Genet Resour Crop Evol (2020) 67:1521–1536
https://doi.org/10.1007/s10722-020-00926-3

RESEARCH ARTICLE

Traditional wild vegetables gathered by four religious groups in Kurram District, Khyber Pakhtunkhwa, North-West Pakistan

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Received: 28 December 2019 / Accepted: 20 March 2020 / Published online: 29 March 2020

Abstract Studying how traditional knowledge regarding wild food plants and particularly wild vegetables changes over time and space is crucial for understanding which socio-ecological variables may have an influence on traditional foraging behaviors. Recent work has found that religious affiliation may play a central role since, in specific cultural contexts, religion shapes kinship relations and consequently the vertical transmission of traditional knowledge and practices. In order to further test this hypothesis, a field ethnobotanical study specifically focusing on wild vegetables was conducted among four religious communities (Shias, Sunnis, Christians, and Sikhs) in Kurram District, North-West Pakistan. Results show that a remarkable bio-cultural heritage comprising fifty-five folk wild food taxa survives today; most of the wild plants were however quoted by few informants, suggesting that this traditional knowledge system is possibly under threat. More than the half of the quoted wild vegetables were not yet reported so far in the Pakistan wild food ethnobotanical literature. The most commonly gathered wild vegetables were *Amaranthus viridis* L., *Margarospermum officinale* L., *Malva neglecta* Wallr., *Portulaca oleracea* L., and *Rumex dentatus* L. Most of the recorded wild vegetables were quoted by Shia and, to less extent, by Sunni community members, while Christians and Sikhs showed an extremely restricted wild plant food repertoire. These differences may be related to the different history and socio-economic conditions of the considered religious groups, to geographical/ecological factors and probably to the very specific origin of the Shia groups (Turi tribe) of the region, which moved from Western Asia a few centuries ago. Moreover, a remarkable portion of the quoted wild vegetables are perceived to have specific medicinal properties. A serious reconsideration of the recorded wild food plant resources, especially also within educational platforms, could be crucial for fostering culturally-appropriate food security strategies in marginal areas of Pakistan.

Keywords Ethnobotany · Pakistan · Kurram · Wild food plants · Religious groups

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Introduction

Studying how the traditional knowledge regarding wild food plants and particularly wild vegetables changes over time and space is crucial for understanding which socio-ecological variables may have an influence on traditional foraging behaviors. Recent work has found that religious affiliation may play a central role since, in specific cultural contexts in which religious affiliation represents the most important cultural marker, religious belonging shapes kinship relations and consequently the vertical transmission of traditional knowledge and practices (Pieroni et al. 2015, 2018). In order to further test this hypothesis, a field an ethnobotanical field study specifically focusing on wild vegetables was conducted among four religious communities (Shia, Sunni, Christian, and Sikh) in Kurram District, North-West Pakistan.

In the ethnobotanical literature of Pakistan, some research has been published on the ethnomedicinal use of plants in Kurram, while no work has been done on the wild vegetables in this area (Hussain et al. 2012, 2013, 2018; Ajaib et al. 2014). Moreover, in Pakistan a proper cross-cultural perspective has never been carried out in an ethnobotanical field survey. The people of the Kurram are economically very disadvantaged. Their main occupation is agriculture, or they work as laborers or are employed in small home-run shops. Children, women and old men are engaged in livestock rearing and they have collected wild vegetables for a long time. The terrain of Kurram District is hilly and most of the villages of the region are cut off from frequent visits to town. It is mainly composed of ethnic Pashtuns (known in the international literature also as "Afghans"), with Muslim Shia and Sunni communities dominating. These two communities have their own cultural rituals and traditional norms/values which they have been following since ancient times. For the people of Kurram, agriculture is the major source of food and income. About 70–80% of the population of Kurram depends on cultivated crops and wild vegetables for their livelihood and also for fodder for their domestic animals. Additionally, over the past decades, most of the local communities inhabiting the north-western border of Pakistan, and notably the district of Kurram, have been badly affected socially and economically by the war against the Talibans, which has inevitably destabilized their social equilibria and possibly their traditional knowledge system as well. The current study aimed to document the use of wild vegetable among the four religious groups living in Kurram. This study contributes to the worldwide wild food ethnobotanical literature and may help to foster endogenous solutions aimed at managing food security strategies.

The research objectives of this fieldwork were:

- to document and identify the diversity of wild vegetables traditionally gathered in Kurram;
- to analyze their detailed local food and possible medicinal perceptions;
- to compare the quoted wild vegetables among the four considered religious groups, in order to possibly interpret cross-cultural commonalities and differences and to better understand the cultural context underpinning wild plant foraging in Kurram.

Materials and methods

The study area

Kurram is a newly-formed Tribal District of Khyber Pakhtunkhwa, Pakistan. It is a beautiful, green valley located in the Northwestern part of the country. The newly-constituted Kurram is situated between 33°20′ and 34°10′ north latitude and 69°50′ and 70°50′ east longitude (Hussain et al. 2018). The word ''Kurram'' takes its name from the River Kurram which flows across the valley. The name Kurram is mentioned in ''*Rag Vide*'' and it is derived from Karma (Hussain et al. 2012). Some historians trace the origin of the word "Kurram" to "Kirram" which means silk. Legend has it that people living in this area once kept silk worms and the silk trade was one of the main sources of livelihood (Khan 2005).

The Kurram Valley is 115 km long and encompasses a total area of 3380 square kilometers (Gilani et al. 2003; Hussain et al. 2012, 2018). According to the 2017 census report, the population of Kurram is 619,553. Turi, Bangash, Mamozai, Muqbal, Zazai, Mangal, Orakzai, Ghilzai, Para Chamkani and Persian speaking Khoshi are the main tribes living in Kurram. The climate of Kurram Valley varies by altitude, ranging from extreme heat to bitter cold. For most of the summer the valley's weather remains pleasant, but

during winter the minimum temperature drops below freezing. The current study was carried out in different villages of Upper, Lower and Central Kurram (Fig. 1).

