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Beyond the border: comparative ethnobotany in Valmalenco (SO, Italy) and Valposchiavo (Canton of Grisons, Switzerland)

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Abstract

Background The ethnobotanical analysis of two bordering areas allows for the in-depth understanding of the dynamics of Local Ecological Knowledge, which mirrors the naturalistic, historical, and sociopolitical features of each area. As part of the Interreg Italy-Switzerland B-ICE&Heritage and GEMME projects, this work is an ethnobotanical comparative study of two neighboring Alpine territories: Valmalenco (Italy) and Valposchiavo (Switzerland).

Methods A total of 471 informants were interviewed on different fields of use (medicinal, food, veterinary, etc.). All data were organized in Excel™ spreadsheets. Informant Consensus Factor was calculated for the pathologies reported. Jaccard's similarity indices were calculated to compare the Valmalenco and Valposchiavo areas. Subsequently, another comparison between Valmalenco/Valposchiavo and Italian/Swiss Alpine neighboring areas was carried out.

Results The number of taxa for Valmalenco was 227 (77 families) and 226 in Valposchiavo (65). Out of the 10 most cited species, 7 were mentioned in both. *Arnica montana* L. was the most cited in Valmalenco, and *Sambucus nigra* L. in Valposchiavo. The 5 most cited families were the same. Regarding the medicinal and food fields, the similarity indices were fairly low (0.31 and 0.34 for the species; 0.22 and 0.31 for the uses). Concerning the comparison with Italian and Swiss Alps, similarity values were slightly higher with Italy (Valmalenco food species: 0.38 with Italy and 0.26 with Switzerland, medicinal: 0.26 IT and 0.14 SW; Valposchiavo food species: 0.36 with IT and 0.26 with SW, medicinal: 0.21 IT and 0.14 SW).

Conclusion Although Valmalenco and Valposchiavo partly share natural environment, language, history, and culture, they had low similarity indices. They both seemed to have more similarities with Italy than Switzerland, maintaining low values with the surrounding territories too. They showed a common core of Local Ecological Knowledge with several divergent branches possibly due to pivotal historical happenings, as well as more modern external influences.

Keywords Local Ecological Knowledge, Valmalenco, Valposchiavo, Borders, Similarity index

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Background

Alpine regions have always been characterized by a rich and complex plant biodiversity, due to their peculiar pedoclimatic features. Unfortunately, these areas are currently also among the most prone to suffer the consequences of the ongoing climate crisis, particularly on account of the receding glaciers and the alteration of the precipitation patterns [1, 2]. Other than this naturalistic and floristic value, these regions also boast a distinctive legacy of centuries-old Local Ecological Knowledge (LEK), specifically revolving around spontaneous plants of the territory and their traditional uses, as corroborated by ethnobotanical investigations carried out along the Alps [3–14]. Traditional uses of plant species by local communities in fact constitute incontrovertible evidence of the strong and vital connection between human beings and their surrounding environment: to investigate and preserve these uses means to defend the environment and the local communities as well.

Between 2018 and 2023, the Interreg Italy-Switzerland B-ICE & Heritage project and its natural continuation, the Interreg Italy-Switzerland GEMME project, were born and carried out with the main purpose of preserving and enhancing the territory around the highest mountain of Lombardy (Pizzo Bernina 4050 m a.s.l.), by promoting new ways of sustainable fruition of the Alpine valleys that lie on both sides of the Pizzo, namely Valmalenco and Val Bregaglia in Italy, Valposchiavo and Upper Engadine in Switzerland [15]. The extraordinary biological and cultural diversity that defines this junction point can easily represent a precious means to abide by the projects' main objectives, as a distinctive and identitarian feature of the area. In the framework of these very projects, ethnobotanical surveys were carried out first in Valmalenco (SO, North of Italy, 2019–2022) and then in Valposchiavo (Canton of Grisons, Switzerland, 2023).

In the last few years, the significance of investigating from an ethnobotanical point of view the territories along a border has been thoroughly assessed by several authors [16–22]. These authors focused their attention on the medicinal, food, and veterinary uses on both sides of a geographical or political border, and the transmission patterns involved, especially in Central and South Asia [16], in the Caucasus region [17], Southeastern Europe [18, 20], but also in Italy [19]. In their work from 2020, for example, Mattalia et al. investigated similarities or discrepancies that could be found between two communities of different languages living in two neighboring territories of the same North Italian region (Friuli Venezia Giulia), thus underlining that sometimes a border is cultural and linguistic, more than physical [22]. According to Prakofjewa et al. ([21] and literature within), a geographical, political, or cultural border between two neighboring territories could act either as a semi-permeable filter or a barrier, depending on their naturalistic, historical, and sociopolitical features. As a result, the LEKs of these areas would mirror these characteristics, by overlapping to different extents so as to share common ground or differ altogether ([21] and literature within).

Either way, ethnobotanical surveys along borders could undoubtedly provide precious information at a given time on the ever-moving processes of 'active diffusion' and 'speciation' of traditional knowledge between two neighboring areas. The phenomenon of 'active diffusion', for example, is possibly supported by the same surrounding environment, from a naturalistic perspective, as well as by peculiar geographical-economic and historical-political dynamics. At the same time, political and religious conflicts over the centuries may be considered promoters of a potential 'speciation' of the LEKs.

With all this in mind, in the study presented herein we focused our attention on conducting ethnobotanical investigations throughout the territories of Valmalenco and Valposchiavo, thus abiding by the objectives of the Interreg B-ICE & Heritage and GEMME projects. Specifically, we: *a)* made a comparison between the two valleys by highlighting both the similarities and discrepancies in their LEKs; *b)* compared the LEKs of Valmalenco and Valposchiavo to the ones of neighboring Italian and Swiss Alpine territories; and *c)* made hypothesis on how external factors may have influenced the LEKs. Finally, we emphasized the pivotal role of the traditional uses of autochthonous spontaneous plant species in preserving and promoting the identity and precious cultural heritage of a territory.

Methods

Study areas

Valmalenco

Valmalenco is an Alpine valley lateral to Valtellina, in the province of Sondrio (Lombardy, North of Italy). Its mountainous territory extends for 15 km from Sondrio toward Pizzo Bernina and is embedded within the Rhaetian Alps. At the bottom of its steep slopes, the Mallero stream flows into the Adda river [23].

The territory is characterized by a diverse vegetation depending on altitude: from the inferior sub-mountainous and mountainous regions, with their broad-leaved woods, through the conifer forests of the superior mountainous region and the ericaceous and juniper shrub lands, it is possible to reach the Alpine tundra and lichen of the snow line [24].

The ethnobotanical survey presented herein was carried out throughout all 5 municipalities of the valley: Caspoggio (1098 m a.s.l.), Chiesa in Valmalenco (960 m

a.s.l.), Lanzada (1000 m a.s.l.), Spriana (754 m a.s.l.), and Torre di Santa Maria (795 m a.s.l.).

Valposchiavo

Valposchiavo lies on the Southern side of the Rhaetian Alps and, along 25 km only, it covers almost 3500 m of height difference (from the mouth of the Poschiavino river at 414 m a.s.l. to the Piz Palü at 3905 m a.s.l.) [25]. Though from the sub-mountainous regions to the snow line Valposchiavo shares the same type of vegetation as Valmalenco, the lower altitudes at the bottom of the valley allow for the presence of Southern plant species, as well as peculiar cultivated species, such as *Vitis vinifera* L. and *Nicotiana tabacum* L. [26].

The ethnobotanical survey was conducted in the municipalities of Brusio (780 m a.s.l.), Miralago (967 m a.s.l.), and Poschiavo (1014 m a.s.l.).

Historical background

For centuries, crossing Rhaetian Alps from Valtellina (province of Sondrio) in Italy to the Canton of Grisons in Switzerland (see Map in Fig. 1) was eased by the presence of a direct passageway that went through Valmalenco, known as *Strada Cavallera del Muretto.* This path, trailed by troops, merchants, smugglers, farmers, and travelers since the ancient Romans, was a major source of exchange of goods, livestock, news, secrets, and knowledge [27, 28].

