Traditional knowledge of wild edible plants used by the people of Lawat, District Neelum, Azad Jammu & Kashmir, Pakistan

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Research

Abstract

Background: Wild Food Plants (WFPs) are a natural source of food in many rural communities and potential source of local food security. However, over-harvesting and excessive utilization endanger their survival. This study was conducted to document the diversity of wild edible plants along with their customary food uses from Lawat area Neelum Valley, Azad Jammu & Kashmir.

Methods: Data on food uses was collected during 5 years observation (2015-2020) by conducting various surveys using semi-structured and freelisting interviews with 70 local participants and self-observations as well. Novelty was checked by comparing the gathered data with the published literature using Jaccard Index (JI). Use-value (UV) was used to check the relative importance of useful plants.

Results: A total of 61 wild food plants belonging to thirty families were collected and identified. The edible parts of all reported species were consumed as fruits, cooked as vegetable and used in herbal tea or eaten raw. *Thirty-two species were used as vegetables, followed by 13 species as fruits, 10 species in herbal* tea, and 6 as condiments. Herbs were recorded with a major contribution of 72%; trees and shrubs contributed 11% each while 4.91% fern. A number of young parts (aerial part and leaves) of most species are used as vegetable. All reported parts of plants were frequently utilized by residents as food and maximum plants are available in the months of June-August. Most of the recorded WFPs belonged to Rosaceae (9 species), followed by Polygonaceae (8 species), Lamiaceae (5 species), Brassicaceae, and Amaryllidaceae (4 species each).

Conclusion: WFPs still play an imperative role in the local food culture and are primary source of food for food insecure families in study area and traditional knowledge attached to them is astonishing in the region. In this study, many wild food plants along with their customary food uses were recorded for the first time in Lawat area with almost 72% of the species followed by 31% at district level and 23% species from Azad Kashmir.

Keywords: Wild food plants, Ethnobotany, Indigenous knowledge, Neelum Valley, Azad Kashmir

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Background

Wild food plants are referred to as non-cultivated plant species that are gathered or harvested by local people from their surrounding ecosystems for use in their food systems (Ju *et al.*, 2013).WFPs have been an important part of the human diet since ancient times especially an important part of rural people's diets. Because of its traditionally acquired knowledge-based ideas, attitudes, and manners, it matches the community of that particular belief and culture as a food (Leonti *et al.* 2006). The nutritional and health benefits of wild plants have been reported widely (Bvenura and Sivakumar 2017; Pieroni *et al.* 2020; Ijaz *et al.* 2021). Many ethnobotanical studies around the globe have focused on traditional plants (Dogan *et al.* 2015; Ijaz *et al.* 2021) and in the past decades, many studies have analyzed the utilization of wild edible plants (Pieroni *et al.* 2005). Many communities in developing countries draw a significant part of their survival and livelihood from wild plants (Schippmann *et al.* 2002). Despite significant increases in food production, 33% of mountain people in developing countries are malnourished, or starving (Romeo *et al.* 2015). Wild food has a number of benefits such as large variety, easy access to local resources, time-tested reliability, little or no management and availability (Turner et al, 2011). Wild edible plants have been a top priority in the USSR during the Second World War most remarkably during the blockade of Leningrad (1941–1944). Where a guide about the significance of wild edible plants was published and distributed among civilians as well as the Army (Shikov *et al.* 2017).

The world's population is anticipated to reach 9 billion by 2050, consuming 70–100% more food than it does now. In order to discover new food assets, this issue requires a lot of attention. Almost half a million known plants exist on earth, but only about 3000 of them are used as crops and only 150 species have been cultivated for commercial purposes (Heywood and Skoula 1999). Around 300 million people worldwide rely on wild food for their survival (Pimentel *et al.* 1997) also the source of income from wild plant products (Schippmann *et al.* 2002). Wild vegetables, salads, fruits, and spices are the foundation of functional foods in the Mediterranean region, including Turkey (Dogan 2012). However, traditional knowledge about the use of wild edible plants is lost at an accelerating rate and therefore it is important to document before it is completely lost (Pieroni *et al.* 2005).

Wild food plants have long been involved in folklore. However, food and pharmacological activities of these plants have been two of the main and continuous reasons for plant management. As a result, ethno-directed research is highly beneficial in the discovery and development of new drugs and foods (Abbasi *et al.* 2013).

Pakistan's current perspective on ethnobotany strengthens the country's natural richness by allowing for the use, exploration, and documentation of indigenous knowledge. Furthermore, it is estimated that around 700 plant species are used for medical and food purposes (Shinwari et al. 1996). Wild edible plants along with their food uses are least documented in Pakistan including Kashmir than ethnomedicinal plants (Abdullah et al. 2021). Although several ethnobotanical assessments have been done by different workers in different localities of the Lesser Himalayas there are still wide gaps in our scientific knowledge (Shaheen *et al.* 2011). Some ethnobotanical studies (two reports) were conducted from same study area''Lawat'' (Dar 2003; Ijaz *et al.* 2019) and ten reports from an entire Neelum district (Dar 2003; Ghafar, *et al.* 2007; Qamar *et al.* 2010; Mahmood *et al.* 2011; Ahmad *et al.* 2012; Ishtiaq *et al.* 2013; Ahmad and Habib 2014; Shaheen *et al.* 2017; Ahmad *et al.* 2017; Ijaz *et al.* 2021) but we hypothesized that there would still be large knowledge gaps. As there is no scientific report which only dealing wild food plants in the study area. The current study had two objectives: First, compile a complete list of local WFPs as well as mode of consuming. Second, to identify the knowledge gape with the studies published before.

