Environment, Development and Sustainability (2021) 23:2358–2381
https://doi.org/10.1007/s10668-020-00678-1

Wild food plants traditionally gathered in central Armenia: archaic ingredients or future sustainable foods?

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Received: 17 January 2020 / Accepted: 9 March 2020 / Published online: 13 March 2020

Abstract
Current debate highlights that sustainable food systems can be fostered by the cautious and germane use of natural resources. Gathering, cooking, and consuming wild food plants that are widely available in a given environment are traditional practices that in many parts of the world have historically been crucial for effecting the food security and food sovereignty of local communities. In the current study, we analyzed the traditional foraging patterns of Armenians, Pontic Greeks, Molokans, and Yazidis living in a mountainous area of central Armenia; via 64 semi-structured interviews, 66 wild food folk taxa were recorded and identified. While Armenians and Greeks gather a remarkable number of wild food plants (36 and 31, respectively) and share approximately half of them, Molokans and, more remarkable, Yazidis gather less wild food plants (24 and 17, respectively) and share only a few plants with Armenians. This may be due not only to the fact that the latter ethno-religious groups have followed endogamic marriage patterns for centuries, which may have limited the exchange of plant knowledge and practices with their Armenian neighbors, but also to the difficult adaptation to a new environment that Yazidis experienced after moving from Eastern Anatolia and the Nineveh Plains to the study area around a century ago. The traditional practice of gathering wild plants for food is, however, still vividly alive among locals in central Armenia and at least a part of this bio-cultural heritage could represent one of the future pillars of local sustainable food systems and platforms.

Keywords Wild food plants · Foraging · Ethnobotany · Armenia · Caucasus

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1 Introduction

One of the most crucial components of sustainable food systems is the prudent and cautious use of natural resources, which, in turn, requires seriously taking into account local Traditional Knowledge (TK), as Article 8 (j) of the Convention on Biological Diversity clearly affirms (CBD 2016). *Bio-cultural refugia* (Barthel et al. 2013) all over the world often host reservoirs of TK related to wild food plants, upon which local communities have built their food security and food sovereignty (Bharucha and Pretty 2010; Neudeck et al. 2012; Kuhnlein 2014; Nolan and Pieroni 2014; Shumsky et al. 2014; Quave and Pieroni 2014; Ong and Kim 2017; Shaheen et al. 2017) or which have help them survive, even recently, periods of famine (Redžić 2010; Redžić et al. 2010; Redžić and Ferrier 2014).

The bio-cultural heritage related to wild food plants and neglected and underutilized species (NUS) have been the focus of a number of investigations in the past decade all around the world, given that the diversification of diets and traditional ingredients (orphan crops, wild plants, wild crop relatives, and wild meat varieties) is considered a key issue in combating malnutrition and hunger (Heywood 2013). Moreover, to focus on traditional plant foraging (i.e. gathering of wild food plants) is essential in many remote areas of the world for a better understanding of its role in informing the sustainability of food systems, for its possible beneficial effects on human health, and also for fostering traditional, reinvented, and new local gastronomies (Heinrich et al. 2005 and 2006; Łuczaj et al. 2012; Pieroni et al. 2015; Hunter et al. 2019).

Several field studies conducted in the past two decades in mountainous regions of Eastern Europe have shown that these areas represent often remarkable reservoirs of disappearing folk plant and ecological knowledge (Pieroni et al. 2005; Redžić 2006; Nedelcheva 2013; Papp et al. 2013; Pieroni et al. 2013; Rexhepi et al. 2013; Molnár et al. 2015; Quave and Pieroni 2014, 2015; Pawera et al. 2017; Pieroni and Sõukand 2017). Moreover, the homogenizing effects of centralization within the former Soviet area, which have affected medicinal plant knowledge seem to have been much less relevant in the food arena and in remote mountainous regions (Sõukand and Pieroni 2016), and therefore the TK related to traditional foraging may still offer very important insights.

The Caucasus has thus far been investigated in only a few areas with regard to traditional wild food plants (Kaliszewska and Kołodziejska-Degórska 2015; Bussmann et al. 2016, 2017; Hovsepyan et al. 2016; Łuczaj et al. 2017; Pieroni and Sõukand 2019; Sõukand and Pieroni 2019); moreover, the ethnobotanical research conducted to date has sporadically followed cross-cultural approaches, despite the fact that this territory was, and still partially is, home to remarkable linguistic and religious diversity (Comrie 2008) and a complex gastronomic heritage (Hercules 2017; Capalbo 2017). In particular, the Caucasus is located at the crossroads of five major historical cultural axes, namely Armenian, Turkish/Azeri, Persian, Russian, and autochthonous Caucasian (Georgian and other minorities), which have also heavily influenced its cuisines.

In the current study, we focused on mountainous multi-ethnic central Armenia, since wild food plant gathering has not yet been systematically and cross-culturally investigated in the country. The objectives of this study were therefore: a. to record traditional plant foraging among four ethno-religious communities living in central Armenia; b. to compare the data among the four communities in order to identify commonalities and differences, and to formulate hypotheses to help explain them; and c. to envision concrete ways in which this bio-cultural food heritage could foster future sustainable food systems.

2 Study area and methodology

2.1 Study area and communities

Figure 1 shows the visited villages in mountainous central Armenia, whose landscape is depicted in Fig. 2. Table 1 presents the characteristics of the selected ethno-religious groups, as well as the socio-economic and cultural characteristics of the utilized sample.

The small proportion of female study participants in the Greek sample was due to the fact that this minority group is extremely small and close to extinction in the considered village in central Armenia, where effectively all remaining inhabitants were sampled.