The Valley of Kurram was one of the easiest and most used routes into India for the great migrations which took place between 4000 and 2000 BC by the Romans (Kapur 1908). The Koh-e-Safaid range which forms the boundary of present-day Kurram appears to be the same as the ancient Svethpatha, and it is likely that the rich and healthy uplands of Kurram would always have been a place of habitation and agriculture. As in other parts of the frontier, a number of Hindu names of mountain peaks and rivers exist to the present day, proving the undoubted occupation of the country by early Hindu and Aryan immigrants. It seems likely that a Greek settlement was established in the area by the successors of Alexander as the inscriptions found in the Sanchi-Stupas include mention of a gift by a Greek resident of the Safaid Koh, or the Svethpatha. Three coins found in the village of Bagzai in Kurram have been identified as belonging to the reign of King Sotermegas or Kodphises; another coin of the bull and horseman type found in the same place has been attributed to the Sahia Dynasty that ruled over the entire territory between the Indus River

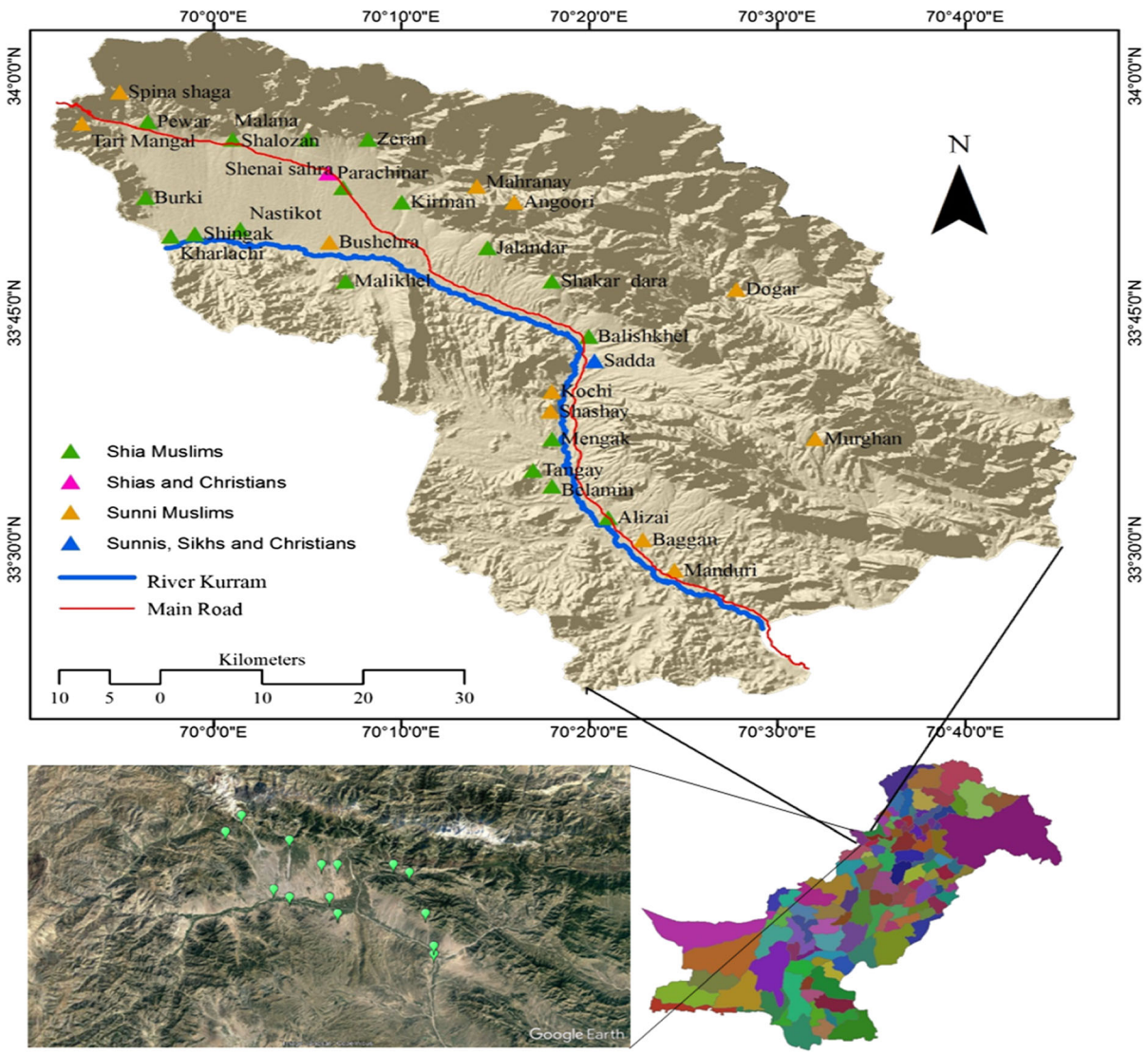

Fig. 1 Map of the study area and villages

and Afghanistan in the tenth century AD (Kapur 1908; Caroe 1958).

The first definite landmark in the history of Kurram was the fact that in 1148 AD Behram Shah of Ghazni field there after being defeated in battle and gathered forces with which he subsequently returned and recovered Ghazni. In 1163 the Sultan of Ghor placed his brother Muhammad in charge of the area, and in 1176-77 he conferred the villages of Shalozan and Kirman, where he used to stop every year on his way to India, on one of his dependents, Taj-ud-din Yalduz. From 1206-39 was a period of confused fighting when a succession of rulers held sway. The erruption of Mongols in 1239 submerged Kurram and the region disappears from the annals of history until Humayun, who then ruled at Kabul, occupied it before his re-conquest of India. On the breakup of the Moghal Empire, Kurram became part of the Kingdom of Afghanistan. The Shia tribe of the Turi, which possibly migrated to the area from Western Asia at least before the sixteenth Century, started migrating up and down Kurram, in the manner of present-day Powindahs, and had settled at Nilab on the banks of the Indus River, when they gradually forced their way, perhaps on account of drought and the pressure of increasing population size, as permanent settlers up to Kurram Valley (Hadi 2009). One theory suggests that they are of Turkish origin, while Muhammad Hayat Khan argues they are Karlanari Afghans, and Lumsden that they have descended from the Mughals. The Turi themselves, however, claim to have moved originally from Persia (Iran) and after wandering in a nomadic fashion they reached the Aryob (Hariob) District of Afghanistan, where they settled at the top of the valley. The Turi established their summer camps at the top of the valley and in winter took their flocks and herds down as far as the Indus, returning each year to the parent colony. Most historians agree however that the origin of the Turi are not Pathans/Afghans and that is be found somewhere in Western Asia (Kapur 1908; Mahon 1912; Caroe 1958; Rieck 2015; Hadi 2009).