Materials and Methods

The study area

The almost 240 km long Neelum Valley situated to the Northeast of Muzaffarabad at 900–6325m (Fig. 1) in the Western Himalaya range. It lies between 32°–35° N and 73°–75° E covering an area of 3737 km2. It is distinguished by snow-covered peaks, scenic beauty, streams, green forests, high-altitude lakes, and panoramic views. The climate has four seasons, winters are very cold, and the area is covered with snow from November to March (Qamar *et al.* 2010; Dar and Malik 2009). The highest average temperature recorded in the area is 37 °C and lowest -2 °C and the reported annual average rainfall is 1650 mm (Ahmad *et al.* 2017). Lawat area is confined to the right bank of river Neelum situated in Neelum district (Neelum Valley) just about 125 km from Capital (Muzaffarabad) of Azad Kashmir (Fig. 1). The climate of the study area range is moist temperate to alpine vegetation covered with heavy snow (3 feet in lower areas and 12 ft. high peaks) during winters-November to March. The mean monthly daily temperature (lowest 3.2 °C and maximum 15.9 °C) in January and 22.8 °C (lowest) and 37.6 °C (maximum) in July were recorded. The mean annually rainfall 1526.7 mm was recorded (Dar and Malik, 2009).

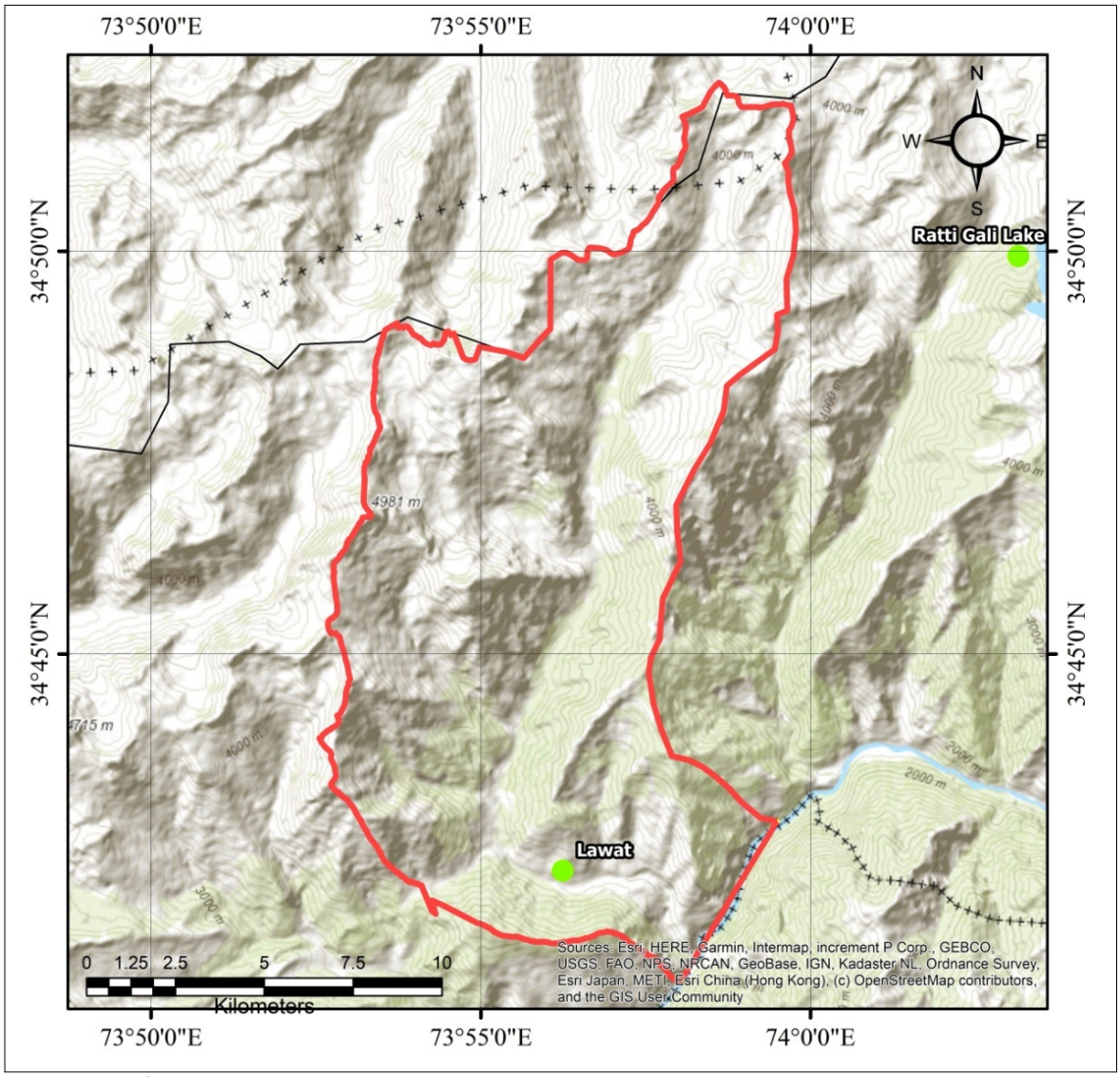

Figure 1. Map of study area Lawat, District Neelum AJ&K

Field study

For ethnobotanical data collection, various surveys were conducted from 2015 to 2020 (mostly from April to August) in the study area. During this period, the diet of the people was examined in detail. The information on WFPs was collected through semi-structured and open-ended interviews (Martin 1995) with 70 inhabitants-men (42.85%) and women (57.14%). including teachers, students, shopkeepers, workers, seasonal nomads, and housewives (Table 1). According to the respondent necessity and response, interviews were conducted into the local common language (Hindko). Most of the people interviewed were 40 years old. We were accompanied by locals during the survey who toured various habitats of plants and obtained data were noted down in the field notebook. All collected WFPs (*in alphabetical order*) and concerning data like scientific names, families, voucher numbers, local names, English names, local names in Urdu script, used part(s), mode of consumption/cuisines, life form, season and use value is summarized in Table 2.

Plant collection and identification

For identification, each mature plant (during flowering and fruiting stages) was collected in the months of mid-July to mid-August from 2015 to 2020. In the second phase collected WFPs were pressed, dried, poisoned, and mounted on standard herbarium sheets. Plant specimens were identified by Authors Shabir Ijaz and Anjum Perveen at Center for Plant Conservation, University of Karachi using the ''Flora of Pakistan" (Nasir and Ali 1971-1994; Ali and Qaiser 1995-2020) and were confirmed by matching with Herbarium specimens. Finally, each species name was conformed from "The Plant List Database'' (TPL 2013). If a species was recognized in database, it was classified as taxonomically valid (i.e., "accepted"). Based on the information presented above, the status of synonyms was determined, and verified synonyms were eliminated. After identification and assigning voucher numbers of plants, specimens were

deposited at Karachi University Herbarium (Prof. Dr. S. I. Ali Herbarium), Centre for Plant Conservation, University of Karachi (Fig. 2).

