frontiers | Frontiers in Sustainable Food Systems

TYPE Original Research
PUBLISHED 09 January 2023
DOI 10.3389/fsufs.2022.991979

OPEN ACCESS

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SPECIALTY SECTION
This article was submitted to Nutrition and Sustainable Diets, a section of the journal Frontiers in Sustainable Food Systems

RECEIVED 12 July 2022
ACCEPTED 16 November 2022
PUBLISHED 09 January 2023

CITATION
Baydoun S, Hani N, Nasser H, Ulian T and Arnold-Apostolides N (2023) Wild leafy vegetables: A potential source for a traditional Mediterranean food from Lebanon.
Front. Sustain. Food Syst. 6:991979.
doi: 10.3389/fsufs.2022.991979

Wild leafy vegetables: A potential source for a traditional Mediterranean food from Lebanon

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Introduction: In Lebanon, wild leafy vegetables (WLVs) continue to be an essential component of people's diet. Nevertheless, little ethnobotanical research has addressed this important potential source for food and nutrition.

Methods: In this study, an ethnobotanical survey was carried out between 2018 and 2022 across 21 villages/towns involving 151 local informants by semi-structured interviews.

Results and discussion: A list of 158 plant species which was still gathered and consumed by traditional Lebanese communities was compiled. The species belonged to 21 families and the most diverse families were Asteraceae (77 species), Brassicaceae (22), and Apiaceae (11). Native species accounted for 147 of the cited species, five of which were endemics to Lebanon and Syria. According to the Relative Frequency of Citation (RFC) index, *Anchusa azurea*, *Centaurea hyalolepis*, *Chondrilla juncea*, *Eruca vesicaria*, *Pseudopodospermum molle*, *Pseudopodospermum papposum*, and *Taraxacum* sect. *Taraxacum* were reported for the first time among the top popular species. Basal rosettes were the main parts consumed both raw and/or cooked. Informants perceived a decline in availability primarily due to habitat loss and land degradation. According to the International Union for Conservation of Nature (IUCN), six of cited species were classified as globally threatened (EN or VU), five of which were narrow endemics. These species scored substantial RFC values. Findings indicate that WEVs of Lebanon offer a promising potential to support food diversity and dietary quality of traditional communities and that threatened endemic species present a high conservation priority. Future research on nutritional contents of these species and highly rated WLVs is recommended.

KEYWORDS

ethnobotany, wild plant, leafy vegetables, traditional knowledge, Lebanon

1. Introduction

Micronutrient deficiencies are among the major public health challenges that have serious socioeconomic implications on populations worldwide (Bailey et al., 2015; Beal et al., 2017). According to the World Health Organization (WHO), more than two billion people worldwide have some form of vitamin and mineral deficiencies, primarily iodine, iron, vitamin A, and zinc (World Health Organization (WHO), 2000). This challenge has recently exacerbated due to the global economic crises and the COVID-19 pandemic along with other drivers, such as climate-related disasters and conflicts, particularly affecting low- and middle-income countries (FAO/IFAD/UNICEF/WFP/WHO, 2020; Lowe, 2021). Diversification and increased use of food with high levels of micronutrients (biofortification) are important food-based strategies which should be applied to improve nutrition, specifically in countries where fortification is inadequately implemented (Beal et al., 2017).

In this context, there is a large body of evidence that demonstrates that high contents of micronutrients in wild vegetables can combat micronutrient deficiencies in human diets (Flyman and Afolayan, 2006; Chacha and Laswai, 2020). Wild vegetables from different regions in many countries have been shown to be excellent sources of micronutrients and can contain higher levels of micronutrients than cultivated species. A comprehensive report of nutrient in wild vegetables consumed by early European farmers shows that nearly all the species contained good amounts of several micronutrients (Guerrero et al., 1998). *Verbena officinalis* L., in particular, was indicated as an excellent source of calcium and magnesium having concentrations of 3 and 1.6 mg/g in fresh leaves, respectively. Also, a study on 25 wild vegetables from Turkey shows that contents of nitrogen, potassium, calcium, and magnesium of these vegetables were all higher than those of several cultivated species, such as spinach, pepper, lettuce, and cabbage (Turan et al., 2003). Therefore, the studied species have the potential of combating micronutrient deficiency worldwide (Turan et al., 2003; Gupta et al., 2005).

Within wild edible plants, Wild Leafy Vegetables (WLVs) have worldwide been valued since antiquity both as a vital and unique source of food and traditional knowledge on interactions between people and plants (Rivera et al., 2006; Hadjichambis et al., 2008; Konsam et al., 2016). Many WLVs have served as alternatives to staple food during famines and crop failure and contributed to maintaining micronutrient requirements and more diversified and heathier diets (Ogle et al., 2001; Pinela et al., 2017; Pawera et al., 2020). The significant contribution of WLVs and other food plants along with associated traditional knowledge of indigenous communities toward achieving sustainable development goals has recently been emphasized (Kumar et al., 2021).

