Sciences, Khyber Medical University Peshawar, Khyber Pakhtunkhwa, Pakistan
[8] Department of Botany, Islamia College University Peshawar, Khyber Pakhtunkhwa, Pakistan

* Corresponding Author: **Muhammad Zubair (zubirhasraat@gmail.com)**

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Abstract

Northern Khyber Pakhtunkhwa province of Pakistan is rich in medicinal plant diversity and traditional knowledge of usage of plant-based drugs against different ailments among indigenous communities. Rural people living in Tangi Dara lower Dir rely on traditional system of herbal medicine due to their strong belief and minimal access to allopathic medicines. Ethnobotanical data were collected from herbalist and native community through semi-structured questionnaires, focus group deliberations and fieldwork during the period of April 2021 to November 2022. A total of 280 people was interviewed to gather traditional ethnobotanical knowledge from the research area in the local language. The results of present study listed 97 plant species classified into 79 genera and 50 families. The dominant families found were Asteraceae and Lamiaceae, followed by Moraceae. The most commonly used plant parts were leaves, followed by fruit. The use value and relative frequency citation showed that *Zanthoxylum armatum* and *Berberis lycium* had high values, at 0.87 and 0.68, respectively. All studied plant species were mostly herbs (58.2%). The remaining percentage was made up of trees (23.5%), shrubs (12.2%), and climbers (6.1%). This knowledge is on the verge of extinction because younger generation is not interested in the process of learning and preservation. Hence, the documentation of traditional ethnobotanical knowledge is crucial for the discovery of novel medications, and the sustainable conservation of local medicinal flora.

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Keywords: Medicinal Plants, Use Value, Tangi Dara, Traditional Knowledge, Conservation

Introduction

Ethnobotany is the study of the complex relationships that exist between plants and humans. This field of study studies how people use local plants in distinct cultures and regions. Ethnobotanists study how plants play important roles in many parts of life, including medicine, food, housing, clothing, hunting, and religious rites. Ethnobotany has developed over the past century from a science primarily concerned with documentation to a more applied field that places a strong emphasis on the preservation and use of sustainable plant resources (Sonnino *et al.* 2017, Amusa *et al.* 2010, Casas *et al.* 2016, Hussain *et al.* 2024) [44, 6, 10, 19].

Globally, medicinal plants have a diverse spectrum of natural occurring and ecological activities, including insect, fungal, disease, and herbivorous animal defense, as well as phytonutrients with recognized or potential biological activity (Gillani *et al.* 2024) [14]. This range of uses extends into their different human applications, ranging from herbal medicine, nutritional additives,

cosmetics, and more (Kumar *et al.* 2017, Haq *et al.* 2020). Medicinal plants can be utilized in many ways, including roots, aerial portions, leaves, flowers, seeds, tubers, and bark, as well as fresh and dry forms, powdered or crushed, and extracts made in a variety of ways (Akarca *et al.* 2015). Medicinal properties of plants include essential oils, gums, leaves, bulbs, flowers, tubers, fatty acids, stems, roots, seeds, rhizomes, and wood (Manzoor *et al*. 2023b, Bahadur *et al.* 2020, Haq *et al.* 2021, Bahadur *et al.* 2022) [29, 8, 9]. They are recognized as the most valuable assets for any country and perform a vital role in agricultural production, giving the scientific community the title of "green gold". Many countries' traditional healthcare systems rely extensively on medicinal and aromatic plants, according to WHO data (Barata *et al.* 2016, Gillani *et al.* 2024a) [14].

In Pakistan, herbal medicines are made from about 6,000 flowering plants (Bano *et al.* 2014) and applied to treat different human illnesses (Ozkan *et al.* 2016; Jima & Megersa 2018, Manzoor *et al.* 2023a, Mirzaman *et al.* 2023, Kayani *et al.* 2024) [23, 28, 32]. Of the roughly 6,000 wild plant species found in the nation, 400–600 have therapeutic value, as noted by (Ali & Qaiser, 2009, Ali *et al.* 2008) [4, 5]. Most of the time, medicinal plants are thought to be exclusive to a particular illness; however, certain medicinal plants are used for multiple purposes (Hamayun *et al.* 2005, Gillani *et al.* 2024a) [14]. Plants and plant-based medicines are the primary sources of daily sustenance for the traditional cultures (Khan *et al.* 2021, Kamal *et al.* 2016) [22]. The bulk of herb collectors lack formal education or expertise (Sodhi *et al.* 2004) [43]. In Pakistan, overuse of some medicinal plants has caused them to go extinct in the past (Rehman *et al.* 2022) [38]. There is still spoken and oral transmission of knowledge regarding the medicinal herb from one generation to the next (Jan *et al.* 2011, Sabran *et al.* 2016) [21, 39].

The Himalayan, Karakorum, and Hindukush regions of northern Pakistan are particularly rich in wildlife (Rehman *et al.* 2023) [37]. Regretfully, the locals harvest these vital therapeutic plants with inadequate and non-scientific ways, frequently storing them incorrectly. People in the area are still unaware of the threats that particular species face, such as unauthorized timber smuggling and animal overgrazing (Alam *et al.* 2023, Haq *et al.* 2022, Ullah *et al.* 2023, Kayani *et al.* 2014) [3, 17, 14]. In order to protect the threatened flora, immediate action is required, which calls for teaching and preparing the local populace to gather therapeutic plants responsibly. Traditional wisdom and customs of the use of medicinal plants in health care is primarily confined to elderly members of the community, with younger generations often unaware of the utilization of natural resources (Gillani *et al.* 2024b, Manzoor *et al.* 2023a) [15, 28]. Indigenous knowledge is disappearing regularly as a result of younger generations leaving for employment and education. As a result, traditional ethnomedical knowledge used by native communities faces a risk of diminishing or going extinct, so its documentation and conservation must be given careful consideration (Manzoor *et al*. 2023b, Mirzaman *et al.* 2023, Kayani *et al.* 2024) [28, 32, 23]. Preserving traditional medical knowledge not only ensures the security of that knowledge but also brings attention to the need for the international community to take action to protect plants (Singh *et al.* 2014; Ijaz *et al.* 2016). The present work has looked into and recorded the traditional, previously unrecorded knowledge of medicinal plants from indigenous communities in Tangi Dara, Lower Dir, Khyber Pakhtunkhwa, Pakistan. The objective of this research was to investigate and compile an exhaustive list of medicinal flora in order to fill this knowledge gap. Record the traditional knowledge of the parts of plants used, the formulation of drugs, and their method of administration. Assess the community's dependence on, authenticity of, and consistency with traditional ethnomedicinal knowledge using a number of quantitative variables.