Table 1. Demographic characteristics of the informants

Factor	Category	Total no. of persons	Percentage
Gender	Male	30	42.85
	Female	40	57.14
Profession	Healers	5	7.14
	Housewives	28	40
	Seasonal nomads	5	7.14
	Students	5	7.14
	Shopkeepers	7	10
	Teachers	6	8.57
	Workers	14	20
Age	14-24	5	7.14
	25-40	13	18.57
	41-50	20	28.57
	51-60	13	18.57
	61-70	11	15.71
	≥71	8	11.42

Quantitative analysis

Use value

For calculating the comparative importance of WFPs we used the formula UVi¼ΣUi/Ni (Polat, 2019). UVi stands for use-value of species; Ui symbolizes reported use of plant species import by the informants and Ni represents the total number of informants interviewed.

Jaccard index (JI)

Jaccard index was used to calculate the similarity coefficient by using the formula JI=c/a+b-c×100 where "a" stands for the number of species documented in research area "a", "b" represents the number of species documented in study area "b," and "c" is the total of species documented in both study areas "a" and "b'' (Yao et al, 2021).

Results and Discussion

In the present study, a total of 61 wild food plants belonging to 49 genera and 28 families (25 Angiosperm families, two families in Pteridophytes, and one Gymnosperm family) were reported. The family Rosaceae (9 species) contributed the highest number of species followed by Polygonaceae (8), Brassicaceae and Amaryllidaceae (4) Compositae and Apiaceae, and Berberidaceae (3), Boraginaceae, Saxifragaceae, Malvaceae, Lamiaceae, Plantaginaceae, and Dryopteridaceae (2 species) remaining 15 families such as Adoxaceae, *Urticaceae*, *Leguminosae, Melanthiaceae,* Taxaceae, Rutaceae, *Caryophyllaceae*, Crassulaceae, *Dennstaedtiaceae*, Geraniaceae, *Liliaceae*, *Caprifoliaceae, Chenopodiaceae*, *Campanulaceae*, and Betulaceae shared with one species each (Table 2). 72% of the species found were herbs, followed by shrubs and trees (11% each) and ferns (5%). All reported edible plants are used by locals as a fresh in season or some of them were preserved in a dried form to overcome food crises throughout the year.

The aerial parts of most plants (22 species) were used in food followed by fruits (13 species), roots (11 species), leaves (7 species) stem and frond (3 each), bark (2 species), petiole, seed and tuber (1 species each). In the study area, the highest used parts of plants as vegetables are aerial part, leaves, stem and frond with 20, 5, 3, 3 species respectively. Similarly, the root of most plants (8 species) was used in herbal tea (Fig. 3). Wild plants were used in three stages viz., young parts, and mature parts, mature and young. Most vegetables (except herbal tea plants, condiments, and fruits) were used young stages because most leafy vegetables become hard at the maturity stage and even lose their nutritional value as well. When these plants mature their use also changed and sometimes the local name too, e.g. *Pteridium aquilinum* when this species (young) is used as a vegetable known as ''longroo''. When same plant (mature) was used for another purpose (nomads collect for sleeping and sitting in the temporary settlements) and known as ''Nunoor''. According to Aumeerudy *et al* (1998), the right timing of collection determines the quality of ingredients and yield percentage of the desired part(s) of plants.

Table 2. Wild food plants traditionally consumed in Lawat area, District Neelum Azad Kashmir

Taxon **Family, Voucher number**	**Local name(s)/ English name (if any) Local name in Urdu script**	**Used part(s)**	**Mode of utilization**	**Earlier reported same use**	**Life form**	**Season**	**Use value**	**Previous recorded any use in the same district and in / (Azad Kashmir/ Pakistan).**
Allium carolinianum DC. Amaryllidaceae, KUH95310	Rich piaz رچھ پیاز	AG^{Yp}	Cooked alone often eaten with rice	Nr	Herb	June-July	0.92	Yes/ Yes
Allium humile Kunth. Amaryllidaceae, KUH95294	Mali piaz مالی پیاز	AG^{Yp}	Condiment	Re	Herb	June-July	0.92	Yes/Yes
Allium schoenoprasum L. Amaryllidaceae, KUH95309	Bhuka / Chives بُھوکاں	AG^{Yp}	Cooked alone	Nr	Herb	June-July	0.50	No/No
Allium victorialis L. Amaryllidaceae, KUH95307	Kahoo /Alpine leek کھہو	AG^{Mp}	Cooked alone or with potato or meat	Nr	Herb	June-July	0.86	Yes/Yes
Angelica glauca Edgew., Apiaceae, KUH95392	Chora/ چورا	R^{Mp}	Condiment	Re	Herb	Aug-Sep	0.34	Yes/Yes
Arnebia benthamii (Wall. ex G. Don) I.M. John. Boraginaceae, KUH95420	Jogi-badsha, Kazban/ کازبان/جوگی بادشاہ	R^{Mp}	Tea made from the root	Re	Herb	Aug-Sep	0.34	Yes/Yes
Berberis lycium Royle. Berberidaceae, KUH95421	Sunmbal سُنبل	F^{Rf}	Fruit edible	Re	Shrub	Sep-Oct	0.36	Yes/Yes
Berberis glaucocarpa Stapf. Berberidaceae, KUH(CN)370	Sunmbal سُنبل	F^{Rf}	Fruit edible	Re	Shrub	Sep- Oct	0.36	Yes/Yes
Bergenia ciliata (Haw.) Sternb. Saxifragaceae, KUH95411	Butwaywa بٹ ویوا	R^{Mp}	Tea made from root	Nr	Herb	Aug-Nov	0.55	Yes/Yes
Bergenia stracheyi (Hook. f. & Thorns.) Engl. Saxifragaceae, KUH95414	Butwaywa بٹ ویوا	R^{Mp}	Tea made from the root	Nr	Herb	Aug-Nov	0.55	Yes/Yes
Betula utilis D. Don. Betulaceae, KUH(CN)713	Burruj بُھرج	B^{Mp}	Tea made from inner bark	Nr	Tree	April- Nov	0.16	Yes/Yes
Bunium persicum (Boiss) Fedtsch. Apiaceae, KUH(CN)371	Kala zeera / Black cumin کالازیرا	S^{Rs}	Condiment	Re	Herb	June	1	Yes/Yes
Campanula latifolia L. Campanulaceae, KUH95293	Meanjera / Giant bellflower مینجڑا	AG^{Yp}	Cooked alone or with potato	Nr	Herb	May-June	0.78	No/No