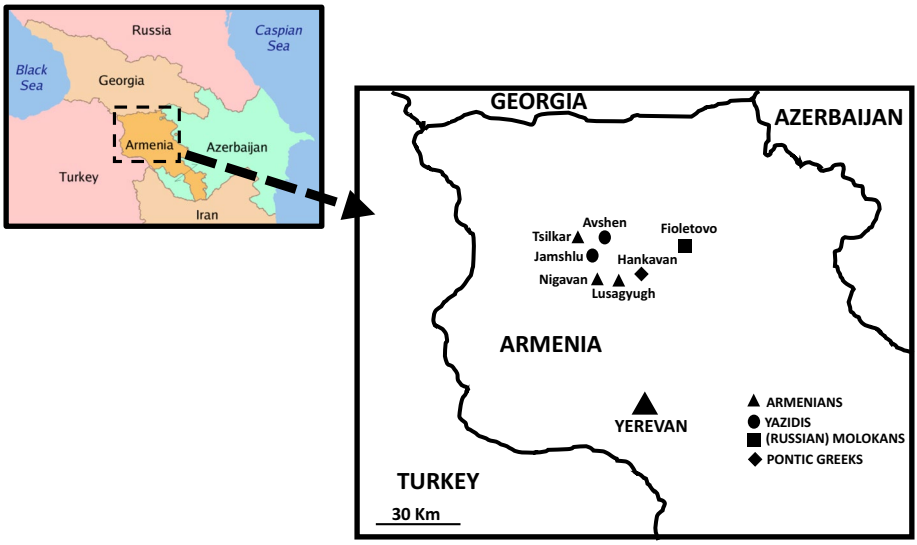

Fig. 1 Study area and visited villages

Fig. 2 Landscape of central Armenia

Table 1 Characteristics of the study participants

Ethno-religious group	Armenians	Pontic Greeks	Molokans	Yazidis
Arrival in the present area	Autochthonous and many also migrated from Eastern and Central Anatolia (historical known as Western Armenia) after the 1915 Armenian-Assyrian Genocide	Second half of the eighteenth century from the Pontus area (southern Black Sea region)	1830 from Russia	End of the nineteenth century and beginning of the twentieth century from Eastern Anatolia and the Nineveh Plains
Approx. number of inhabitants in Armenia	3 Mio	1000	2000	35,000
Geographical characteristics of the study villages	Mountainous: Tsilkar, 2150 m a.s.l Nigavan, 2050 m a.s.l Lusagyugh, 2000 m a.s.l	Mountainous: Hankavan, 2000 m a.s.l	Mountainous: Fioletovo, 1700 m a.s.l	Mountainous: Avshen, 2150 m a.s.l Jamshlu, 2100 m a.s.l
Original language	Armenian	Pontian Greek	Russian	Kurmanji Kurdish
Socio-linguistic characteristics of the study villages	Bilingual in Armenian and Russian	Trilingual in Armenian, Pontic Greek, and Russian	Mainly monolingual in Russian; some bilingual in Armenian and Russian	Trilingual in Kurdish, Armenian, and Russian
Religion	Orthodox Christianity	Orthodox Christianity	Spiritual Orthodox Christianity (sect)	Yezidism
Inter-marriages	Exogamic with other Orthodox Christians only (Greeks and Russians)	Exogamic with other Orthodox Christians only (Armenians and Russians)	Strictly endogamic	Strictly endogamic
Traditional subsistence economy	Horticulturalism and pastoralism	Forestry, horticulturalism, and pastoralism (in the past)	Horticulturalism and forestry	Pastoralism
Estimated average socio-economic status of the study participants	Middle low	Middle low	Middle low	Low
Number of study participants	18	9	18	19
% of women	50	33	56	63
Overall mean age of the study participants	54	69	64	48

2.2 Field study and methods

The field study was conducted during September 2019 and the study participants were selected, using a snowball technique, from among middle-aged and elderly inhabitants (over 50 y.o.) living in rural areas, who we identified as possible local traditional knowledge holders.

Verbal consent was always obtained before each interview and the Code of Ethics of the International Society of Ethnobiology (ISE 2008) was followed. Semi-structured interviews were conducted in Russian or sometimes in Armenian. The interviews focused on gathered wild food plants including: non-cultivated vegetables; wild plants used as starters in baking or yogurt making, such as rennet for preparing *sarma*, or in home-made fermented products; wild fruits and other wild plants used in sweet preserves and/or liquors; and wild plants used for seasoning foods and making home-made herbal teas. Moreover, we made note of a few unusual uses of cultivated plants as well. For each of the free-listed plant items, local names and exact details of traditional culinary preparations were recorded.

Plants were identified using the Flora of Armenia (Takhtajan et al. 1954–2009), while nomenclature follows The Plant List database (2013) and family assignments are consistent with the Angiosperm Phylogeny Website (Stevens 2017). The collected voucher specimens are deposited at the Herbarium of the Department of Environmental Sciences, Informatics, and Statistics of the Ca' Foscari University of Venice, Italy (UVV). All local plant names were transcribed from the recorded local languages using the Latin alphabet; among the most relevant phonemes that do not occur in English it is worth mentioning that the voiceless velar fricative was reported as "kh", the *schwa* as "ə", and the voiceless uvular fricative as "gh".

2.3 Data analysis

Data were compared with the most important worldwide wild food plant compendia (Hedrick 1919; Tanaka 1976; Facciola 1998) as well as the wild food ethnobotanical studies conducted in the last decade in the Caucasus (see aforementioned literature in the Introduction).

In addition, a Venn diagram was drawn based on the wild food taxa quoted by the four selected communities and the Jaccard Similarity Index for each pairing of the considered groups was calculated (Gonzáles-Tejero et al. 2008).