Through the *Cavallera del Muretto*, Valmalenco was directly linked to the Upper Engadine, from where Valposchiavo was easily accessed through the Bernina Pass. The *Strada Cavallera del Muretto* remained one of the easiest and most direct ways to reach the Canton of Grisons for centuries, allowing Valmalenco to be at the heart of a crucial and lively path until the second half of the eighteenth century. By that time, the transport of goods had been gradually transferred to more convenient pathways, such as the Bernina and the Spluga Passes. Although Valposchiavo could also be reached from Valmalenco (and still can be) thanks to another less accessible and less traveled eastern Pass, known as Pass *d'Uer*, the discontinuation of trading on the *Cavallera* resulted in the closure of this main path and subsequently led to the progressive isolation of Valmalenco in the nineteenth century [28]. Additionally, perhaps also due to the presence of this passageway, Valmalenco and Valposchiavo mostly suffered the same fate throughout history, by sharing for a long time invaders, rulers, religions. In fact, religion was one of the leading causes of conflict between Valposchiavo and Valmalenco. During the second half of the sixteenth century, the mainly peaceful, albeit difficult and forced, cohabitation between Catholics and Reformed Protestants throughout the valleys on Italian territory (Valmalenco, but also Valtellina and others) began simmering with old resentments. This situation came to a head during the summer of 1620, in what is

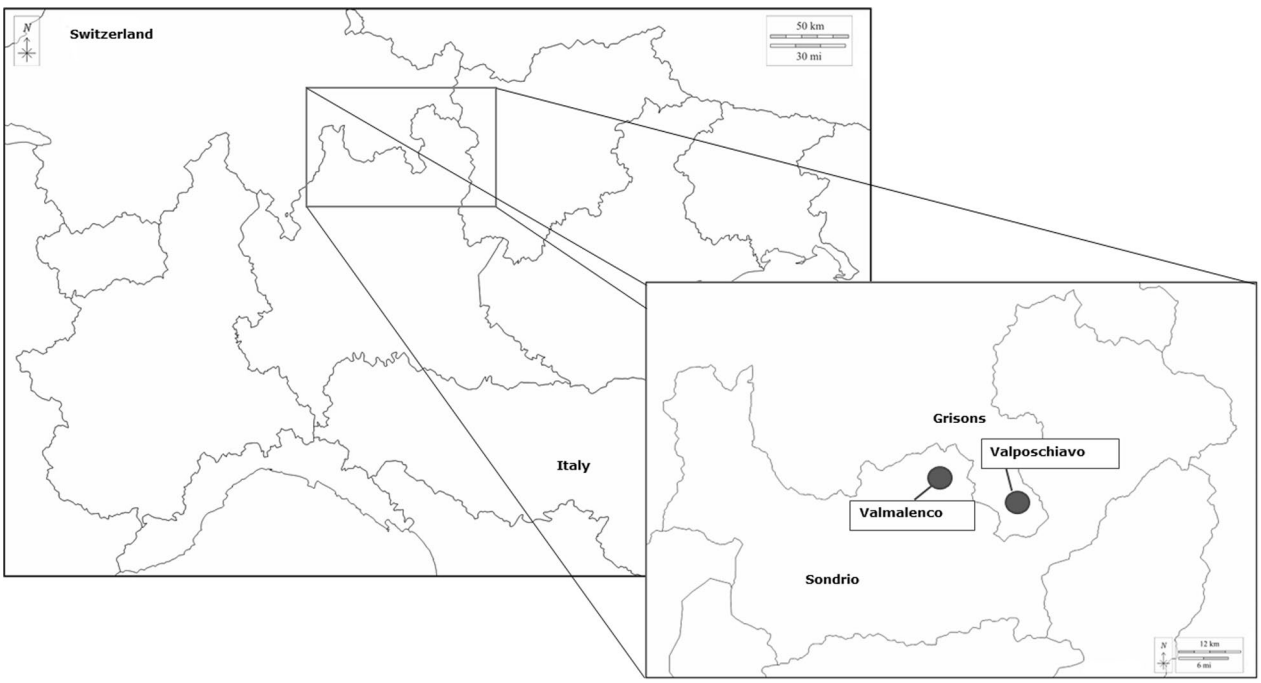

Fig. 1 Bordering Alpine territories of Valmalenco (province of SO, Lombardy, Italy) and Valposchiavo (Canton of Grisons, Switzerland). Maps modified from https://d-maps.com/m/europa/italia/italienord/italienord16.pdf and https://d-maps.com/m/europa/italia/sondrio/sondrio06.pdf

now known as the Valtellina Massacre of Protestants [29, 30]. This event completely erased the Protestant creed in the Italian valleys, where it became an old and fading memory, while remaining strong in Valposchiavo.

Ethnobotanical survey

The two ethnobotanical surveys were conducted at different times, namely from June 2019 to April 2022 in Valmalenco and from June to September 2023 in Valposchiavo. Further information on the number of interviews per year per municipality can be found in Table 1.

Prior to the field work, preliminary bibliographic investigations on the two areas and the spontaneous flora of Valmalenco and Valposchiavo were performed through the consultation of local botany textbooks (reference). The lists of wild species, along with the respective photographic archive, were produced to help the informants identify the plants during the interviews. The selection process of the informants was the same in both territories: we were able to reach the first informants in Valmalenco and Valposchiavo through personal acquaintances and we then proceeded with the snowball sampling approach, with no restriction of age, nor of social or cultural background. We selected mainly residents, but also returning vacationers who had been visiting the valleys for at least 20 years. For this last type of informants, we removed any information that wasn't linked to the traditions of the territories. Open and semi-structured interviews were carried out in Italian, according to both the Ethical Guidelines of the International Society of Ethnobiology and the Guidelines put forth by the Ethical Committee of the University of Milan [31]. Every informant was given complete information regarding methods, scopes, and aims of the projects. With respect to anagraphical data, we took steps to ensure a minimum use of personal and identifiable information. For example, we opted to classify the informants in age ranges instead of using their exact birth date. We lead the interviews through some questions, such as: *1)* Do you use any plants in your everyday life and how? *2)* What part of the plant do you use? *3)* (If medicinal) How do you prepare and administer the remedy? *4)* Where do you find the plants? Do you also cultivate them in your garden? *5)* Who did you learn from? *6)* Is this something you do yourself or do you know someone else who use this plant?

The informants were left as free as possible to reminisce and narrate their stories. We did not record the interviews, but extensive notes were taken by at least one member of the research group. The following data about the plant species and their uses were collected: taxon identification, common and vernacular names (phenomena of under- and over-differentiation in the identification of the species by the locals were noted during the interviews and the information subsequently archived), sector of use (11 sectors: agropastoral, artisanal, domestic, food, hunting_fishing, magic_medicinal, magic_ritualistic_superstitious, medicinal, recreational, religious, and veterinary), part of the plant used, detailed use, forms of preparation and administration (applicable to the medicinal field). All ailments mentioned in the medicinal sector were inserted in 17 categories of use that fit best with data acquired during the interviews, after adjusting the categories of Economic Botany Data Collection Standards [32, 33]. The complete dataset was organized in Microsoft Excel™ sheets. Each row

Table 1 Number of interviews per year per municipality conducted in the two valleys between 2019 and 2023

Valmalenco	**2019**	**2020**	**2021**	**2022**	**2023**	**Total number of informants per municipality**
Caspoggio	137	1	0	14	0	**152**
Chiesa in Valmalenco	73	51	0	16	0	**140**
Lanzada	61	9	0	2	0	**72**
Spriana	0	0	7	4	0	**11**
Torre di Santa Maria	4	0	22	0	0	**26**
Informants Valmalenco per year	**275**	**61**	**29**	**36**	**0**	**401**
Valposchiavo	**2019**	**2020**	**2021**	**2022**	**2023**	**Total number of informants per municipality**
Poschiavo	0	0	0	0	70	**70**
Informants Valposchiavo per year	**0**	**0**	**0**	**0**	**70**	**70**

Bold values indicate the totals of informants per year or per municipality

of the dataset represented a use report (UR), defined as a single use reported for a single species by a single informant. The use reports (URs) were considered as "distinct" if differing in at least one of the following columns: species, informant, sector of use, category of use, detailed therapeutic use (if medicinal use), part of the plant, form of preparation, and way of administration. The standardization while filing the datasets helped us in data browsing, in data analysis with Pivot tables and charts, and in statistical elaboration. Each informant was recorded with a one-to-one identification code. Plant species' identification was performed in the field by Professor Gelsomina Fico, Professor Claudia Giuliani, and Dr. Paola Sira Colombo following Pignatti et al., 2017 [34]. Herbarium specimens of the most relevant species were collected and deposited in the *Herbarium* of the G.E. Ghirardi Botanical Garden of the University of Milan (DISFARM, Toscolano Maderno, Brescia, Italy). When collecting herbarium specimens was not possible, for example because of the high number of species used, the weather, and the not always favorable periods of time spent *in loco*, pictures of the species were taken by both the members of the research group and the informants during and after the field work to facilitate or confirm the identification. Voucher codes for herbarium specimens and species pictures were appointed and recorded in Table S1. The botanical names of all the species and botanical families were reported according to https://www.worldfloraonline.org/ (last accessed May 2024) [35]. *Cetraria islandica* L. (Icelandic moss, family Parmeliaceae), though being a lichen, was included in the list of plant species.

The Informant Consensus Factor (ICF) was calculated following Trotter and Logan, 1986 [36] to identify the main categories of pathology cited by the informants and determine the agreement concerning the use of medicinal plants for the treatment of a specific ailment. The closer ICF is to 1, the higher the agreement. It was calculated as follows: ICF: (nur—nt)/(nur—1); where nur represents the number of URs for each category of use (apparatus) and nt the number of species used for each category.

Jaccard's Similarity Index

Jaccard similarity indices (JI) were calculated according to the following formula:

$$JI = (C/(A + B - C))$$

where A is the number of species in sample A, B is the number of species in sample B and C is the number of species common to A, and B. JI ranges between 0 and 1 and the closer to 1, the higher the similarity between the two areas.

Comparison with neighboring Alpine territories

We compared the species used in the medicinal, veterinary, and food sectors in our field surveys with the species used in the neighboring Italian and Swiss Alpine territories, taking into account the available literature for both sides [3, 5, 7, 9, 14, 37–41]. For the Italian side, we focused our attention especially to the Lombardy region.

Statistics

To identify the most used plant taxa, the most frequently reported food and medicinal categories in Valmalenco and Valposchiavo, and to verify the overlaps between the two areas, 3D scatter plots were designed in Statistica for Windows 2007–2012 software packages (StatSoft Inc. STATISTICA, 2010, version 10.1.). Spearman's test was used to correlate the number of common uses and the number of different uses for the reported taxa. To compare food and plants species used in the investigated valleys with those reported in neighboring areas both in Italy and Swiss, we performed Venn plots by using past software version 4.16 [42].