Capsella bursa-pastoris (L.) Medik. Brassicaceae, KUH95308	Palpayncha / Shepherd's purse پل پینچا	AG^{Yp}	Cooked alone or with potato	Nr	Herb	April- June	0.95	Yes/Yes
Cardamine loxostemonoides O.E. Schulz. Brassicaceae, KUH95405	Lambi-chachri / Cuckoo flower لمبی چھپھڑی	AG^{Yp}	Cooked alone or with potato	Nr	Herb	June-July	0.34	No/No
Chenopodium album L. Chenopodiaceae, KUH95290	Bathua / Fat hen بتھوا	AG^{Yp}	Cooked alone or with potato	Nr	Herb	May-August	0.92	Yes/Yes
Chorispora sabulosa Camb. Brassicaceae, KUH95302	Chachri چھچھڑی	AG^{Yp}	Cooked alone or with potato	Nr	Herb	July -Aug	0.80	No/No
Cotoneaster integerrimus Medik. Rosaceae, KUH(CN)099	Lunri لونڑی	F^{Rf}	Fruit edible	Nr	Shrub	Aug	0.28	No/No
Crataegus songarica K. Koch., Rosaceae, KUH(CN)191	Sinjli / Hawthorn سِنجلی	F^{Rf}	Fruit edible	Re	Tree	Aug	1	No/Yes
Dipsacus inermis Wall. Caprifoliaceae, KUH95295	Happla ہپلا	AG^{Yp}	Cooked alone	Re	Herb	May- June	0.45	Yes/Yes
Dryopteris crassirhizoma Nakai. Dryopteridaceae, KUH95400	Kandayra / Crown wood-fern کنڈھیرا	Fr^{Yp}	Cooked alone or with beans	Nr	Fern	June	0.82	No/No
Dryopteris stewartii Fraser-Jenk. Dryopteridaceae, KUH95319	Kunji کُنجی	Fr^{Yp}	Cooked alone or with beans	Re	Fern	April- May	0.98	Yes/Yes
Fragaria nubicola (Hook. f.) Lindl. ex Lacaita. Rosaceae, KUH(CN)225	Khat-march / Wild strawberry کھٹ مرچ	F^{Rf}	Fruit edible	Re	Herb	June- July	1	Yes/Yes
Gagea lutea (L.) Ker-Gawl. Liliaceae, KUH95389	Cooker-buna / Yellow star of Bethlehem کُکربُونڑاں	AG^{Yp}	Cooked alone	Nr	Herb	April	0.48	No/No
Geranium wallichianum D. Don ex Sweet. Geraniaceae, KUH95410	Ratan-jog رتن جوگ	R^{Mp}	Tea made from the root	Nr	Herb	Aug-Sep	0.58	Yes/Yes
Helianthus tuberosus L. Compositae, KUH95297	Kariensa / Jerusalem artichoke کنڑینسا	Tu^{Mp}	Tuber eaten raw	Nr	Herb	Oct- Dec	0.70	No/Yes
Lavatera cachemiriana Camb. Malvaceae, KUH95389	Dung-sonchal / Lavatera ڈنگ سونچل	L^{Yp}	Cooked alone or with potato	Nr	Herb	June-July	0.48	Yes/Yes
Ligularia jacquemontiana (Decne) M.A. Rau. Compositae, KUH95306	Mutakaysh مُتاخیش	St^{Yp}	Tender stem is eaten raw	Nr	Herb	June-July	0.80	No/No

Lindelofia longiflora (Benth.) Baill. Boraginaceae KUH95412	Lehndi لہندی	R^{Mp}	Tea made from the root	Nr	Herb	August	0.65	Yes/Yes
Malva neglecta Wallr. Malvaceae, KUH95303	Sonchal / Dwarfmallow سونچل	L^{YM}	Cooked alone or with potato	Re	Herb	May- Sep	1	Yes/Yes
Megacarpaea polyandra Benth ex Madden. Brassicaceae, KUH(CN)373	Chach چھچھ	L^{Yp}	Usually cooked with meat	Nr	Herb	June-July	0.75	No/No
Mentha longifolia (L.) L. Lamiaceae, KUH95286	Poodna / Horsemint پودنا	L^{YM}	Leaves used in a salad/ condiment	Re	Herb	Apr-Sep	0.98	Yes/Yes
Oxyria digyna (L.) Hill. Polygonaceae, KUH95298	Khatla / Mountain sorrel کھٹلا	AG^{Yp}	Stem and leaves are eaten raw	Re	Herb	June- Aug	0.86	Yes/Yes
Persicaria amplexicaulis (D. Don) Ronse Decr. Polygonaceae, KUH95402	Masloonr ماس لونڑ	R^{Mp}	Tea made from the root	Nr	Herb	Aug- Sep	0.44	Yes/Yes
Plantago lanceolata L. Plantaginaceae, KUH95304	Chamchi-Patra / Ribwort plantain چمچی پترا	AG^{Yp}	Cooked alone or with potato	Nr	Herb	June-July	0.84	Yes/Yes
Plantago major L. Plantaginaceae, KUH95301	Chamchi-patra / Common plantain چمچی پترا	AG^{Yp}	Cooked alone or with potato	Re	Herb	June- July	0.84	Yes/Yes
Polygonum affine D. Don. Polygonaceae, KUH(CN)233	Masloonr ماس لونڑ	R^{Mp}	Tea made from the root	Re	Herb	Aug-Sep	0.82	No/No
Polygonum aviculare L. Polygonaceae, KUH95288	Durhubbra / Knotweed دُرھبڑا	AG^{Yp}	Cooked alone or with potato	Nr	Herb	June- Aug	1	Yes/Yes
Polygonum molle D. Don. Polygonaceae, KUH95300	Chikroon چکروں	AG^{Yp}, St^{Yp}	Cooked alone or with potato, tender stem eaten raw	Nr	Herb	May-July	0.94	No/No
Prunus avium (L.) L. Rosaceae, KUH(CN)200	Glass / Wild cherry گلاس	F^{Rf}	Fruit edible	Re	Tree	June-July	1	Yes/Yes
Prunus cornuta (Wallich ex Royle) Steud. Rosaceae, KUH(CN)354	Bharith / Himalayan bird cherry بھرتھ	F^{Rf}	Fruit edible	Nr	Tree	Aug	1	No/No
Prunus cerasus L. Rosaceae, KUH(CN)190	Lucha /Sour cherry لوچا	F^{Rf}	Fruit edible	Re	Tree	July	1	No/Yes
Pteridium aquilinum (L.) Kuhn. Dennstaedtiaceae, KUH95318	Longroo / Bracken لانگڑو	AG^{Yp}	Cooked alone or with potato	Re	Fern	April-May	1	Yes/Yes