3 Results and discussion

3.1 Traditional wild food plants in central Armenia

Table 2 shows the wild food plants traditionally gathered and consumed in the study area. For each folk taxon, the botanical binomials and families, their folk names, the plant parts used, the exact details of the traditional culinary preparations, and the frequencies of quotation are reported. Sixty-six wild food taxa were identified and recorded while eight remained unidentified.

Table 2 Wild food plants gathered among the four considered ethnic groups

Botanical taxa; botanical families (voucher specimen code)	Local names	Used parts	Gathering area and season	Traditional culinary uses and quotation frequency	Season and frequency of consumption
Allium paradoxum (M.Bieb.) G.Don; Amaryllidaceae[#]	Dikiy luk[M] Səkhtoruk[A] SirmiY Skordotsank[G]	Leaves	W, S	Snack[A], cheese seasoning[Y], fried[G], soups[M], pickled in brine (lacto-fermented)[AA,YY]	S (pickled: AL), DF
Allium victorialis L.; Amaryllidaceae (AM30)	CheremshaM Ghandzil[G,Y] Hamas[A] Soghik[Y] Soi[Y] Sokh[A] Sokhik[Y] SokhukA	Young shoots and leaves	W, S	Snack[A], cheese seasoning[A,G,Y], boiled[M], fried with eggs[G,MMM,YY], soups[YY], pickled in brine (lacto-fermented)[AA,GG,MMM,YY] Molokan old saying: "*Cheremsha poshla, zimu perezili*" ("wild garlic comes out: we have survived the winter")	S (pickled: AL), DF
Amaranthus retroflexus L.; Amaranthaceae (AM07, AM27)	Krasni koren[M]	Leaves	AE, S and SU	Fried[M], soups[M]	S and SU, SF
Anthriscus nemorosa (M.Bieb.) Spreng.; Apiaceae (AM14, AM29)	Armyanskie kapuri[M] Khərkhənduk[A,G]	Young aerial parts	AE, S	Snack[GG], fried[GG], pickled in brine (lacto-fermented)[AA,GG,MMM]	S (pickled: AL), DF
Arctium lappa L. and possibly *A. palladinii* Grossh.; Asteraceae[#]	Kratuk[A] Lopukh[M] Purchukli[G]	Young stems	AE and GR, S	Snack[A,MM,G]	S, SF

Table 2 (continued)

Botanical taxa; botanical families (voucher specimen code)	Local names	Used parts	Gathering area and season	Traditional culinary uses and quotation frequency	Season and frequency of consumption
Armoracia rusticana P.Gaertn. B.Mey. & Scherb.; Brassicaceae* (AM25)	Khren[M]	Roots	AE, SU and A	Salads[M], seasoning[M], pickled in vinegar[MMM]	SU and A (pickled: AL), DF
		Leaves	AE, S	Seasoning for pickled (lacto-fermented) cucumbers[M]	AL, OF
Artemisia absinthium L.; Asteraceae (AM41)	Havshan[A]	Stems	GR, S and SU	Snack[A]	S and SU, OF
Caltha palustris L.; Ranunculaceae[#]	Kəngərosh[G]	Young shoots	WE, S	Boiled and fried[GG]	S, OF
Chaerophyllum bulbosum L.; Apiaceae (AM17, AM19, AM42)	Gəmuk[A] Ghemias[G] Mendik[Y] Mendek[A,Y] Shushan[A,Y]	Young shoots	WO, S	Boiled and fried with eggs[AAA,G,YY], soups with cereals[A], pickled in brine (lacto-fermented)[AAA,GGG,YYY]	S (pickled: AL), DF
		Tubers	WO, SU	Snack[AA,YY]	SU, OF
Chenopodium album L.; Amaranthaceae (AM05, AM26; AMD01)	Lebeda[M] Səlmask[Y] Vartakul[A]	Leaves	AE, S and SU	Boiled[M(only during famine times)Y], fried with eggs[AA,YYY], preserved dried for the winter[A,YYY]	S and SU (dried: AL), DF
Cirsium vulgare (Savi) Ten.; Asteraceae (AM37)	Khaspush[A]	Flower receptacles	GR, S	Snack[A]	S, OF
Convolvulus sp., Convolvulaceae#	Batatuk[A]	Leaves	AE, S	Soups[A]	S, OF
Crocus sp., Iridaceae	Chikiten[G]	Bulbs	WO and AE, S and SU	Snack[G]	S and SU, OF

Table 2 (continued)

Botanical taxa; botanical families (voucher specimen code)	Local names	Used parts	Gathering area and season	Traditional culinary uses and quotation frequency	Season and frequency of consumption
Elaeagnus rhamnoides (L.) A.Nelson, Eleagnaceae[#]	Chichkhan[A]	Fruits	GR, S	Compote[A]	AL, OF
Falcaria vulgaris Bernh.; Apiaceae[#]	Pəkhask[Y] Sibegh[A] Sibekh[A]	Young shoots	GR, S	Snack[A,Y], boiled and fried with eggs[A,Y], pickled in brine (lacto-fermented)[A,YY]	S (pickled: AL), DF
Fagus orientalis Lipsky; Fagaceae (AMD05)	Chinariki[M]	Seeds	WO, A	Fried and consumed as a snack (like sunflower seeds)[MM]	A, OF
Fragaria vesca L., Rosaceae[#]	Getnamori[A]	Fruits	WO, S	Snack[A], jam[A]	S (preserves: AL), OF
Helianthus tuberosus L.; Asteraceae (AMD08)*	Getnakhəndzor[A] Sari khəndzor[A] Sevibanaghd[Y]	Tubers	AE, A	Snack[AA,YY]	A, OF
Heracleum trachyloma Fisch. & C.A.Mey. (AM12) and possibly *H. antasiaticum* Manden. (AMD07) and *H. pastinacifolium* C. Koch (AM43), Apiaceae	Akeria[G] Baldərghan[A,G] Barchovki[M] Borshevik[M] Kegh[A] So[Y] Sou[Y] Tatarskie kapuri[M]	Stems	GR, S	Snack[M,Y], pickled in brine (lacto-fermented)[AA,GG,MMM,YYY]	S (pickled: AL), DF
		Leaves	GR, S	Fried[GG,M], soups[M]	S, OF
Humulus lupulus L.; Cannabaceae (AM23)	Khmel[M]	Female inflorescences	WE, SU and A	Baker's "yeast balls" (*drodzy*—decoction mixed with bran and then dried)[M(in the past)]	AL, OF
Lathyrus cicera L., Fabaceae[#]	Sholak[Y]	Pods	GR, S	Snack[Y]	S, OF

