The Inextricable Link between Ecology and Taste: Traditional Plant Foraging in NW Balochistan, Pakistan

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Cross–cultural food studies among various ethnic groups are crucial for understanding patterns of food preferences. The study recorded wild food plants (WFPs) gathered among Baloch, Brahui, Dehwar, Hazaras, and Pathans living in northwest Balochistan, Pakistan. A total of 68 taxa were recorded, of which only one–fifth were commonly used among the various groups. Hazaras and Pathans differed in their WFP foraging patterns while the other groups shared considerably more commonalities in the gathering of WFPs. The distinctiveness of Hazara–foraged ingredients can be explained by the fact that they still rely on foraging conducted over the border in the Afghan mountains, and thus their food knowledge is to some extent less "mixed" with that of the other groups. Slight differences in patterns of wild plant preferences are also shaped by the importance of certain plant tastes, especially sour and bitter ones, among Hazaras and Pathans. The complex mosaic patterns of WFP gathering among the researched groups indicate the prevalence of different ecological attitudes, as well as social customs. Future research trajectories will also have to consider the sensory acceptance of WFPs among groups and generations in order to articulate strategies for incorporating local food biocultural heritage into development programs.

Key Words: Food heritage, wild food plants, plant taste, Hazaras, Pathans, ethnobotany

Introduction

Wild food plants (WFPs) were, and partially still are, an important asset in the traditional food systems of various local cultures around the world. One of the major research questions in food ethnobotany is explaining the preference for a specific plant ingredient within a given culture. This can be addressed by examining the historical prevalence of WFP gathering patterns in a given socio–ecological environment. For the last decade, traditional foraging–centered research has focused on the cross–cultural comparison of folk plant uses among various ethnic groups (Abbas et al. 2020; Aziz et al. 2020a, b; Aziz et al. 2021; Majeed et al. 2021; Pieroni et al. 2018; Pieroni and Sõukand 2019). Data from these studies have shown how complex cultural and social components may affect the utilization and processing of an available plant ingredient in local and traditional cuisines, even when the available plant ingredients are the same. In

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addition to the availability of a specific plant part or ingredient, taste is an important element affecting the food choices of various cultures. In a cross–cultural study from Kurdistan, for instance, Pieroni et al. (2018) highlighted the role of taste in the preference for wild vegetables; the authors recorded significant dissimilarities in WFP gathering patterns among the studied groups. Pawera et al. (2020) found that taste is one of the many factors that plays a large role in the selection and culinary use of particular WFPs by the local population.

In Pakistan, emerging cross–cultural research on WFP uses have shown that folk plant uses have been strongly influenced by a complex set of cultural, social, economic, and political factors (Abbas et al. 2020; Aziz et al. 2020a, b; Aziz et al. 2021; Majeed et al. 2021). Our recent research in North and West Pakistan has clearly shown remarkable commonalties in WFP preferences among diverse ethnic groups demonstrating the interplay of socio–cultural and geo–political factors that have influenced local food systems in the recent past (Aziz et al. 2020a, b; Aziz et al. 2021).

Balochistan is a part of the Southeastern Iranian Plateau and comprises an area of half a million square kilometers. The region is home to several linguistic groups, such as Balochi, Hazargi, Pashto, Saraiki, Sindhi, Dehwari, Brahui, Jadgali, and Khetrani.

The region sits at the crossroads of different cultural groups, and is therefore a useful location for ethnobiological field research. Neolithic sites dating back 8,000 years demonstrate the transition from a gathering and hunting way of life to a more settled agro–pastoral system. Nomadism, following distinctive traditional and seasonal patterns and their associated gastronomic practices, remains one of the prominent features of the region (GoB and IUCN Pakistan 2000). Thus, each culture maintains its own particular plant–related gastronomic practices. One of the important points for scientific discussion in ethnobiology is the impact that linguistic affiliation has on the effective transformation of traditional gastronomic knowledge among individuals of diverse ethnic groups. In this context, the current study aimed to record WFP gastronomic practices among five ethno–linguistic groups living in the northwestern part of Balochistan in order to detect possible convergences/divergences in gastronomic uses of WFPs. The main objectives of the study were to:

a) Record the phytonyms and uses of the gathered WFPs among the researched groups,
b) Compare the recorded WFPs and their uses and tastes among the diverse groups in order to understand the possible social–ecological factors affecting foraging, and Compare the data with the existing literature to identify novel food ingredients.

This study represents the first–ever attempt at making a cross–cultural comparison of WFP uses among several of the important linguistic groups in Balochistan.

Materials and Methods

Study Area and Researched Communities

Balochistan is located in the southeastern part of the Iranian plateau (Fig. 1). Its topography is extremely broken and mountainous, varying in altitude from 1,500–2,000 m.a.s.l. (the steppe on the edge of the Iranian plateau, at the base of mountains) to over 3,500 m.a.s.l. in the north and northeast and to sea level on the coastal plain (Figs. 1 and 2).

The linguistic and cultural attributes of the study communities are presented in Table 1. The population of Balochistan is not ethnically homogeneous. Some communities are identified as Baloch, with the implication that they are descended from those who entered the area as Baloch, while others, though considered members of Baloch society now and identifying as Baloch in relation to the outside world, have more recently adopted Baloch identity (Spooner 1988). The anthropological literature has shown that the history of the present–day Baloch goes back around three millennia when Aryan nomadic pastoralists left Central Asia, settling on the northwestern Iranian Plateau, a region then called Balashakan. However, these peoples, the Balashchik, were soon forced to migrate, settling after several centuries along the southeastern edges of the Iranian Plateau, and now known as Baloch. The settlement that they

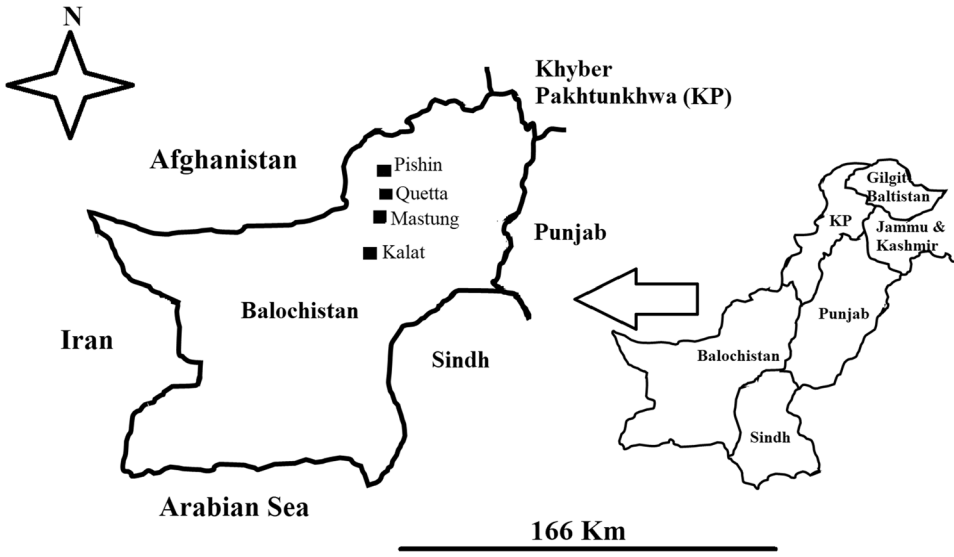

Fig. 1. Map of the study area.

Fig. 2. Landscape of the study area: (**a**) A wheat field at the outskirts of the city of Mastung; (**b**) Rangeland dominated by vegetation–type *Artemisia–Haloxylon* shrub steppe and *Cymbopogon–Chrysopogon* mixed shrub grassland near Hazarganji, Quetta, Pakistan.

ultimately inhabited was called Balochistan, the land of the Baloch people (Dashti 2012; Sahlins 1968). Arabic writers in the 3rd to 10th centuries mentioned them, usually as Balūṣ, in association with other tribal populations in the area between Kerman, Khorasan, Sistan, and Makran. Historically, the Baloch people were pastoralists, herding goats and sheep, and, like other Middle Eastern pastoralists, they were highly mobile, if not entirely nomadic, living in tribal communities (Spooner 1988) Table 1.