Data collection

The study was conducted in different parts of the district of Kurram from September 2018 to September 2019. A questionnaire was used for the collection of data about the traditional use of wild vegetables and their importance. The data were collected in different areas of Kurram including villages and cities (Fig. 1). The information on wild vegetables were collected by individual interviews and group discussions with locals too.

A total of 120 interviews (30 from each community) were conducted among Shia, Sunni, Christian and Sikh communities. All the interviews were conducted in Pashto, the local language of the communities. All informants were local and most of them live in villages. The sample of interviewees included: 17 females and 13 males from the Shia community; 10 females and 20 males from the Christian community; 30 males from the Sikh community; and 30 males from the Sunni community, as direct interviews with women were not possible due to cultural constraints. The age of female interviewees varied between 28 to 80 years with an average age of 44, while the age of male interviewees ranged from 25 to 105 years with an average age of 42.

Data analysis

Data gathered among the four considered groups were compared via Venn diagrams and calculating the Jaccard (similarity) Index (JI) of each couple of datasets (Jaccard 1902; Kayani et al. 2015).

To determine the similarity between two sets the following formula was used:

$$\text{Jaccard Index} = (\text{the number in both sets}) / (\text{the number in either set}) \times 100$$

The formula in notation is as follows:

$$J(X, Y) = |X \cap Y| / |X \cup Y|$$

Moreover, the recorded data were also compared with the wild food ethnobotanical literature of Pakistan in order to assess their possible novelty (Shad et al. 2013; Shah et al. 2015; Ahmad and Pieroni 2016; Tareen et al. 2016; Ahmad et al. 2019).

Results and discussion

Wild vegetables in Kurram

The study recorded a total of fifty-five folk taxa (fifty-three plants and two mushrooms) belonging from twenty-nine families, which represent the wild food

plants of Kurram District. Local names, parts used, gathering seasons, traditional culinary uses, perceived medicinal properties, and quotation index were recorded for all of the wild vegetables and mushrooms, as shown in Table 1. The large majority of the wild vegetables were quoted by less than one third of the informants, thus suggesting that this kind of Traditional Environmental Knowledge is seriously threatened. *Amaranthus viridis* L., *Margarospermum officinale* L., *Malva neglecta* Wallr., *Portulaca oleracea* L., and *Rumex dentatus* L., represented the most quoted species.

Most of the folk taxa were reported by the Shia and, to less extent, by the Sunni communities (Fig. 2), while Christian and Sikh communities reported the use of very few wild vegetables. This remarkable difference is possibly due to the fact that Christians and Sikhs primarily live in urban environments, and thus they have limited access to the natural habitats, such as agricultural lands and fields.

It was further observed while conducting this research that most of these community members consume a few wild species only that are available in the market or found near their houses.

Caralluma tuberculata N.E.Br., *Rumex dentatus*, *Lepidium draba* L., *Malva neglecta, Mentha spicata* L., *Portulaca oleracea*, *Stellaria media* (L.) Vill., *Trifolium repens* L., and *Nasturtium officinale* R.Br. were available in the market while was found near the homes of interviewees as well as in the market. The dominant families were Asteraceae, Brassicaceae, Fabaceae, Lamiaceae and Polygonaceae (four species each), followed by Boraginaceae and Plantaginaceae (three species each) and Amaranthaceae, Apiaceae, Asparagaceae, Caryophyllaceae, Cucurbitaceae, Amaryllidaceae and Liliaceae (two species each). Two mushrooms species, *Morchella esculenta* Fr., and *Calvatia gingantea* (Batsch ex Pers.) Lloyd, belonging to the Morchellaceae and Agaricaceae families, respectively, were also recorded. Very few species (i.e. *Caralluma turberculata* were found also to be cultivated in fields. Some wild vegetables were frequently found in almost everywhere in the study area, while some other vegetables such as *Scorpiurus muricatus* L., *Polygonatum verticillatum* (L.) All., *Allium roylei* Stearn., *Chaerophyllum reflexum* Aitch., and *Bistorta amplexicaulis* (D. Don) Greene, were found to be restricted to particular areas at high altitudes. All the wild vegetables are mainly consumed in young stages of growth. Mostly the green leaves or aerial parts of the plant are used. Some plants such as *Trifolium repens*, and *Mentha longifolia* (L.) L., are also stored and used for cooking in dried form. Generally most of the wild vegetables are found in crop fields, on the banks of rivers and streams, on hilly terrain and the lower slopes of hills, in deserts and moorland, and along the roadside, but some species like *Bistorta amplexicaulis* and *Chaerophyllum reflexum* are found at high altitudes.

Cross-cultural comparison

Figure 2 shows the Venn diagram of the comparison among the four communities. The Shia community shows the highest variety of wild vegetables (37 or which 25 exclusively used by them), while Sunnis quoted 28 taxa (15 exclusively mentioned by them) and Sikhs and Christians quoted very few plants.

Sociological, ecological and anthropological factors may have played a role in shaping such differences. Christians and Sikhs represent in fact minority groups that mainly live in the towns of Parachinar, Sadda and Alizai. They are often employed as urban laborers while Muslims are, for the most part, engaged in ago-pastoralist activities. Moreover, the Sikh community is predominately involved in business activities and mainly depends upon cultivated vegetables sold in markets rather than those collected from the wild. Christians are instead largely employed in governmental jobs and not normally involved in farming and pastoralist activities. Due to the aforementioned limitations, a proper cross-cultural comparison among the four considered groups is problematic. While this is indeed possible between the two major Muslim groups, which reported a large number of wild vegetables, a comparison between the Muslim groups and Christians and Sikhs is strongly affected by the very restricted domains of the latter two groups; that is also why the Christian and Sikh wild food ethnobotanies are reported in dashed lines, considering the limited extension of these communities in the study area, as well as their very limited exposure to the natural envionment.