Materials and Methods

Study Area

The present research study was conducted in Khyber Pakhtunkhwa, Pakistan, specifically in Tangi Dara, Dir Lower. The total population of the district Lower Dir was recorded at 1,436,082 according to the 2017 census. At a distance of 124 kilometers from Peshawar, Dir Lower borders Afghanistan to the west on the international level (Fig. 1). It is located in the lesser Hindukush range, with an area of 1583 km², between 35°-10′ and 35°-16′ N Latitude and 71°-50′ to 71°-83′ E Longitude (Khan *et al.*, 2010). The district shares borders with Upper Dir to the north, Swat District to the east, and Malakand Agency to the south (Champion *et al.*, 1965; Ahmad *et al.*, 2015) [11, 2].

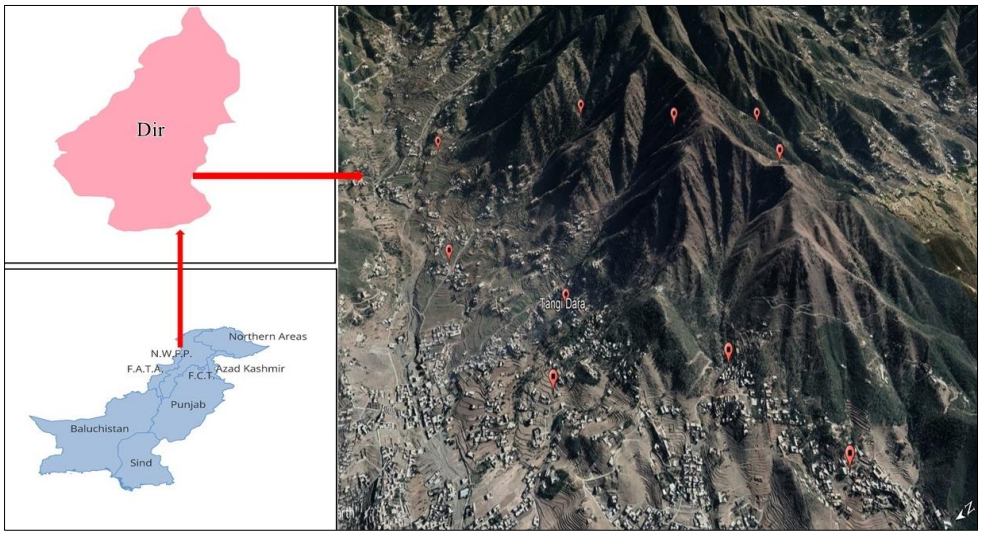

Fig 1: Map of the study area.

Data collection and interviews

The ethnobotanical survey was carried out from April 2021 to November 2022 among people who were native to and still resided in the research area. A total of 140 people was interviewed. The purpose of the survey was to gather ethnobotanical data from native communities, especially those groups residing in more remote locations. Only those who consented to participate were interviewed in more detail. The permission for conducting our study in each area has been obtained from the study region's local elder. We approached native people and requested individuals who exhibited an interest in indigenous medicinal plants to participate in an interview. During group discussions, all interviews were recorded in Pashto, the indigenous language. We used the standard methodology of Martin (1995) [31] and Cotton (1996) [13] to ask questions about the local names of the plants, their medicinal uses, the parts of the plants that are used, when they flower and fruit, how they are prepared, administered, full recipes, and how drugs are prepared in group discussions and ethnobotanical interviews.

Plant Collection & Identification

A number of field trips were conducted from April to August 2023 in order to get plant specimens and traditional ethnomedical knowledge. Throughout the collection procedure, every plant was given a proper label and recognized using its local name. Plant sample pressing, drying, and mounting on herbarium sheets were done with precision. Using the "Flora of Pakistan" as a guide and following the instructions provided by Stewart *et al.* (1972) [45], in addition to using a number of internet sites, made it easier to identify these specimens. Every plant name was checked by looking up the information in the World Online Flora.

Data Analysis

Quantitative metrics such as the Use Value (UV), and Relative Frequency of Citation (RFC) were used to analyze the data.

Use value (UV)

UV determines the relative importance of each medicinal plant species to the local communities, calculated by using the formula (Gairola *et al.* 2013, Gillani *et al.* 2024b) [15].

$$UV = \sum Ui / N$$

Where, N is the total number of informants and Ui is the number of uses for a certain species that each informant reported.

Relative Frequency Citation (RFC)

The RFC provides insights into the most commonly used medicinal plants in local communities. The significance of relative frequency citation (RFC) was used to assess ethnobotanical information. By taking into account the frequency citation (FC), which is calculated by dividing the total number of informants (N) in the ethnobotanical survey, this measure highlights the importance of local plant species (Mirzaman *et al.* 2023, Gillani *et al.* 2024b, Manzoor *et al.* 2024b) [32, 14, 29]. The higher value of RFC indicated the significance of the species. The following formula can be used to calculate the RFC:

$$RFC=FC/N$$

Results and Discussion

Demography of the informants

Participants' demographic characteristics were noted and investigated during group discussions and personal interactions. The interviews involved 140 individuals, with 28 women and 112 men participating. Because the research setting restricted women's connections with outsiders and external community members, the bulk of informants (80%) were male. Women are often prohibited from entering markets, towns, or ceremonial sites, resulting in lower female participation in the current study. According to study, elderly individuals have a better understanding of plants' medicinal properties. Those with a strong educational background are typically unaware of the traditional use of medicinal plants. A high number of survey respondents believe that transmitting ancestral wisdom from one generation to the next is inefficient due to younger people's lack of interest in learning and applying such knowledge.