Rheum australe D. Don. Polygonaceae, KUH95296	Gol chotial / Himalayan rhubarb گول چٹیال	St^{Yp}	Stem is eaten raw	Nr	Herb	June	1	Yes/Yes
Rheum webbianum Royle. Polygonaceae, KUH95299	Chotial / Rhubarb چٹیال	L^{Mp}, P^{YM}	Cooked alone or with potato, petiole eaten raw	Nr	Herb	July-Aug	1	Yes/Yes
Rhodiola heterodonta (Hook. f. & Thomson) Boriss. Crassulaceae, KUH95394	Bug-masti بگمستی	R^{Mp}	Tea made from its root	Nr	Herb	Aug-Sep	0.40	No/No
Rosa macrophylla Lindl. Rosaceae, KUH(CN)478	Shingari شنگاری	F^{Rf}	Fruit edible	Nr	Shrub	Aug	1	Yes/Yes
Rubus sanctus Schreb. Rosaceae, KUH(CN)465	Bhukanra بھوکانڑاں	F^{Rf}	Fruit edible	Nr	Shrub	July- Aug	0.80	No/No
Rumex nepalensis Spreng. Polygonaceae, KUH95287	Hola ہولا	L^{Yp}	Cooked alone or with potato	Nr	Herb	May-Sep	0.88	Yes/Yes
Silene vulgaris (Moench) Garcke Caryophyllaceae, KUH95292	Murkunr / Maidenstears مُرکنڑ	AG^{Yp}	Cooked alone or with potato	Nr	Herb	May	0.76	No/Yes
Sinopodophyllum hexandrum (Royle) T.S. Ying. Berberidaceae, KUH95424	Khakhri / Himalayan Mayapple کھکھڑی	F^{Rf}	Fruit edible	Re	Herb	Aug	1	Yes/Yes
Sium suave Walter. Apiaceae, KUH95305	Shah gunji / Water parsnip شاہ گُنجی	R^{Mp}	Root is eaten raw	Nr	Herb	Aug-Oct	0.52	No/No
Skimmia laureola Franch Rutaceae, KUH95425	Nera نیرا	L^{YM}	Condiment	Nr	Shrub	April-Dec	0.32	Yes/Yes
Sorbus cuspidata (Spach) Hedl. Rosaceae, KUH(CN)092	Dooda ڈوڈا	F^{Rf}	Fruit edible	Nr	Small Tree	Aug-Sep	0.90	No/No
Taraxacum oblongatum Dahlst. Compositae, KUH95284	Hund ھند	AG^{YM}	Cooked alone	Re	Herb	July-Aug	0.88	Yes/Yes
Taxus baccata L. Taxaceae, KUH(CN)374	Thuni/ Common yew ٹُھونڑی	B^{Mp}	Condiment	Nr	Tree	April-Nov	0.20	Yes/Yes
Thymus linearis Benth. Lamiaceae, KUH95413	Bunjamari بنڑجمینڑی	AG^{YM}	Aerial part used in herbal tea	Re	Herb	June-Aug	0.44	Yes/Yes
Trifolium repens L. Leguminosae, KUH95283	Sinja / White clover سنجا	AG^{Yp}	Cooked alone	Nr	Herb	June- July	0.44	Yes/Yes
Trillium govanianum Wall. ex D. Don. Melanthiaceae, KUH95285	Trey patra ترے پترا	AG^{Yp}	Cooked alone	Nr	Herb	June	0.56	Yes/Yes

Urtica dioica L. Urticaceae, KUH95391	Kayri / Stinging nettle کیری	L^{Yp}	Cooked alone or with potato	Nr	Herb	May- June	0.84	Yes/Yes
Viburnum grandiflorum Wall. ex DC. Adoxaceae, KUH(CN)151	Ikloon, Guch / Cranberry bush اکلوں گچھ	F^{Rf}	Fruit edible	Re	Shrub	July-Aug	1	Yes/Yes

Key: Nr= Not reported, Re= Reported, Rf= Ripe fruit, YM= Young and mature, Rs= Ripe seed, Yp= Young part, Mp= Mature part, AG= Aboveground, R=Root, L= Leaves, F= Fruit, B=Bark, St= Stem, Tu=Tuber, Fr= Frond, S=Seeds.

Figure 2. Author (first) during plant identification and submission of herbarium specimens.

In the study area, the availability of WFPs was 8 species in April, 15 species in May, 31 species in June, 30 species in July, 32 species in August, 18 species in September, 9 species in October, 6 species in November, and two species in December. Although most recorded species were available in other months, the period listed in Table 2 was regarded as the most favorable for collecting, consuming, and storing wild food plants (April to December). However, the availability of most plants for consumption and storage was optimum from June to August.