Table 2 (continued)

Botanical taxa; botanical families (voucher specimen code)	Local names	Used parts	Gathering area and season	Traditional culinary uses and quotation frequency	Season and frequency of consumption
Lathyrus tuberosus L., Apiaceae[#]	Kochghes[A]	Bulbs	GR, S	Snack[A,YY]	S, OF
Malus orientalis Uglitzk. Ex Juz.; Rosaceae (AM32)	Mila[G] Vayri khənzor[A]	Fruits	AE, SU and A	Snack[A], compote[G], juice[A], molasse[A]	AL, DF
Malva pusilla Sm. (AM02) and *Malva neglecta* Wallr. (AM04); Malvaceae	Havi takhtik[A] Pipert[A,G] Pishink[M] Teluk[A] Tolək[Y]	Leaves	AE, S	Salads[A], boiled and fried with eggs[AAA,G(in the past), M,YY], soups[M]	S, DF
	Ghelut[A]	Fruits	AE, S	Snack[AA,M]	S, OF
Mentha longifolia (L.) L.; Lamiaceae (AM06, AM36, AMD02)	Daghdz[A] Pung[A,Y] Vejme[G]	Aerial parts	AE, S	Snack[A], seasoning[G,YY] (soup seasoning[GG], cheese seasoning[A]), recreational tea[AA,G,Y]	S (seasoning and tea: AL), DF
Papaver spp.; Papaveraceae[#]	Khash-khash[G]	Fruits	GR, S	Snack[G]	S, OF
Podospermum canum C.A.Mey.; Asteraceae[#]	Kasmatki[M]	Stems, leaves	AE, S	Snack[M]	S, OF
Polygonum aviculare L.; Polygonaceae (AM03)	Chənchəghpashar[A] Gusina travka[M] Nanjujək[Y] Sandrug[G] Sporish[M]	Young aerial parts	GR, S	Snack with salt[A,M,YY], fried with eggs[G,M], soups with cereals[A (in the past),YY]	S, DF
Portulaca oleracea L.; Portulacaceae[#]	Dandur[A]	Aerial parts	AE, SU	Fried[A], pickled in brine (lacto-fermented)[A]	SU (pickled: AL), DF
Populus alba L. Salicaceae[#]	Topol[M]	Seed "cotton"	WO, S	Chewed[M(in the past)]	S, OF

Table 2 (continued)

Botanical taxa; botanical families (voucher specimen code)	Local names	Used parts	Gathering area and season	Traditional culinary uses and quotation frequency	Season and frequency of consumption
Prangos ferulacea (L.) Lindl., Apiaceae and possibly *Bilacunaria microcarpa* (M.Bieb.) Pimenov & V.N.Tikhom., Apiaceae[#]	Kalamania[G]	Stems	GR, S	Boiled and then fried[G], pickled in brine (lacto-fermented)[GGG]	S (pickled: AL), DF
Primula veris L., Primulaceae[#]	Maranda[G] Vichak[A]	Flowers	WO, S	Snack[A,G], syrup[G]	S (preserves: AL), OF
Primula woronowii Losinsk.; Primulaceae[#]	Barashki[M]	Flowers	WO, S	Snack[M]	S, OF
Prunus mahaleb L.; Rosaceae (AM18)	Gilas[G]	Fruits	WO, A	Snack[GG], compote[G]	A (preserves: AL), OF
Prunus spinosa L.; Rosaceae (AM24)	Shəlor[Y] Tsyoren[M]	Fruits	WO, A	Compote[M,Y], jam[M]	A (preserves: AL), OF
Pyrus caucasica Fed.; Rosaceae (AM11)	Apidea[G] Apivè[G] Akhladia[G] Dikaia grusha[M] Karcin[Y] Panda[A]	Fruits	WO, A	Snack[G], compote[AA,GG,M,Y], jam[M,Y], *kulaga* (berry dessert)[M], pies[M], fermented and distilled[A,G]	A (preserves: AL), DF
Ribes armenum Pojark, Rosaceae[#]	Gharaghate[G]	Fruits	WO, S	Snack[G]	S, OF
Ribes nigrum L., Rosaceae[#*]		Leaves	AE, S	Dolma[G]	S, OF
Rosa canina L. (AM21) and *Rosa spinosissima* L. (AM34); Rosaceae	Masur[A,G] Shilan[Y]	Pseudofruits	WO, A	Snack[Y], compote[Y], juice[AA,GGG,Y], recreational tea[A,G,Y], fermented in wine[Y]	A (preserves and wine; AL), DF

Table 2 (continued)