Results and discussion

Overview of the results in Valmalenco and in Valposchiavo

We interviewed 471 people: 401 in Valmalenco (123 men and 278 women; age ranges went from 10–19 to 90–99) and 70 in Valposchiavo (30 men and 40 women; age ranges went from 20–29 to 80–89). A total of 17,949 URs for 321 taxa were recorded during the field work. Informants from Valmalenco cited 227 taxa belonging to 77 botanical families. The most relevant species were *Arnica montana* L. (n. of URs = 784; 5.7% of total URs), *Vaccinium myrtillus* L. (761; 5.5%), and *Achillea erba-rotta* All. subsp. *moschata* (Wulfen) I.Richardson (680; 4.9%), while the most cited families were Asteraceae (3360; 24.3%), Rosaceae (1814; 13.1%), and Ericaceae (1216; 8.8%). Concerning the 70 interviews conducted in Valposchiavo, a total of 226 taxa belonging to 65 botanical families were mentioned. The most cited species were *Sambucus nigra* L. (n. of URs = 227; 5.5% of total URs), *Urtica dioica* L. (209; 5.1%), and *Taraxacum officinale* F.H.Wigg. (206; 5.0%), while the most cited families were Asteraceae (765; 18.6%), Rosaceae (467; 11.4%), and Lamiaceae (467; 11.4%). Further information is provided in Table 2.

Both in Valmalenco and in Valposchiavo, the most relevant fields of use were food and medicinal (with 50.4% and 37.2% of total URs in Valmalenco; 53.9% and 32.9% of total URs in Valposchiavo), followed by domestic (VM $n = 480$, 3.47% of URs; VP 136, 3.31%) and agropastoral (VM 421, 3.04%; VP 233, 5.67%).

The Jaccard similarity index showed that the taxa overlaps between the two studied areas were relatively low (JI = 0.40) compared to studies conducted along the

Table 2 Most cited species and botanical families in the study area

Valmalenco	Valposchiavo
Ten most cited species (n. of URs; % on the total reports of the valley)	
Arnica montana L. (784; 5.7%)	*Sambucus nigra* L. (227; 5.5%)
Vaccinium myrtillus L. (761; 5.5%)	*Urtica dioica* L. (209; 5.1%)
Achillea erba-rotta All. subsp. *moschata* (Wulfen) I.Richardson (680; 4.9%)	*Taraxacum officinale* F.H.Wigg. (206; 5.0%)
Pinus mugo Turra (629; 4.5%)	*Thymus* spp. (164; 4.0%)
Malva sylvestris L. (611; 4.4%)	*Achillea erba-rotta* All. subsp. *moschata* (Wulfen) I.Richardson (161; 3.9%)
Taraxacum officinale F.H.Wigg. (608; 4.4%)	*Vaccinium myrtillus* L. (129; 3.1%)
Sambucus nigra L. (572; 4.1%)	*Vaccinium vitis-idaea* L. (116; 2.8%)
Thymus spp. (526; 3.8%)	*Arnica montana* L. (108; 2.6%)
Rubus idaeus L. (516; 3.7%)	*Larix decidua* (L.) Mill. (102; 2.5%)
Urtica dioica L. (501; 3.6%)	*Salvia officinalis* L. (101; 2.5%)
Five most cited families (n. of species; n. of URs; % on the total reports of the valley)	
Asteraceae (27; 3360; 24.3%)	Asteraceae (25; 765; 18.6%)
Rosaceae (21; 1814; 13.1%)	Rosaceae (25; 467; 11.4%)
Ericaceae (4; 1216; 8.8%)	Lamiaceae (21; 467; 11.4%)
Pinaceae (8; 1111; 8.0%)	Pinaceae (6; 319; 7.8%)
Lamiaceae (19; 957; 6.9%)	Ericaceae (4; 253; 6.2%)

Italian-Slovenian border [22] and in post-Soviet regions [18, 43].

The highest similarity was recorded for food and veterinary species (JI = 0.34) and for medicinal and domestic species (JI = 0.31). VM and VP shared 83 edible plants (83 common species of the total 242 food species recorded in both areas) and 11 veterinary species (11 common species of all the 32 species used in this sector in both area). Medicinal (49 common species of all 157 medicinal species in both area) and domestic plants (33 common species of all the 107 species in this sector in both area) had slightly lower JI value. Agropastoral (20% of all the 103 species in this sector) and recreational species (18% of the 33 species in this sector) showed the lowest JI values (Table 3).

When we compared the uses within each sector for the two area, food uses showed the highest similarity values (JI = 0.31; 185 common uses of the 599 recorded in both area), followed by medicinal uses (JI = 0.22; 90 common uses of the 403 in both areas). Intermediate values were found for veterinary (JI = 0.15; 7 common uses of the 47 in the sector), artisanal (JI = 0.14; 10 common uses on the 70 uses) and domestic uses (25 common uses of all the 173). The use of agropastoral (16 common of the total 137 uses) and recreational (4 common of all the 43 uses) species showed the lowest similarity values (JI = 0.20 and = 0.18, respectively).

Table 3 Jaccard's Similarity Indices (JI) between VM (Valmalenco) and VP (Valposchiavo) regarding species and uses in the different sectors; n. of species/uses: VM = total number of species/uses in Valmalenco; VP = total number of species/uses in Valposchiavo; Common: number of species/uses common to both areas

	JI	n. of species/uses		
		VM	VP	Common
Species				
Food	0.34	151	174	83
Veterinary	0.34	26	17	11
Medicinal	0.31	110	96	49
Domestic	0.31	78	62	33
Artisanal	0.28	29	12	9
Agropastoral	0.20	61	63	21
Recreational	0.19	29	9	6
Others	0.03	17	18	1
Uses				
Food	0.31	372	412	185
Medicinal	0.22	311	182	90
Veterinary	0.15	31	23	7
Artisanal	0.14	62	18	10
Domestic	0.14	113	85	25
Agropastoral	0.13	67	70	16
Recreational	0.09	38	9	4
Others	0.03	11	25	1

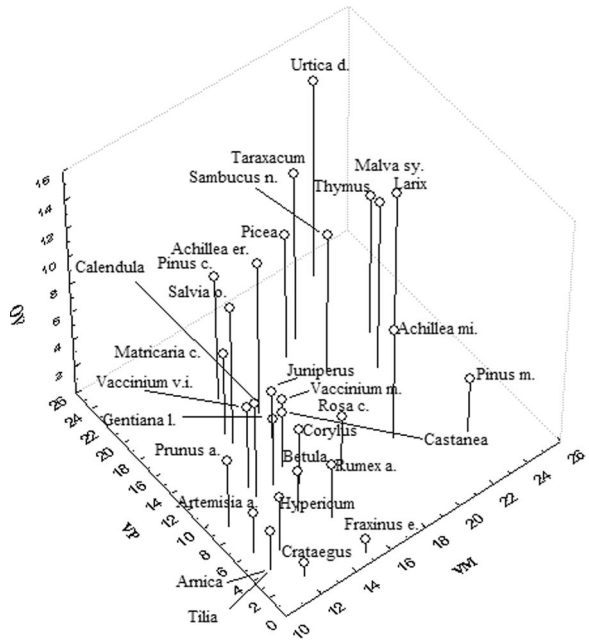

Fig. 2 3D scatter plot of the taxa with the highest number of URs in Valmalenco (VM) and Valposchiavo (VP); OV: overlaps

Figure 2 shows the taxa with the highest overlap in use diversity, as well as those used only on one of the studied valleys. The taxa with greater number of common uses showed generally more varied uses (Spearman test: $R = 0.77$; $p < 0.01$). Of all the reported taxa, 97 (30.5%) had at least one common use; out of these, 48 had 1–2 common uses, 28 had 3–4 common uses, 10 had 5–7 common uses and 11 more than 8 common uses. The taxa with the highest number of common uses were also among the ones with the highest number of URs in both valleys: *Urtica dioica* (14 common uses; 30% of the total uses, common and exclusive, recorded for this species in both areas); *Malva sylvestris* L. and *Taraxacum officinale* (12; 37% and 33%, respectively); *Achillea erba-rotta* subsp. *moschata* (11; 34%) (Table S1). Thirty-one % of the uses reported in Valmalenco were common to Valposchiavo while 38% of the uses reported in Valposchiavo were also found in Valmalenco.

For the complete list of plant species cited in Valmalenco and in Valposchiavo, along with the Fields of use for each species, please see Table S1 of the Supplementary Materials. For further information, as a way of example we collected the complete data concerning both common and different uses of 10 species mentioned in Valmalenco and in Valposchiavo in Table 4.

We then focused our attention on similarities and differences found in the different Fields of use. We report the most interesting examples hereafter.

Food uses

Regarding the food uses, only the category 'Cooked and preserved in alcohol' was reported solely on one side of the border, specifically in Valposchiavo (Fig. 3). The uses with the highest overlaps were 'Flavoring' (JI = 0.33), 'Liquor' (JI = 0.47), and 'Cooked vegetables' (JI = 0.28).

Taking into account the areas surrounding Valmalenco and Valposchiavo, Venn diagrams and Jaccard similarity indices in Fig. 4 reflect differences and similarities between the food species recorded in the two investigated areas and those reported in literature sources from Italian [3, 5, 7, 9, 10, 14, 37, 38] and Swiss [39] Alpine areas. Forty-four and 61 food species were specific to Valmalenco and Valposchiavo, respectively (that is, they were not mentioned in the literature source of the neighboring areas). Higher similarity was found with literature on Italian Alpine areas (JI: VM = 0.38; VP = 0.36) compared to Switzerland (JI: VM = 0.26; VP = 0.26).