Despite these valuable advantages, wild edible plants have been neglected and not included in most policies and research or development programs (Pawera et al., 2020). Barriers of a wider recognition of wild edible plants include lack of information, research and policies, decreased availability due to habitat destruction, urbanization, expansion of agriculture, climate change and changes in lifestyle (Smith et al., 2019; Borelli et al., 2020; Pawera et al., 2020). There is still a high number of "neglected and underutilized" WLVs of high importance that could be brought into the food systems to diversify diets, improve micronutrient intakes and increase food supplies (Ceccanti et al., 2018) while helping local communities cope with pervasive climate change (Padulosi et al., 2011; Ulian et al., 2020).

In the Mediterranean region, WLVs represent today a revival in the modern Mediterranean diet for their potential use as functional foods (Pinela et al., 2017; Ceccanti et al., 2018) and to meet the daily micronutrient needs of rural communities and vulnerable groups (Tardío et al., 2006; Garcia-Herrera et al., 2014; Beal et al., 2017). Such wild species, along with the wealth of associated traditional knowledge, offer a largely untapped resource to support diversified nutritious diets and sustainable food systems (Khoury et al., 2014; Ulian et al., 2020; Ahmad et al., 2022).

In efforts to revitalize the importance of wild edible plants and promote their integration into agricultural sustainable food systems, several ethnobotanical studies have focused on their identification and documentation of associated traditional knowledge in the Mediterranean region. In 2008, a circum-Mediterranean survey of wild edible plants in seven Mediterranean countries (Albania, Cyprus, Egypt, Greece, Italy, Morocco, and Spain) recorded the gathering and consumption of 294 different taxa (Hadjichambis et al., 2008). The comparative analysis indicated high variations among the plant species used and their associated traditional knowledge. From the 294 taxa recorded, 77% were reported as exclusively used at a local level and high variations in cultural importance and use of cited plants in local cuisines were found. Findings suggested that there was not a unique "Mediterranean" cultural heritage in the region regarding the gathered food plants (Hadjichambis et al., 2008).

In Lebanon, an Eastern Mediterranean country recognized for its rich floristic biodiversity and traditional ethnobotanical knowledge (Davis and Heywood, 1994; Arnold et al., 2015), wild edible plants are still currently highly valued and gathered by local communities (Batal and Hunter, 2007; Marouf et al., 2015). These plants are perceived as healthy foods and mainly harvested by women for subsistence and as a source of income among vulnerable rural communities. The traditional knowledge of collection and practices continues to be transmitted from older to younger generations through observation and training (Batal and Hunter, 2007). Unfortunately, this traditional knowledge

is under threat with the disappearance unless this knowledge is recorded and maintained (Marouf et al., 2015). This fact has motivated a few recent studies to better understand the nutritional value of some common taxa and their potential to improve nutrition and food security (Baydoun et al., 2020). However, scientific interest in wild edible plants in general and WLVs in particular is still restricted to a few commonly known taxa and many remain largely ignored and unexplored. The present study aims to preserve the traditional knowledge and identify priority WLVs from Lebanon for supporting their conservation and integration into sustainable food systems. The study was performed in partnership with MAVA project "Building the ecologic and socio-economic resilience of the Shouf Mountain Landscape by restoring and strengthening the socio-cultural fabric which sustains its biodiversity and cultural values of Shouf Biosphere Reserve (SBR), Lebanon." MAVA project entails among its components the establishment of an inventory of wild edible plants of SBR used by communities in the buffer zone of reserve and the development of sustainable harvesting guidelines and advocacy actions for the adoption of regulations and successful implementation.

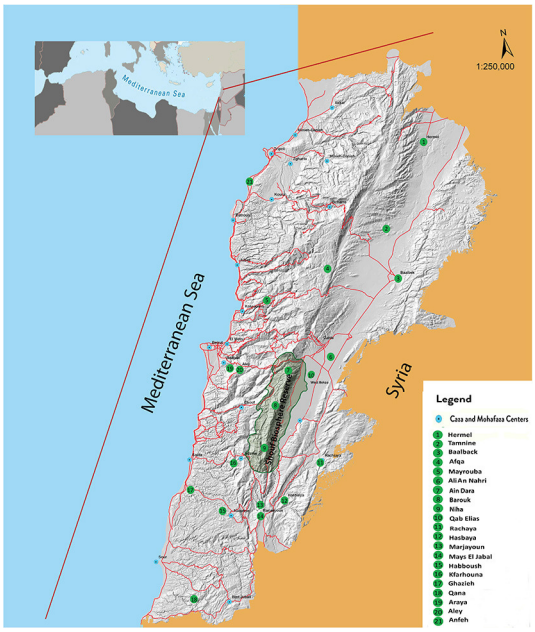

FIGURE 1
Study sites: 21 villages and towns of SBR and other provinces representing the various biogeoclimatic zones and high topographic variability of Lebanon.

2. Materials and methods

This ethnobotanical research was conducted during March 2014–September 2019 employing a community-based approach to ensure the involvement and active participation of local communities in all study sites and following the International Society of Ethnobiology (2006) and participants were familiarized with the research objectives, methods and expected results and informed consents were verbally obtained.