The development of modern healthcare services is mostly responsible for the reduction of traditional knowledge among the indigenous communities of Tangi Dara Lower Dir, Khyber Pakhtunkhwa, Pakistan. Our results are comparable with prior studies in the same region, revealing constancy in plant use among ethnically varied communities in Khyber Pakhtunkhwa, Pakistan, with diverse cultural backgrounds (Irfan *et al.* 2023, Shinwari *et al.* 2010, Shinwari *et al.* 2011, Rahim *et al.* 2023, Khan *et al.* 2015, Hussain *et al.* 2024) [42, 41, 20, 36, 19].

Medicinal Plants diversity

In the research area, we identified 97 species from 50 botanical families and 79 genera. These were cited as traditional medicines utilized by the study's local community to address a variety of health conditions. Asteraceae has the most species, 11 in total, followed by Lamiaceae, which had 6 and Moraceae had 5 (Fig. 2). Thirty-one plant families had only one species, whereas three families had four, four families had three, and nine families had two species (Table 2). All listed plant species were mostly herbs (58.2%). The remaining percentage was made up of trees (23.5%), shrubs (12.2%), and climbers (6.1%) (Fig 3). Asteraceae is one of the major families in Pakistan's flora. This ecological niche is characterized by a diverse range of herbaceous species, as well as favorable climatic circumstances, as evidenced by research conducted in northern mountain ranges (Abbas *et al.* 2019, Shaheen *et al.* 2023, Manzoor *et al.* 2023) [28, 40]. These families are dominant due to their abundance in the area and easy accessibility to locals. Our results were parallel to the previous reports from Pakistan (Kayani *et al.*2014, Khan *et al.* 2021, Kayani *et al.* 2024, Gillani *et al.* 2024b) [24, 25, 15, 23].

Table 1: Demographic features of investigated communities of Tangi Dara.

Demographic Information	Informants	Percentage
Gender		
Men	112	80%
Women	28	20%
Informants Category		
Indigenous people	124	88.57%
Local Herbal practitioners	16	11.42%
Informants age group		
Between 25-35	12	8.57%
Between 36-45	24	17.14%
Between 45-60	62	44.28%
> 65 years	42	30%
Informants' education level		
Intermediate or above	08	5.71%
Middle Level	17	12.14%
Primary Level	30	21.42%
Illiterate	85	60.71%

Table 2: Plant diversity, families, used part, habit and ethnomedicinal uses of medicinal flora from Tangi Dara.

Sr. No.	Plant Name	Family	Vernacular name	Voucher number	Habit	Part Used	Uses	RFC	UV
1.	*Adiantum capillus-veneris* L.	Adiantaceae	Sumbal	KBot. 1 (PUP)	Herb	Leaves	Expectorant, diuretic, Febrifuge	0.25	0.03
2.	*Adiantum venustum* D. Don.	Adiantaceae	Babozi	KBot. 3 (PUP)	Herb	Leaves	Expectorant, scorpion bites, emetic	0.21	0.03
3.	*Allium cepa* L.	Amaryllidaceae	Piaz	KBot. 11 (PUP)	Herb	Bulb	high blood pressure, diuretic, expectorant	0.31	0.78
4.	*Allium sativum* L.	Amaryllidaceae	Oga	KBot. 13 PUP)	Herb	Cloves	Diuretic, aphrodisiac, effective against high blood pressure, diabetic	0.26	0.76
5.	*Narcissus tazetta* L.	Amaryllidaceae	Gul-e- nargas	KBot. 14 (PUP)	Herb	Flowers, bulbs	Strong emetic, Bouquets are made from flower scrapes that are kept in water containers.	0.08	0.20
6.	*Pistacia chinensis* Bunge.	Anacardiaceae	Sherwan	KBot. 43 (PUP)	Tree	Fruits, leaves	Tuberculosis, dry cough	0.11	0.20
7.	*Coriandrum sativum* L.	Apiaceae	Dhanya	KBot. 48 (PUP)	Herb	Leaves, fruit	Vomiting, diarrhoea	0.37	0.28
8.	*Foeniculum vulgare* Mill.	Apiaceae	kagaenalay	KBot. 49 (PUP)	Herb	Seed, leaves	Carminative, diuretic, digestive problems, dry cough, vomiting, chest infection	0.39	0.33
9.	*Hedera nepalensis* K. Koch.	Araliaceae	Faloda	KBot. 44 (PUP)	Climber	Whole plant	Sedative, anthelmintic, abdominal pain	0.13	0.23
10.	*Periploca aphylla* Dcne.	Asclepiadaceae	Bararna	KBot. 47 (PUP)	Shrub	Whole plant, latex	Digestive trouble, skin swellings, gum diseases	0.06	0.65
11.	*Artemisia scoparia* Linn.	Asteraceae	Jawkay	KBot. 52 (PUP)	Herb	Leaves, stem, roots	Respiratory stimulant, purgative, anthelmintic	0.06	0.31
12.	*Artemisia vulgaris* L.	Asteraceae	Tarkha	KBot. 53 (PUP)	Herb	Leaves	Dysmenorrhea, insect repellent	0.07	0.44
13.	*Calendula arvensis* L.	Asteraceae	Ziar guly	KBot. 55 (PUP)	Herb	Whole plant	astringent, blood purifier, immunity booster,	0.06	0.23
14.	*Carthamus oxyacantha* Bieb.	Asteraceae	Ziargulay	KBot. 56 (PUP)	Herb	Leaves, seeds, flowers	bronchitis, heart diseases,	0.05	0.55
15.	*Conyza canadensis* (L.) Cronq.	Asteraceae	Maloch	KBot. 58 (PUP)	Herb	Whole plant	diarrhoea, dysentery	0.10	0.31
16.	*Helianthus annuus* L.	Asteraceae	Nwar parast	KBot.61 (PUP)	Herb	Seed, leaves	Skin sores, swellings, rheumatic joints, as antidote for scorpion bit, Oil from seeds	0.08	0.03
17.	*Lactuca seriola* L.	Asteraceae	Shawdapai	KBot. 65 (PUP)	Herb	Whole plant	Gastrointestinal disorder,	0.08	0.52
18.	*Sonchus asper* (L.) Hill	Asteraceae	Shodpi	KBot. 71 (PUP)	Herb	Flower	To treat constipation	0.13	0.32
19.	*Tagetes minuta* L.	Asteraceae	Kach Hamesha	KBot. 73 (PUP)	Herb	Flower	Jaundice, hepatitis cure	0.11	0.29
20.	*Taraxicum officinale* F.H.Wigg	Asteraceae	Toora daal	KBot. 74 (PUP)	Herb	Leaves, roots	Liver tonic, blood purifier	0.06	0.53
21.	*Xanthium stramonium* L.	Asteraceae	Ghat gishkay	KBot. 75 (PUP)	Herb	Leaves, fruits	Malaria, anorexia	0.09	0.03
22.	*Berberis lycium*	Berberidaceae	Kwary, ziar	KBot. 76 (PUP)	Shrub	Root, bark	Hepatitis, wound healing,	0.68	0.63