In Valmalenco, spontaneous plant species, such as *Taraxacum officinale*, *Urtica dioica*, *Silene vulgaris* (Moench) Garcke, and *Chenopodium bonus-henricus* L., were commonly consumed as ingredients for traditional dishes, as we thoroughly reported in Milani et al. [44]. Albeit with some local variations, these species were also included in the everyday diet of the inhabitants of Valposchiavo and were thus often cited by the Swiss informants too. Among these shared species, in the Italian Alpine regions and the Swiss Valais territory, we could find, once again, wild species included in the everyday diet as side vegetables (mainly cooked or raw in salads) or important ingredients of first courses, such as *Taraxacum officinale*, *U. dioica*, *S. vulgaris,* and *C. bonus-henricus*.

One of the species typically collected in Valmalenco is *Aruncus dioicus* (Walter) Fernald, which is then boiled or steamed as an asparagus (it is also called wild asparagus by the inhabitants of the valley) and immediately eaten or then preserved in oil. One percent of the URs (number of URs = 133) is dedicated to this use that can be found in other Italian alpine neighboring valleys of the province of Sondrio [5, 14], but also in the Western Alps [3]. Interestingly, only 0.2% of the URs collected in Valposchiavo ($n = 7$) involved the use of this species for culinary purposes, while in the Swiss territory of Valais this species was not mentioned at all [39], a possible indication of influences coming from the Italian side of the border on the territory of Valposchiavo.

Liquors and aromatized grappa were also commonly reported in both valleys, with *Achillea erba-rotta* subsp. *moschata* and *Artemisia genipi* Weber ex Stechm among the most cited species for this purpose. Especially during the first half of the twentieth century, these two species played a key role in the economy of Valmalenco, as

Table 4 Detailed traditional uses of 10 relevant species in Valmalenco (Italy) and Valposchiavo (Switzerland)

Family	Species English common name, Italian common name Local names Voucher codes	Part of plant	Use in Valmalenco	Use in Valposchiavo
Amaryllidaceae	*Allium cepa* L. Onion, Cipolla AC-23-001	Bulbs	AGR: horticulture DOM: dyeing plant DOM/COS: bulbs blended with nettles for a strengthening poultice for hair	FOOD: flavoring MED: slices of onion put on the throat against sore throat, on the ear against inflammation, or inhaled as expectorant and antipyretic. Syrup against cough
Asteraceae	*Achillea erba-rotta* All. subsp. *moschata* (Wulfen) I.Richardson Simple leaved milfoil, Erba Iva *Erba Iva, Aneda, Daneda, Taneda* (Valm); *Erba Iva* (Valp) AM-21-001/ AM-21-002 (GBG123/GBG124)	Aerial parts Inflorescences Leaves	FOOD: flowers and whole epigeal parts as flavorings for dishes, liquors, grappa, herbal teas MED: Infusion and decoction of inflorescences or whole epigeal parts drunk as digestive, against dyspepsia, gastritis, ulcer, abdominal and stomach aches, as carminative; foot baths for inflamed and aching feet or drunk for muscle pains; used in vaginal douching against vaginal infections or drunk against period related disorders; as sedative, hypotensive or generic anti-inflammatory; compresses as anti-inflammatory and wound healing for the skin Infusion of whole epigeal parts drunk against cough and sore throat Leaves chewed for gingivitis VET: decoction or infusion of flowering aerial parts given to animals (*i.e.,* cattle) as digestive, against bloating, gut disorders, and problems during delivery	DOM: flowers used to deodorize the laundry FOOD: flowers and whole epigeal parts as flavorings for dishes, liquors, grappa, herbal teas MAG/RIT/SUP: burning flowering aerial parts as a propitiatory ritual, specifically nearing winter holidays MED: Infusion of the inflorescences or whole epigeal parts drunk against sore throat, as diaphoretic, against flu, colds, and cough; digestive, abdominal and stomach aches; menstrual pains; generic anti-inflammatory and depurative, against hangover VET: infusion of flowering aerial parts given to cattle as digestive. The dried plants were also given to rabbits as forage as digestive

Table 4 (continued)

Family	Species English common name, Italian common name Local names Voucher codes	Part of plant	Use in Valmalenco	Use in Valposchiavo
	Artemisia absinthium L Absinth, Assenzio *Erba blanca* (Valp) AA-23-001	Aerial parts Inflorescences Leaves	AGR: farmers once knew that cattle should not have eaten absinth as forage because their milk would have become too bitter for the children to drink DOM: the aerial parts or the whole epigeal parts were used as repellent against rats or put in the closets against bugs and moths FOOD: aerial parts or leaves as flavoring for liquors and grappa MAG/MED: the aerial parts were put in children's beds and cradles to keep bowel worms away MED: infusion of flowering aerial parts drunk as digestive, or against cephalea caused by bad digestion. Infusion of the leaves against gastritis, as digestive and laxative. Topical cream prepared with the whole epigeal parts used for bruises and contusions VET: Decoction of the plant given to cattle after delivery, as a fortifying remedy. The infusion of the leaves or leaves as they are given to goat against bloating	FOOD: aerial parts as flavoring for liquors MED: infusion of aerial parts or whole epigeal parts as digestive; as antipyretic. Infusion of whole epigeal parts against cough and bronchitis and as general depurative VET: infusion of the leaves for bloating cattle
Caryophyllaceae	*Silene vulgaris* (Moench) Garcke Bladder campion, Silene rigonfia SI-21-001	Aerial parts Flowers Herbaceous stems Leaves Sprouts	AGR: if the flowers collected in the fields are still closed and pop if smashed, it means that it is not time to make hay yet DOM: flowers of bladder campion were used along with dandelions and other plants to create garlands FOOD: young leaves collected in the spring eaten raw in salads or cooked in soups, rice, pasta LUD: the flowers, still closed, were popped against the forehead by children	FOOD: young leaves collected in the spring eaten raw in salads or cooked in soups, specifically the '*minestra da lait*' (milk based soup) LUD: the flowers, still closed, were popped against the hands by children MAG/RIT/SUP: dried bladder campion, along with other plants, were burnt in fire pits as a propitiatory rite around Christmas

Table 4 (continued)

Family	Species English common name, Italian common name Local names Voucher codes	Part of plant	Use in Valmalenco	Use in Valposchiavo
Cupressaceae	*Juniperus communis* L. Juniper, Ginepro JC-23-001	Cones Galbula Woody stems/branches	DOM: branches as ornaments FOOD: galbuli as flavorings in traditional dishes (especially meat) and liquors and grappa MED: galbuli chewed raw against gingivitis but also as digestive. Also, infusions of the galbuli used as digestive and carminative as well. Eaten raw as disinfectant for the urinary tract and prostate, for the regulation of menstrual cycle, as tonic, against infections, and as anti-inflammatory for joint pain. Galbuli of juniper, mixed with *A. erba-rotta* subsp. *moschata* and *Tilia* spp., as relaxant. Infusions or syrups used against cough and sore throat	DOM: galbuli burnt as incense DOM/COS: one of the ingredients of the 'Four thieves' vinegar' used also for relaxing footbaths FOOD: galbuli as flavorings in traditional dishes (especially meat) and liquors and grappa MAG/RIT/SUP: dried branches of juniper, along with other plants, were burnt in fire pits as a propitiatory rite around Christmas MED: galbuli eaten for 10–20 days as depurative. Infusions of crushed galbuli inhaled as expectorant, against bronchitis. Juniper is one of the ingredients of the 'Four thieves' vinegar' that was drunk as antibiotic, antipyretic and was applied externally against ingrown nails and mycosis
Ericaceae	*Rhododendron ferrugineum* L. Rusty-leaved alpenrose, Rododendro ferrugineo RF-23-001	Inflorescences Fruits Galls Woody stems/branches	AGR: apiculture (rhododendron honey) FOOD: galls and flowers eaten raw in the fields as snacks LUD: branches used to build wooden toys MAG/RIT/SUP: in one of the municipalities, Chiesa in Valmalenco, rhododendron is one of the symbols of the town. The women of Chiesa were once (and still are, during town festivals) called 'Rododendre' and wore the typical dresses and headsquares with rhododendron flowers embroidered	AGR: apiculture (rhododendron honey) MED: rhododendron honey is considered an expectorant and decongestant remedy
Hypericaceae	*Hypericum perforatum* L. St. John's wort, Iperico HP-23-001	Aerial parts Flowers Whole alive plant	DOM/COS: oleolite of the aerial parts are applied as cosmetic on the skin MAG/RIT/SUP: whole dried plants hung to the doors to keep demons away MED: oleolite used against burns and sunburn as anti-inflammatory. Also applied to muscles and joints for pain and inflammation and to the legs for varicose veins. Also used against sciatica. Infusions drunk as sedative and antidepressant	MED: oleolite used against burns and sunburn as anti-inflammatory. Also applied to contusions and bruises. Warm oleolite, applied drop by drop in the ear, used as anti-inflammatory for otitis and other inflammations of the ear

Table 4 (continued)