2.1. Study area

This study was conducted in 21 selected villages/towns of SBR and other provinces of Lebanon representing the various biogeoclimatic zones and high topographic variability of the country (Figure 1) (Saleh and Safi, 1988). The general climatological setting of Lebanon features a gradient from a typically Mediterranean climate along the coast to a pre-steppe Mediterranean climate inland. Annual average precipitation varies between 700 and 1,000 mm. It reaches 1,400 mm or above at high mountain peaks and drops down to 200 mm in the North-Eastern part of the country (Jomaa et al., 2019). Until recently, the population of the country has been estimated at around 4.5 million inhabitants. However, since the beginning of the Syrian conflict in 2011, about 1.5 million of displaced Syrians fled across borders (UNHCR/Government of Lebanon, 2017), surging the population to over 6.5 million people (The World Bank, 2021).

The natural vegetation typically features a Mediterranean sclerophyll forest of coniferous and deciduous forests characterized by leathery leaved trees, shrubs, and steppe-maquis. Vegetation assemblages falls into one of the five Mediterranean bioclimatic zones that start at the shoreline and climb to a subalpine zone at the highest elevations (>2,000 m) or pre-steppic Mediterranean zone (900–2,400 m), which is restricted to the Northern Eastern part of the country (Zohary, 1973; Saleh and Safi, 1988). Today, the persistence of over-exploitation, habitat fragmentation, and repetitive landscape transformation have distinctly altered the climax vegetation and resulted in the introduction of cultivated and alien wild species (MoE/GEF/UNIP/ELARD, 2015).

2.2. Ethnobotanical knowledge and plant identification

In this study, traditional knowledge on WLVs was collected by an ethnobotanical field survey in the selected study sites each represented by 6–8 informants. With exception to some species with edible leaves of other classes, the "Leafy vegetables (including Brassica leafy vegetables)" class of the index of classes of the CODEX Alimentarius Commission of Joint FAO/WHO Food Standards Programme was mainly considered in this study (FAO/WHO, 2006). Through the survey and field walks with

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TABLE 1 Wild leafy vegetables cited by informant in study sites, families, common names, edibles parts and mode of consumption, Relative Frequency of Citation (RFC) values, nativity and IUCN threat status.

Voucher specimen	Plant taxon	Family	Common English name(s)	Common Arabic name(s)	Edible parts, consumption mode, preparation	RFC	Nativity/ IUCN threat status	Citation
LV001-2019	*Aetheorhiza bulbosa* (L.) Cass.	Asteraceae	Tuberous Hawk's-beard	Bayed El-Ard	- Basal rosettes and Leaves—Raw in salads/Cooked as stew in mixture of mountain greens	0.60	Native/NE	Pres.
LV002-2020	*Amaranthus caudatus* L.	Amaranthaceae	Foxtail Amaranth, Velvet Flower	Aitiefeh, Erf Eddik	- Leaves—Cooked in stew with little fried onions in olive oil	0.65	Introduced/NE	Pres.
LV003-2015	*Amaranthus graecizans* L.	Amaranthaceae	Mediterranean Amaranth	Aitiefeh, Erf Eddik		0.75	Native/NE	1
LV004-2015	*Amaranthus retroflexus* L.	Amaranthaceae	Red-Root Amaranth	Aitiefeh, Erf Eddik		0.72	Introduced/NE	2
LV005-2016	*Anchusa azurea* Mill.	Boraginaceae	Garden Anchusa	Lissan El-Thawr, Fiddrieh	- Young leaves and Young stem tops—Cooked as stew with little fried onions and chickpeas in olive oil or meat	0.76	Native/NE	Pres.
LV006-20017	*Anchusa hybrida* Ten.	Boraginaceae	Hybrid Bugloss	Aitiefeh, Erf Eddik		0.60	Native/NE	1
LV007-2014	*Anchusa strigosa* Banks and Sol.	Boraginaceae	Prickly Alkanet	Aitiefeh, Erf Eddik		0.30	Native/NE	Pres.
LV008-20114	*Apium graveolens* L.	Apiaceae	Wild Celery	Krafs Barri	- Young shoots and Leaves—Raw as salads/Cooked as pie filling after salting and draining juice out and mixing with onions, some pomegranate, lemon juice and olive oil	0.60	Native/LC	Pres.
LV009-2020	*Arctium minus* (Hill) Bernh.	Asteraceae	Common Burdock	Arktyoun	- Basal rosettes, Leaves and Young stem tops—Raw as salad/Cooked as a stew alone or in mixture of mountain greens - Young root—Raw after peeling as a snack	0.10	Native/NE	Pres.
LV010-2014	*Arum palaestinum* Boiss.	Araceae	Palestine Arum, Solomon's Lily	Louf Falastini	- Leaves—Cooked as a stew after boiling and straining water out	0.33	Endemic: Syr., Leb. to Jor./NE	Pres.
LV011-2015	*Asphodeline lutea* (L.) Rchb.	Asphodelaceae	Yellow Asphodel	A'slan Asfar	- Young shoots – Cooked as stew in mixture of mountain greens - Tubers—Cooked (steamed) or roasted like potatoes	0.12	Native/NE	Pres.