	Royle.		largy				jaundice, abdominal pain, high blood pressure, toothache, throat sore dry root bark		
23.	*Brassica napus* L.	Brassicaceae	Da ghar sharsham	KBot. 83 (PUP)	Herb	Leaves, seed oil	Anti-inflammatory, diuretics, fodder, massage	0.13	0.39
24.	*Sisymbrium irio* L.	Brassicaceae	Zangali Awray	KBot. 86 (PUP)	Herb	Leaves, seeds	Throat and chest infection, induce tearing and cleansing of eyes	0.10	0.65
25.	*Eruca sativa* Mill.	Brassicaceae	Jamama	KBot. 84 (PUP)	Herb	Leaves, Seed oil	Antioxidant, antimicrobial properties	0.08	0.54
26.	*Buddleja crispa* Benth.	Buddlejaceae	sperkay	KBot. 81 (PUP)	Shrub	Whole plant	Reducing high blood pressure and obesity	0.16	0.38
27.	*Sarcococca saligna* Muell. Arg.	Buxaceae	Shanely	KBot. 87 (PUP)	Shrub	Leaves, fruits	Jaundice, hepatitis, skin disorders, edema, mouth ulcers, sore throat	0.08	0.47
28.	*Cannabis sativa* L.	Cannabaceae	bhang	KBot. 88 (PUP)	Herb	Leaves	Sedative, narcotic	0.31	0.55
29.	*Viburnum cotinifolium* D.Don	Caprifoliaceae	Shanglo	KBot. 90 (PUP)	Shrub	Fruit, whole plant	Abdominal pain, purgative, wound curative	0.14	0.53
30.	*Stellaria media* (L.) Vill	Caryophyllaceae	Charg kulmay	KBot. 92 (PUP)	Herb	Whole plant	Emollient, massaged,rheumatism	0.19	0.46
31.	*Chenopodium album* L.	Chenopodiaceae	Skha botay	KBot. 93 (PUP)	Herb	Leaves	Diuretic, Carminative, vomiting, piles and dysentery	0.23	0.65
32.	*Chenopodium ambrosides* L.	Chenopodiaceae	Sarmy	KBot. 95 (PUP)	Herb	Whole plant	intestinal parasites, amoebic dysentery	0.13	0.63
33.	*Chenopodium botrys* L.	Chenopodiaceae	Skha boty	KBot. 94 (PUP)	Herb	Leaves	Allergic cough, asthmatic attacks, catarrh, insect repellent	0.15	0.54
34.	*Spinacia oleracea* L.	Chenopodiaceae	Palak	KBot. 96 (PUP)	Herb	Leaves, seeds	Laxative and hypoglycaemic, control hepatitis	0.17	0.36
35.	*Convolvulus arvensis* L.	Convolvulaceae	Prewatai	KBot. 97 (PUP)	Herb	Whole plant	Strong purgative, used as fodder	0.16	0.06
36.	*Ipomoea purpurea* (L.) Roth	Convolvulaceae	Prewata	KBot. 98 (PUP)	Herb	Whole plant, seed	Intestinal worms, eliminate of constipation	0.10	0.31
37.	*Cucurbeta pepo* L.	Cucurbitaceae		KBot. 104(PUP)	Climber	Fruit, seed	Anti-inflammatory, Analgesic urinary disorders, antioxidant	0.09	0.33
38.	*Cucurbeta maxima* Duch. ex Lam.	Cucurbitaceae	khog Kado	KBot.101(PUP)	Climber	Stem, fruit, seeds	Immunity booster, detoxifier, brain tonic, refrigerant emollient, demulcent,	0.26	0.54
39.	*Luffa acutangula* (L.) Roxb.	Cucurbitaceae	Toorai	KBot.106(PUP)	Climber	Fruit, seeds, leaves	Haemorrhoids, jaundice	0.24	0.65
40.	*Cupressus sempervirens* L.	Cupressaceae	Sarwa	KBot. 10 (PUP)	Herb	Cones	Asthma treatment, common colds cough, whooping cough, cough with blood in sputum, spasmodic sore throat	0.20	0.65
41.	*Cuscuta reflexa* Roxb.	Cuscutaceae	Maichey botoay	KBot.100(PUP)	Climber	Whole plant	Joint pains, shoulders pains, jaundice, hepatitis	0.16	0.43
42.	*Cyperus rotundus* L.	Cyperaceae	Deela	KBot. 18 (PUP)	Herb	Rhizome, stem	stomach pain fodder of low quality	0.24	0.02
43.	*Diospyros kaki* L.	Ebenaceae	Ghat Amlok	KBot.107(PUP)	Tree	Fruit, stem bark	Stopping bleeding, healing wound, constipation	0.21	0.58
44.	*Equisetum arvense* L.	Equisetaceae	Band bandakay	KBot. 5 (PUP)	Herb	Stem	Stopping bleeding, regenerating the damaged tissue	0.33	0.03
45.	*Euphorbia prostrata* Ait	Euphorbiaceae	Warmaga	KBot. 109 (PUP)	Herb	Whole plant	Anti- hemorrhoidal, antioxidant, anti-inflammatory	0.16	0.46
46.	*Ricinus communis* L.	Euphorbiaceae	Harhanda	KBot. 110 (PUP)	Shrub	Seeds, leaves	Purgative, emetic, elimination and control of dandruff	0.21	0.53
47.	*Quercus baloot* Griff	Fagaceae	Serhai	KBot. 111 (PUP)	Tree	Bark, fruit	Anti- haemorrhages (bleeding in urine), Anti diarrheal, dysentery	0.30	0.83
48.	*Quercus dilatata* Royle	Fagaceae	Toor Banj	KBot. 112 (PUP)	Tree	Leaves, fruit	Indigestion, asthma. agricultural tool making, as fodder for goats and sheep	0.28	0.53
49.	*Quercus incana* W.Bartram	Fagaceae	Serhai	KBot. 113 (PUP)	Tree	Fruit	Anti-haemorrhages (bleeding in urine), purgative, diuretic. as fodder for goat and sheep	0.21	0.55
50.	*Hypericum perforatum* L.	Hypericaceae	Kashne	KBot. 118 (PUP)	Herb	Whole plant	Relieve anxiety and depression	0.17	0.37
51.	*juglans regia* L.	Juglandaceae	Ghoz	KBot. 119 (PUP)	Tree	Leaves, fruits	Diarrhoea, sinusitis, stomach-ache, arthritis, asthma	0.44	0.64
52.	*Ajuga bracteosa* Wall. ex Benth.	Lamiaceae	Gooti	KBot. 120 (PUP)	Herb	Leaves	Carminative. urticaria, abscess, abdominal pain, erythema	0.11	0.31