Family	Species English common name, Italian common name Local names Voucher codes	Part of plant	Use in Valmalenco	Use in Valposchiavo
Pinaceae	*Larix decidua* (L.) Mill Lark, Larice *Largù* (Valp. Resin.) LD-23-001	Buds Cones Wood Woody stems/Branches Resin	AGR: apiculture. Production of farm tools (baskets called '*gerle*') ART: building materials. Furniture, such as tables, cabinets. Carving and statues DOM: Its wood burns more slowly and is considered long-lasting FOOD: buds and leaves as flavorings (*i.e.*, for liquors and grappa) LUD: the balsamic resin was once chewed as 'natural' chewing-gum by children. The longest branches were once used as a swing. Children used to make toys, ropes, and bracelets from the younger branches MED: the fluid resin was applied on gums against gingivitis. It was also mixed with fat to obtain an ointment, useful as cicatrizing agent on wounds or against burns. The resin was also applied as it was or mixed with fat as anti-inflammatory on contusions or on fractured limbs as a 'natural cast'. The balsamic ointment was massaged on the chest as an expectorant against cough and bronchitis VET: The resin or ointment were also used on cattle, sheep, or goats' hooves as anti-inflammatory on contusions or on fractured legs as a 'natural cast'	AGR: production of farm tools ART: Furniture, such as tables, cabinets DOM: Its wood burns more slowly and is considered long-lasting DOM/COS: Ointment for softening the skin FOOD: buds and leaves as flavorings LUD: the balsamic resinwas once chewed as 'natural' chewing-gum by children MED: the resin was mixed with fat to obtain an ointment (called '*largù*'), useful as cicatrizing agent, as a powerful astringent agent for splinters, as disinfectant against micosis and ingrown nails. The ointment was cited as useful against bruises and contusions. A syrup obtained from the young buds or the resin was used against cough, while an infusion of the leaves was inhaled as expectorant VET: The resin or ointment were also used on cattle, sheep, or goats' hooves as anti-inflammatory and wound healing agent

Table 4 (continued)

Family	Species English common name, Italian common name Local names Voucher codes	Part of plant	Use in Valmalenco	Use in Valposchiavo
	Pinus mugo Turra Creeping pine, Pino mugo PM-23-001	Buds Cones Leaves Resin Roots Wood Woody stems/Branches	ART: pinecones were put together to create little baskets. The resin was used as lubricant for the turning machine (soapstone production) DOM: Young branches, rich in resin, were used as 'candles' (*lumìn*). Needles put on heaters to perfume rooms. Wood burnt in the fireplace DOM/COS: resin chewed to clean teeth FOOD: needles and green pinecones used as flavorings for liquors and grappa LUD: resin chewed by children as 'natural chewing-gum' MAG/RIT/SUP: branches, inflorescences, and pinecones used as ornaments for cows in parades during town festivals MED: syrup of the young pinecones used both as preventive and treatment for colds and cough, bronchitis, as expectorant. The resin, mixed with vegetable or animal fat, applied to wounds as disinfectant and wound healing agent VET: resin, raw or as an ointment, applied on hooves and paws as disinfectant and wound healing agent	DOM: Wood burnt in the fireplace FOOD: young buds used as flavoring for desserts MED: infusions of young buds inhaled as balsamic and expectorant. Syrup of young buds or green pinecones against cough. These parts were also used to prepare a balsamic ointment applied on the chest

Table 4 (continued)

Family	Species English common name, Italian common name Local names Voucher codes	Part of plant	Use in Valmalenco	Use in Valposchiavo
Urticaceae	*Urtica dioica* L Stinging nettle, Ortica comune UD-21-001	Aerial parts Inflorescences Herbaceous stems Roots Leaves Sprouts	AGR: the whole plants were macerated in water for weeks to obtain a natural antiparasitic preparation sprayed in the gardens and orchards DOM: the infusion could be used as dye DOM/COS: the infusion used to make the hair more shining and the scalp stronger FOOD: young leaves cooked and used in local dishes (soups, gnocchi, pasta, risotto etc.) LUD: children used the stinging fronds to play fights with each other MED: infusions rubbed on the scalp against hair loss and head lice. Leaves eaten cooked as part of the diet were considered depurative of the blood or of the intestine. People used to sting the joints with the plant to 'improve circulation' and reduce inflammation. Poultices of the leaves were applied on bruises and contusions. Infusion of the leaves drunk as diuretic, depurative of the urinary tract. Infusion considered generic depurative for the whole body or tonic VET: leaves given to hens to make them produce more eggs	AGR: AGR: the whole plants were macerated in water for weeks to obtain a natural antiparasitic preparation sprayed in the gardens and orchards DOM: used experimentally as textile fiber. Powder of the plants used to start compost fermentation DOM/COS: the infusion used to make the hair more shining and the scalp stronger. The infusion used also in the production of soaps FOOD: young leaves cooked and used in local dishes (soups, ravioli, pasta, risotto etc.) MED: ingredient for a herbal tea against sore throat, colds, and flu, but also digestive (with other plants). Infusions rubbed on the scalp against hair loss and head lice or as anti-inflammatory for acne and other skin problems. Leaves eaten cooked as part of the diet were considered depurative of the blood. Poultices of the leaves were applied to improve circulation. Infusion of the leaves drunk (or leaves eaten cooked) as diuretic, depurative of the urinary tract. People used to sting the joints with the plant to 'improve circulation' and reduce inflammation. Infusion considered generic depurative for the whole body or tonic VET: cooked leaves given to cows, but also chickens, as tonic, restorative, depurative

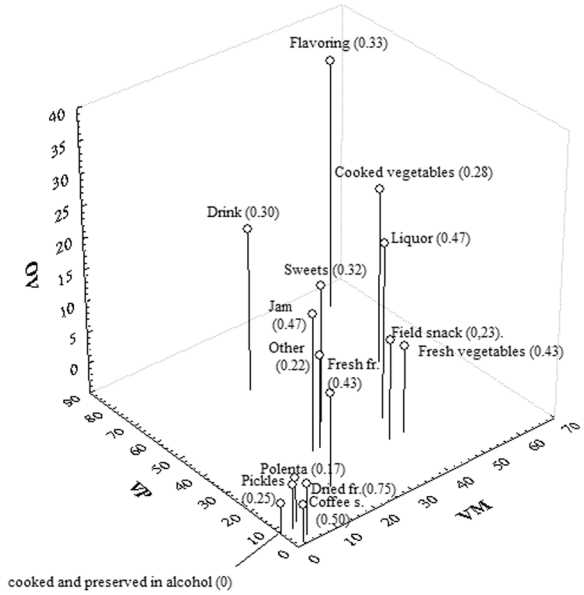

Fig. 3 3D scatter plot of the recorded food categories in Valmalenco (VM) and Valposchiavo (VP). OV: overlaps. Jaccard's Similarity values are reported between brackets

a significant amount was collected and sold to pharmacies and liquor distilleries as a means of livelihood [45]. While these species are known and common also in Valposchiavo, their traditional use and collection apparently was never a raw necessity as it once was in Valmalenco, also due to the agricultural activities that more easily sustained the population of the Grisons, as reported by one of the Swiss informants. In fact, this informant also mentioned that in the past, people from Valmalenco could be seen collecting *A. erba-rotta* subsp. *moschata* and *A. genipi* also beyond the Passes, in Swiss territory. These two species were among the most cited species for the production of liquors or flavored grappa in all the considered neighboring territories.

Other important plants used especially in the past for these same purposes were species of the genus *Gentiana*, both in the Italian and the Swiss regions surrounding Valmalenco and Valposchiavo. The most common species were *G. lutea* L. and *G. acaulis* L. [3, 5, 7, 9, 10, 14, 39] but others, such as *G. verna* L. and *G. punctata* L., made an appearance in some of the works too [5, 14, 39].

Another interesting example was the case of *Prunus spinosa* L.: while its sour fruits were known and consumed by the inhabitants of both Valmalenco and Valposchiavo, 71.4% of our Swiss informants cited them as the main ingredient of a local liquor called '*Parmognuli*' (from the *Poschiavino* vernacular name for the fruits, '*Parmògnule*'). Considering the neighboring territories, this species was known both in the Italian and the Swiss sides: the fruits were eaten raw or used in liquors or alcoholic preserves throughout the province of Sondrio [5, 9, 14], on the Italian Western Alps [3, 7], and in Lower and Central Valais [39]. In Valmalenco, we recorded only the vernacular name of '*Raspa boca*' from a single informant,