Brahui is a Dravidian language, and the most common theory is that the Brahui people took part in the original Dravidian invasions of India from the northwest in the 3rd millennium B.C.E. The Brahui are more likely to be relatively recent immigrants to their present homeland in Pakistan from the western Deccan Plateau. Perhaps in the 7th century, loose congeries of nomadic groups began to split off from their nearest neighbors, northwest Kuṛukh and Malto Dravidians, and to migrate northwestward.

Table 1. Characteristics of the study participants.

Language	Village	Elevation (m.a.s.l.)	Total number of inhabitants	Number of interviewees	Religion (Faith)	Endogamic/ Exogamic rules	Subsistence activities
Pashto	Bagar Zai, Pishin	1,557	3,000	15	Sunni	Endogamic	Pastoralism and urban occupations
Balochi	Mangocher, Kalat	1,772	35,000	15	Sunni	Exogamic (except with Punjabis)	Horticulturalism and urban occupations
Brahui	Mastung city	1,598	25,000	15	Sunni	Exogamic (except with Punjabis)	Horticulturalism and urban occupations
Dehwari	Pring Abad, Mastung	1,672	5,000	15	Sunni	Exogamic (except with Punjabis)	Horticulturalism and urban occupations
Hazaragi	Mari Abad, Quetta	1,717	300,000	15	Shia	Endogamic (very rarely exogamic)	Urban occupations (nowadays), mountain horticulturalism (in the past)

The Brahui migration was not en masse but rather in waves, over several centuries. Those who wandered northward for several centuries across Gujarat, Kathiawar, and Sind reached the Hyderabad area in some strength before the 10th century, but were never more than an ad hoc assemblage of nomads, associated more by common interests than by a common origin. After further migration northwestward, the Brahui perforce encountered Jaṭs, who had been present in Sind since the 5th century; they would take their present name of Brāhūī/ Brāhōī from the Jats. Over the past hundred years, there have been fundamental changes in Brahui life. As "long–distance cattle–herders," no fewer than 80 percent of these tribesmen were tent–dwelling nomads in 1880, while fewer than 20 percent were described as settled. In 1975, the proportions were almost exactly the opposite, and Brahui settlement in large towns has been increasing ever more rapidly, especially since 1947. Ethnically, the Brahui have tended to become even more closely identified with the Baloch, a process that has been continuing since at least the 16th century and probably for much longer (Elfenbein 1989).

Dehwari is a southwestern Persian language spoken by thousands of people that are concentrated in Mastung, Khuzdar, Nushki, Kharan, Sarlath, Dalbandin, and Kalat. The Dehwar traditionally have been settled agriculturalists. They may be descendants of settled local populations predating the Baloch migration (Spooner 1988). Hazaragi is an eastern variety of Persian that is spoken by the Hazaras people, primarily in the Hazarajat region of Central Afghanistan, as well as in other Hazaras–populated areas of their native homeland of Afghanistan. It is also spoken by the Hazaras of Pakistan and Iran and also by the Hazaras diaspora (Britannica 2020; Parkes 2020). The well–known Pashto–speaking Pashtun tribe is a large and highly self–aware ethnic group inhabiting the adjoining areas of West Pakistan and Afghanistan.

Field Study

A field survey was carried out in March and April 2021. From each of the linguistic groups, we selected 15 participants for semi–structured interviews. Study participants were chosen among middle–aged and elderly individuals (range: 45 to 70 years old), including shepherds and farmers, who were potential holders of local knowledge and had strong connections with nature. During the study we were not allowed to carry out interviews with female community members due to the practice of pardah (veil). Prior to interviews, we explained the main objective of the study to each of the participants and verbal consent to share their traditional knowledge was received. We also obtained verbal consent for publication of the images taken during the study. We recorded the WFPs that were commonly consumed among the various researched groups, as reported by the study participants, along with their botanical names, families, local names, and voucher specimen numbers. In addition, we recorded information regarding the perceived tastes of the quoted taxa that were recorded in Urdu language and then translated to English. We also gathered data of foraging locations, plant parts used, and culinary uses of the quoted taxa. All the interviews were conducted in Urdu as informants were able to respond in that language and used open–ended questions and direct observations. The interviews focused on gathered WFPs used as raw snacks, as cooked vegetables, in seasonings, and for recreational teas. We also asked specific questions about the uses of WFPs in lacto–fermentation and dairy products. Each of the plant and fungal taxon was recorded with the local name described by the given linguistic group.

In addition, we recorded qualitative ethnographic information via open–ended questions and direct observations. Throughout the study we strictly followed the recommendations of the International Society of Ethnobiology (ISE 2008). Herbarium voucher specimens were identified by the third author using the *Flora of Pakistan* (Ali and Qaiser 1993–2009; Nasir and Ali 1970–1979; Nasir 1980–1989, 1989–1992). Specimens were deposited at the Department of Botany, University of Balochistan, Pakistan. There were certain botanical taxa for which voucher specimens could not be collected and these were identified through their folk names and the available ethnobotanical literature from the study region. The Plant List database (2013) was used to verify the nomenclature of each plant taxon and the Index Fungorum (2021) was utilized to crosscheck fungal nomenclature. Plant family assignments were consistent with the Angiosperm Phylogeny Website (Stevens 2012).

Data Analysis

We compared the number and uses of the recorded WFPs through Venn diagrams, which were drawn using free software (http://bioinformatics.psb.ugent.be/webtools/Venn/ [22 April 2021]). Certain plants and their uses were reported by more than 50 percent of the participants within a given group and we referred to them as the *most quoted* ones throughout the text. We also applied the Jaccard index to determine the level of similarity between each two individual sets of data. In addition, we assigned to each recorded WFP the prevalent taste as reported by the local people, and then the data were further analyzed using pie charts. The data were also compared with the existing food ethnobotanical literature of Pakistan (Abbas et al. 2020; Abbasi et al. 2013; Abdullah et al. 2021; Ahmad and Pieroni 2016; Ahmad et al. 2019; Aziz et al. 2020a, b; Aziz et al. 2021; Khan et al. 2015; Majeed et al. 2021; Tareen et al. 2016).

Results and Discussion

Traditional Foraging in the Food Systems of Balochistan

A total of 68 botanicals were documented, which included two mushroom taxa (Table 2). Some of the WFPs collected from the study area were also photographed (Fig. 3). Most of the WFPs were consumed raw as snacks (36 taxa) or cooked as vegetables (26 taxa). Snack plants were usually gathered in the mountains/foothills and rangelands where local people used to graze their animals. Our results are in line with previous ethnobotanical studies that documented raw snacks as a dominant food category. High consumption of snack taxa may have emerged during the development of mobile pastoralism (Aziz

Table 2. Traditional uses of wild food plants among the different linguistic communities in Northwestern Balochistan, Pakistan.

Botanical Taxon/Taxa; Family; Voucher Specimen Code	Recorded local names	Parts used	(Etic) taste/smell characteristics	Gathering areas	Recorded local gastronomic uses	Previously reported in Pakistan
Alhagi maurorum Medik.; QUETTA000140 Leguminosae;	Doz [P] Makhay [P] Zoz [P]	Whole plant	Slightly sweet	Grazing rangelands	Chewed as raw snacks [P***]	Yes
Allium sp.; Amaryllidaceae	Anjawara [P] Sorsu / Sirso [H]	Aerial parts	Onion like taste	Mountains	Cooked [H***, P***] Salad [H***, P***] Raw snacks [H***, P***] Chatni [P***]	Yes
Allium sp.; Amaryllidaceae	Bolo [H]	Aerial parts	Onion like taste	Mountains	Salad [H***]	Yes
Allium sp.; Amaryllidaceae	Spanrhsakai [P]	Aerial parts	Neutral taste	Plain areas	Raw snacks [P***]	Yes
Allium carolinianum DC.; Amaryllidaceae; QUETTA000396	Tosla [H]	Aerial parts	Onion like flavor, spicy flavor	Mountains	Cooked [H***]	Yes
Amaranthus viridis L.; Amaranthaceae; QUETTA000128	Javo saag [Ba, Br, D,] Taj Khru [H]	Aerial parts	Taste like spinach	Fields	Cooked [Ba**, Br**, D**, H***]	Yes
Artemisia maritima L.; Asteraceae; QUETTA000121	Jir [Br]	Leaves	Aromatic and bitter taste	Grazing rangelands	Tea [Br*]	Yes
Atriplex dimorphostegia Kar. & Kir; Amaranthaceae; QUETTA000402	Mughair [Ba, Br, D]	Leaves	Taste like spinach	Mountains	In yogurt [Ba***, Br***, D***] Cooked [Ba***, Br***, D***]	–
Asphodelus tenuifolius Cav.; Xanthorrhoeaceae; QUETTA000395	Pimalak[Ba, Br, D] Zrhongi [Br, D]	Whole plant	Taste like onion – pungent taste	Fields	Cooked [Ba***, Br***, D***] Salad [Ba***, Br***, D***] Chatni [Br*]	Yes