The Jaccard index indicates a level of similarity of 21% between the Shia and Sunni communities in the Kurram District (Fig. 2), although the Z-test shows that this difference is not statistically significant ($p = 0.23$). However, the *qualitative* difference between

Table 1 Wild vegetables gathered in the study area

Plant taxon, family and voucher code	Local names	Religious groups				Used parts	Habit	Gathering period	Traditional food use	Perceived medicinal properties/treated illnesses	Quotation index	Food use previously reported in Pakistan
		Sh	Su	Ch	Si							
Allium griffithianum Boiss., Amaryllidaceae, W.A.101.GPGC.PCR	Pizaki	–	+	–	–	Whole plant	Herb	March–June	Seasoning	None	0.1	Tareen et al. (2016)
Allium roylei Stearn., Amaryllidaceae, W.A.102.GPGC.PCR	Poopy	+	–	–	–	Whole plant	Herb	March–June	Seasoning	None	0.1	Ahmad and Pieroni (2016)
Amaranthus viridis L., Amaranthaceae, W.A.103.GPGC.PCR	Rinzaka	+	+	–	–	Leaves	Herb	March–October	Cooked	Laxative	0.3	Ahmad et al. (2019), Tareen et al. (2016), Shah et al. (2015)
Angelica ternata Regel & Schmalh., Apiaceae, W.A.104.GPGC.PCR	Krawsha	–	–	+	–	Leaves	Herb	June–October	Cooked	None	0.2	No
Artemisia absinthium L., Asteraceae, W.A.105.GPGC.PCR	Mastyara	+	–	–	–	Leaves	Shrub	March–August	Seasoning	Blood purifier	0.1	No
Asparagus officinalis L., Asparagaceae, W.A.106.GPGC.PCR	Lakhtey	+	–	–	–	Stems	Shrub	March–June	Cooked	Constipation	0.1	No
Bistorta amplexicaulis (D. Don) Greene, Polygonaceae, W.A.107.GPGC.PCR	Sarka	–	+	–	–	Leaves	Herb	March–August	Cooked	None	0.2	Shah et al. (2015)
Buglossoides arvensis (L.) I.M.Johnst., Boraginaceae, W.A.108.GPGC.PCR	Saraw Saba/ Speer Saba	+	–	–	–	Leaves	Herb	March–October	Cooked	Anemia	0.2	No
Caralluma tuberculata N.E.Br., Apocynaceae, W.A.109.GPGC.PCR	Pamani	+	+	+	+	Whole plant	Herb	March–October	Salad	Diabetes mellitus	0.2	Ahmad et al. (2019), Ahmad and Pieroni (2016), Tareen et al. (2016), Shah et al. (2015)
Lepidium draba L., Brassicaceae, allium griffthian W.A.110.GPGC.PCR	Bashkay	+	–	+	–	Leaves	Herb	March–June	Cooked	None	0.1	No
Chaerophyllum reflexum Aitch., Apiaceae, W.A.112.GPGC.PCR	Zanrkay	–	+	–	–	Leaves	Herb	March–June	Cooked	None	0.2	No

Table 1 continued

Plant taxon, family and voucher code	Local names	Religious groups				Used parts	Habit	Gathering period	Traditional food use	Perceived medicinal properties/treated illnesses	Quotation index	Food use previously reported in Pakistan
		Sh	Su	Ch	Si							
Chenopodium album L., Amaranthaceae, W.A.113.GPGC.PCR	Sormi	+	+	–	–	Leaves	Herb	March–June	Cooked	Urinary tract infections	0.2	Ahmad et al. (2019), Tareen et al. (2016), Shah et al. (2015)
Citrullus colocynthis (L.) Schrad., Cucurbitaceae, W.A.114.GPGC.PCR	Pirpandyan	+	–	–	–	Whole plant	Herb	July–September	Cooked	Diabetes mellitus	0.1	No
Commelina benghalensis L., Commelinaceae, W.A.115.GPGC.PCR	Jawarzaal	+	–	–	–	Leaves	Herb	March–May	Cooked	None	0.2	Shah et al. (2015)
Convolvulus arvensis L., Convolvulaceae, W.A.116.GPGC.PCR	Parvaty	+	–	–	–	Leaves	Herb	March–June	Cooked	None	0.1	No
Cucurbita maxima Duchesne, Cucurbitaceae, W.A.117.GPGC.PCR	Kadoo Gul	+	–	–	–	Flowers	Herb	March–October	Cooked	None	0.1	No
Eremurus himalaicus Baker, Asphodelaceae/Xanthorrhoeaceae, W.A.118.GPGC.PCR	Hezee	–	+	–	–	Leaves	Herb	March–October	Cooked	None	0.2	No
Heliotropium cabulicum Bunge, Boraginaceae, W.A.119.GPGC.PCR	Shirghandoki	+	–	–	–	Leaves	Herb		Cooked	Chest pains	0.1	No
Lathyrus aphaca L., Fabaceae, W.A.120.GPGC.PCR	MarghayoHpay	+	–	–	–	Leaves	Herb	March–June	Cooked	None	0.1	Ahmad et al. (2019)
Lepidium virginicum L., Brassicaceae, W.A.121.GPGC.PCR	Zangali Teraba	–	+	–	–	Leaves	Herb	March–August	Salad	None	0.2	No
Margarospermum officinale (L.) Decne, Boraginaceae, W.A.122.GPGC.PCR	Noraki Saba	+	–	–	–	Whorls	Herb	March–October	Cooked	Anemia	0.3	No
Malva neglecta Wallr., Malvaceae, W.A.123.GPGC.PCR	Tikalay	+	+	+	+	Leaves	Herb	March–October	Cooked	Urinary tract infections	0.5	Shah et al. (2015)
Medicago polymorpha L., Fabaceae, W.A.124.GPGC.PCR	Kundi	–	+	–	–	Leaves	Herb	March—August	Cooked	None	0.2	Ahmad et al. (2019), Shah et al. (2015)
Mentha longifolia (L.) L., Lamiaceae, W.A.125.GPGC.PCR	Vilanay	+	–	–	–	Leaves	Herb	March–October	Salad	Gastrointestinal troubles	0.2	Ahmad et al. (2019), Tareen et al. (2016)
Mentha spicata L., Lamiaceae, W.A.126.GPGC.PCR	Podina	+	+	+	+	Leaves	Herb	March–October	Salad	Stomach-ache, indigestion, intestinal pains	0.1	Tareen et al. (2016), Shah et al. (2015)
Mentha royleana Wall. ex Benth., Lamiaceae, W.A.127.GPGC.PCR	Speer Vilanay	–	–	–	+	Leaves	Herb	March–October	Salad	Gastrointestinal troubles	0.2	Tareen et al. (2016)
Nannorrhops ritchieana (Griff.) Aitch., Arecaceae, W.A.129.GPGC.PCR	Patawa	–	+	–	–	Young shoots	Tree	March–June	Cooked	None	0.1	No