(Continued)

TABLE 1 (Continued)

Voucher specimen	Plant taxon	Family	Common English name(s)	Common Arabic name(s)	Edible parts, consumption mode, preparation	RFC	Nativity/IUCN threat status	Citation
LV012-2019	*Astartoseris triquetra* (Labill.) N.Kilian, Hand, Hadjik., Christodoulou and Bou Dagh.	Asteraceae	Triquetrous Scoriola	Scaroila Zara'a	- Basal rosettes—Raw in salads/Cooked as stew in mixture of mountain greens	0.10	Endemic: Cyp.and Leb./NE	Pres.
LV013-2015	*Bellis annua* L.	Asteraceae	Annual Daisy	Zahr El-Lo' Lo'	- Basal rosettes and Leaves—Raw as salad/Cooked as stew in mixture of mountain greens	0.70	Native/NE	Pres.
LV014-2015	*Bellis perennis* L.	Asteraceae	English Daisy	Zahr El-Rabii'		0.60	Native/NE	Pres.
LV015-2016	*Bellis sylvestris* Cirillo	Asteraceae	Southern Daisy	Zahr El-Ghabeh		0.51	Native/NE	Pres.
LV016-2017	*Blitum virgatum* L.	Amaranthaceae	Strawberry Goosefoot	Rejel El Waz	- Basal rosettes and Leaves—Cooked in stew as in spinach alone or in mixture of mountain greens	0.21	Native/NE	Pres.
LV017-2019	*Borago officinalis* L.	Boraginaceae	Borage, Tailwort	Lisan El Thawr	- Basal rosettes and Young leaves—Raw in salads/Cooked as stew with little amount of cooked chick peas or in mixture of mountain greens	0.25	Native/NE	2
LV018-2019	*Brassica juncea* (L.) Czern.	Brassicaceae	Black Mustard	Khardal Aswad	- Basal rosettes and Young shoots—Raw in salads	0.55	Introduced/LC	Pres.
LV019-2019	*Cakile maritima* Scop.	Brassicaceae	European Searocket	Rachad El-Bahr	- Young shoots—Raw in salads	0.52	Native/NE	Pres.
LV020-2019	*Calendula arvensis* L.	Asteraceae	Field Marigold	Azaryoun	- Basal rosettes and Young shoots—Raw in salads/Cooked as stew alone or in mixture of mountain greens	0.61	Native/NE	Pres.
LV021-2018	*Capparis spinosa* L.	Capparaceae	Caper	Cappar	- Flower buds and Young shoots—Raw as pickled in salt and vinegar	0.50	Native/LC	3
LV022-2018	*Capsella bursa-pastoris* (L.) Medik.	Brassicaceae	Shepherd's Purse	Jarras El Raii	- Basal rosettes—Raw in salads/Cooked as a stew alone or in mixture of mountain greens	0.41	Native/NE	Pres.
LV023-2019	*Cardamine hirsuta* L.	Brassicaceae	Hairy Bittercress	E'rret El-Kroum	- Basal rosettes and Leaves—Raw as salad/Cooked as stew in mixture of mountain greens	0.31	Native/NE	Pres.
LV024-2018	*Carduus argentatus* L.	Asteraceae	Silver Thistle	Kherfaish Feddieh	- Basal rosettes—Raw in salads/Cooked as a stew alone or in mixture of mountain greens	0.51	Native/NE	Pres.

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TABLE 1 (Continued)

Voucher specimen	Plant taxon	Family	Common English name(s)	Common Arabic name(s)	Edible parts, consumption mode, preparation	RFC	Nativity/IUCN threat status	Citation
LV025-2018	*Carduus pycnocephalus* L.	Asteraceae	Italian Thistle	Kherfaish, Harshaf	- Basal rosettes—Raw in salads/Cooked as stew alone or in mixture of mountain greens. Young stem—Raw peeled as a snack	0.50	Native/NE	Pres.
LV026-2018	*Centaurea calcitrapa* L.	Asteraceae	Purple Star Thistle	Dardarieh, Murrayr	- Basal rosettes—Cooked by steaming and straining and served as in salad or topped with fried onion wings in olive oil	1.00	Native/NE	Pres.
LV027-2017	*Centaurea hyalolepis* Boiss.	Asteraceae	Eastern Star Thistle	Dardarieh, Marrair		0.78	Native/NE	Pres.
LV028-2018	*Centaurea iberica* subsp. *Hermonis* (Boiss.) Bornm.	Asteraceae	Iberian Hermon Star Thistle	Shawk El-Derdar		0.60	Endemic: Leb. and Syr./NE	Pres.
LV029-2015	*Centaurea iberica* subsp. *meryonis* (DC.) Bornm	Asteraceae	Iberian Star Thistle	Shawk El-Derdar		0.61	Endemic: E. Medit./NE	Pres.
LV030-2016	*Centaurea pallescens* Delile	Asteraceae	Pale Star, Pale Knapweed	Dardar, Kantaryoun		0.63	Native/NE	2
LV031-2015	*Centaurea solstitialis* L.	Asteraceae	Yellow Star-Thistle	Murrayr, Kantaryoun		0.62	Native/NE	Pres.
LV032-2016	*Chenopodiastrum murale* (L.) S.Fuentes, Uotila and Borsch	Amaranthaceae	Nettle Leaf Goosefoot	Sermek El Hitan	- Leaves—Cooked as a stew with little fried onions in olive oil and topped with garlic and coriander	0.61	Native/NE	Pres.
LV033-2017	*Chenopodium album* L.	Amaranthaceae	Wild Spinach	Rejl El-Wazzeh		0.60	Native/NE	Pres.
LV034-2014	*Chenopodium opulifolium* Schrad. ex W.D.J.Koch and Ziz	Amaranthaceae	Gray Goosefoot	Sermok Khman		0.51	Native/NE	Pres.
LV035-2014	*Chondrilla juncea* L.	Asteraceae	Naked Weed	Ya'did	- Basal rosettes—Cooked as a stew alone or in mixture of mountain greens	0.75	Native/NE	Pres.