53.	*Isodon rugosus* (Wall. E x Benth.) Codd.	Lamiaceae	Krachy	KBot. 121 (PUP)	Shrub	Leaves	hepatitis, diarrhoea, dysentery, sore throat, eye infection	0.14	0.61
54.	Mentha arvensis L.	Lamiaceae	Podina	KBot. 123 (PUP)	Herb	Leaves	As stimulant, carminative, diuretic, effective against constipation	0.10	0.44
55.	*Mentha longifolia* (L.) L.	Lamiaceae	Wenaly	KBot. 124 (PUP)	Herb	Leaves, roots	Jaundice, vomiting, hepatitis, cholera,	0.45	0.86
56.	*Micromeria biflora* (Duch. -Ham ex D.Don.) Benth.	Lamiaceae	Nary Shamkay	KBot. 125 (PUP)	Herb	Leaves	Purgative, laxative carminative, body pain	0.05	0.06
57.	*Teucrium stocksianum* Boiss.	Lamiaceae	Kwandi Botay	KBot. 129 (PUP)	Herb	Whole plant	Jaundice, diaphoretic stimulant	0.09	0.63
58.	*Malva neglecta* Wallr.	Malvaceae	Paneerak	KBot. 131 (PUP)	Herb	Whole plant	Purgative in nature, as vegetable	0.26	0.56
59.	*Melia azedarach* L.	Meliaceae	Tora shandi	KBot. 132 (PUP)	Tree	Bark	Typhoid, treat fever (pyrexia) and body ache	0.31	0.38
60.	*Acacia modesta* Wall.	Mimosaceae	Paloosa	KBot. 133 (PUP)	Tree	Flowers	Chronic disorder, gastric disorder	0.13	0.58
61.	*Acacia nilotica* (L.) Delile	Mimosaceae	Keekar	KBot. 134 (PUP)	Tree	Stem bark, seeds, gum	Controlling cough, curing bronchitis. throat sores	0.12	0.45
62.	*Ficus carica* L.	Moraceae	Ghat Inzar	KBot. 137 (PUP)	Tree	Fruits, latex	Laxative, demulcent, constipation, latex used to remove the spines, fruits are edible	0.20	0.65
63.	*Ficus palmata* Forssk	Moraceae	Kach Inzar	KBot. 136 (PUP)	Tree	Fruits, leaves	Laxative, demulcent, Constipation	0.18	0.64
64.	*Ficus sarmentosa* Bush. Ham. ex J.E.Smith	Moraceae	Enzar mewa	KBot. 138 (PUP)	Climber	Whole plant, fruit	Fever, swollen joints, inflammations	0.05	0.43
65.	*Morus alba* L	Moraceae	Spin toot.	KBot. 139 (PUP)	Tree	Fruits, leaves, branches	Laxative purgative, fruits are eaten both fresh and dry	0.21	0.49
66.	*Morus nigra* L.	Moraceae	Toor toot.	KBot. 140 (PUP)	Tree	Fruits, leaves	Diaphoretic, emollient, laxative, astringent.	0.18	0.53
67.	*Myrsine africana* L.	Myrsinaceae	Kach manrho	KBot. 141 (PUP)	Shrub	Fruit, leaves	Anthelmintic, cure abdominal pain, digestive disorders, vomiting	0.43	0.54
68.	*Olea ferruginea* Royle.	Oleaceae	Khona	KBot. 143 (PUP)	Tree	Leaves	Sore throat, jaundice, Diabetes,	0.35	0.65
69.	*Oxalis corniculata* L.	Oxalidaceae	Manzakay Tarookay	KBot. 142 (PUP)	Herb	Leaves	Jaundice, hepatitis, blood clotting	0.14	0.43
70.	*Indigofera heterantha* Wall.ex Brand	Papilionaceae	Ghwareja	KBot. 146 (PUP)	Shrub	Whole plant	Making roofs as hedges, for making basket and birds cages, stem bark used as ropes	0.13	0.40
71.	*Medicago lupulina* L.	Papilionaceae	Shpeshtary	KBot. 150 (PUP)	Herb	Whole plant	Laxative, as vegetable food	0.21	0.56
72.	*Pinus roxburghii* Sarg.	Pinnaceae	Nakhtar	KBot. 8 (PUP)	Tree	Resin	Astringent, operative against measles	0.40	0.13
73.	*Pinus wallichiana* A.B. Jaks.	Pinnaceae	Sraf	KBot. 9 (PUP)	Tree	Resin	Resin is used to treat stomach-ache, skin irritation, and asthma	0.38	0.12
74.	*Plantago lanceolata* L.	Plantaginaceae	Ghwaye Jabai	KBot. 159 (PUP)	Herb	Roots, leaves	Used to cure asthma, mild purgative	0.14	0.38
75.	*Plantago major* L.	Plantaginaceae	Jabai	KBot. 160 (PUP)	Herb	Leaves, root	Antidote for snake bites diuretic, body cooling agent	0.13	0.54
76.	*Apluda mutica* L	Poaceae	Pashkaly wakha	KBot. 22 (PUP)	Herb	Shoots, root	Gonorrhoea treatment, diuretic, common forage, fodder species	0.13	0.02
77.	*Aristida cyanantha* Nees ex Steud	Poaceae	Mashkanrhay	KBot. 23 (PUP)	Herb	Stem	Brooms making, used as fodder	0.14	0.10
78.	*Cynodon dactylon* (L.) Pers.	Poaceae	Kabal	KBot. 30 (PUP)	Herb	Whole plant	Abdominal pain, leg pain, as astringent	0.17	0.03
79.	*Dichanthium annulatum* (Forssk.) Stapf.	Poaceae	Palwan	KBot. 31 (PUP)	Herb	Stem, whole plant	forage grass used fresh and in hay form, tooth pick	0.12	0.03
80.	*Rumex dentatus* L.	Polygonaceae	Shalkhay	KBot. 161 (PUP)	Herb	Leaves, bark	Arthritis, wound healing, abscess	0.20	0.45
81.	*Rumex hastatus* D. Don	Polygonaceae	Taruky	KBot. 162 (PUP)	Herb	Roots, leaves	Diarrhoea, bleeding of wound	0.23	0.03
82.	*Punica granatum* L.	Punicaceae	Anangorhay	KBot. 165 (PUP)	Tree	Bark, fruits	Abdominal pain, intestinal parasites, dysentery, diarrhoea	0.24	0.66
83.	*Ziziphus nummularia*	Rhamnaceae		KBot. 174	Shrub	Roots,	Skin diseases, cure of itching,	0.11	0.58