Many WFPs were locally well known in the local people's diet and are commonly used. Among the recorded plants fourteen plants such as *Bunium persicum, Crataegus songarica, Fragaria nubicola, Malva neglecta, Polygonum aviculare, Prunus avium, Prunus cornuta, Prunus cerasus, Pteridium aquilinum, Rheum australe, Rheum webbianum, Rosa macrophylla, Sinopodophyllum hexandrum* and *Viburnum grandiflorum* had the highest use-value (1). Thirty-one plants were reported between 0.98 to 0.50 use-value ranges; sixteen plants were reported between 0.16 to 49 use-value ranges. The lowest use value was recorded for the *Betula utilis* and *Taxus baccata* which had 0.16 and 0.20 respectively (Table. 2). Low use-value indicates that very few people used these plants in their diet or less knowledge about their use.

Demographic uniqueness of the informants

Table 1 shows the characteristics of 70 respondents interviewed during surveys, of which 57.14% were women and 42.85% of men. Of the participants, most were housewives (40%) followed by workers (20%), shopkeepers (10%), teachers (8.5%), healers, seasonal nomads, and students (7.14%). Only five persons were under 14-24 years old, 13 were 25-40 years old, twenty were 41-50, thirteen were 51-60, eleven were 61-70, eight were above 70. Traditional food was considered a gender-based practice. Gender has been broadly studied to recognize whether wild plant knowledge varies with gender (Silva *et al.* 2011). In the study area, women (especially housewives), workers, and shopkeepers had knowledge. Women learned from their parents through regular observations and shopkeepers usually bought some wild medicinal plants from housewives and workers. The livelihood of most workers depended on wild food plants.

Knowledge was highest among elders. People over the age of 40 had vast information about plant usage. In this study, educated informants shared less information than uneducated respondents. Most young people were benefiting from modern facilities and were less aware of traditional knowledge.

Wild vegetables

Among all recorded plants (vegetables) were a chief source of local food security, the majority of them were found in alpine zone, subalpine pastures and forests. The used plant parts are shown in Fig. 3).-

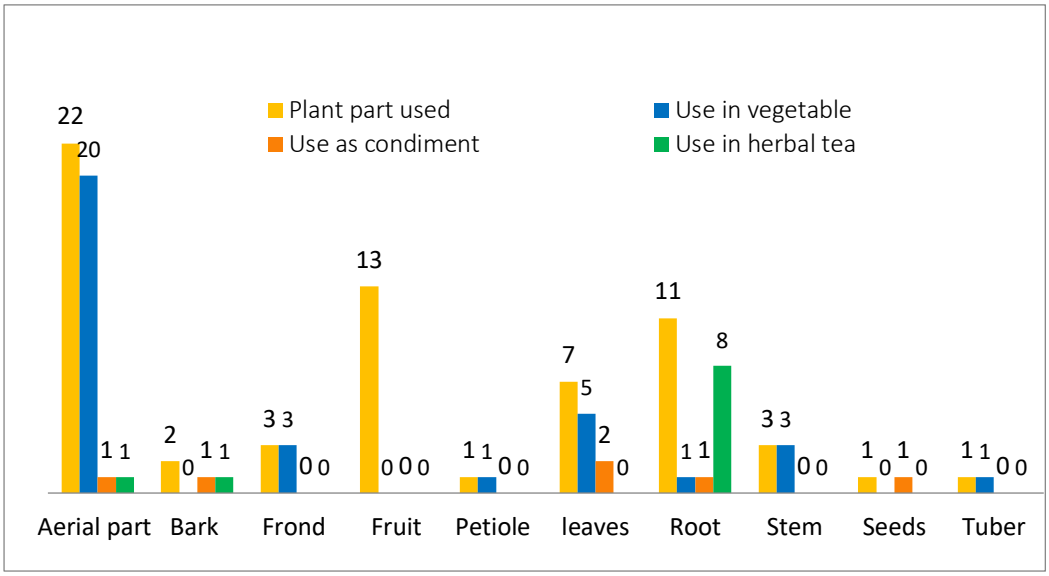

Figure 3. Plant parts used

We recorded 27 species such as *Allium carolinianum, Allium schoenoprasum, Allium victorialis, Campanula latifolia, Capsella bursa-pastoris, Cardamine loxostemonoides, Chenopodium album, Chorispora sabulosa, Dipsacus inermis, Dryopteris crassirhizoma, Dryopteris stewartii, Gagea lutea, Lavatera cachemiriana, Malva neglecta, Plantago lanceolata, Plantago major, Polygonum aviculare, Polygonum molle, Pteridium aquilinum, Megacarpaea polyandra* (Fig. 4), *Rheum webbianum, Rumex nepalensis, Silene vulgaris, Taraxacum oblongatum, Trifolium repens, Trillium govanianum* and *Urtica dioica* that are used as vegetables most cooked alone or with potato, beans and meat and few are eaten raw (Table. 2; Fig. 5a,b,c,e,f,g,h,i).

Figure 4 *Megacarpea polyandera* (endemic plant to the Himalaya region) heavily used as a vegetable and preserve for consuming in off-season.

Five species-*Helianthus tubeorosus* (tuber) (Fig. 5i), *Ligularia fischeri* (tender stem Fig. 5d), *Oxyria digyna* (young stem, leaves) *Sium suave* (root Fig. 5h), *Rheum australe* (tender stem), and *Rheum webbianum* (leaf petiole) were eaten raw. We observed some vegetables-*Campanula latifolia, Capsella bursa-pastoris, Chorispora sabulosa, Gagea lutea, Helianthus tuberosus, Lavatera cachemiriana, Malva neglecta, Plantago lanceolata, Plantago major, Silene vulgaris, Trillium govanianum*, and *Urtica dioica* being consumed only when in season not stored because if these plants are preserved, they loss their nutrients. The remaining vegetables were mostly dried during summer and consumed in season and in winter as well. There are two different methods for vegetables preservation (i) some vegetables are preserved after drying (ii) some are half boiled (freshly collected)

before drying. Bvenura and Sivakumar (2017) said that the reason for boiling vegetables is to expel non-nutrient/toxic compounds.