Table 2. (continued)

Botanical Taxon/Taxa; Family; Voucher Specimen Code	Recorded local names	Parts used	(Etic) taste/smell characteristics	Gathering areas	Recorded local gastronomic uses	Previously reported in Pakistan
Berberis baluchistanica Ahrendt.; Berberidaceae; QUETTA000008	Zerbrag [H]	Fruit	Tart flavor, slightly sweet	Foothills	Raw snacks [H***]	Yes
Bunium persicum (Boiss.) B.Fedtsch.; Apiaceae; QUETTA000248	Riza [Ba, Br, D, H] Zira [P]	Seeds	Nutty flavor and aroma, taste like sweet chestnuts	Mountains	Flavoring agent [Ba***, Br***, D***, H***, P***]	Yes
Caralluma tuberculata N.E.Br.; Apocynaceae; QUETTA000255	Marmutk [Ba, Br, D,] Malakhay [H]	Aerial parts	Bitter taste	Mountains	Cooked [Ba***, Br***, D***, H***]	Yes
Celtis australis L.; Cannabaceae; SWAT005474	Togha [Br, Ba, D,] Takhum [H]	Fruit	A mealy, pleasant taste	Mountains	Raw snacks [Ba***, Br***, D***, H***]	Yes
Chenopodium album L.; Amaranthaceae; QUETTA000021	Malheerhy [Ba] Mazmal [Ba] Sarmakai [P] Sarmi [Br, D] Shorki [H]	Aerial parts	Taste like spinach (the taste is rather bland and dull)	Fields	Cooked [Ba**, Br**, D**, H***, P***]	Yes
Cotoneaster ellipticus (Lindl.) Loudon; Rosaceae; QUETTA000103	Dolana [H]	Fruit	Sweet taste	Foothills	Raw snacks [H**]	Yes
Cydonia oblonga Mill.; Rosaceae; QUETTA000351	Bidana [Ba, D]	Fruit	Sweet taste	Mountains	Raw snacks [Ba*, D*]	–

Table 2. (continued)

Botanical Taxon/Taxa; Family; Voucher Specimen Code	Recorded local names	Parts used	(Etic) taste/smell characteristics	Gathering areas	Recorded local gastronomic uses	Previously reported in Pakistan
Cymbopogon jwarancusa (Jones) Schult.; Poaceae; QUETTA000343	Sarghasay [P]	Flower	Neutral	Grazing rangelands	Raw snacks [P*]	No
Daucus carota L.; Apiaceae; QUETTA000397	Pat–Gajir [Ba, Br, D,] Koh Gajir [Ba] Gajir [P]	Root	Slightly sweet	Grazing rangelands	Raw snacks [Ba**, Br**, D**, P**] Cooked [Ba*, P*]	Yes
Descurainia sophia (L.) Webb ex Prantl; Brassicaceae; QUETTA000369	Rush[Br] Shairgi[D]	Aerial parts		Fields	Cooked [Br**, D**]	Yes
Ducrosia anethifolia (DC.) Boiss.; Apiaceae	Masakonrhai [P] Shirilgi [H]	Arial parts	Taste like mint	Foothills	Flavoring agent [H*, P**]	Yes
Elaeagnus angustifolia L.; Elaeagnaceae; QUETTA000199	Sinjid [Ba, Br, D] Sundata [P] Sunjid [H]	Fruit	Sweet taste	Gardens	Raw snacks [Ba***, Br***, D***, H***, P***]	Yes
Eremurus stenophyllus (Boiss. & Buhse) Baker; Xanthorrhoeaceae; QUETTA000039	Saij [H] Sraishkoh [Ba, Br, D]	Aerial parts	Spinach taste	Rangelands, mountains	Cooked [Ba***, Br***, D***, H***]	Yes
Ferula assa–foetida L.; Apiaceae; QUETTA000339	Hing [Ba, Br, D] Inj [P]	Fruit, root powder	Pungent and bitter taste	Mountains	Meat preservation [Ba***, Br***, D***, P**]	No
Ficus carica L.; Moraceae; QUETTA000204	Injir [Ba, Br, D, H, P]	Fruit	Sweet taste	Mountains	Raw snacks [Ba***, Br***, D***, H***, P***]	Yes

Table 2. (continued)

Botanical Taxon/Taxa; Family; Voucher Specimen Code	Recorded local names	Parts used	(Etic) taste/smell characteristics	Gathering areas	Recorded local gastronomic uses	Previously reported in Pakistan
Foeniculum vulgare Mill.; Apiaceae; QUETTA000012	Badyan [H] Khwazaolanay [P] Ost khalti [Ba] Radush [Ba] Woduf [Ba, Br, D] Zarkhwash [Ba]	Seeds	Aromatic, characteristic smell, and slightly sweet	Mountains	Flavoring agent [Ba***, Br***, D***, H***, P***]	Yes
Fritillaria imperialis L.; Liliaceae	Logor [H]	Bulb	Bitter taste	Mountains	Cooked [H**]	No
Goldbachia laevigata (M.Bieb.) DC.; Brassicaceae	Ghulaif [Ba, Br, D] Pushtaknil [D]	Leaves	Taste like spinach	Fields, plain areas	Cooked [Ba***, Br***, D***]	Yes
Heracleum afghanicum Kitam.; Apiaceae	Balderghu [H]	Stem	Sour taste	Mountains	Raw snacks [H***]	No
Hertia intermedia (Bioss.) Kuntze; Asteraceae; QUETTA000099	Mangoli saag [Br, D] Gango [D] Gungo [H]	Leaves	Bitter taste	Mountains	Cooked [Br*, D*], Tea [H**]	No
Ixiolirion tataricum (Pall.) Schult. & Schult.f.; Ixioliriaceae; QUETTA000108	Chanrhaskay [P] Nilopher [Br, D] Shimshak[Br] Shoshing[Ba, Br]	Flower, bulb	Slightly sweet, more similar to the taste of flowers such as rose	Fields	Raw snacks [Ba***, Br***, D***, P***]	No
Koelpinia linearis Pall.; Asteraceae; QUETTA000094	Kashovi [P] Rizobozuk [Br] Zampad [Ba, Br, D]	Aerial parts	Slightly sweet, taste like milk	Fields	Raw snacks [Ba**, Br**, D**, P**]	No
Lallemantia royleana (Benth.) Benth.; Lamiaceae; QUETTA000092	Tukhmalanga [P]	Seeds	Bland, soothing, and spicy taste, mucilaginous	Foothills	Herbal drink [P**]	Yes

Table 2. (continued)

Botanical Taxon/Taxa; Family; Voucher Specimen Code	Recorded local names	Parts used	(Etic) taste/smell characteristics	Gathering areas	Recorded local gastronomic uses	Previously reported in Pakistan
Launaea taraxacifolia (Willd.) Amin ex C.Jeffrey; Asteraceae	Shirtizak [H] Shodagai [P]	Leaves	Slightly bitter	Fields, foothills	Raw snacks [H*, P*]	Yes
Launaea spinosa (Forssk.) Kuntze; Asteraceae; QUETTA000394	Sundraizi [P] Toqi [H]	Whole plant	Neutral taste	Fields, foothills	Raw snacks [H*, P**]	Yes
Lepidium draba subsp. *chalepense* (L.) P.Fourn.; Brassicaceae; QUETTA000117	Bashka [P] Bozond [D] Bujindak [H] Gerbosat [Ba, Br, D]	Leaves	Spicy mustard flavor	Fields	Cooked [Ba***, Br***, D***, H***, P***] Salad [Ba, *** Br***, D***, H***, P***] Raw snacks [Ba***, Br***, D***, H***, P***] Bread [Ba***, Br***, D***	Yes
Malcolmia africana (L.) R.Br.; Brassicaceae; QUETTA000036	Chamar [Ba, Br] Khachmar [Br] Khar Rhak [P] Nagator [D]	Aerial parts	Sweet taste	Grazing rangelands, fields, mountains	Cooked [Br***, D***] Raw snacks [Ba***, Br***, P***] Salad [Ba***, Br***, P***	No
Malcolmia behboudiana Rech. f. & Esfand; Brassicaceae; QUETTA000401	Bahwshuk [Ba, Br, D] Sochak[Ba]	Leaves	Pungent taste	Plain areas	Cooked [Ba***, Br***, D***] Salad [Ba***, Br***, D***] Raw snacks [Ba***, Br***, D***	–
Mentha longifolia (L.) L.; Lamiaceae; QUETTA000344	Purchinak [Ba, Br, D] Nana [H] Shanshobay [P]	Aerial parts	Aromatic, characteristic	Near water courses	In yogurt [Br**, P***] Tea [Ba**, Br**] Chatni [Ba***, Br***, D***, H***, P***	Yes