Table 1 continued

Plant taxon, family and voucher code	Local names	Religious groups				Used parts	Habit	Gathering period	Traditional food use	Perceived medicinal properties/treated illnesses	Quotation index	Food use previously reported in Pakistan
		Sh	Su	Ch	Si							
Nasturtium officinale R.Br., Brassicaceae, W.A.130.GPGC.PCR	Shiree	–	+	+	+	Young stems and leaves	Herb	March–October	Salad	Urinary tract infections	0.2	Ahmad et al. (2019), Shad et al. (2013), Shah et al. (2015)
Oxalis corniculata L., Oxalidaceae, W.A.131.GPGC.PCR	Bibi Shaftala	+	–	–	–	Leaves	Herb	March–October	Salad	None	0.1	Ahmad and Pieroni (2016), Tareen et al. (2016), Shad et al. (2013)
Plantago lanceolata L., Plantaginaceae, W.A.132.GPGC.PCR	Poly Spara	–	+	–	–	Leaves	Herb	March–October	Cooked	None	0.1	No
Plantago major L., Plantaginaceae, W.A.133.GPGC.PCR	Ghayo Zhabey	+	–	–	–	Leaves	Herb	March–October	Cooked	None	0.1	Shad et al. (2013)
Polygonum plebeium R.Br., Polygonaceae, W.A.134.GPGC.PCR	Bandoki	+	–	–	–	Stems	Herb	March–June	Cooked	None	0.2	No
Polygonatum verticillatum (L.) All., Asparagaceae, W.A.135.GPGC.PCR	Noor-e-Alam	+	+	–	–	Whole plant	Herb	March–August	Cooked	None	0.2	No
Portulaca oleracea L., Portulaceae, W.A.136.GPGC.PCR	Varhori	+	+	+	–	Leaves and stems	Herb	March–October	Cooked	Asthma	0.4	Ahmad and Pieroni (2016)
Pteridium aquilinum (L.) Kuhn subsp. *aquilinum*, Dennstaedtiaceae, W.A.137.GPGC.PCR	Kawsay	–	+	–	–	Leaves	Herb	March–June	Cooked	None	0.1	No
Quercus baloot Griff., Fagaceae, W.A.138.GPGC.PCR	Pargi	–	+	–	–	Seeds	Tree	June–October	Roasted	None	0.1	No
Rumex chalepensis Mill., Polygonaceae, W.A.139.GPGC.PCR	Spin Zamda	+	–	–	–	Leaves	Herb	March–October	Cooked	None	0.1	Tareen et al. (2016)
Rumex dentatus L., Polygonaceae, W.A.140.GPGC.PCR	Zamda	+	+	+	–	Leaves	Herberb	March–October	Cooked	Kidney stones	0.3	Ahmad et al. (2019), Shah et al. (2015)
Salvia nubicola Wall. ex Sweet, Lamiaceae, W.A.141.GPGC.PCR	Darshool	+	–	–	–	Leaves	Herb	March–July	Cooked	None	0.1	No
Scorpiurus muricatus L., Fabaceae, W.A.142.GPGC.PCR	Spinki Saba	+	–	–	–	Leaves	Herb	March–October	Cooked	Chest pains	0.2	No
Scorzonera raddeana C. Winkl., Asteraceae, W.A.143.GPGC.PCR	Mutayer	+	–	–	–	Leaves	Herb	March–June	Cooked	None	0.1	No
Senecio chrysanthemoides DC., CAsteraceae, W.A.144.GPGC.PCR	Ghra Shalgham	–	+	–	–	Leaves	Herb	March–July	Cooked	None	0.1	No

Table 1 continued

Plant taxon, family and voucher code	Local names	Religious groups				Used parts	Habit	Gathering period	Traditional food use	Perceived medicinal properties/treated illnesses	Quotation index	Food use previously reported in Pakistan
		Sh	Su	Ch	Si							
Silene conoidea L., Caryophyllaceae, W.A.145.GPGC.PCR	Kozo Saba	+	–	–	–	Leaves	Herb	March–June	Cooked	Anemia	0.1	No
Sisymbrium irio L. Brassicaceae, W.A.146.GPGC.PCR	Woraki	+	–	–	–	Leaves	Herb	March–July	Cooked	None	0.2	Tareen et al. (2016)
Solanum villosum Mill., Solanaceae, W.A.147.GPGC.PCR	Kharsobay	+	–	–	–	Leaves	Herb	March–June	Salad	None	0.1	No
Sonchus oleraceus, (L.) L., Asteraceae, W.A.148.GPGC.PCR	Tarizha	+	–	–	–	Leaves	Herb	March–October	Cooked	Anemia	0.1	No
Stellaria media (L.) Vill., Caryophyllaceae, W.A.149.GPGC.PCR	Vilaghori/ Badsha Saba	+	+	–	–	Leaves	Herb	March–October	Cooked	None	0.2	No
Trifolium repens L., Fabaceae, W.A.150.GPGC.PCR	Shaftale	+	+	+	–	Whorls	Herb	March–June	Salad	None	0.1	Shah et al. (2015)
Tulipa clusiana DC., Liliaceae, W.A.151.GPGC.PCR	Sor Shondi	–	+	–	–	Stems	Herb	March–May	Cooked	None	0.1	Shah et al. (2015)
Tulipa lanata RegelLiliaceae, W.A.152.GPGC.PCR	Spin Shondi	+	–	–	–	Stems	Herb	March–May	Cooked	Colic pains	0.1	No
Urtica dioica L,. Urticaceae, W.A.153.GPGC.PCR	Sezoonki	–	+	–	–	Leaves	Herb	March–May	Cooked	None	0.1	No
Veronica anagallis– aquatica L.Plantaginceae, W.A.154.GPGC.PCR	Obo Saba	–	+	–	–	Leaves	Herb	June–October	Cooked	Laxative	0.1	No
Viola canescens Wall., Violaceae, W.A.155.GPGC.PCR	Belamsha/ Tora Panri	+	+	–	–	Leaves	Herb	March–May	Seasoning	Lung infections	0.2	No
Kingdom Fungi												
Calvatia gigantea (Batsch ex Pers.) Lloyd, Agaricaceae, W.A.111.GPGC.PCR	Sheeshtee	–	+	–	–	Fruiting body	Mushroom	March–August	Cooked	None	0.1	No
Morchella esculenta Fr., Morchellaceae, W.A.128.GPGC.PCR	Klikichok	+	–	–	–	Fruiting body	Mushroom	March–October	Cooked	None	0.1	No