Figure 5. (A) *Allium humile*, (B) *Gagea lutea*, (C) *Allium schoenoprasum,* (D) *Ligularia jacquemontiana* stem is eaten raw (E) *Chorisopra sabulosa*, (F) *Campanula latifolia*, (G) *Lindelofia longiflora*, (H) Root of *Sium suave*, (I) Tuber of *Helianthus tuberosus*

The freshly collected material of *Allium carolinianum* (Rich piyaz), *Dryopteris crassirhizoma* (Kandayra), *Dryopteris stewartii* (Kunji), *Pteridium aquilinum* (Longroo), *Megacarpaea polyandra* (Chach), *Rheum webbianum* (Chotial) were first half boiled and then dried under sunlight and preserved in the cloth bags. Vegetables like *Polygonum aviculare, Polygonum molle, Taraxacum oblongatum* and *Rumex nepalensis* were preserved in a dried form without boiling. Off-season availability of WFPs by drying and storing is beneficial as it ensures food stability and food security throughout the year. Almost all reported plants are medicinally important and their use in ethnomedicine was reported by several workers (Khan *et al.* 2013; Ahmad *et al.* 2014; Mahmood *et al.* 2011; Ahmad *et al.* 2017; Ijaz *et al.* 2021). We found one new ethnomedicinal use of *Megacarpaea polyandra* root, tea of its root part is useful against pneumonia.

Wild edible fruits, condiment and herbal tea plants

The fruits of thirteen taxa-*Berberis lycium, Berberis glaucocarpa, Cotoneaster integerrimus, Crataegus ambigua, Fragaria nubicola, Sinopodophyllum hexandrum, Prunus cerasus, Prunus avium, Prunus cornuta, Rosa macrophylla, Rubus sanctus, Sorbus cuspidata* and *Viburnum grandiflorum* are edible and were widely consumed in season. However, the fruits of *Berberis lycium, Berberis glaucocarpa, Sinopodophyllum hexandrum, Rosa macrophylla, Rubus sanctus* and *Cotoneaster integerrimus* only consumed by locals when people are suddenly passing by them.

Fruit plants like *Prunus cornuta, Viburnum grandiflorum, Berberis spp, Rubus sanctus* and *Sorbus cuspidate* generally grows in the forests or forest margin. However, *Prunus cornuta* and *Sorbus cuspidate* were also planted in agricultural land. *Sinopodophyllum hexandrum* and *Fragaria nubicola* frequently found in subalpine pastures. Other plants such as *Prunus cerasus, Prunus avium, Cotoneaster integerrimus* are semi-wild trees grow near houses or margin of agricultural land.

We recorded six species-*Allium humile* (young aerial parts), *Angelica glauca* (root), *Bunium persicum* (seeds), *Mentha longifolia* (leaves), *Skimmia laureola* (leaves) and *Taxus baccata* (bark) used as condiments. Among all reported condiments *Mentha longifolia* and seeds of *Bunium persicum* heavily used in curry and sauce. A little pinch of root powder of *Angelica glauca* is used in beans curry which has very pleasant smell and best match with this curry in terms of taste and aroma. We observed that dried aerial parts of *Allium humile* is a substitute of Onion (*Allium cepa*) and used in every local curry in season and heavily in off-season. *Skimmia laureola* and *Taxus baccata* were not commonly used in curries.

Amidst the reported plants ten species such as *Arnebia benthamii* (root), *Bergenia ciliata* (root), *Bergenia stracheyi* (root), *Betula utilis* (inner bark), *Geranium wallichianum* (root), *Lindelofia longiflora* (root), *Persicaria amplexicaulis* (root), *Polygonum affine* (root), *Rhodiola heterodonta* (root) and *Thymus linearis* (aerial part) were used in herbal tea. Herbal tea was most favorite among people particularly preferred in case of health care or cure common illnesses (flu, fatigue, body and muscle pain) as well as used as a tonic.

Jaccard index (JI)

The current study was compared with other fifteen studies conducted in Kashmir, Northern areas of Pakistan and Nepal, using the Jaccard index (JI). The degrees of similarities (JI) were recorded from Pakistan with studies conducted by Ijaz et al, 2021; Dar, 2003; Khan et al, 2013, Mahmood et al, 2011, Shaheen et al, 2017; Mir et al, 2021; Ahmad et al, 2017; Aziz et al, 2020; Ahmad and Habib, 2014; Khan and Khatoon, 2008; Ahmad et al, 2012; Ahmad et al, 2021; Qamar et al, 2010; Ishtiaq et al, 2013 with descending order (18.69) > (15.30) > (15.15) > (14.77) > (12.5) > (12.04) > (9.90) > (8.97) > (8.10) > (6.06) > (5.49) > (5.05) > (4.91) > (1.38) respectively. Our study was totally dissimilar (similarity was zero) with the study conducted by Bhatt et al, (2020) Table .3.

Newly reported WFPs from the study area Lawat, district scale and in Azad Kashmir