Botanical taxa; botanical families (voucher specimen code)	Local names	Used parts	Gathering area and season	Traditional culinary uses and quotation frequency	Season and frequency of consumption
Rubus armeniacus Focke (AM33) and possibly other *Rubus* spp.; Rosaceae	Aigharasia[G] Malina chernaia[A] Mosh[A]	Fruits	WO, SU	Snack[A,G], compote[G], jam[A,G]	SU (preserves: AL), DF
Rubus idaeus L.; Rosaceae[#]	More[G]	Fruits	WO, SU	Snack[G], compote[G], jam[G]	SU (preserves: AL, DF
		Leaves	WO, S	Dolma[G]	S, OF
Petasites sp., Asteraceae[#]	Loshtak[A]	Leaves	WE, S	Dolma[A]	S, OF
Pimpinella spp., Apiaceae[#]	Andison[G]	Fruits	GR, SU	Seasoning for pickles[G]	AL, OF
Rumex acetosa L. (AM31) and *R. acetosella* subsp. *acetoselloides* (Balansa) Den Nijs; Polygonaceae (AM38)	Sariplar[A] Shavel [M] Stupitsas[G] Ttu lavash[A]	Leaves	AE and GR, S	Snack[GG], soups[GG,MMM], sweet pies[MM]; preserved dried[GG]	S (dried: AL), DF
Rumex alpinus L. Polygonaceae (AM01)	Pejak[A]	Stems	GR, S	Snack[A]	S, OF
Rumex crispus L. (AM10, AM16), *Rumex obtusifolius* L. (AM09), and possibly *R. patientia* L.[#]; Polygonaceae	Aveluk[A,G] Avluk[G] Tərsho[Y] Tursho[Y] Turshu[Y]	Leaves	AE and GR, S	Boiled and eaten with garlic and other seasoning [AA,GG,YY], fried with eggs[AAA,GG,Y], soup with cereals[AA,G,YYY], pickled in brine (lacto-fermented)[Y] and preserved dried for winter[AAA,GG,YYY]	S (dried and pickled: AL), DF
Sempervivum caucasicum Rupr.; Crassulaceae[#]	Lavash[A]	Leaves	GR, S	Snack[AA]	S, OF

Table 2 (continued)

Botanical taxa; botanical families (voucher specimen code)	Local names	Used parts	Gathering area and season	Traditional culinary uses and quotation frequency	Season and frequency of consumption
Silene latifolia Poir. (AM40); Caryophyllaceae and possibly *Plantago major* L.; Plantaginaceae[#]	Yezan lezu[A]	Leaves	GR, S	Dolma[A]	S, OF
Sorbus aucuparia L.; Rosaceae[#]	Aroseni[A] Atkitia[G]	Fruits	WO, A	Snack (after first frost)[GG], compote[A], fermented and distilled[AG]	A (preserves: AL), OF
Taraxacum campylodes G.E.Haglund; Asteraceae (AM39)	Khatutik[A] Oduvanchiki[G]	Leaves	AE, S	Salads[A,G]	S, OF
		Flowers	AE, S	Syrup[G]	S, OF
Thymus kotschyanus Boiss. & Hohen.; Lamiaceae (AMD03, AMD04)	Chebrets[M] Jantri[Y] Jatri[Y] Timbira[G] Urtz[A]	Aerial parts	GR, SU	Seasoning[A,G,M,YYY] (cheese seasoning[AA]), recreational tea[A,M,Y]	AL, DF
Tragopogon spp.; Asteraceae[#]	Ketket[Y] Səpəng[Y] Sinch[G] Sindz[A] Zunzunas[G]	Young shoots (with flower buds)	GR, S	Snack[A,GG,YYY]	S, DF
		Young roots	GR, S	Chewed[YYY]	S, OF
Tussilago farfara L.; Asteraceae (AM35)	Hortmair[A] Loshtak[A] Tatrak[A]	Leaves	WE, S	Dolma[A,G,M]	S, OF
		Stems	WE, S	Snack[A]	S, OF

Table 2 (continued)

Botanical taxa; botanical families (voucher specimen code)	Local names	Used parts	Gathering area and season	Traditional culinary uses and quotation frequency	Season and frequency of consumption
Urospermum picroides (L.) Scop. ex F.W.Schmidt; Asteraceae (AM22)	Garlupa[M]	Stems	GR, S	Eaten raw as snack[M]	S, OF
Urtica dioica L.; Urticaceae (AM13)	Gasgask[Y] Gesges[Y] Gesgesk[Y] Haghinj[A] Yeghinj[A] Kandea[G] Keshkejuk[A] Kindea[G] Krapiva[M]	Young aerial parts	AE, S	Salads[A], boiled[G,Y], fried with eggs[A,YY], as a vegetable ingredient in meatballs[A], soups [AAA,GG,MM, YY], pickled in brine (lacto-fermented)[Y]	S (pickled: AL), DF
		Leaves	AE, S	Snack with salt and bread[AA,GG,Y], dolma[M]	S, DF
Viburnum lantana L.; Adoxaceae[#]	Chornaya kalina[M]	Fruits	WO, A	Snack[MM]	A, OF
Unidentified Apiaceae sp. (possibly *Ferula* or *Bilacunaria* spp.)	Chertika[G] Chiavik[G] Chikitem[G]	Stems	GR, S	Pickled in brine (lacto-fermented)[GG]	AL, OF
Unidentified Apiaceae sp.	Chirè[G] Kira[G]	Stems	GR, S	Snack[G], pickled in brine (lacto-fermented)[G]	S (pickled: AL), OF
Unidentified Asteraceae sp.	Konkulech[G]	Stems	GR, S	Snack[G]	S, OF
Unidentified Fabaceae sp.	Ket[Y]	Leaves	GR, S	Snack with salt[Y]	S, OF
Unidentified taxon	Alafofoshkas[G] Alofofoshkas[G]	Young aerial parts	GR, S	Boiled and fried[G], pickled in brine (lacto-fermented)[GG]	S (pickled: AL), OF
Unidentified taxon	Chokuk[A]	Stems	GR, S	Snack[A]	S, OF