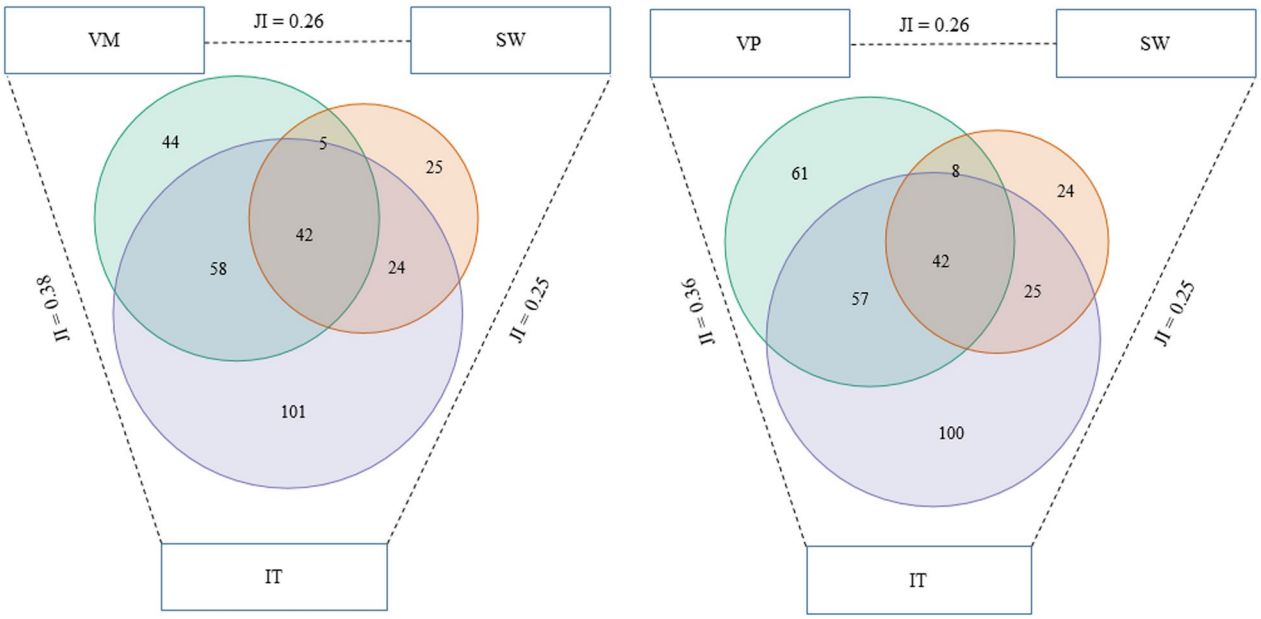

Fig. 4 Food uses. Venn diagrams showing species in common among Valmalenco (VM), Italian Alpine regions (IT) and Swiss regions (SW), and among Valposchiavo (VP), Italian Alpine regions (IT) and Swiss Alpine regions (SW), with related Jaccard's similarity indices (JI)

as a way to describe the astringent and sour taste of the unripen fruits. However, the *Poschiavino* term '*Parmògnule*' widely used in Valposchiavo to indicate the fruits, seemed closer to the local vernaculars recorded on the neighboring Italian province of Sondrio ('*Primuli*' in Sondalo, [5];'*Prúmul*' or '*Brúmul*' in Valfurva, [9]; '*Brúmol*' throughout the Stelvio Park, [14]) than the one of Lower and Central Valais ('*Belosai*' [39],), which in turn has a more French influence to it.

Medicinal uses

The three most reported medicinal species in Valmalencowere *Arnica montana* (specifically for contusions and muscle and joint pains; n. of URs = 768), *Malva sylvestris* (as an anti-inflammatory for the treatment of various ailments; $n = 479$), and *Pinus mugo* Turra (particularly in case of upper airway problems; $n = 470$), while the most cited categories of pathology (apparatuses) were musculoskeletal traumas (n. of URs = 1145; n. of species = 30), respiratory disorders (1076; 36), and digestive system problems (892; 36). The most versatile taxa were *Thymus* spp. with 14 different pathologies treated, *Achillea millefolium* L. with 13, and *M. sylvestris* with 12.

In Valposchiavo, the most relevant species were *Arnica montana* (same uses as in Valmalenco; n. of URs = 96), *Urtica dioica* (as diuretic and depurative for the whole body; $n = 95$), and *Thymus* spp. (for colds and other upper airway problems; $n = 90$). The first three categories of pathology were respiratory disorders (n. of URs = 385; n. of species = 40), general condition (general anti-inflammatory, tonic, general depurative etc. 385; 40), and musculoskeletal traumas (199; 32). The most versatile species were *U. dioica* and *M. sylvestris*, with 9 different pathologies treated each.

Among the 17 treated diseases, only 3 were reported solely in Valmalenco (external parasites, metabolic disorders, and head pain) although at very low UR frequency (Fig. 5); none was cited solely in Valposchiavo (Fig. 5). The highest number of common species was recorded for respiratory disorders (JI = 0.33), followed by musculoskeletal treatments (0.33), digestive system diseases (JI = 0.22), and skin diseases and traumas (JI = 0.27) (Fig. 5).

Concerning ICFs for the categories of pathology, the highest values were recorded in Valmalenco for musculoskeletal traumas and respiratory disorders (both 0.97), followed by digestive system problems, eye problems, and skin diseases and traumas (0.94 for all three).In Valposchiavo, the highest values were recorded for respiratory disorders (0.90), musculoskeletal traumas (0.87), oropharyngeal affections (0.86), and general condition and digestive system problems (both 0.84).

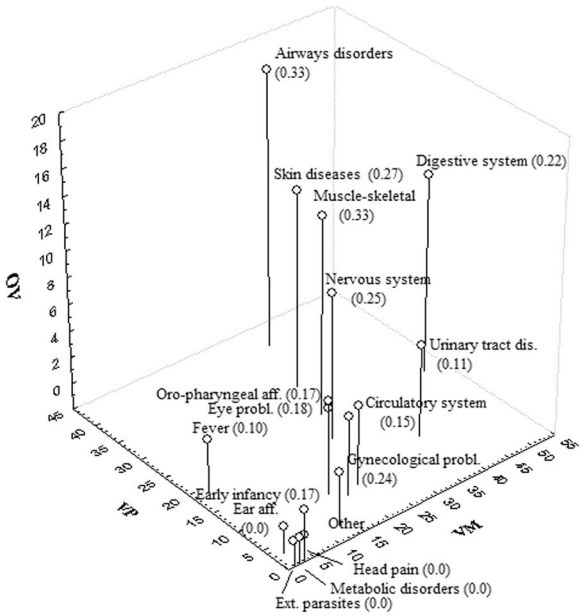

Fig. 5 3D scatter plot of the recorded medicinal categories in Valmalenco (VM) and Valposchiavo (VP). OV: overlaps. Jaccard's Similarity values are reported between brackets

Table 5 Categories of pathology cited in Valmalenco, with ICFs

Category (apparatus)	URs	Species	ICF
Musculoskeletal traumas	1145	30	0.97
Respiratory disorders	1076	36	0.97
Digestive system problems	892	51	0.94
Eye problems	152	10	0.94
Skin diseases and traumas	496	32	0.94
Oro-pharyngeal affections	210	18	0.92
Nervous system disorders	284	29	0.90
General condition	341	42	0.88
Urinary tract disorders	258	39	0.85
Circulatory system problems	119	22	0.82
Gynecological problems	88	17	0.82
Early infancy disorders	21	5	0.80
Fever	10	3	0.78
Metabolic disorders	6	3	0.60
Other	44	13	0.72
External parasites	2	2	0.00
Ear affections	2	2	0.00

Overall, albeit with some differences between the two valleys, these results suggest that established cultural criteria are implicitly employed by the local populations when selecting medicinal plants in the treatment of these pathologies. Similar results can be found in previous ethnobotanical investigations in neighboring Alpine areas [5, 6, 9, 38]. Further information

Table 6 Categories of pathology cited in Valposchiavo, with ICFs

Category (apparatus)	URs	Species	ICF
Respiratory disorders	385	40	0.90
Musculoskeletal traumas	174	23	0.87
Oro-pharyngeal affections	66	10	0.86
General condition	199	32	0.84
Digestive system problems	132	22	0.84
Skin diseases and traumas	166	31	0.82
Urinary tract disorders	55	11	0.81
Ear affections	10	3	0.78
Eye problems	23	7	0.73
Gynecological problems	30	9	0.72
Circulatory system problems	25	8	0.71
Nervous system disorders	41	18	0.58
Fever	37	19	0.50
Early infancy disorders	3	2	0.50
Other	3	3	0.00
External parasites	1	1	–

concerning the pathologies and the ICFs can be found in Tables 5 and 6.

As for the forms of preparation, in both valleys the infusion was the most common (n. of URs in Valmalenco = 2258; n. in Valposchiavo = 569), followed by 'other preparation' (*i.e.,* part of the plant applied as it is. 1151; 427) and syrup (587; 191). These were mainly administered either orally or externally.

Comparing the results obtained for Valmalenco and Valposchiavo, and the ones on the Italian [3, 5, 7, 9, 10, 14, 37, 38] and Swiss [40] Alpine regions (Fig. 6), only 18 medicinal species were found specific to Valmalenco and 0 to Valposchiavo. It seems appropriate to mention that this result may also be influenced by the different numbers of informants in Valmalenco and in Valposchiavo. Jaccard indices showed higher similarity values for Valmalenco and Valposchiavo with Italian Alpine areas (VM = 0.26; VP = 0.21) compared with Switzerland (VM = 0.14; VP = 0.14).

Some interesting examples of peculiar uses were found during the comparison. The macerated oil prepared with the flowering aerial parts of *Hypericum perforatum* L. was often cited by the informants of Valmalenco as a valid external remedy against musculoskeletal inflammations and pains (n. of URs = 139), or for the treatment of skin traumas, such as burns and sunburn (n. of URs = 77).