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TABLE 1 (Continued)

Voucher specimen	Plant taxon	Family	Common English name(s)	Common Arabic name(s)	Edible parts, consumption mode, preparation	RFC	Nativity/IUCN threat status	Citation
LV036-2015	*Cichorium intybus* L.	Asteraceae	Common Chicory	Henddbe' Barriyeh, A'lt	- Basal rosettes and Young leaves—raw in salads/Cooked steamed, alone or in mixture with other species, fully strained and served as salad or topped with fried onion wings in olive oil	1.00	Native/NE	2, 4, 5
LV037-2014	*Cichorium pumilum* Jacq.	Asteraceae	Dwarf Chicory	Henddbe' Barriyeh		0.30	Native/NE	Pres.
LV038-2019	*Cirsium vulgare* (Savi) Ten.	Asteraceae	Common Thistle	Kaswan	- Basal rosettes—Cooked as stew alone or in mixture of mountain greens	0.70	Native/NE	Pres.
LV039-2019	*Coleostephus myconis* (L.) Rchb. f.	Asteraceae	Corn Marigold	Akhawan	- Basal rosettes—Cooked as stew alone or in mixture of mountain greens	0.21	Medit./NE	Pres.
LV040-2017	*Cousinia libanotica* DC.	Asteraceae	Lebanese Cousinia	Cousinia Lebnaneh	- Basal rosettes—Cooked as stew alone or in mixture of mountain greens	0.42	Endemic: Mt. Leb./VU	Pres.
LV041-2018	*Cousinia ramosissima* DC.	Asteraceae	Branched Cousinia	Cousinia		0.31	Endemic: Tur. to Leb./NE	Pres.
LV042-2019	*Crambe orientalis* L.	Brassicaceae	Oriental Colewort.	Kremb	- Basal rosettes—Raw in salads	0.54	Native/DD	Pres.
LV043-2018	*Crepis reuteriana* Boiss.	Asteraceae	Hawk's Beard	Khefieh	- Basal rosettes—Cooked as stew alone or in mixture of mountain greens	0.39	Endemic: E. Medit./NE	Pres.
LV044-2018	*Crithmum maritimum* L.	Apiaceae	Sea Fennel	Choumar Bahri	- Leaves and Stem tops—Raw as a side vegetable or pickled in salt and vinegar.	0.40	Native/NE	Pres.
LV045-2019	*Cyanus cyanoides* Wahlenb.	Asteraceae	Syrian Cornflower-Thistle	Kantarion Azrak	- Basal rosettes—Raw in salads/Cooked as stew alone or in mixture of mountain greens	0.30	E. Medit./NE	Pres.
LV046-2018	*Cyclamen persicum* Mill.	Primulaceae	Persian Cyclamen	Bakhour Mariem	- Leaves – Cooked as a substitute of vine leaves stuffed with rice and minced meat or fresh tomatoes, onions, lemon juice and olive oil	0.40	Native/NE	Pres.
LV047-2017	*Cynara auranitica* Post	Asteraceae	Middle-East Wild Artichoke	Kharsouf Hourani	- Basal rosettes—Raw in salads/Cooked as stew alone or in mixture of mountain greens	0.63	Native/NE	Pres.
LV048-2019	*Cynara syriaca* Boiss.	Asteraceae	Syrian Artichoke	Kharsouf Souri		0.51	Endemic: Syr. to Isr./NE	Pres.
LV049-2016	*Descurainia sophia* (L.) Webb ex Prantl	Brassicaceae	Flixweed, Herb-Sophia	Sophia, Samaret El-Hekmeh	- Young shoots—Raw in salads	0.32	Native/NE	Pres.
LV050-2019	*Diplotaxis erucoides* (L.) DC.	Brassicaceae	White Wall Rocket, Wasabi Herb	Jarjir Abyad	- Young shoots—Raw in salads	0.52	Native/NE	Pres.
LV051-2019	*Eremurus spectabilis* M. Bieb.	Asphodelaceae	Foxtail Lilly	Aassayl	- Roots—Raw as a snack/Cooked as omelets - Leaves and Young shoots - Cooked as stews	0.42	Native/NE	Pres.