Table 2. (continued)

Botanical Taxon/Taxa; Family; Voucher Specimen Code	Recorded local names	Parts used	(Etic) taste/smell characteristics	Gathering areas	Recorded local gastronomic uses	Previously reported in Pakistan
Myrtus communis L.; Myrtaceae	Morhth [Ba, Br, D]	Leaves, fruit	Leaves have spicy, astringent, and bitter taste; berries are sweet, with juniper and rosemary–like flavors	Mountains	Tea [Ba*, Br*, D*] Raw snacks [Ba*, Br*, D*]	No
Nasturtium officinale R.Br.; Brassicaceae; QUETTA000058	Thra [H]	Leaves	Pungent, rocket–like taste	Near water courses	Salad [H***]	Yes
Nepeta praetervisa Rech.f.; Lamiaceae; QUETTA000063	Simsok [Ba, Br, D] Samsok [P] Pishi Khorak [H] Gurba Khorak [H]	Leaves	Aromatic herb with a mint–oregano flavor, like green tea, bitter taste	Foothills, grazing rangelands	Tea [Ba***, Br***, D***, H*, P***]	Yes
Olea europaea subsp. *cuspidata* (Wall. & G.Don) Cif.; Oleaceae; QUETTA000176	Khath [Ba, Br, D]	Leaves	Green tea	Mountains	Tea [Ba***, Br***, D***]	Yes
Oxalis corniculata L.; Oxalidaceae; QUETTA000065	Khasiko [Ba]	Leaves	Sour taste	Mountains	Raw snacks [Ba*]	Yes
Peucedanum aucheri Boiss.; Apiaceae	Raghborhi [P]	Aerial parts	Black pepper	Foothills	Salad [P**] Chatni [P**]	No
Pistacia atlantica Desf.; Anacardiaceae; QUETTA000079	Kasorh/ Gaun [Ba, Br, D] Chaka [H]	Fruit	Resinous, mastic–like taste	Mountains	Cooked [Ba***, Br***, D***, Raw snacks [Ba***, Br***, D***, H***]	Yes
Pistacia khinjuk Stocks; Anacardiaceae; QUETTA000080	Gaun [Ba, Br, D] Khinjak [H] Shinay [P]	Fruit	Resinous, mastic–like taste	Mountains	Raw snacks [Ba***, Br***, D***, H***, P***] Leaves: Tea [H*]	Yes

Table 2. (continued)

Botanical Taxon/Taxa; Family; Voucher Specimen Code	Recorded local names	Parts used	(Etic) taste/smell characteristics	Gathering areas	Recorded local gastronomic uses	Previously reported in Pakistan
Polygonum aviculare L.; Polygonaceae; QUETTA000078	Sairinj [Br]	Aerial parts	Bitter taste	Fields	Cooked [Br*]	Yes
Portulaca oleracea L.; Portulacaceae; QUETTA000254	Bichli [Ba] Kulfa [H] Margharhi [P] Pichili [Ba, Br, D]	Aerial parts	Sour taste	Fields	Cooked [Ba***, Br***, D***, H***, P***]	Yes
Prunus amygdalus Batsch; Rosaceae; QUETTA000169	Badam [Ba, Br, D] Badam Koh [Ba]	Fruit	Sweet taste	Mountains	Raw snacks [Ba***, Br***, D***]	Yes
Psammogeton biternatum Edgew.; Apiaceae; QUETTA000398	Izbotk [D]	Leaves	Slightly pungent	Mountains	Chatni [D*]	Yes
Punica granatum L.; Lythraceae; QUETTA000047	Anar [Ba, Br, D, H, P]	Fruit	Sour taste	Mountains	Raw snacks [Ba***, Br***, D***, H***, P***]	Yes
Rheum ribes L.; Polygonaceae; QUETTA000246	Chokri [H] Pshaiy [P] Rawash [H]	Young stems	Sweetish and sour taste	Mountains	Lacto– fermentation [P*] Raw snacks [H***, P***]	Yes
Rumex dentatus L.; Polygonaceae; QUETTA000399	Thrishpako [Ba, Br, D] Tharwokay [P] Wula [H]	Leaves	Sour taste	Near water courses	Cooked [Ba*, Br*, D*, H***, P***]	Yes
Scorzonera tunicata Rech.f. & Köie; Asteraceae;	Dagham [Ba, Br, D]	Root	Slightly sweet	Mountains, foothills	Raw snacks [Ba***, Br***, D***]	No
Silene conoidea L.; Caryophyllaceae; SWAT005514	Gok zaban [Ba] Zaban–e–bhara [Ba, Br, D, H]	Leaves	Taste like spinach	Fields, plains	Cooked [Ba***, Br***, D***]	Yes

Table 2. (continued)

Botanical Taxon/Taxa; Family; Voucher Specimen Code	Recorded local names	Parts used	(Etic) taste/smell characteristics	Gathering areas	Recorded local gastronomic uses	Previously reported in Pakistan
Solanum americanum Mill.; Solanaceae; QUETTA000009	Angortora [P] Tolangor [Ba, Br, D]	Fruit, leaves	Fruit is savory and sweet	Fields	Raw snacks [Ba***, Br***, D***, P***] Cooked [Ba*]	Yes
Spergularia spp.; Caryophyllaceae	Pishi pong [Br, D]	Aerial parts	Pungent taste	Fields	Cooked [D*] Raw snacks [Ba*, Br*, D*]	No
Thymus vulgaris L.; Lamiaceae; QUETTA000400	Turmori [Ba, Br, D] Bandak [H]	Aerial parts	Aroma warm, pungent taste	Foothills or grazing rangelands	Tea [Ba***, Br***, D***, H**]	Yes
Tulipa lehmanniana Merckl.; Liliaceae; QUETTA000178	Gwarhikh [Ba, Br, D] Lalag [H] Raghpata [P] Sandigul [P] Sh'kar [P]	Bulb, whole plant	Sweet taste	Foothills or grazing rangelands	Bulb: raw snacks [Ba***, Br***, D***, H***, P***] Whole plant: raw snacks [P***]	Yes
Withania coagulans (Stocks) Dunal; Solanaceae; QUETTA000018	Paneerband [Ba, Br, D] Paneerbad [H]	Fruit	Bitter taste	Foothills	Lacto–fermentation [Ba***, Br***, D***, H***]	Yes
Ziziphora clinopodioides Lam.; Lamiaceae; QUETTA000106	Koh–e–chah[Ba]	Leaves	Aromatic	Mountains	Tea [Ba***]	Yes
Ziziphus jujuba Mill.; Rhamnaceae; QUETTA000316	Chella [Ba, Br, D] Anaab [H]	Fruit	Sweet taste	Mountains	Raw snacks [Ba***, Br***, D***, H***]	Yes
Ziziphus nummularia (Burm.f.) Wight & Arn.; Rhamnaceae; QUETTA000314	Jangli Ber [H] Jangli Bera [P] Kuner [Ba] Pissi [Ba, Br, D]	Fruit	Sweet taste	Mountains	Raw snacks [Ba***, Br***, D***, H***, P***]	Yes

Table 2. (continued)