While in Valposchiavo this species was widely known for the same purposes, one particular use caught our attention: the red oleolite of St. John's Wort was also used by five informants (60–89 years old range) as a remedy against ear inflammations, poured warm drop by drop directly in the ears and kept in place with a cotton pad. This particular use of *H. perforatum* was not reported in any of the ethnobotanical surveys conducted in the Italian neighboring territories nor in Switzerland. It is interesting to underline that not only our five informants were among the elders of the community, but they had

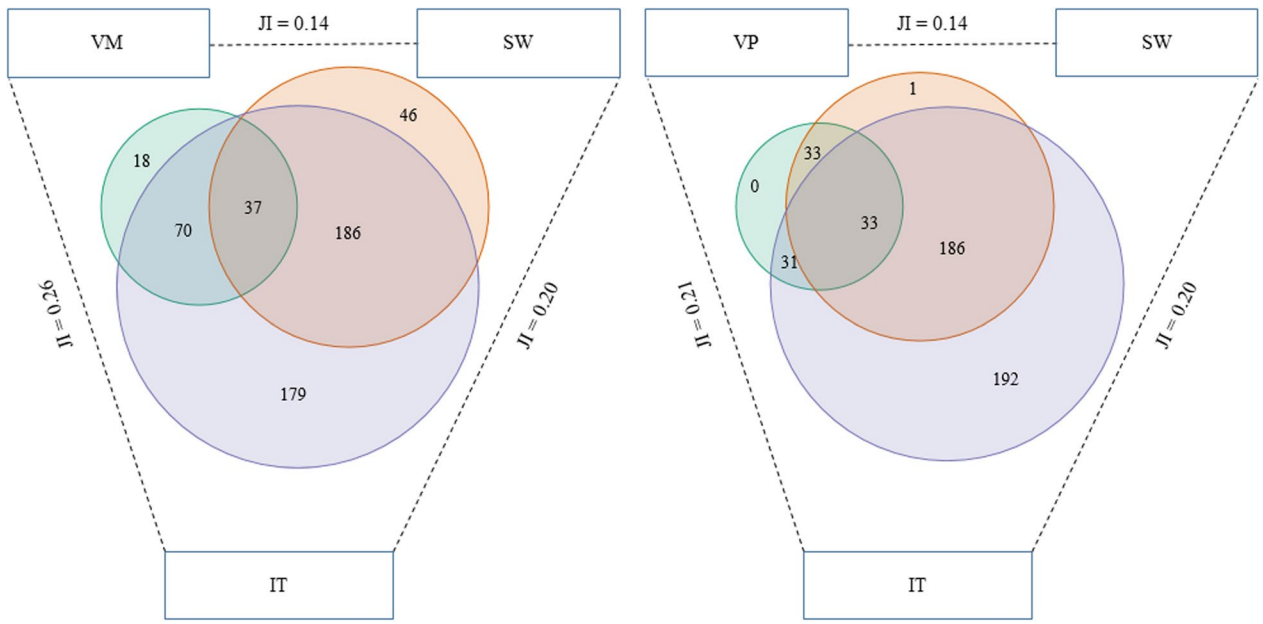

Fig. 6 Medicinal uses. Venn diagrams showing species in common among Valmalenco (VM), Italian Alpine regions (IT) and Swiss Alpine regions (SW), and among Valposchiavo (VP), Italian Alpine regions (IT) and Swiss Alpine regions (SW), with related Jaccard's Similarity Indices (JI)

also learned the traditional uses of local species mainly through family transmission, with no major influence from books, courses, or the Internet.

Another example concerns *Allium cepa* L.: while in Valmalenco it was never cited for medicinal purposes, in Valposchiavo it was considered a useful expectorant and antipyretic remedy. The bulbs were sliced and put for an entire night on the nightstand to induce expectoration or tied around the throat against sore throat. In the neighboring Italian alpine valleys of Valfurva, Sondalo, and Stelvio Park, *A. cepa* was also considered an expectorant remedy, but the bulbs were boiled in milk or used to prepare a syrup, then taken orally to obtain the desired effect [5, 9, 14].

One elder informant told us that slices of onion kept tied at the soles of the feet for three consecutive nights could be a powerful antipyretic remedy. *A. cepa* was also cited by an informant as an anti-inflammatory remedy for ear inflammation: also in this case, a slice of onion kept in place in the ear would suffice to obtain the desired effect. The same use was recorded in the territory of Stelvio Park [14]. Although *A. cepa* was mentioned in a work that compared past and current choices in Swiss flora for medicinal purposes, no information regarding the specific use of this species was reported [40].

The resin of *Larix decidua* (L.) Mill. was known in Valmalenco as 'lark turpentine' and used specifically for different skin ($n=17$) and musculoskeletal ($n=14$) problems. It was described as more fluid compared to the resin of other conifers and was often mixed with animal or vegetable fats (butter, pork fat, oil) to obtain ointments with different degrees of smoothness. The ointments were then applied to the skin, specifically on wounds, as a cicatrizing agent. The raw resin mixed with pork fat ('*sungia*'), and sometimes with resin from other conifers too, was also used to prepare a 'natural cast' in case of fractures. This cast was considered more efficient than the ones prepared in the hospital, because the lark resin would allegedly keep the muscle from losing its tone and strength.

In Valposchiavo, both the lark resin and the ointment obtained mixing it with fat was called '*largù*'. '*Largù*' was considered a wondrous astringent remedy to remove splinters by 50% of the informants, and it was even sold in pharmacies with its vernacular name and with the same purpose.

Different medicinal uses of the resin of *L. decidua* were reported in several different valleys of the Italian side of the border, alternatively similar to the ones in Valmalenco and the ones in Valposchiavo with vernacular names that were reminiscent of the *Poschiavino* one: in the territory of Stelvio Park (vernacular name '*largá*', '*largé*') and in Val San Giacomo ('*laràs*'), the resin was mentioned as a useful remedy against infected wounds and fractures [14, 38], while in Valfurva ('*larĝé*') and in Sondalo ('*argaa*') it was the main ingredient in producing an ointment to remove splinters and wooden shards [5, 9]. No information could be found concerning the medicinal uses of the resin of *L. decidua* in the Swiss neighboring territories.

It is interesting to highlight that, although in Valmalenco the ointment of lark resin was not used specifically as an astringent agent to remove thorns as in the other analyzed areas, the ointment obtained from the resin of another member of the Pinaceae, *Picea abies* (L.) H.Karst., was cited by two informants with this same use.

Finally, we consider the case of *A. erba-rotta* subsp. *moschata* noteworthy. We already mentioned the importance that this species used to have in the past for the economy of Valmalenco and this importance is still reflected in the high number of informants who cited the species and of total URs (percentage of informants = 84.3%; n. of total URs = 680; n. of URs in the medicinal sector = 397).

A. erba-rotta subsp. *moschata* was well known as '*taneda*', '*daneda*', or '*aneda*', which are all vernacular names used in the different municipalities of the valley, as well as with the common Italian name '*erba iva*'. We easily spotted bundles of e*rba iva* hanging to dry in every household and the decoction of this species was considered a powerful remedy against digestive problems, from dyspepsia to gastritis and even ulcers [45]. *A. erba-rotta* subsp. *moschata* is endemic to the Alpine areas and was widely cited also in the other investigations conducted in neighboring valleys and along the Italian Alpine territory [3, 5, 7, 9, 14, 38].

In Valposchiavo, this species was known as well and generally cited for the same purposes (52.9%; 161; 68), but we noticed an important difference: while in Valmalenco this was almost always the first species spontaneously mentioned during the interviews, in Valposchiavo *A. erba-rotta* subsp. *moschata* was brought up by the informants almost as an afterthought and only upon inquiring from the members of the research group, usually at the end of the interview (*i.e.,* 'Do you happen to know a plant named *erba iva*?'). Additionally, no vernacular name was mentioned for this species in Valposchiavo.

Other uses

The agropastoral was the third most cited field in Valposchiavo (n. of URs = 233; 5.7% of the total) and the fourth in Valmalenco (421; 3%), and in both valleys it encompassed several activities, such as horticulture (included the preparation of 'natural anti-parasite' for the garden), apiculture (especially with the production of the local honey of alpine rose, *Rhododendron ferrugineum* L.), and animal fodder.

Although most of the species cited during the field work were spontaneous, it is interesting to underline that the 3500 m of height spread within the territory of Valposchiavo were reflected in the selection of some peculiar cultivated species that grow more easily at lower altitudes. Hemp (*Cannabis sativa* L.; n. of URs = 5, n. of informants = 5) and tobacco (*Nicotiana tabacum* L.; 19, 19), for example, were commonly cultivated in the past in Brusio [46, 47] and this piece of information came out repeatedly also during the interviews in Switzerland. The cultivation of hemp and tobacco was reported also in Valmalenco, but only by a single informant for each species and as a long forgotten occurrence in Torre di Santa Maria and Spriana, respectively.

Another important species in the agropastoral field in Valposchiavo is *Vitis vinifera* L.: nineteen informants (27% of the total) mentioned the cultivation of vineyards both in Brusio and in the neighboring valley (Valtellina, SO, Italy) with which the territory of Valposchiavo has special agreements concerning viticulture.

Byproducts of the wine, such as grappa, were also employed in Valposchiavo in the veterinary field for cattle and sheep both as a disinfectant agent in case of wounds or as an ingredient for beverages administered to the animals with compromised rumen function.

An infusion of fruits of *Carum carvi* L. was considered a good remedy for abdominal bloating as well, especially for cattle. In the Italian Alpine regions this use was not reported, while it was known in Switzerland, only in German speaking regions [12].

In Valmalenco, a common species cited for the same purposes was *Achillea millefolium*, known as'*danedùn*', prepared as an aromatic and slightly bitter infusion. This use was reported in some of the territories of the province of Sondrio and Brescia [5, 14, 37], as well as in Switzerland [12, 41].

Bitter and aromatic spontaneous species commonly used in both valleys for rumen health were *Achillea erbarotta* subsp. *moschata* (the same use found also in Italy [5, 9, 14, 38]), *Artemisia absinthium* L. (found also both in Italian and Swiss Alpine areas [3, 5, 9, 12, 14, 38, 41]), and *Gentiana lutea* (found also in Switzerland [41], while other species of the genus *Gentiana* L. were mentioned in [5, 9, 37]), the latter especially in the past.