Sh Shias, *Su* Sunnis, *Ch* Christians, *Si* Sikhs

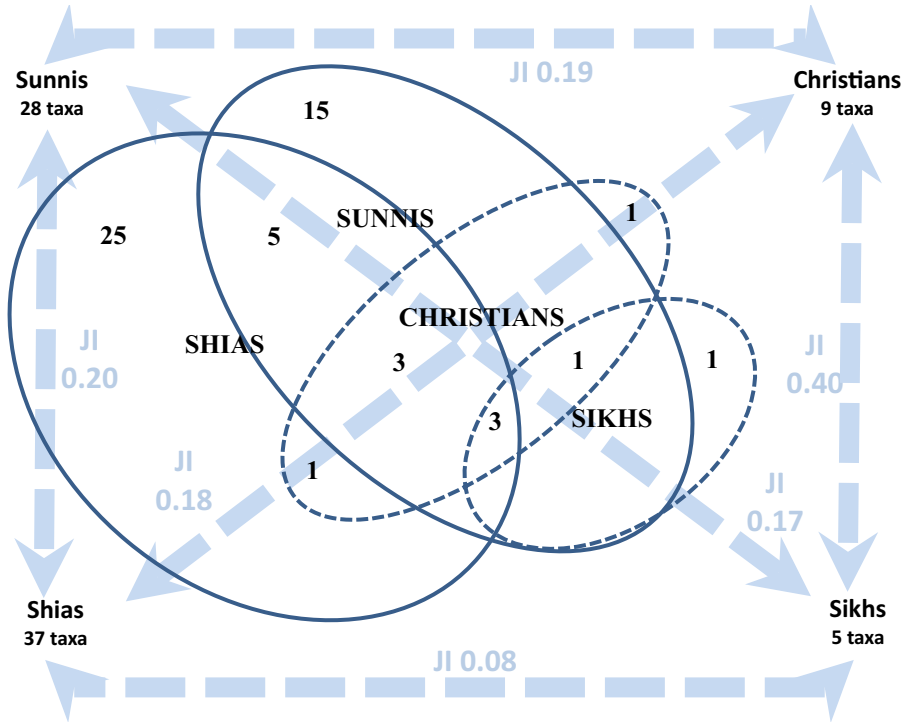

Fig. 2 Venn diagram showing the overlapping of the wild vegetables among the four studied as well as their Jaccard Indexes (JIs)

Shia and Sunni wild food plants is interesting: we could observe in fact a clear prevelance of the use of *weedy* plants growing in anthropogenic environments amongs Shias. This phenomenon could be explained by two - tightly intertwined - reasons: a) Sunnis more frequently inhabit villages at higher elevations, although many of them do share with Shias lower environments (with the same topographic, climatic, and plant ecological factors); b) Shias (esp. the Turi tribe) migrated to Kurram from the Middle East a few centuries ago and they may have retained more ties to typical post-Neolithic horticultural settling systems and tharefore to the attached foraging patterns (in which weeds abound, Pieroni et al. 2018). Moreover, since ecological and anthropological trajectories always co-evolve, they have also informed divergent Shia and Sunni cultural customs.

Although both Shia and Sunni communities do share some old cultural tradition, as for example that of *Jirga* (an assembly of elderly leaders, to help find a solution when there is any conflict, problems or disputes among people, Hussain et al. 2018; Ali et al. 2019), specific wild plants are gathered by each community for specific religious festivities. In the Shia community, the most frequently collected and used wild vegetables were *Margarospermum officinale, Silene conoidea* L., *Scorpiurus muricatus* and *Buglossoides arvensis* (L.) I.M.Johnst, since these wild vegetables have special a cultural importance in one dish made from these species, along with *Cucurbita maxima* Duchesne, which must be present at the special cultural and religious festival of *Eid-e-Nowruz*. Besides cooking, the Shia community also perceived nearly twenty-five vegetables as having medicinal properties and nearly ten species having market value. In the Sunni community, the most frequently consumed and collected wild vegetable species were *Chaerophyllum reflexum, Bistorta amplexicaulis* and *Pteridium aquilinum* (L.) Kuhn, which do generally grow at higher altitudes, where a relevant part of the Sunni community members live. In the Sunni community, fourteen species are perceived as having medicinal value and seven species provide financial support by being sold in the market. In the kitchen, Christian and Sikh communities primarily only use those wild vegetables species that are easily available in the market like *Caralluma tuberculata*, *Lepidium draba, Mentha spicata*, *Portulaca oleracea, Trifolium*

repens, and *Nasturtium officinale*. In these two communities, only one species, *Caralluma tuberculata,* has a perceived medicinal value.

Wild vegetables and the agricultural landscape

For the people of Kurram, agriculture is the major source of food and income. About 70–80% of the population of Kurram depends on cultivated crops for their livelihood. The major crops include wheat, rice, maize, potatoes, tomatoes, and peanuts. Some cultivated vegetables also help to meet their food requirements and provide financial support to the people of Kurram. The local variety of rice (*Kurmewalay wreezhey*) is quite famous and it is exported to different parts of Pakistan. In those areas where water is available throughout the year, rice is cultivated and the people of those areas mainly depend on rice for their food and livelihood, cooking and eating rice almost every night. Dependence on cultivated crops is the main reason for the decrease of traditional wild vegetable knowledge among people in the area. Out of a total of fifty-five species, eighteen species of wild vegetables were reported as weeds from agriculture fields and unprotected areas.

As addressed in the preceding paragraphs, Shia wild food ethnobotany seems to be more based more upon horticultural-driven *weedy* plants compared to that of the other groups and this could be also linked to their western Asian origin since weeds are well known to represent a crucial portion of the Neolithic horticultural Middle Eastern food heritage (Pieroni et al. 2018).

The way agriculture is managed may also affects the number of wild vegetables in the area because some farmers lack awareness about the detrimental effects of the excessive use of herbicides and fertilizers on crops. Poor drainage leads to the wasting of agricultural fields due to polluted water which also causes serious damage to wild vegetables in adjoining areas.