Botanical Taxon/Taxa; Family; Voucher Specimen Code	Recorded local names	Parts used	(Etic) taste/smell characteristics	Gathering areas	Recorded local gastronomic uses	Previously reported in Pakistan
Agaricus bisporus; Agaricaceae	Khappa [Ba, Br, D] Kharmairhi [P] Khulaiy [H]	Aerial parts	Taste like meat	Foothills	Cooked [Ba***, Br***, D***, H***, P***]	Yes
Unidentified taxa; Brassicaceae	Shoglak [Ba, Br, D]	Aerial parts	Mustard flavor	Fields	Bread [Ba***, Br***, D***] Cooked [Ba***, Br***, D***] Raw snacks [Ba***, Br***, D***] Salad [Ba***, Br***, D***] Appetizer [Ba*, Br*, D*]	–
Unidentified taxon; Liliaceae	Tatokay [P]	Bulb	Taste like beet	Foothills	Raw snacks [P***]	Yes
Unidentified taxon	Chotko [Ba, Br, D]	Aerial parts	Slightly sweet	Mountains Plain areas	Raw snacks [Ba***, Br***, D***]	–
Unidentified fungal taxon	Arhtko [Ba] Nothko [Br, D]	Aerial parts	Taste like meat	Foothills	Cooked [Ba***, Br***, D***]	–

[Ba]Folk name recorded among Baloch people; [Br]Folk name recorded among Brahui people; [D]Folk name recorded among Dehwar people; [H]Folk name recorded among Hazaras people; [P]Folk name recorded among Pathans. *Quoted by less than 25% informants; **Quoted by more than 25 and less then 50% of informants; ***Quoted by more than 50% of informants.

Fig. 3. (**a**) Local Pathan foragers in a remote village of Pishin along with (**b**) Some of the foraged WFPs; i.e., *Allium* sp., *Chenopodium album, Ducrosia anethifolia* (DC.) Boiss., *Ixiolirion tataricum* (Pall.) Schult. & Schult.f., *Koelpinia linearis* Pall., *Lallemantia royleana* (Benth.) Benth., *Launaea taraxacifolia* (Willd.) Amin ex C.Jeffrey, *Launaea spinosa* (Forssk.) Kuntze, *Malcolmia africana*; (**c**) Local Brahui foragers collecting WFPs in a wheat field at Mastung; (**d**) A local Pathan vendor selling WFPs in Quetta Bazar; (**e**) An aged person describing the use of WFPs used among Hazara community.

et al. 2020a, b; Aziz et al. 2021; Pieroni et al. 2019). Pastoralism plays an important role in shaping relationships between humans and their environment (Fernández-Giménez and Estaque 2012; Ghimire and Aumeeruddy-Thomas 2009; Oteros-Rozas et al. 2013). In this study, the commonly used wild vegetables were *Amaranthus viridis* L., *Asphodelus tenuifolius* Cav., *Chenopodium album* L., *Descurainia sophia* (L.) Webb ex Prantl, *Eremurus* sp., *Goldbachia laevigata* (M.Bieb.) DC., *Lepidium draba* subsp. *chalepense* (L.) P.Fourn., *Malcolmia africana* (L.) R.Br., *Portulaca oleracea* L., *Rumex dentatus* L., and *Silene conoidea* L. Some of these, such as *Lepidium draba* subsp. *chalpense*, *Malcolmia africana*, and *Portulaca oleracea*, were picked and consumed during daily walks, informal conversations, and especially everyday outdoor activities. Study participants affirmed that most of the vegetables grow in the early spring after there has been sufficient rain, but now the frequency of rain is gradually decreasing, thus severely affecting their growth. One of the study participants (a 68–year–old man; SS) stated:

> Self growing plants have an important role in our traditional cuisines and still certain plants are very popular in our food system. We forage for WFPs, especially wild vegetables from our fields, and we make special visits to the mountains in order to collect them. This is a common practice in the early spring among all the local people who think wild vegetables are more delicious than commercial ones.

Some participants stated that people who tend to go hunting in the mountains have strong connections with nature and they thus retain more knowledge about natural resources with WFPs forming an important part of their outdoor dietary system Table 2 and Fig. 3.

The recorded WFPs were mostly gathered in herbaceous form, and aerial parts (the entire plant excluding roots) (22 taxa) were the most frequently consumed plant parts followed by leaves (18 taxa). Some of the wild vegetables gathered from fields by the local communities were weeds. The use of weeds, mostly gathered in anthropogenic environments, as wild vegetables is prevalent in various food ethnobotanies in North and West Pakistan (Ahmad et al. 2019; Aziz et al. 2021), which may be due to their broad ecological amplitude (Ahmad et al. 2009; Lyimo et al. 2003) as they need less care and protection. Ethnobotanists argue that weeds may help achieve nutritional goals in times of food scarcity (Mertz et al. 2001; Ogoye-Ndegwa 2003). Fruits (16 taxa) were also much used, which may be due to their peculiar sweetish taste. Some wild fruits are available in shops, known as *Pansars*, run by local vendors. We also observed some other WFPs in an informal market (Fig. 3) such as *Eremurus* sp., *Rumex* sp., and *Lepidium draba* subsp. *chalepense*, which were gathered from the surroundings and brought to the local market, were equally prevalent among all the studied groups. Very few WFPs were used in lacto–fermentation, in meat preservation, and as appetizers. The dominant families of the recorded botanical taxa were Apiaceae (eight taxa), Asteraceae, and Brassicaceae (six taxa each). We found that the elderly people of these communities have considerable local ecological knowledge (LEK) of wild food resources, while younger individuals are less familiar with WFPs and their nutritional importance. As in other areas of the country, rapid social change is also a critical issue that has greatly affected the traditional lifestyle and the associated gastronomic practices.

Cross–Cultural Comparison

The results were compared and analyzed through Venn diagrams, and the Jaccard similarity index was applied to determine possible similarities and differences in overall WFP uses (Fig. 4) and most frequent uses (Fig. 5) reported among the different researched groups. Comparative analysis demonstrated by Venn diagrams and the results obtained from Jaccard indices (Table 3) demonstrated close similarities among the food ethnobotanies of the Baloch, Brahui, and Dehwar. This result may be attributed to their mixed population and strong sociocultural adaptations, which could be seen in the form of intermarriages. The mix of population has facilitated the intercultural transmission of LEK of WFPs. Overall, one–fifth of the recorded plant taxa were commonly quoted by all the studied groups (Figs. 4 and 5), Table 3.

Some of the traditional foraged ingredients among the Hazara and Pathan groups were