Table 2 (continued)

Botanical taxa; botanical families (voucher specimen code)	Local names	Used parts	Gathering area and season	Traditional culinary uses and quotation frequency	Season and frequency of consumption
Unidentified taxon	Maduk[A]	Roots	GR, S	Snack[A]	S, OF
Unidentified taxon	Molokashki[M]	Stems	WO, S	Snack[MM]	S, OF
Unidentified taxon	Peshkapuk[A]	Stems	GR, S	Snack[A]	S, OF

AE anthropogenic environments, *GR* grassland, *WE* wetland, *WO* Woodland, *S* spring, *SU* summer, *A* autumn, *W* winter, *AL* all through the year, *DF* daily food, *OF* occasional food

[#]Identification made on the basis of plant description, folk names, and/or pictures provided by the informants

[*]Cultivated taxon (whose recorded folk culinary use is "unusual")

[A]Folk name(s) recorded among Armenians; [G]Folk name(s) recorded among Greeks; [M]Folk name(s) recorded among Molokans; [Y]Folk name(s) recorded among Yazidis

[X]Rarely quoted (less than 20% of study participants); [XX]Commonly quoted (10–40% of informants); [XXX]Very commonly quoted (more than 40% of informants)

All of the quoted wild plants are very widely available in the natural environment of the study area, and not a single taxon represents a threatened or rare species. This confirms the intrinsic sustainable nature of traditional foraging in central Armenia, where most plants collected by Armenians, Yazidis, and Pontic Greeks are gathered from pastures, while Molokans seem to also favor weeds found around houses and home gardens. Greeks and Molokans gather some plants from the forest as well. This pattern is linked to the fact that Armenians and Yazidis are still traditionally engaged in shepherding activities, while Molokans are primarily horticulturalists and, together with Pontic Greeks, still actively involved in the management of forests (see Table 1). Moreover, both pastures and forests, and the communal land which provides access to them, is free to every community member in the study area.

The wild vegetables gathered in mountain pastures are mainly crunchy aerial shoots belonging to the Apiaceae family, which are nowadays largely consumed as a side-dish only after lacto-fermentation (Fig. 3), but which in the past possibly represented snacks to be consumed on the spot.

Very rarely a few wild vegetables and culinary herbs are preserved for the winter in dried form, such as *Rumex* spp., *Thymus kotschyanus* (these two genera are also very often sold in farmers' markets) and *Chenopodium album* (Fig. 4).

A large portion of the recorded taxa has also been previously recorded in Armenia (among Yazidis and Kurds), as well as in Georgia and Azerbaijan (see aforementioned literature), suggesting a common foraging ground in the Caucasus, due to both similar mountainous environments and especially socio-cultural contexts, the latter possibly reinforced during the Soviet period. In particular, the common food uses of *Allium paradoxum, A. victorialis, Anthriscus, Chaerophyllum, Falcaria, Heracleum, Portulaca, Prangos,* and *Rumex* spp. (mostly preserved in the form of lacto-fermented pickles) could possibly be considered part of a "pan-Caucasian" bio-cultural gastronomic heritage, which also has important links to Turkish, Kurdish and Western Persian wild food ethnobotany (Pieroni and Sõukand 2017; Pieroni et al. 2018, 2019, and references therein).

Fig. 3 Lacto-fermented *Falcaria, Chaerophyllum*, and *Heracleum* spp. stems

Fig. 4 *Chenopodium, Rumex,* and *Thymus* spp. stored for winter

3.2 Cross-cultural comparison

Figure 5 presents a Venn diagram showing the overlap among the four studied communities (number of cited folk taxa) and the related Jaccard Similarity Indexes.

Molokans and, more remarkable, Yazidis gather less wild food plants and share only a few plants with Armenians. This may be due to the fact that these ethno-religious groups have followed endogamic marriage patterns for centuries, which may have limited the exchange of plant knowledge and practices with their Armenian neighbors, and also to the difficult adaptation to a new natural and socio-cultural environment. Additionally, Yazidis, who moved from Eastern Anatolia and the Nineveh Plains to the study area approximately one century ago, may not have encountered in the new natural environment the flora with which they were familiar in their area of origin. This could also explain why Yazidis gather fewer wild food plants in comparison to Molokans.

In other studies we conducted among diaspora, we hypothesized that migrants preserve more restricted wild plant repertoires not necessarily only because of the lack of availability of certain natural resources in the new environment, but possibly also because of complex cultural adaptation processes (Pieroni and Quave 2005). Yazidis in central Armenia seem to have focused much less than the other groups on using wild food plants: they exhibit only one *plant cultural marker* (sensu Pieroni et al. 2015), in contrast to the other groups which show 13, 12, and 10 uniquely used wild taxa.