	Buem.f. Weig			(PUP)		fruits, leaves	scabies and boils		
84.	*Ziziphus oxyphylla* Edgew	Rhamnaceae	Elanai	KBot. 175 (PUP)	Tree	Fruit, leaves	Jaundice, hepatitis, expectorant and emollient	0.08	0.53
85.	*Cotoneaster nummularia* Fish. & Mey.	Rosaceae	Ghata Kharawa	KBot. 175 (PUP)	Shrub	Roots, fruits	dysentery, vomiting, cholera calculi of kidney, antidiabetic, expectorant	0.31	0.48
86.	*Fragaria nubicola* Lindl.	Rosaceae	Zmaky toot	KBot. 177 (PUP)	Herb	Fruits, leaves	Dysentery, diarrhoea	0.16	0.61
87.	*Fumaria indica* (Hausskn.) Pugsley	Rosaceae	Shadkaray	KBot. 178 (PUP)	Herb	Stem	stomach trouble, constipation, vomiting, diarrhoea	0.23	0.56
88.	*Prunus persica* (L.) Batsch.	Rosaceae	Shaltalo	KBot. 182 (PUP)	Tree	Flower	Anthelmintic, Diuretic purgative	0.19	0.45
89.	*Zanthoxylum armatum* DC.	Rutaceae	Dambara	KBot. 189 (PUP)	Tree	Fruit, seeds	Carminative, dry cough, Fever	0.33	0.87
90.	*Salix tetrasperma* Roxb	Salicaceae	Wala	KBot. 190 (PUP)	Tree	Bark, leaves	Diabetes, erythema	0.18	0.09
91.	*Dodonaea viscosa* (L.) Jacq.	Sapindaceae	Ghwarhaskay.	KBot. 207 (PUP)	Shrub	Leaves, seeds	Astringent, treatment of wounds, swelling and bur	0.26	0.52
92.	*Verbascum thapsus* L.	Scrophulariaceae	Khardag	KBot. 195 (PUP)	Herb	Leaves, seeds	Seed as aphrodisiac, leaves poultice against boils	0.21	0.56
93.	*Ailanthus altissima* (Mill.) Swingle.	Simarubaceae	Spina shandi	KBot. 199 (PUP)	Tree	Leaves	blood purification and scabs	0.28	0.65
94.	*Datura innoxia* Mill.	Solanaceae	Batura	KBot. 200 (PUP)	Herb	Seeds, leaves	Gonorrhoea, anodyne, sedative	0.07	0.45
95.	*Datura stramonium* L.	Solanaceae	Batura	KBot. 201 (PUP)	Herb	Leaves, seed	Antispasmodic bandages on abscess	0.15	0.36
96.	*Celtis caucasica* Willd.	Ulmaceae	Taghaga	KBot. 210 (PUP)	Tree	Fruits, leaves	As a refrigerant, it is also used as fodder	0.26	0.64
97.	*Viola canescens* Wall.	Violaceae	Banafsha	KBot. 215 (PUP)	Herb	Whole plant	Chest infection, cough, flue, fever and malaria	0.28	0.56

Abbreviations: UV= Use value, FRC= Relative frequency citation.