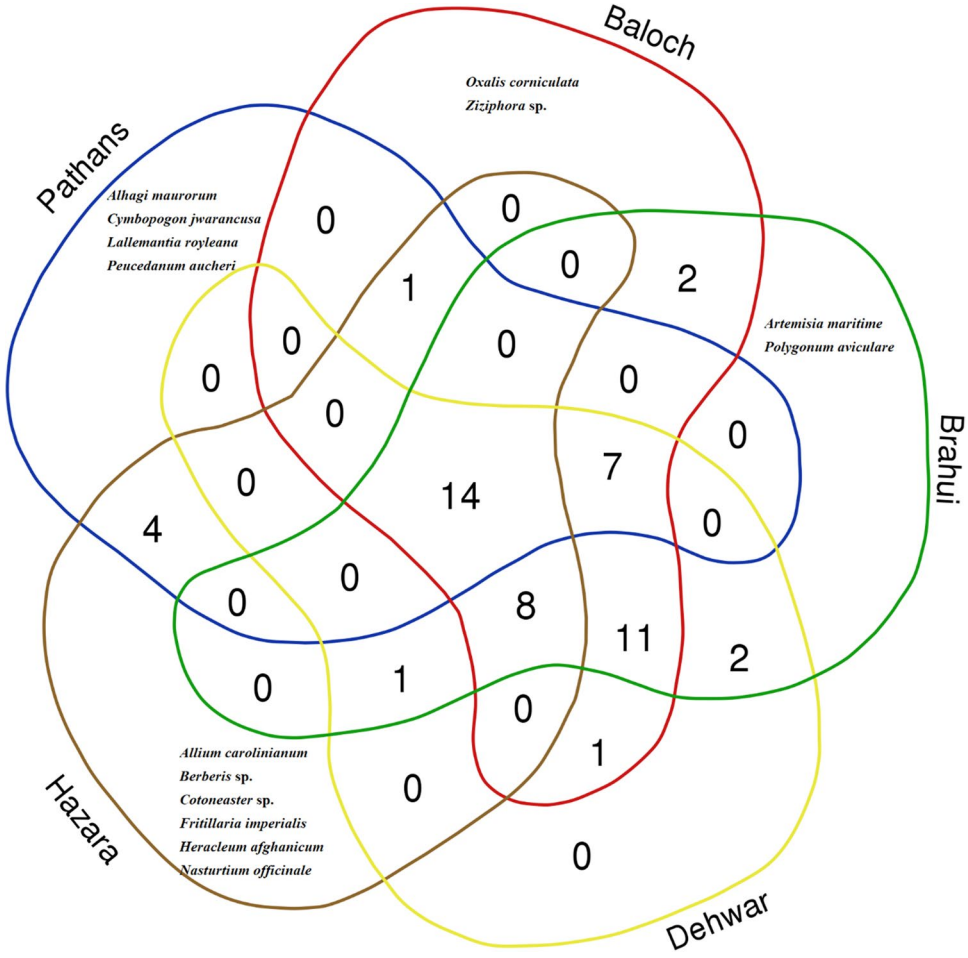

Fig. 4. Venn diagram showing overlap of all reported wild food plant and mushroom taxa among the studied groups.

quoted solely by them and not by the other three groups (Fig. 5). Most of these taxa, especially the distinctive food ingredients of the Hazaras, are native to (high) mountains. Moreover, Hazaras and Pathans are strictly endogamic and are therefore more "socio–culturally" isolated from the other groups (Table 1), which may have prevented the exchange of vertically transmitted "family–centered" LEK between them and their neighbors. This has been well shown in other studies, where endogamic patterns seem to have preserved different foraging approaches (Aziz et al. 2020b; Pieroni et al. 2020; Pieroni et al. 2018).

Foraging Locations

We have presented graphically the gathering locations of the recorded WFPs from each of the groups (Fig. 6). It is worth mentioning that gathering environments play a crucial role in determining the historical settlements of different cultural groups within a given socio–ecological space. Historically, the Baloch and Brahui were nomads, whereas the Dehwar were agriculturists. However, possibly after arrival in the area, all three adopted a similar mosaic pattern of agro–pastoral practices (GoB and IUCN Pakistan 2000), evident in their similar WFP

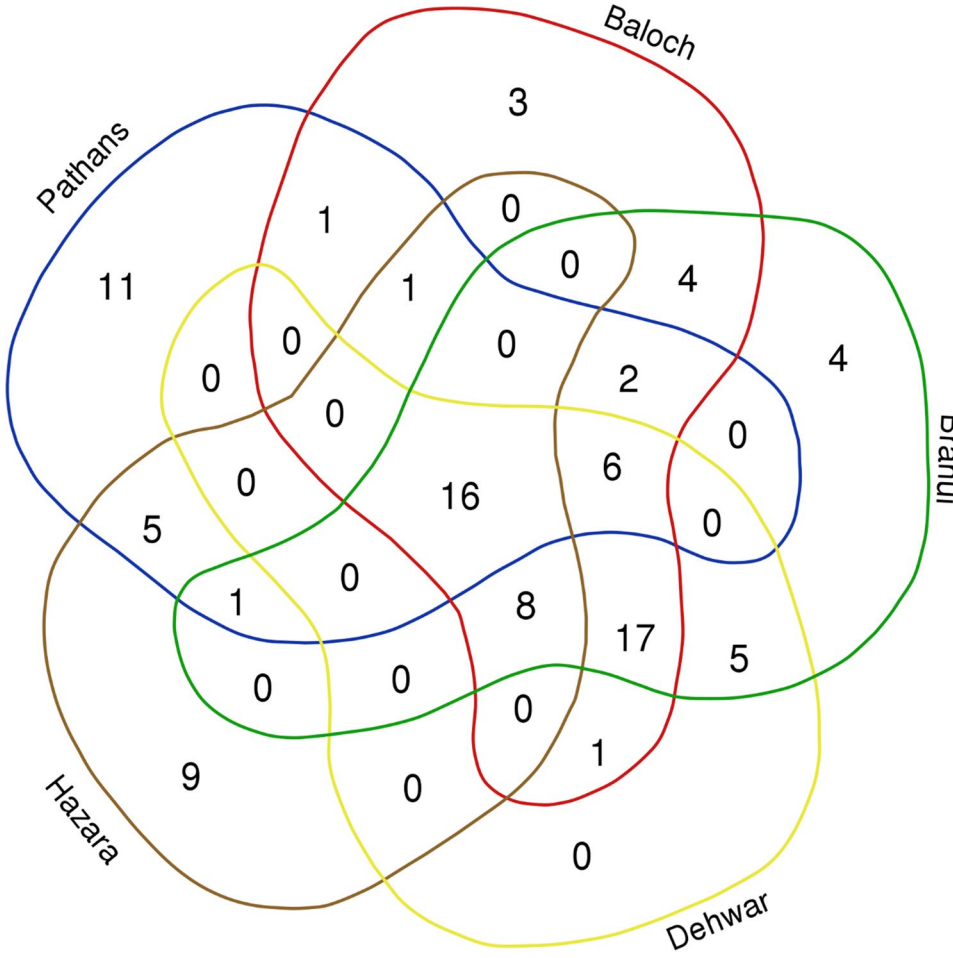

Fig. 5. Venn diagram showing Jaccard similarity indexes and overlap of frequently reported wild food plant and mushroom taxa among the studied groups.

TABLE 3. JACCARD SIMILARITY INDEXES FOR THE OVERALL RECORDED PLANT USES AND FREQUENTLY REPORTED USES (MORE THAN 50 % OF THE PARTICIPANTS) AMONG THE CONSIDERED GROUPS.

	Overall plant use					Frequently reported uses				
	Baloch	Brahui	Dehwar	Hazaras	Pathans–	Baloch	Brahui	Dehwar	Haz-aras	Pathans–
Baloch	×	0.45	0.46	0.28	×	×	0.41	0.42	0.25	
Brahui	×	×	0.47	0.28	×	×	×	0.46	0.25	0.24
Dehwar	×	×	×	0.29	×	×	×	×	0.25	
Hazaras	×	×	×	×	0.29	×	×	×	×	0.27
Pathans	0.29	0.27	0.28	×	×	0.25	×	0.22	×	×