This peculiar pattern may also be due to a difficult social adaptation to the new environment: Yazidis, in fact, represent the most economically disadvantaged group in the study

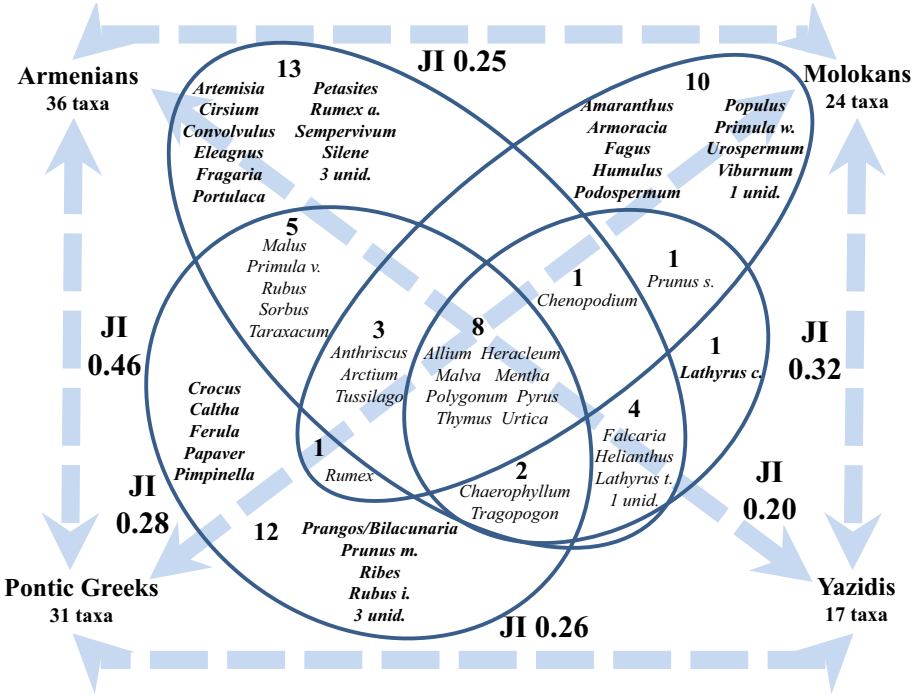

Fig. 5 Venn diagram showing the overlap among the four studied communities for the recorded wild food taxa and related Jaccard Similarity Indexes (JIs)

area and this may have affected, and may continue to affect, the *cultural and practical space* (i.e. access) in which experimenting with new food plants could take place.

The traditional practice of gathering wild plants for food is, however, still vividly alive among all considered locals in central Armenia and at least a part of this bio-cultural heritage could represent one of the future pillars of local sustainable food systems and platforms.

Armenians and Greeks share some important similarities and approximately half of their gathered taxa are identical, which may be due to the fact that these groups share the same religion and have historically had frequent inter-marriages.

The idea that religious affiliation may play a crucial role in informing kinship relations and subsequently the vertical transmission of TK confirms the main results of a few other recent studies conducted by our research group in Europe (Bellia and Pieroni 2015; Pieroni et al. 2015; Pieroni and Sõukand 2019) and the Middle East (Pieroni et al. 2018).

Moreover, the wild food plants exclusively used by the Molokan community include two forest genera (*Fagus* and *Viburnum*) and four weedy taxa (*Amaranthus, Armoracia, Humulus and Urospermum* spp.), which seems to confirm the prominent horticultural nature of this group.

3.3 Wild food plants in Armenia: archaic ingredients or novel/new sustainable foods?

While the European Union defines *novel foods* as those items not consumed "significantly" prior to May 1997 and, therefore, mainly includes food types from new sources, new substances used in food, as well as new ways and technologies for producing food (EFSA 2019), wild food plants represent ancient food sources emerging from human substance economies, ranging from hunting and gathering societies to post-Neolithic horticultural and pastoralist communities.

Particularly within the context of the Mediterranean, the Middle East, and the Caucasus, foraging for weedy plants might have increased during the Neolithic Revolution, when populations have possibly started to preferably gather species growing around cultivated horticultural areas (Leonti 2012; Pieroni et al. 2018; Pieroni and Cattero 2019). Most of these weedy species have a bitter or pungent taste, which is also a distinctive characteristic of the wild portion of the Mediterranean Diet (Della et al. 2006; Nebel et al. 2006; Rivera et al. 2006; Biscotti and Pieroni 2015).

We also believe that after the Neolithic period the foraging of wild plant "snacks" (possibly derived from pre-existing practices), which grow in pastures where nomadic and semi-nomadic shepherding communities used to bring their herds to graze (Pieroni et al. 2019; Mattalia et al. submitted), may have intensified.

From the perspective of human ecology, the foraging of wild food plants in the study area, therefore, represents a way of optimizing the sustainable use of widely available natural resources, contributing to the food security of local communities with relatively little expenditure of time and energy. Thus, knowledge and practices, including both environmental and culinary aspects, need to be actively preserved.

Food security has been defined by FAO in 1996 as a situation in which "all people at all times have physical, social and economic access to food, which is safe and consumed in sufficient quantity and quality to meet their dietary needs and food preferences, and is supported by an environment of adequate sanitation, health services and care, allowing for a healthy and active life" (FAO 2008). In other words, in relation to the concept of food security the key issue of *access* is central: access does not only mean, therefore, the availability of food, but also the possibility of obtaining it both physically and socio-economically and within a context of adequate health care. All these aspects are ensured by the traditional foraging of wild food plants we analyzed in central Armenia.

The recorded plants are in fact available in the natural environment and most of them are even quite easily physically accessible in private home-gardens, as well as communal lands and forests. Moreover, it is increasingly known that wild food plants (especially wild vegetables) may have a beneficial effect on human health (Heinrich et al. 2005; Bvenura and Sivakumar 2017; Aworh 2018; Savo et al. 2019).