Finally, two Swiss informants mentioned the infusions of aerial parts of *Leontopodium nivale* subsp. *alpinum* (Cass.) Greuter to induce lactation in cows (this species was cited only in Switzerland and for a different use [41]).

A. absinthium was cited only in Valmalenco also for a curious remedy in the magical-medicinal field: in the past, whole branches of this species were put in cradles because it was believed they were able to ward off children's internal parasites, such as worms. Interestingly, no species were mentioned in Valposchiavo in this field of use.

Still on the subject of 'magical' beliefs, one of the Swiss informants told us about an ancient ritualistic practice that was once known in Valposchiavo: dried branches of *Juniperus communis* L., along with leaves of *Picea abies* and *Pinus cembra* L., flowers of *Lavandula angustifolia* Mill. and *Sambucus nigra*, and others, were burnt in fire pits as a propitiatory rite around Christmas.

In the magical-ritualistic-superstitious field, in Valmalenco we recorded some interesting uses as well. For example, *Carlina acaulis* L. were once used as 'weather forecaster'. The flowerheads were observed in the fields by shepherds and farmers: if they were 'open', the weather would be sunny, perfect for leading sheep and cattle to pasture. At the contrary, if they were 'close', the rain would soon come.

Finally, we cite the domestic field, which includes the cosmetic uses of plants. One preparation in particular stood out in Valposchiavo: the 'Four thieves' vinegar', which is a mix of different plants (*Vitis vinifera*, *Salvia officinalis* L., *Rosmarinus officinalis* L., *Thymus* spp., *Lavandula angustifolia*, *Allium sativum* L., *Juglans regia* L., *Laurus nobilis* L., *Syzygium aromaticum* (L.) Merr. & L.M.Perry, *Cinnamomum verum* J.Presl, *Cetraria islandica* (L.) Ach., *Juniperus communis*) macerated in vinegar and used from cosmetic to medicinal uses, especially for ingrown nails and calluses. The uses for this concoction were actually considered numerous and allegedly the original recipe was born in the fourteenth century Marseille, as a remedy to fight the plague. This preparation was apparently particularly popular in Valposchiavo, as it could also be found in books, while it was never mentioned in Valmalenco.

Factors affecting LEK in the two study areas

As pointed out in literature, geographical characteristics, language, and historical and socioeconomic factors could play a pivotal role in shaping the Local Ecological Knowledge of neighboring areas. In fact, two bordering territories might share a common core of knowledge that however splinters in different directions and in various degrees based on both the aforementioned aspects and their interactions [17, 22, 43].

Although Valmalenco and Valposchiavo LEKs were intimately intertwined, they showed fairly low similarity indices among the different fields of use. The highest similarity indices, which concerned the food field, were only 0.34 and 0.31 for the common species and uses, respectively (as shown in Table 2). This could be the result of complex past and present interactions among several factors that should be considered as a whole and not individually. For example, language certainly has a heavy

influence on similarities and differences between LEKs of people that share a same surrounding environment but not the same tongue [22]. However, there are instances where this is not the case; that is, places located within the same country and that share the same language were shown to have several differences ([12] and literature within), thus indicating that language cannot be considered the sole deciding factor.

People living in Valmalenco and Valposchiavo share the same main language (Italian) and similar vernaculars ('*malenco*' in Valmalenco and '*poschiavino*' in Valposchiavo). In fact, at least concerning Food and Medicinal sectors, Valposchiavo had slightly higher JI toward the Italian Alpine area compared to Switzerland. However, even in this case, these indices were low in value. Furthermore, there are examples in literature that describe situations (*i.e.,* ethnoveterinary uses) in which Italian speaking Swiss regions showed more similarities with the other Swiss Cantons compared to Italian Alpine regions [12]. Finally, it is important to note that, though Italian is the main language in Valposchiavo, the inhabitants of Grisons are usually multilingual, as they often interact with German and French speaking Cantons.

In terms of natural environment, as mentioned before, Valmalenco and Valposchiavo share a lot of plant species at higher altitudes. However, the lower altitudes at the bottom of Valposchiavo allow for the cultivation of Southern species, such as grapevine, hemp, and tobacco. Additionally, the wide flatlands around Poschiavo are used by local farms to cultivate both autochthonous and non-autochthonous species such as *Leontopodium nivale* subsp. *alpinum*, *Mentha* spp., and *Fagopyrum esculentum* Moench. On the other hand, both the geographical position and the conformation of the territory of Valmalenco never allowed for the extensive cultivation of plant species.

Another major contributing factor to the similarities and differences between the two regions could be pivotal historical events. For example, as previously discussed, the closing of the *Strada Cavallera del muretto* caused the progressive isolation of the territory of Valmalenco from the surrounding valleys during the nineteenth century, thus making direct interactions progressively harder [28]. Even today, it is easier to access Valposchiavo coming from the nearby Valtellina (province of Sondrio, Italy) than from Valmalenco. Another even more dramatic example of historical event that made a significant impact on the relationships between the two Valleys is the Valtellina Massacre of Protestants that wiped away the Protestant Creed throughout Valmalenco in the early seventeenth century [29]. The result of this event is still evident to this day: in Valposchiavo, the coexistence of both Catholic and Protestant religions impacts the culture of the valley differently than in Valmalenco, where only the Catholic faith still remains.

From a sociological standpoint, it is interesting to highlight that the populations of the two valleys seemed to be characterized by different approaches to 'tradition.' In Valmalenco during the interviews, people considered it as a crucial part of their everyday life, a true source of pride, and they seldom strayed from it: the more they stayed true to tradition, the better. On the contrary, in Valposchiavo, although still very important, tradition could be safely considered as a starting point to innovate and look to the future. For example, we met informants (also restaurant owners) who decided to insert invasive neophyte species, such as *Reynoutria japonica* Houtt., in their menus in order to keep their expansion under control. They would either prepare these species the same way as spontaneous plants of their territory or they would try recipes learned from cookbooks or culinary courses. Another interesting take on this came from an informant who told us that they were experimenting with a method similar to vacuum cooking to obtain syrups from green pinecones and young buds of conifers, such as *Pinus mugo* and *Pinus cembra*, in a faster way than leaving them for 3 months in glass jars under the summer sun, as usually dictated by tradition. Although it may be difficult to explain this difference in attitude concerning 'tradition', it may be possible to hypothesize plausible causes: for example, the aforementioned past isolation of Valmalenco and the multicultural and multilingual aspects of Valposchiavo. Furthermore, it has been documented that LEK is heavily affected by modern external sources of information such as the Internet or Social Media, and LEKs in bordering communities may diverge because of different transmission patterns of the knowledge [22, 48]. In our own investigation, we found that 67% of the informants in Valposchiavo relied also on sources other than family and community for their knowledge, such as books, Internet, courses, etc., as opposed to Valmalenco where only 8% of the informants reported doing the same.

Nevertheless, whether as irreplaceable cornerstone or fluid guidelines, the traditions revolving around plant species were still alive and thriving in both valleys, with 95% and 97% of the uses considered as 'current' in Valmalenco and in Valposchiavo, respectively.

Conclusion

The relevance of analyzing LEKs in bordering areas lies in the opportunity to study interesting 'active diffusion' and 'speciation' phenomena related to traditional knowledge. These processes occur under the influence of several factors, including natural surrounding environment, language, religion, historical events, and socioeconomic and political dynamics.

The two territories examined in this work share, for the most part, environment, language, history, and cultural characteristics, and they have been shown to have a common core of traditional knowledge and several divergent branches caused, in all likelihood, by pivotal historical happenings that determined the division of the two neighboring communities, as well as by more modern external influences, such as books, courses, the Internet, etc. Among the future steps of our investigation of these territories, a linguistic approach in order to assess more in-depth the matter of the multilingualism *vs* monolingualism question and its influence on the LEK will be taken into account.

The work presented herein, and the projects of which it is part, not only enriched the existing literature concerning ethnobotany in bordering areas, but also contributed to improve the understanding of, preserve, and enhance the biological and cultural diversities of these territories, treating them as a precious identitarian patrimony.

Abbreviations

ICF	Informant Consensus Factor
IT	Italy
JI	Jaccard's Index
LEK	Local Ecological Knowledge
OV	Overlap
SW	Switzerland
UR(s)	Use report(s)
VM	Valmalenco
VP	Valposchiavo

Supplementary Information

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Supplementary Material 1.

Supplementary Material 2.

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Author contributions
GF conceptualized the work. All authors were involved in the methodology, resources, investigation, and data curation. GF, CG, and PSC performed the infield identification of plant species. PB did the formal analysis. FM, MB, PB worked at the original draft preparation, while all authors did the revision and edit of the work. PB, CG, and GF validated the work. FM, MB, CG, PB, and GF did the visualization. GF supervised the work, administered the project, and did the acquisition of the funding. All authors have read and approved the manuscript.

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Availability of data and materials
This paper and its supplementary materials contain all the necessary data concerning the comparison of LEKs between the valleys involved.

Declarations

Ethics approval and consent to participate
The Ethics Committee of the University of Milan has approved the ethnobotanical study protocol (Protocol number 40/23 on 04/04/23). The interviews followed the Ethical Guidelines of the International Society of Ethnobiology, 2008. All the people interviewed were informed about the objectives of our investigation and gave their oral and written consent to share the information.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. P.B. is part of the Editorial Board of the JEE.

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