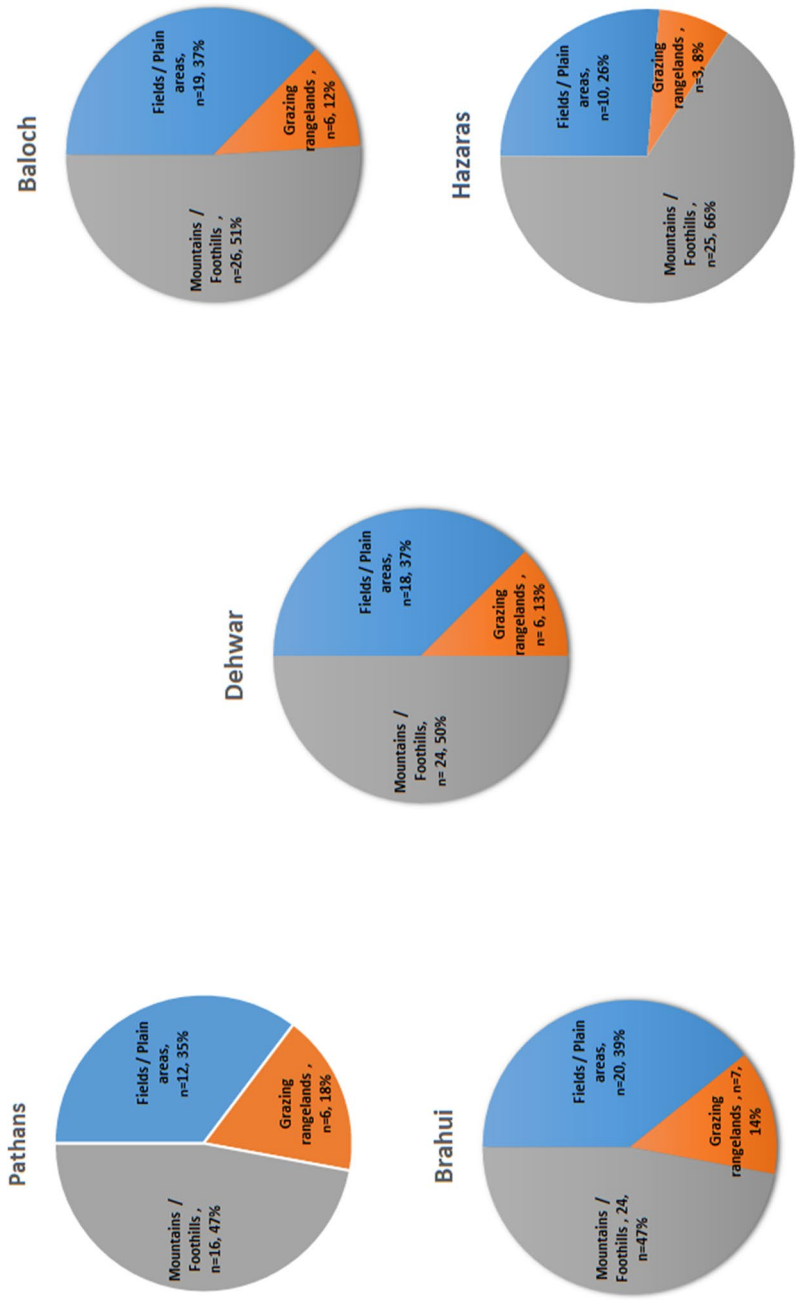

Fig. 6. Showing the proportion and number of WFPs gathered from various locations by the studied groups.

gathering patterns, reflecting long–term exposure to common ecological conditions Fig. 6.

The Hazaras frequently gather WFPs from high mountain areas as their ancestors historically resided there. Being a cultural diaspora, the Hazaras arrived in the region in the 19th century from Hazarajat, Central Afghanistan (Bacon 1951; Monsutti 2004), but they still retain ties to their homeland since they gather WFPs in the mountains there during parts of the year. They may also get WFPs when they visit relatives. Therefore, we suggest that this specific socio–cultural context of the Hazaras has slowed the homogenization of their food heritage. Some of the WFPs, including an unidentified taxon, locally known as "*Shoglak*," were popular in food preparations among the studied groups. *Pistacia atlantica* Desf. is used in a traditional winter dish "*Kachri*," which is prepared in a specific way. The fruit of the plant is finely ground and then put in hot water and squeezed to make an extract, with this process repeated several times. Afterwards, the raw material is thrown away and the extract is mixed with spices, cooked, and served with bread. This is highly popular among the Baloch, Brahui, and Dehwar. Similarly, "*Tiki Tali*" is a famous bread among the Baloch, Brahui, and Dehwar, prepared along with some wild vegetables such as *Asphodelus tenuifolius*, *Goldbachia laevigata*, *Lepidium draba* subsp. *chalepense*, *Malcolmia africana*, and *Portulaca oleracea* (Fig. 7).

Moreover, the young stems of *Rheum ribes* L. are snacked on by Hazaras and Pathans, but it is also used as a fermentation starter among the latter.

Taste

Fischler (2011) stated that although commensality—the practice of eating together—is highly valued across cultures, its value is distributed differently: as the value of food solely depends on an individual who consumes the food material and this could lead to the argument that to analyze taste as a cultural phenomenon means, primarily, exploring how individuals interpret symbolic meanings of food, as explained by Kant through the "*aesthetic judgment of quality*" (Kant 2007). In terms of taste perceptions, the graphs (Fig. 8) show the prevalence of sweetness as it is preferred among the various cultural groups due to its pleasant taste. A pungent taste was highly favored by all the studied groups except Hazaras, who show a preference for sour tastes. In order to obtain a clearer overview of the preferred tastes among the studied groups, we also present the prevalent tastes preferred by the groups for the most frequently used WFPs (Fig. 9). The data demonstrate that, comparatively, Hazaras prefer sour tastes while Pathans have little affinity for bitter and pungent tastes. An herbaceous/neutral taste was popular among Pathans as compared to the other groups. The overall taste preferences of the Baloch, Brahui, and Dehwar were quite similar as compared to the other two groups, which could be due to their mutual social and cultural interactions (Spooner 1988) and a possible coevolution of food tastes

Fig. 7. Traditional bread known as "*Tiki Tali*" (Photo: M. A. Aziz).

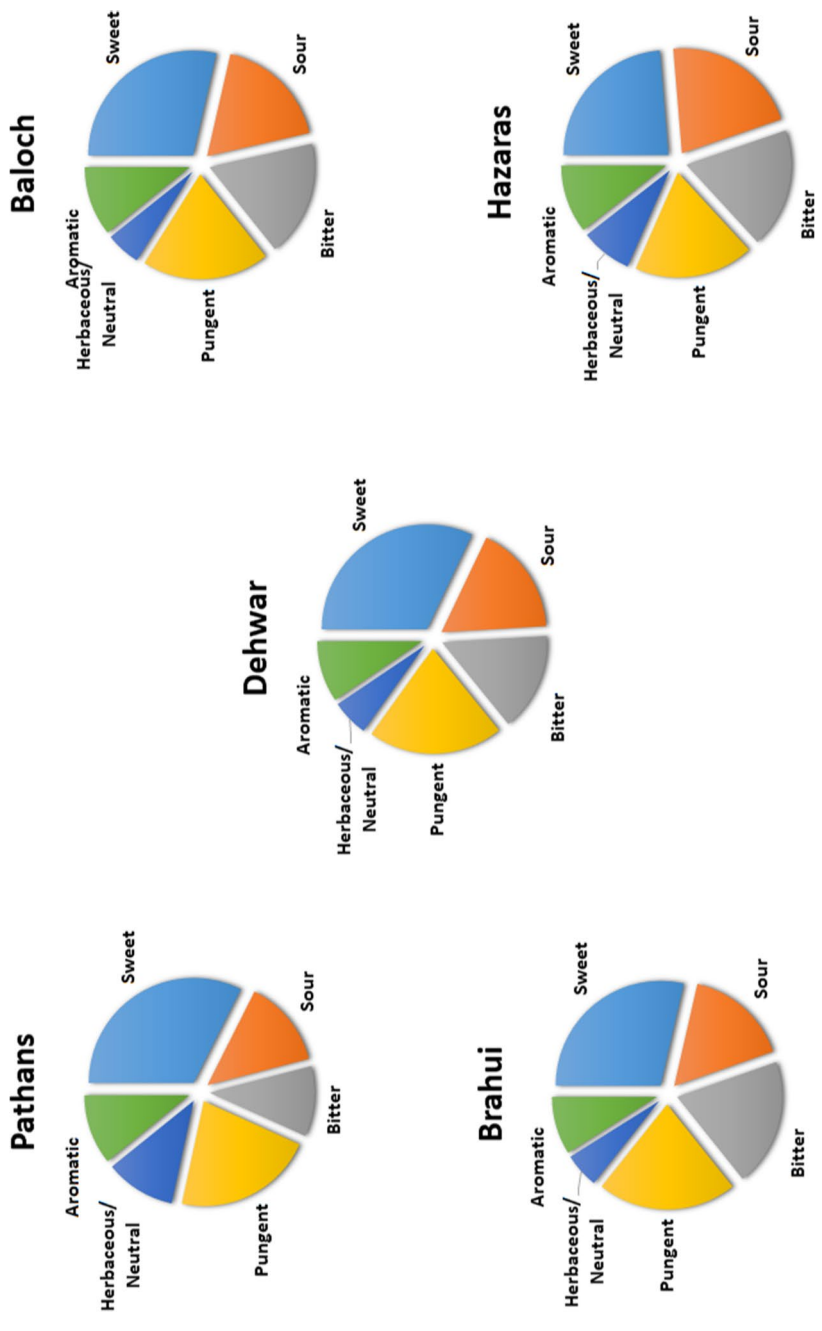

Fig. 8. Tastes of the gathered WFPs among the studied groups.