Temporal shifts in the wild food ethnobotany of Kurram

The low quotation indexes we recorded suggested that the bio-cultural heritage of gathering wild food plants is threatened. During the present study, informants were asked whether the consumption and collection of wild vegetables has increased or decreased during the last two decades. Almost every informant affirmed that the consumption and collection of wild vegetables has been significantly decreasing. These informants highlighted several reasons for their decreasing consumption and collection, including the inability of the young generation to identify the species, their decreased participation in collection, and their dependence on cultivated crop species. Destruction of the original habitats due to natural disasters, conversion of land for residential purposes as a result of rapid population growth in the area, and climate change are other reasons for the decreasing collection and consumption of wild vegetables by local people. Additional reasons identified by local informants regarding the reduction in the collection and consumption of wild vegetables include: overgrazing, increasing demand for meat and junk food, lack of knowledge among people in recognising the important nutritional properties of wild vegetables, and limited time to collect wild vegetables in their natural habitat due to increasing responsibilities in urban occupations.

Foraging and gender roles

During interviews, respondents were asked about the collection and utilization of wild vegetables. Study participants explained that compared to men and children, women play a major role in the collection and utilization of wild vegetables. According to key informants in the Shia community, women have a larger role in the collection and identification of wild vegetables than men because women have much more plant knowledge compared to men. The major part of the male participants in the Shia community seem to not have enough time to collect wild vegetables as they are busy with their jobs and careers. Also in the Sunni community women participate considerably more than men in the collection and identification of wild vegetables; however, Sunni men play an important role as well in wild vegetable collection compared to male members of the Shia community. Sunni male community members possess a relevant folk knowledge regarding wild vegetables since they often live in mountainous areas without employment. In the Christian and Sikh communities instead, only the men purchase wild vegetables from the market and consume them. The Christian community collects only one wild edible

species, *Malva neglecta* that is found near their residences. They do not collect and identify many - wild vegetables because most Christians live in the congested parts of cities. Moreover, while Muslim women play a main role in gathering wild vegetables, Sikh and Christian women seem to be more confined to their homes due to cultural constrains and thus they have more limited access to the environments where wild plant ingredients grow.

Cooking wild vegetables

The use of wild edible species, consumed in many ways in the study area, depends on taste and preference. The cooking methods reported for all wild vegetables in the different cultural communities of Kurram derived from personal observations as well as corner meetings with herdsmen and shepherds. For example, onion and garlic is fried in oil. Tomatoes, green chilies, coriander and cumin may be added, depending on their availability and flavor. Afterwards, wild vegetables are added and heated until a large portion of the water is vaporized and oil or ghee is visible on the upper layer of the vegetables. But the various species have to be treated according to their texture. Soft and delicate vegetables such as *Malva neglecta* are cut into chunks and immediately cooked. Harder vegetables, i.e. *Rumex dentatus* and *Margarospermum officinale*, are cut into small pieces and boiled in water three to four times until the water is evaporated, and then red chilies and salt are added. In the next step, garlic is fried with oil, then sprinkled over the top and everything is mixed with rice. Bitter vegetables like *Caralluma tuberculata are* chopped into pieces, sprinkled with salt and allowed to sit for 1 h, after which they are rinsed prior to cooking. Some wild vegetables like *Mentha spicata, Nasturtium officinale, Caralluma tuberculata.* and *Allium griffithianum* Boiss, are used by local people in salads and in cooked dishes. The seeds of *Quercus baloot* Griff., are roasted on coals.

All the seasonal wild vegetables are combined intermittently and a particular dish of seven to ten species is cooked during festivals (Nowruz) in the Shia community. There are many recipes for the preparation of wild vegetables in the area. The wild vegetables are also dried in sunlight and preserved. In the offseason, these dried wild vegetables are prepared in different recipes. Therefore, there is variation in the cooking of traditional wild vegetables in Kurram District. It is recommended that traditional recipes utilized by different groups be made accessible to the women of all the communities, as it is assumed that access to a greater variety of cooking processes and methods would enhance the presence of wild vegetables in their diets, consequently improving dietary diversity (Pieroni and Cattero 2019).

Wild vegetables as food-medicines

The current study reveals the medicinal uses of wild vegetables. In the district of Kurram, the different traditional communities use the desiccated leaves of various wild vegetables as medicines to treat various disorders.

The quotations of the perceived medicinal value and market occurrence of the recorded wild vegetables among the four different communities are presented in Table 1.

Twenty-four species of wild vegetables were used for medicinal purposes by the people of the Shia community, fourteen species by the Sunni community, and only one or two species are used to treat ailments by the Sikh and Christian communities. The young leaves of *Amaranthus viridis*, were used to treat dysentery. *Nasturtium officinale*, was used by local people of Kurram District for urinary tract inflammation. *Artimisia absinthium* L., was used as a blood purifier and an antipyretic, while *Tulipa lanata* Regel, was used in the treatment of colic pain. For cough, *Viola canescens* Wall., was effective. *Citrullus colocynthis* (L.) Schrad., *Amaranthus viridis* and *Caralluma tuberculata*, were regularly consumed by indigenous people for the treatment of diabetes mellitus.

The present study reveals that wild edible vegetables are not only important from a nutritional perspective, but also from a nutraceutical one, as they are also used for the treatment of various disorders. Christian and Sikh community members members seem to have less knowledge about the possible medicinal properties of wild vegetables and they mainly consume wild vegetables without ascribing them any therapeutic effect. Some reported wild vegetable species quoted by Muslims are perceived instead having important medicinal value in the study area, most commonly among people living in hilly areas. Stomach ache, body ache, intestinal pain, and

fever were the general complaints of people living in mountainous areas due to the rugged landscape and widespread physical work in the fields.

The medicinal uses of *Asparagus officinalis* L., *Artimisia absinthium*, *Tulipa lanata*, *Urtica dioica* L., and *Viola canescens* Wall., were also reported in previous studies conducted in Kurram (Hussain et al. 2012, 2018).

For generations, people living in rural and remote areas have been using native plants as remedies to treat various illnesses with the help of traditional knowledge handed down from one generation to the next (Shah and Khan 2006; Gawali and Narkhede 2018). There is a decrease in traditional knowledge among the local people of Kurram District regarding the medicinal and nutritional value of the reported plants. New practices are therefore needed to avoid the loss of this traditional knowledge, particularly among the younger generations in the area. The main reason given by local informants for the dwindling folk knowledge in the area is the increased use and effectiveness of allopathic drugs to treat diseases (Hussain et al. 2012, 2013).