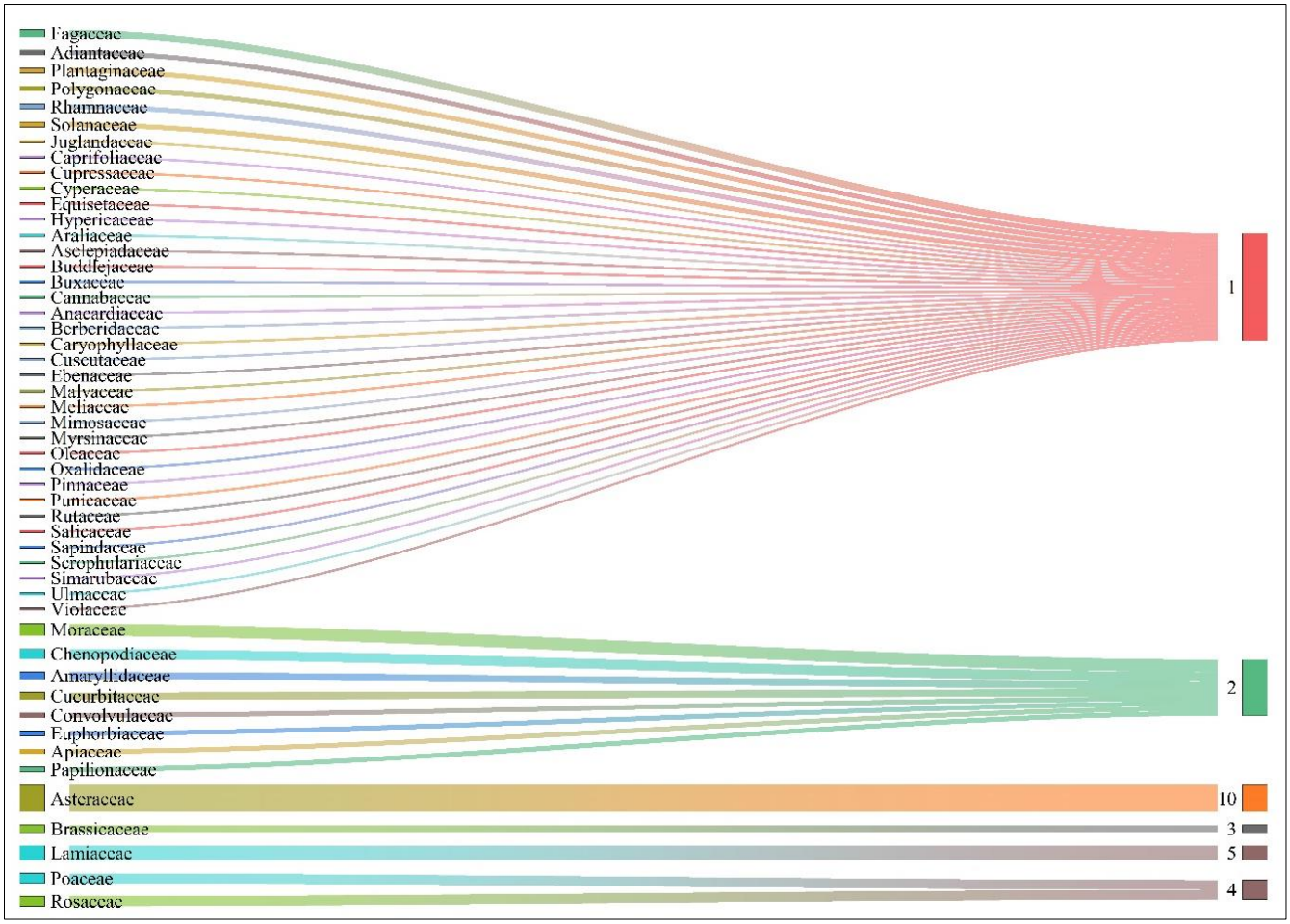

Fig 2: Alluvial diagram illustrating the distribution of medicinal plant families.

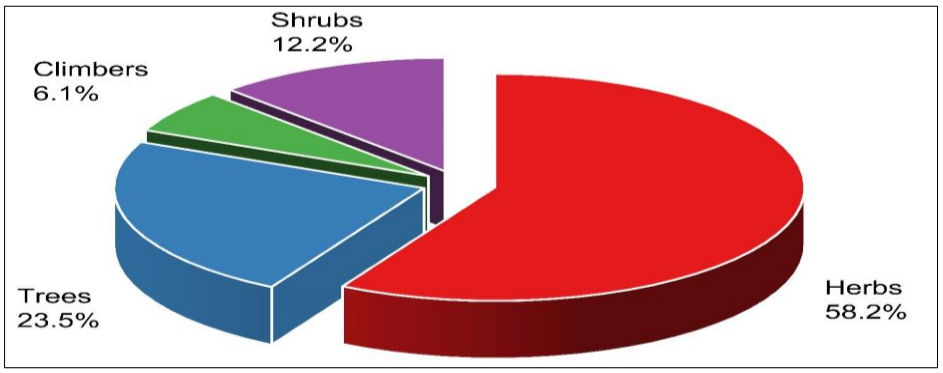

Fig 3: Habit Classification of medicinal flora.

Plant Part Used

The indigenous inhabitants of the research area had been found to use 14 different plant components to prepare traditional medicines to treat various diseases, as represented. Data from this study indicates leaves (30.25%) were the most commonly used plant parts, followed by fruits (16.67%), whole plant (13.58%), seed (11.11%), stem (6.79%), root (6.17%), bark (4.94%), flower (3.70%), resin (1.85%), rhizome, resin, and latex (1.23%) each, and cone and gum (0.62%) each (Fig. 4). Plant leaves are the primary photosynthetic organs responsible for the creation of pharmacologically active compounds that combat various ailments (Passalacqua *et al.* 2007) [34]. Generally, all parts of the plant were employed to heal various ailments. In line with this, Ahmad *et al.* (2014) showed that leaves were the most widely used plant portion in herbal treatments, accounting for approximately 33%. However, our findings are comparable with those of Adnan *et al.* (2015), who explored the ethnobotanical use of medicinal plants in Pashtun tribal areas and discovered that the locals primarily employed whole plants (33%) and leaves (31%), respectively, to cure a variety of ailments. In numerous cases, multiple components of the same species, such as leaves and aerial parts, were employed in herbal remedies and treatments. Previous research has indicated that leaves are the most common component of traditional herbal medications (Cornara *et al.* 2009) [12]. Roots, leaves, seeds, tubers, and fruits contain more physiologically active chemicals than other plant components, making them ideal for traditional medicine (Hart & Bussmann, 2014). The frequent use of roots, seeds, and fruit has a negative impact on plant development and population in nature, whereas the use of leaves is safe and sustainable (Mirzaman *et al.* 2023) [32].