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TABLE 1 (Continued)

Voucher specimen	Plant taxon	Family	Common English name(s)	Common Arabic name(s)	Edible parts, consumption mode, preparation	RFC	Nativity/IUCN threat status	Citation
LV052-2015	*Eruca vesicaria* (L.) Cav.	Brassicaceae	Arugula, Rucola	Rokka, Jarjir	- Shoots and Leaves—Raw in salads	1.00	Native/NE	Pres.
LV053-2019	*Eryngium billardierei* F. Delaroche	Apiaceae	BillardiereiEryngo	Chindab	- Basal rosettes—Raw as side vegetable or in salads	0.60	Native/NE	Pres.
LV054-2019	*Eryngium creticum* Lam.	Apiaceae	Cretan Eryngo	Kers A'nneh		1.00	Native/NE	2, 4, 5
LV055-2018	*Eryngium desertorum* Zohary*	Apiaceae	Desert Eryngo	Kers A'nneh Sahrawi		0.10	Endemic: Syr. and Leb./NE	Pres.
LV056-2016	*Eryngium falcatum* F. Delaroche	Apiaceae	Falcate Eryngo	Chindab		0.31	Native/NE	Pres.
LV057-2018	*Eryngium glomeratum* Lam.	Apiaceae	Clustered Eryngo	Chindab		0.43	Native/NE	Pres.
LV058-2017	*Eryngium heldreichii* Boiss.	Apiaceae	Bourgatii Eryngo	Chindab		0.72	Endemic: Tur., Syr. to Leb./NE	Pres.
LV059-2019	*Foeniculum vulgare* Mill.	Apiaceae	Common Fennel	Choumar Barri	- Leaves and Young shoots—Raw as side vegetable/Cooked as omelets	1.00	Native/NE	2, 5
LV060-2019	*Gelasia mackmeliana* (Boiss.) Zaika, Sukhor. and N.Kilian	Asteraceae	Mackmelian Salsify	Dabbah El-Makmel	- Leaves—Cooked as stew alone or in mixture of mountain greens	0.61	Endemic: Leb./EN	Pres.
LV061-2017	*Geropogon hybridus* (L.) Sch. Bip.	Asteraceae	Pasture Goatsbeard	Lehyet Et-Tayes	- Leaves—Cooked as stew alone or in mixture of mountain greens	0.22	Native/NE	Pres.
LV062-2019	*Glebionis coronaria* (L.) Cass. Ex Spach	Asteraceae	Crown Daisy	Ikhwan	- Leaves—Cooked as stew alone or in mixture of mountain greens	0.70	Native/NE	Pres.
LV063-2017	*Glebionis segetum* (L.) Fourr.	Asteraceae	Corn Marigold, Eastern Star	Aqhawan	- Leaves—Cooked as stew alone or in mixture of mountain greens	0.23	Native/NE	Pres.
LV064-2016	*Gundelia tournefortii* L.	Asteraceae	Tumble Thistle	A'koub	- Young inflorescence and Leaves—Raw/Cooked after removing spines in stew with olive oil and little chopped onion or with meat and chickpeas	1.00	Native/NE	2, 4, 5, 6,

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TABLE 1 (Continued)