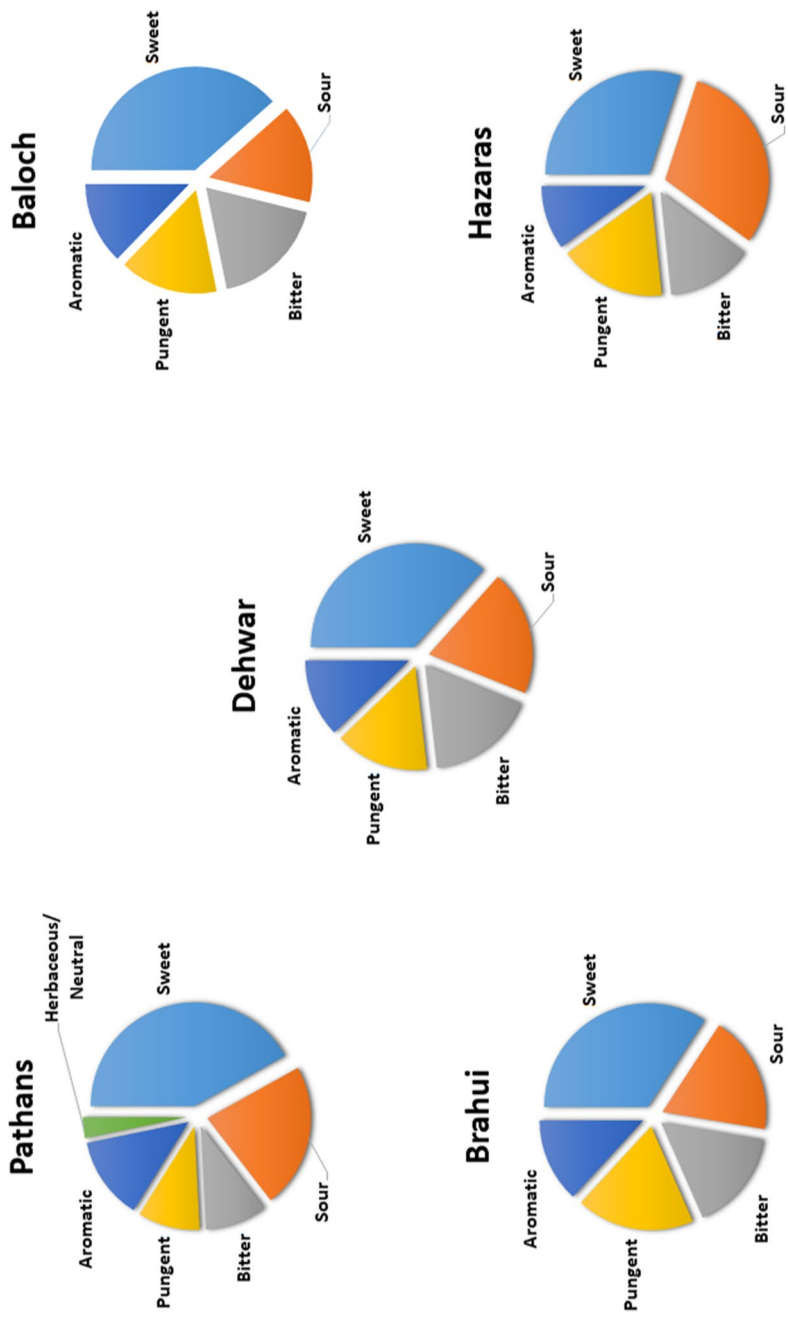

Fig. 9. Tastes of the *most quoted* WFPs among the studied groups.

in these groups. In sum, we can assume that the possible differences in taste preferences among the cultural groups may be due to the availability of different food plants in their surrounding ecological environment, which in turn could also be affected by the study area's different socioecological attitudes (Pieroni et al. 2018), which have greatly affected the choice of a specific plant part. It is possible that the arrival of grocery stores in villages has changed the popularity of traditional tastes, as evidenced by the decreasing popularity of WFPs among the younger generations. In other areas of the region a similar "change in taste" has started to occur among younger individuals who interact less with nature and are more exposed to markets and more processed foods (Chauhan et al. 2018; Cruz García 2006; Thakur et al. 2017). Moreover, exotic species are also penetrating markets in many parts of the world, with traditional species becoming less–valued (Bharucha and Pretty 2010) Figs. 8 and 9.

Comparative Analysis with the Pakistani Food Literature

The pre–existing literature on Pakistani WFP use can help identify WFP uses that are limited to particular groups. We found six comprehensive studies of WFP use (Abdullah et al. 2021; Ahmad and Pieroni 2016; Aziz et al. 2020a, b; Aziz et al. 2021; Majeed et al. 2021); and other studies partially focused on WFPs in which only wild vegetables were recorded (Abbas et al. 2020; Ahmad et al. 2019). Some studies addressed the role of WFPs in traditional medicine and these were also included (Abbasi et al. 2013; Khan et al. 2015; Tareen et al. 2016). The literature review of Pakistani food ethnobotany demonstrated that most of the research on WFPs has been carried out in North and West Pakistan. In Pakistan, a total of five cross–cultural studies on WFPs were found, which includes our recent research focusing on the comparison of plant uses among different linguistic and religious groups (Abbas et al. 2020; Aziz et al. 2020a, b; Aziz et al. 2021; Majeed et al. 2021). The literature review also showed that most of the plants recorded in the current study were also documented in the previous ethnobotanical research studies conducted in Pakistan, with the most frequent taxa being *Allium* spp., *Amaranthus* spp., *Berberis* spp., *Caralluma* spp., *Chenopodium* spp., *Cotoneaster* spp., *Eremurus* spp., *Lepidium* spp., *Malva* spp., *Medicago* spp., *Mentha* spp., *Portulaca* spp., *Rumex* spp., and *Silene* spp. Quantitative data obtained from the reviewed literature reveals that the largest number of taxa (77 botanicals) was recorded in our recent research from Jhelum District. In the current study, we recorded 68 botanicals, similar to other research investigations that have documented considerable traditional knowledge of WFPs. Similarly, a comparable number of WFP taxa have been reported from around the country: 58 botanicals were reported from Chitral (Aziz et al. 2020b), 55 from Kurram District (Abbas et al. 2020), 51 from Thakht–e–Sulaiman Hills (Ahmad and Pieroni 2016), 52 from Kaniguram (Aziz et al. 2021), 45 from Lesser Himalayas–Pakistan (Abbasi et al. 2013), and 40 from Ghizar, Gilgit–Baltistan (Aziz et al. 2020a). The WFP taxa quoted in those studies were frequently consumed as snacks or cooked as vegetables. After a thorough review of the available food ethnobotanical studies for Pakistan, the following taxa emerged as novel or rarely used elsewhere in our Balochistan study region: *Cymbopogon jwarancusa* (Jones) Schult., *Ferula assa–foetida* L., *Fritillaria imperialis* L., *Heracleum afghanicum* Kitam., *Hertia intermedia* (Bioss.) Kuntze, *Ixiolirion tataricum* (Pall.) Schult. & Schult.f., *Koelpinia linearis* Pall., *Malcolmia africana*, *Peucedanum aucheri* Boiss., *Scorzonera tunicata* Rech.f. & Köie, *Spergularia* sp., and *Rheum ribes,* and this could be due to the fact that these plants are mainly grow in these regions.

Conclusions

The ethnolinguistic groups we considered here in this study show significant divergence in the use of WFPs. The observed commonalities recorded in food ethnobotanies among certain studied groups could be referred to their strong socio–cultural interactions, which in turn led them to share ethnobotanical knowledge. For instance, the food ethnobotanies of Baloch, Brahui, and Dehwar were more similar, as compared to the other two groups. Similarly, we also argue that the idiosyncrasy on the use of certain plant ingredients reported among Hazaras and Pathans

could also be referred to different human ecological experiences, which possibly has played a central role in reshaping food ethnobotanies among the studied groups. In order to understand how the biocultural heritage of WFPs evolves over time and space, it is important to comprehensively study the WFP foodscapes in other parts of the Iranian Plateau, as all the studied groups are scattered across various geographical areas. It is also crucial to know how the younger generations rearticulate traditional gastronomic knowledge of WFPs. More importantly, the food ethnobotanical data recorded among the Hazaras diaspora should be compared with the wild food foraging of Hazarajat in Afghanistan in order to understand the impacts of spatial and temporal dynamics and historical exchanges of traditional food systems. It is recommended that local ecological knowledge should be given appropriate attention in educational programs and that biocultural heritage should be part of future development programs.

Acknowledgments

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