Conclusion

In rural and urban areas of Pakistan, various wild vegetables are consumed as food or as herbal remedies (Khan et al. 2013). The recent literature has shown that there are twenty-five wild vegetable species commonly consumed in different districts of Khyber Pakhtunkhwa (Ahmad et al. 2019). Ahmad and Pieroni (2016) documented fifty-one wild edible plants used by tribal communities in the Thakht-e-Sulaiman hills of North-West Pakistan. Tareen et al. (2016) recorded fifty-nine wild edible vegetables utilized by the local people of Harniai District, Balochistan, Pakistan. A literature review confirmed that very little research has been carried out on the use of wild vegetables in Khyber Pakhtunkhwa and in Pakistan in general. The present study recorded a large number of wild vegetables, i.e. fifty-five species, which were used by the people of four religious groups in the district of Kurram. Current results showed that the study area was rich in terms of indigenous knowledge of wild vegetables and their diversity. The reported wild vegetable species were mostly herbs, and the most frequent used parts of these plants were green leaves, young stems, and flowers. Some species were dried in sunlight and consumed as vegetables during the offseason by the local people of Kurram. A total of seventeen wild vegetables in the current study were also reported from other parts of Pakistan by Ahmad and Pieroni (2016), Tareen et al. (2016) and Ahmad et al. (2019). The people of Kurram collect wild vegetables from their natural habitat in different seasons of the year for different purposes, especially as a source of food due to poverty and limited access to the local vegetable market. Nowadays urban people depend less on wild vegetables as compared to the past in Kurram. Literature review confirmed that during ancient times human food included plants which were collected from the wild and that people in the past relied more than they do now on wild plants during periods of starvation (Kaliszewska and Kołodziejska-Degórska 2015; Singh et al. 2016; Kebede et al. 2017; Thakur et al. 2017; Bhatia et al. 2018; Shin et al. 2018). Even in more industrialized countries, wild edible plant species still represent sometimes an important resource for marginalized local communities (Imran et al. 2007; Luczaj 2010; Uprety et al. 2012; Deb et al. 2013; Ju et al. 2013; Geng et al. 2016; Cornara et al. 2018). Ahmad and Pieroni (2016) reported that seven wild food species were marketed in NW Pakistan while in the current study we recorded nine marketed species within the Shia community (*Caralluma tuberculata*, *Rumex dentatus, Lepidium draba, Mentha spicata*, *Portulaca oleracea, Stellaria media*, *Trifolium repens, Malva neglecta,* and *Amaranthus viridis*) and six species among Sunnis (*Caralluma tuberculata, Mentha spicata*, *Portulaca oleracea, Trifolium repens, Malva neglecta*, and *Nasturtium officinale*). Most of the wild vegetables were collected by the people of Kurram for domestic use only. The Christian and Sikh communities, in contrast, mainly depend on marketed wild edible plants. Only *Malva neglecta*, which was found in the periphery of residential areas, was also collected by the Christian community.

Wild edible plants also play a vital role in some religious and cultural food rituals (Dogan 2016; Salvi and Katewa 2016; Chauhan et al. 2018). In Kurram, this includes wild vegetables such as *Lithospermum officinale., Malva neglecta*, *Portulaca oleracea, Silene conoidea, Scorpiurus muricatus*, and *Buglossoides arvensis*. It is especially important that at least one dish made from these species, along with

Cucurbita maxima is present at the special cultural and religious festival of Eid-e-Nowroz.

Most of the youngest community members of the study area are however nowadays unaware of the existence of widely available wild edible plants and their means of consumption as the knowledge is limited to the elderly population. Since ancient times, this knowledge has however been transmitted orally from generation to generation. However, due to the migration of people from villages to cities, changes in cultural practices, and the reduction of extension of natural environments, knowledge about wild edible plants is decreasing (Heywood and Skoula 1999; Abbasi et al. 2013a, b; García et al. 2015; Jhamta et al. 2019). The present study reveals that in Kurram traditional knowledge regarding the consumption and collection of wild vegetables is decreasing due to the inability of young generations to identify the species or participate in their collection. Young people primarily consume cultivated crop species also because sometimes the natural habitat has been partly damaged as a result of intense conversion of land for residential purposes and urbanization. Moreover, there is an increasing demand for junk foods among the youngest population. Our results are in line with the work of Abbasi et al. (2013a, b), Shad et al. (2013), and Shah et al. (2015), who also noted a robust reduction of Traditional Knowledge regarding the consumption of wild edible plants in their study areas.

Many ethnobotanical surveys have shown that the patterns of wild plant consumption are generally not constant and there is frequent loss of Traditional Knowledge. Eventually, it is essential to re-discover wild plant sources for food, well-being, and commercial purposes, too, due to the alarming growth of the human population and reduction of income (Nordeide et al. 1996; Pimentel et al. 1997; Sundriyal and Sundriyal 2001; Abbasi et al. 2013a, b; Luczaj et al. 2013; Rao et al. 2015; Konsam et al. 2016). Additionally, Pakistan is 11th in the list of countries facing food security risks, despite having a rich biodiversity. According to a national nutrition survey of Pakistan in 2019, an alarmingly high number of children are suffering from a poor diet and an inadequate food system. Likewise, UNICEF has warned that 50% of childhood deaths are directly or indirectly related to insufficient food and malnutrition in Pakistan (Munir and Ejaz 2010; FAO 2010; Government of Pakistan/UNICEF 2019). The wild vegetables recorded in this study could represent than an important pillar within educational projects aimed at countering food insecurity, as well as the possible consequences of food scarcity and unavailability due to climatic changes.

Acknowledgements This research work is the part of Bachelor of Science research work of first and second author. We are very thankful to the rural communities of the study area for their hospitality and support and for sharing their knowledge. This project would never have been possible without their cooperation. We offer sincere and deep thanks to all of the people around us who contributed and provided help throughout the study. Special thanks are also due to the University of Gastronomic Sciences, Pollenzo, Italy, which partially funded the research.

Author's contributions Wasim Abbas and Wajid Hussain collected the data and wrote initial manuscript. Wahid Hussain supervised the project. Lal Basdshah helped in data analysis, Kamal Hussain helped to make the map of the research area. Andrea Pieroni contributed in designing the study as well as in data analysis and cultural interpretation.

Compliance with ethical standards

Conflict of interest The authors declared that they had no conflict of interest. Study participants provided verbal consent for the information they shared to be used for academic purposes.

Ethical statement We certify that preparation of this manuscript has been clearly described in compliance with the ethical standards section of the journal.

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