Voucher specimen	Plant taxon	Family	Common English name(s)	Common Arabic name(s)	Edible parts, consumption mode, preparation	RFC	Nativity/IUCN threat status	Citation
LV065-2018	*Hedypnois rhagadioloides* (L.) F. W. Schmidt	Asteraceae	Cretanweed, Scaly Hawkbit	Serret El-Kabesh	- Basal rosettes—Raw as a side vegetable or in salads - Cooked as in chicory (*Cichorium* sp.)	0.22	Native/NE	Pres.
LV066-2019	*Helminthotheca echioides* (L.) Holub	Asteraceae	Bristly Oxtongue	Merrair	- Basal rosettes—Raw as a side vegetable or in salads - Cooked as in chicory (*Cichorium* sp.)	0.70	Native/NE	Pres.
LV067-2017	*Helosciadium nodiflorum* (L.) W.D.J.Koch	Brassicaceae	Fool's Water Cress	Kerrah, Jarjir	- Young shoots and Leaves—Raw as salads/Cooked as pie filling after salting and draining juice out and mixing with onions, pomegranate seeds, lemon juice and olive oil	0.70	Native/LC	2
LV068-2014	*Hirschfeldia incana* (L.) Lagr.-Foss.	Brassicaceae	Mediterranean Mustard	Khardal	- Basal rosettes and Young shoots - Raw in salads	0.26	Native/NE	Pres.
LV069-2018	*Hyoseris scabra* L.	Asteraceae	Annual Hyoseris	Hyoseris	- Basal rosettes—Cooked in stew alone or in mixture of mountain greens	0.24	Medit./NE	Pres.
LV070-2019	*Hypochaeris glabra* L.	Asteraceae	Smooth Cat's Ear	Houdla, Hypoceris	- Basal rosettes—Raw as a side vegetable or in salads - Cooked as in chicory (*Cichorium* sp.)	0.13	Native/NE	Pres.
LV071-2016	*Inula crithmoides* (L.) Dumort.	Asteraceae	Golden Samphire	Echbet El Bahr	- Young shoots and Leaves—Raw as side vegetable or pickle in salt and vinegar	0.50	Medit./NE	1
LV072-2017	*Isatis lusitanica* L.	Brassicaceae	Aleppo Woad	Wasmeh	- Young shoots—Raw in salads	0.16	Native/NE	Pres.
LV073-2018	*Klasea cerinthifolia* (Sm.) Greuter and Wagenitz	Asteraceae	Saw Wort	Warrayka	- Basal rosettes—Cooked in a stew alone or in mixture of mountain greens	0.35	Native/NE	Pres.
LV074-2019	*Klasea pusilla* (Labill.) Greuter and Wagenitz	Asteraceae	Dwarf Saw- Wort	WarraykaKazameh	- Basal rosettes—Raw as a side vegetable or in salads - Cooked as in chicory (*Cichorium* sp.)	0.61	Endemic: Syr. to Jor./NE	Pres.
LV075-2016	*Lactuca orientalis* (Boiss.) Boiss.	Asteraceae	Split-Leaf Lettuce	Khas Barri		0.50	Native/NE	Pres.
LV076-2017	*Lactuca serriola* L.	Asteraceae	Prickly Lettuce	Khas Barri, Khas El Zayt	- Basal rosettes—Raw as salad/Cooked as chicory (*Cichorium* sp)	0.62	Native/NE	Pres.
LV077-2019	*Lactuca tuberosa* Jacq.	Asteraceae	Tuberous Lettuce	Khas Helou		0.60	Native/NE	2

(Continued)

TABLE 1 (Continued)

Voucher specimen	Plant taxon	Family	Common English name(s)	Common Arabic name(s)	Edible parts, consumption mode, preparation	RFC	Nativity/IUCN threat status	Citation
LV078-2018	*Lapsana communis* L.	Asteraceae	Common Nipplewort	Khafej	- Basal rosettes—Raw as aside vegetable/Cooked as a stew alone or in mixture of mountain greens	0.62	Native/NE	Pres.
LV079-2019	*Leontodon asperrimus* (Willd.) Endl.	Asteraceae	Red Dandelion	Ya'did Ahmar	- Basal rosette and Leaves and Tuberous roots—Raw as a snack/Cooked as a stew alone or in mixture of mountain greens	0.71	Native/NE	Pres.
LV080-2018	*Leontodon libanoticus* Boiss.	Asteraceae	Lebanese Dadlion	Ya'did Lebnani		0.50	Endemic: Leb./VU	Pres.
LV081-2017	*Leontodon tuberosus* L.	Asteraceae	Tuberous Hawkbit	Ya'did Askouli		0.65	Medit./NE	Pres.
LV082-2018	*Lepidium draba* L.	Brassicaceae	Whitetop, Hoary Cress	Qnaibrah	- Basal rosettes and Young shoots—Raw as a side pungent vegetable or in salads	0.62	Native/NE	Pres.
LV083-2016	*Lepidium latifolium* L.	Brassicaceae	Pepperweed	Rachad Barri		0.68	Native/NE	Pres.
LV084-2016	*Lobularia maritima* (L.) Desv.	Brassicaceae	Sweet Alyssum	Alyssum El-Bahr	- Young shoots—Raw as side vegetable or in salads for pungency	0.12	Native/NE	Pres.
LV085-2018	*Lotus edulis* L.	Fabaceae	Edible Bird's-Foot-Trefoil	Qern El-Ghazal	- Young seedpods—Cooked stewed with little garlic or onions and coriander in olive oil	0.51	Medit./NE	Pres.
LV086-2017	*Malva neglecta* Wallr.	Malvaceae	Mallow, Dwarf Malva	Khebbayze'		1.0	Native/NE	Pres.
LV087-2017	*Malva nicaeensis* All.	Malvaceae	French Mallow	Khebbayze'	- Basal rosettes and Young shoots—Cooked as a stew, mixed sometimes with Fennel leaves, in olive oil. Little Burghul wheat can be added. Leaves are dried for storage	0.70	Native/NE	Pres.
LV088-20169	*Malva parviflora* L.	Malvaceae	Cheeseweed	Khebbayze'		0.65	Native/NE	Pres.
LV089-2018	*Malva sylvestris* L.	Malvaceae	Wood Mallow	Khebbayze'		1.00	Native/NE	2, 5
LV090-2018	*Nasturtium officinale* W.T. Aiton	Brassicaceae	Watercress	Errah	- Young shoots—Raw as side vegetable or salad/Cooked with onions and olive oil and Lemon juice or Pomegranate condensed juice (Debs Reman) as a pie filling	1.00	Native/LC	5
LV091-2019	*Noccaea perfoliata* (L.) Al-Shehbaz	Brassicaceae	Perfoliate Penny-Cress	Tlapsy El-Rihan	- Young leaves—Raw added to salads	0.12	Native/NE	Pres.