Food insecurity in the world, caused by demographic factors, the industrialization of agriculture and environmental deterioration, can therefore be seriously addressed by reconsidering and revitalizing the rich bio-cultural food heritage that local communities have shaped over centuries (Declaration of Nyéléni 2007; Gordillo and Jerónimo 2013) and which represents a focal component of sustainable food systems (Nabhan 2014). Armenia, along with Georgia, has the highest hunger index in Europe, despite the fact that hunger decreased more than 50% in the last two decades (Global Hunger Index 2019). In order to implement food security in Armenia, the recorded local wild food plants will need to be promoted via appropriate education tools within the country and perhaps become the focus

of niche local food products that could be internally marketed (Table 3), especially—but not exclusively—in local farmers' markets and within eco-tourism and agro-tourism initiatives. Only a few recorded wild plants (most notably, young stems and shoots of *Allium victorialis*, *Chaerophyllum, Portulaca* and *Prangos,* and possibly *Bilacunaria* spp.) are processed in domestic arenas or by small-scale food factories (pickled in brine, or lacto-fermented, in glass jars) and are currently sold both in farmers' markets and by a few retailers in the largest urban centers. The large majority of the recorded wild plants, however, do not yet reach the market, despite their remarkable potential.

Food ethnobiological field studies, therefore, play an essential role in what we nowadays call *foodscouting*, i.e. recognizing, documenting, valorizing, and—together with local communities—disseminating the unique and diverse local food resources of the world. This would subsequently help stimulate the creation of platforms where the diverse actors of the foodscape could encourage small scale entrepreneurs, local communities, and neighboring consumers to expand their dietary repertoire (Slow Food 2019).

In contrast, the perceptions, knowledge and practices concerning the plant items we recorded, as well as their cooking processes and consumption contexts, represent the result of complex co-evolution between local populations and the natural environment, which have ultimately built their resilience over centuries (Berkes et al. 2003). This complex and diverse heritage, therefore, needs to be not only dynamically preserved in bio-conservation and cultural heritage-driven strategies but also concretely put at the center of rural development programs in order to foster culturally-sensitive endogenous solutions aimed at shaping food sustainability and food security (Bvenura and Afolayan 2015).

Additionally, a lot of work is still needed at the crossroads between *foodscouting* and public health/nutritional governmental strategies in fostering projects aimed at improving food diversity and at promoting health. To achieve these goals, appropriate educational

Table 3 Possible wild food plant-derived central Armenia local products that could be promoted in the near future (for description of the wild plant ingredients and their processing see Table 2)

Food product	Botanical name(s) of the wild food plant ingredients
Dried fat hen	*Chenopodium album*
Dried wild hop baker's "yeast balls"	*Humulus lupulus*
Grated wild horseradish in vinegar	*Armoracia rusticana*
Motal ewe/goat cheese seasoned with wild garlic and wild thyme	*Allium paradoxum* and *Thymus kotschyanus*
Pickled cow parsnip	*Heracleum* spp.
Pickled prangos and bilacunaria	*Prangos ferulacea and Bilacunaria microcarpa*
Pickled wild chervil	*Anthriscus nemorosa* and *Chaerophyllum bulbosum*
Pickled wild garlic	*Allium paradoxum* and *Allium victorialis*
Pickled wild purslane	*Portulaca oleracea*
Preserved mixed wild *dolma*	*Plantago major, Rubus ideaus, Silene latifolia,* and *Tussilago farfara*
Rowan jam and compote	*Sorbus aucuparia*
Sea buckthorn jam and compote	*Elaeagnus rhamnoides*
Sloe jam and compote	*Prunus spinosa*
Wild apple jam, compote and molasses	*Malus orientalis*
Wild Mahaleb cherry jam and compote	*Prunus mahaleb*
Wild pear jam and compote	*Pyrus caucasica*

platforms able to regenerate local knowledge systems among the younger and middle-aged generations, as well as public engagement for increasing awareness among all citizens regarding the importance of neglected and disappearing traditional food ingredients, will be essential.

4 Conclusion

The traditional practice of gathering wild plants for food is still very much alive among locals in central Armenia and this bio-cultural heritage could represent one of the pillars of future local sustainable food systems and platforms.

While Armenians and Greeks gather a remarkable number of wild food plants and share approximately half of them, Molokans and, more remarkable, Yazidis gather less wild food plants and share only a few plants with Armenians. This may be due to the fact that the latter ethno-religious groups have followed endogamic marriage patterns for centuries, which may have limited the exchange of plant knowledge and practices with their Armenian neighbors and also to the difficult adaptation to a new environment that Yazidis experienced after moving from Eastern Anatolia and the Nineveh Plains to the study area around one century ago.

As the recorded wild plants entirely represent widely available species belonging to the local biodiversity, the recorded neglected food plant ingredients could play a role in Armenia in shaping culturally appropriate policies of rural development and eco-tourism, which may be particularly important in peripheral, less-advantaged, mountainous areas.

Moreover, the current study may suggest that some of these food sources could also be important for coping with food insecurity, especially within the most disadvantaged households and among Yazidi families.

Some of these food ingredients (for example, the wild food plants uniquely used by each group) represent identity-drivers that could promote the local gastronomic heritage of the different studied communities. For each of these communities, the culturally more salient wild food plants occasionally represent identity-drivers and could help locals in promoting their specific gastronomic heritage.

Finally, it will also be important to link this work to further nutraceutical studies aimed at evaluating the biologically beneficial properties of these wild food botanicals and associated dishes and their possible effects in the prevention of diseases, which could in turn help further national and regional institutions and food activism in promoting local wild plant food ingredients.

Acknowledgements We are grateful to all the study participants who shared their plant knowledge with the field researchers; to the Italian Ministry of Foreign Affairs and International Cooperation (MAECI), who financed the field study within its program for archeological and ethnological missions abroad (Grant Number 2019/368); and to the University of Gastronomic Sciences, Pollenzo, for having additionally contributed to the research funding.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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