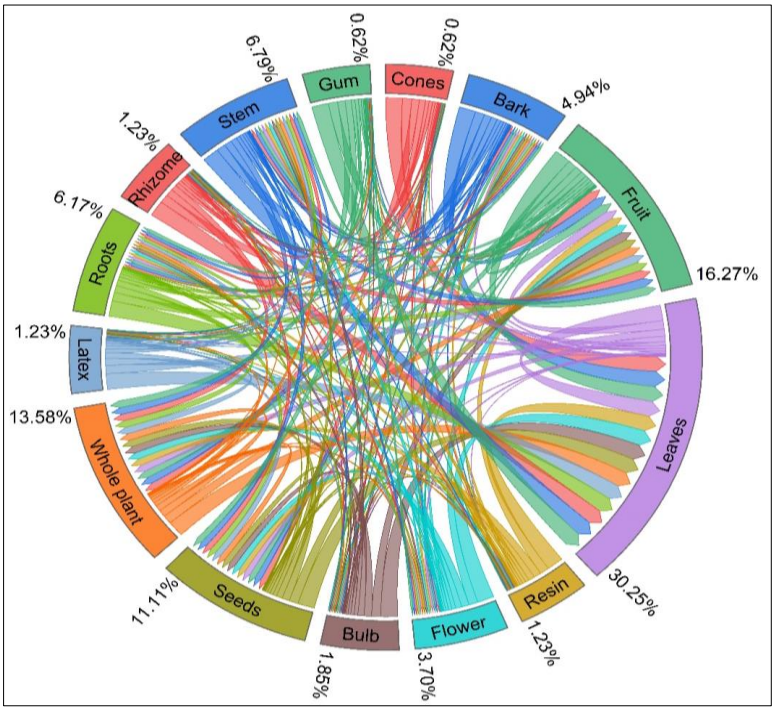

Fig 4: Proportion of used parts of investigated medicinal plants from Tangi Dara.

Use Value

The Use Value Index is a significant quantitative method used in ethnobotanical research that evaluates the relative importance of medicinal plant species among ethnic communities based on their uses and the species that are prioritized for conservation efforts (Phillips *et al.* 1994) [35]. The use value is used to determine the plants that are most frequently employed (or recommended) in the treatment of any disease. The highest use value was recorded as 0.87 for *Zanthoxylum armatum*, followed by *Mentha longifolia* (0.86), *Quercus baloot* (0.83), *Allium cepa* (0.78), *Allium sativum* (0.76), and *Punica granatum* (0.66) (Table 2). Some

species, such as *Zanthoxylum armatum* and *Mentha longifolia* have higher UV levels, which may be related to their well-known range of medicinal uses. The findings of the current study are consistent with earlier studies from Pakistan (Khan *et al.* 2018, Umair *et al.* 2017, Manzoor *et al.* 2023b, Mirzaman *et al.* 2023, Gillani *et al.* 2024) [27, 47, 32, 15, 28]. UV fluctuations are often caused by differences in plant understanding within a specific area. The fact that these plants are multipurpose could result in increased dependence and higher UV. High UV values imply frequent consumption, although lower UV values do not diminish a plant's therapeutic efficacy (Kayani *et al.* 2024, Zain-ul-Abidin *et al.* 2018, Manzoor *et al*. 2024b) [24, 48, 29].

Relative Frequency Citation

The relative frequency of citations indicates the local significance of a plant species for the treatment of various ailments. The RFC values also show the strong and long-term link of residents with local flora, as well as the relevance of species in relation to the number of local informants participating in this study (Ahmad *et al.*, 2014). According to the findings of this study, the highest RFC was calculated for *Berberis lycium* (0.68) followed by *Mentha longifolia* (0.45), *Juglans regia* (0.44), *Myrsine africana* (0.43), *Pinus roxburghii* (0.40), Foeniculum vulgare (0.39), Pinus wallichiana (0.38), and Coriandrum sativum (0.37) (Table 2). The highest RFC values of *Berberis lyceum*, *Mentha longifolia*, and *Juglans regia* indicate that a significant number of informants reported using these medicinal plant species, as RFC is based on the proportion of respondents who mention using a particular plant species. These abovementioned medicinal plants are frequently used for the treatment of various diseases. Other researchers from various sections of the country have also reported on the applications of these species (Ullah *et al.* 2023, Manzoor *et al.* 2023a; Ayub *et al.* 2023, Gillani *et al.* 2024a, Haq *et al.* 2022, Hussain *et al*. 2024) [46, 7, 19, 16, 14, 28].

This current ethnobotanical research has revealed a long history of medicinal plant use among the indigenous communities of Tangi Dara, Lower Dir, Khyber Pakhtunkhwa, Pakistan. This study provided us with vital insights into the communities' profound knowledge and reliance on natural medicines. The different plant species used reflect the region's unique ecological and cultural environment. Our findings not only help to record traditional medicinal practices but also highlight the significance of maintaining and incorporating indigenous knowledge into modern healthcare systems. Further research and collaboration are required to evaluate the efficacy of these medicinal plants and assure their long-term protection for future generations.

Conclusion

The present investigation documented the unique traditional knowledge of medicinal plants among the indigenous communities of Tangi Dara Lower Dir in Khyber Pakhtunkhwa, Pakistan. The documenting of this rich traditional ethnomedicinal knowledge has provided us with new information that will help us recognize previously undocumented knowledge. Plants are still an important source of medicine for the area's remote communities; thus, a comprehensive ethnobotanical investigation is recommended to support the comprehensive documentation of traditional ethnomedicinal knowledge before the area's biocultural heritage disappears. A significant number of survey respondents believe that passing down ancestral knowledge from one generation to the next is inefficient due to younger people's lack of interest in learning and implementing such knowledge. This is the first ethnomedical investigation in the Tangi Dara Lower Dir, and it could serve as a useful baseline for future conservation and management of the medicinal plant resources. It will also encourage policymakers to conserve medicinal flora in the traditional healthcare system, as well as plan for its long-term conservation and use.

Declarations

List of Abbreviations

RFC= relative frequency of citation, UV= use value.

Ethics Approval and Consent to Participate

Prior to the survey, we obtained oral informed consent from each informant.

Consent for Publication

Not applicable.

Availability of data and materials

All data generated or analyzed during this study are included in this published article.

Competing interests

The authors have no relevant financial or non-financial interests to disclose.

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CRediT Author Contributions

KU: Conceptualization, Field work, Writing – Original
Draft.LB: Writing – Original
Draft.MZ: Data Curation, Literature Review, critical review and refining
MZ: Data Curation, Literature Review.
SA: Investigation, Writing – SAK: Investigation, Writing
MN: Writing – Review & Editing.
NF: Statistical Analysis and Visualization.

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