We compared our findings ethnobotanical studies from Pakistan (Dar 2003; Khan and Khatoon 2008; Qamar *et al.* 2010; Mahmood *et al.* 2011; Ahmad *et al.* 2012; Khan *et al.* 2013; Ishtiaq *et al.* 2013; Ahmad 2014; Ahmad and Habib 2014; Shaheen *et al.* 2017; Ahmad *et al.* 2017; Aziz *et al.* 2020; Ijaz *et al.* 2021) (Table. 3). Ethnobotanical uses of 44 edible plants-*Allium carolinianum, Allium schoenoprasum, Allium victorialis, Berberis glaucocarpa, Bergenia ciliate, Bergenia stracheyi, Betula utilis, Bunium persicum, Campanula latifolia, Cardamine loxostemonoides, Chorispora sabulosa, Cotoneaster integerrimus, Crataegus songarica, Dryopteris crassirhizoma, Dryopteris stewartii, Fragaria nubicola, Gagea lutea, Geranium wallichianum, Helianthus tuberosus, Lavatera cachemiriana, Ligularia fischeri, Lindelofia longiflora, Malva neglecta, Megacarpaea polyandra, Oxyria digyna, Persicaria amplexicaulis, Plantago major, Polygonum affine, Polygonum aviculare, Polygonum molle, Prunus avium, Prunus cornuta, Prunus cerasus, Pteridium aquilinum, Rheum australe, Rhodiola heterodonta, Rubus sanctus, Silene vulgaris, Sium suave, Skimmia laureola, Sorbus cuspidata, Taraxacum oblongatum, Taxus baccata, and Trillium govanianum* were reported first time from the study area ''Lawat''. Food uses of 19 edible taxa-*Crataegus songarica, Helianthus tuberosus, Prunus cerasus, Silene vulgaris, Allium schoenoprasum, Campanula latifolia, Cardamine loxostemonoides, Chorispora sabulosa, Cotoneaster integerrimus, Dryopteris crassirhizoma, Gagea lutea, Ligularia fischeri, Megacarpaea polyandra, Polygonum affine, Polygonum molle, Prunus cornuta, Rubus sanctus, Sium suave, and Sorbus cuspidata* were reported for the first time at the district level.

In this study 14 plant taxa such as *Allium schoenoprasum, Cardamine loxostemonoides, Chorispora sabulosa, Cotoneaster integerrimus, Dryopteris crassirhizoma, Gagea lutea, Ligularia fischeri, Megacarpaea polyandra, Polygonum affine, Polygonum molle, Prunus cornuta, Rubus sanctus, Sium suave,* and *Sorbus cuspidata* were newly reported for Azad Kashmir/Pakistan.

Surveys found a variety of new traditional foods recipe (especially mode of consuming edible parts of plants), e.g. *Allium carolinianum, Allium schoenoprasum, Allium victorialis, Bergenia ciliata, Bergenia stracheyi, Betula utilis, Campanula latifolia, Capsella bursa-pastoris, Cardamine loxostemonoides, Chenopodium album, Chorispora sabulosa, Cotoneaster integerrimus, Dryopteris crassirhizoma, Gagea lutea, Geranium wallichianum, Helianthus tuberosus, Lavatera cachemiriana, Ligularia jacquemontiana, Lindelofia longiflora, Megacarpaea polyandra,*

Persicaria amplexicaulis, Polygonum aviculare, Polygonum molle, Prunus cornuta, Rheum australe, Rheum webbianum, Rhodiola heterodonta, Rosa macrophylla, Rubus sanctus, Rumex nepalensis, Silene vulgaris, Sium suave, Skimmia laureola, Sorbus cuspidata, Taxus baccata, Trifolium repens, Trillium govanianum and *Urtica dioica* (Table. 2).

Table 3. Comparing the present study with previous reports at neighboring, regional, and global level as performed by Jaccard Index (JI)

Study area	**Total reported taxa (a)**	**Total reported taxa in present work (b)**	**Same use in both studies**	**Dissimilar use in current study**	**Common plant in both areas (c)**	**Jaccard Index (JI)**	**Citation**
Lawat area	52	61	11	70	15	15.30	Dar, 2003
Gilgit, Pakistan	89	61	00	81	9	06.06	Khan and Khatoon, 2008
Neelum valley, AJ&K	67	61	00	81	6	04.91	Qamar et al, 2010
Neelum valley, AJ&K	40	61	08	73	13	14.77	Mahmood et al, 2011
Sharda, Neelum Valley	39	61	00	81	5	05.05	Ahmad et al, 2012
Naran Valley, Pakistan	101	61	10	71	22	15.15	Khan et al, 2013
Neelum valley, AJ&K	12	61	01	80	1	01.38	Ishtiaq et al, 2013
Dawarian, Neelum valley	59	61	03	78	9	08.10	Ahmad and Habib, 2014
Neelum valley, AJ&K	56	61	06	75	13	12.50	Shaheen et al, 2017
Kel, Neelum valley	50	61	00	81	10	09.90	Ahmad et al, 2017
North Pakistan	41	61	08	73	7	08.97	Aziz et al, 2020
Neelum district AJ&K	66	61	16	65	20	18.69	Ijaz et al, 2021
District Upper Dir Pakistan	50	61	04	77	05	05.49	Ahmad et al, 2021
Kashmir Himalaya	32	61	05	06	10	12.04	Mir et al, 2021
Hindu Kush valleys, Pakistan	63	61	04	04	08	12.93	Abdullah et al, 2021
Western Nepal	74	61	00	81	00	00.00	Bhatt et al, 2020

Conclusion

WFPs are still a prominent component of local food culture in Lawat area Neelum Valley and food source for food-insecure families. We reported 61 wild food plants that are widely used as vegetables, fruit, condiment, and in herbal tea. Aside from their nutritional importance, WFPs have additional properties such as therapeutic potential, cultural applications, marketing, and preservation that make them more valuable in local culture while also predisposing them to widespread exploitation. This study also indicates that there is a still vast knowledge gap between current study and early published reports. Wild edible plants and related knowledge are now under huge threat due to overcollection from natural areas, habitat degradation, and deforestation. The current study can be helpful to understand the diversity of wild food plants of Lawat area and their traditional food uses. WFPs harvesting, domestication, and selling have a lot of potential in the area, and if done well, they might be a source of wealth for residents.

Declarations

Ethics approval and consent to participate: The local authorities granted permission for the data collecting and final oral consents were gained from the informants before to the interviews through group discussions regarding

the study's objectives. After the research findings were presented, Center for Plant Conservation, University of Karachi certified them.

Availability of data and materials: All appropriate data are within the manuscript.

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

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Author's contributions: All authors have read and approved the manuscript. SI conducted field survey, gathered, and analyzed data, and prepared the manuscript's first draft. AP Supervised the research, AP, SA, RA, SK and ZA**,** read, corrected, and approved the manuscript. MA drew the map of the study area. All authors agree to be responsible for all parts of their work, hand have read and approved the manuscript, ensuring accuracy and integrity.

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