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TABLE 1 (Continued)

Voucher specimen	Plant taxon	Family	Common English name(s)	Common Arabic name(s)	Edible parts, consumption mode, preparation	RFC	Nativity/IUCN threat status	Citation
LV092-2018	*Notobasis syriaca* (L.) Cass.	Asteraceae	Syrian Thistle	Kherfaich	- Basal rosettes—Raw in salads/Cooked as a stew alone or in mixture of mountain greens - Stems—Raw after peeling as snacks - Inflorescence (capitulum base) – Cooked, after removal of flowers and bracts, as a stew with minced meat or with little onions in olive oil or as salad	0.71	Native/NE	Pres.
LV093-2017	*Onopordum acanthium* L.	Asteraceae	Scotch Thistle	Ras E-Shwak	- Basal rosettes—Raw in salads/Cooked as a stew alone or in mixture of mountain greens	0.52	Not reported/NE	Pres.
LV094-2018	*Onopordum cynarocephalum* Boiss. and C.I. Blanche	Asteraceae	Artichoke Cotton-Thistle	Kherfaich		0.55	E. Medit./NE	Pres.
LV095-2018	*Onopordum heteracanthum* C.A.Mey.	Asteraceae	Artichoke	Kherfaich		0.55	Native/NE	6
LV096-2018	*Origanum ehrenbergii* Boiss.	Lamiaceae	Ehrenberg's Marjoram	Za'atar Barri	- Leaves—Raw as salad or dried in Za'atar mixture with sumac (*Rhus coriaria*) and sesame seeds	0.70	Endemic: Leb./VU	Pres.
LV097-2014	*Origanum syriacum* L.	Lamiaceae	Bible Hyssop, Syrian Oregano	Za'atar		1.00	Native/NE	2, 5
LV098-2017	*Oxalis corniculata* L.	Oxalidaceae	Wood-Sorrel, Changeri	Hommaydah	- Leaves and Petioles—Raw in salads/Cooked after salting and straining juice as pie (Fatayer) filling	0.70	Introduced/NE	Pres.
LV099-2016	*Oxalis pes-caprae* L.	Oxalidaceae	Sourgrass	Hommaydah		0.60	Introduced/NE	2
LV100-2018	*Papaver rhoeas* L.	Papaveraceae	Common Poppy	Shaka'ik-Un-noman	- Leaves—Cooked as stews in mixture of mountain greens or in soups	0.22	Native/NE	2
LV101-2017	*Picris rhagadioloides* (L.) Desf.	Asteraceae	Tall Ox-Tongue	Murrair Taweil	- Basal rosettes—Raw as side vegetable/Cooked as chicory (*Cichorium* sp.)	0.61	Native/NE	Pres.
LV102-2018	*Plantago coronopus* L.	Plantaginaceae	Buckshorn Plantain	Lisan Ul-Hamel		0.35	Native/NE	Pres.
LV103-2015	*Plantago lanceolata* L.	Plantaginaceae	Ribwort, Plantain	Lisan Ul-Hamel	- Young leaves and Petioles—Cooked as stew alone or in mixture of mountain greens	0.70	Native/VU	Pres.
LV104-2019	*Plantago major* L.	Plantaginaceae	Broadleaf Plantain	Lisan Ul-Hamel		0.71	Native/LC	2

(Continued)

TABLE 1 (Continued)

Voucher specimen	Plant taxon	Family	Common English name(s)	Common Arabic name(s)	Edible parts, consumption mode, preparation	RFC	Nativity/IUCN threat status	Citation
LV107-2018	*Portulaca oleracea* L.	Portulacaceae	Purslane	Bakleh, Farfahin	- Leaves and Young Stem tops—Raw as salads especially Bread Salad (Fatouch)/Cooked as stew or pie (Fatayer) filling	1.00	Native/NE	2, 5
LV108-2017	*Primula vulgaris* Huds.	Primulaceae	Common Primrose	Zaghda	- Leaves—Cooked in stew or pie filling as in purslane (*Portulaca oleracea)*	0.25	Native/NE	Pres.
LV109-2018	*Pseudopodospermum libanoticum* (Boiss.) Zaika, Sukhor. and N.Kilian	Asteraceae	Lebanese Salsify	Dabah Lebnani	- Leaves—Raw as a snack/Cooked as a stew alone	0.60	Endemic: Syr. and Leb./EN	6
LV110-2017	*Pseudopodospermum molle* (M.Bieb.) Kuth.	Asteraceae	Wave-leaved Viper's-grass	Dabah Taree, Al Meshe		0.75	Native/NE	Pres.
LV111-2019	*Pseudopodospermum papposum* (DC.) Zaika, Sukhor. and N.Kilian	Asteraceae	Oriental Salsify	Dabbah Laylaky		0.76	Native/NE	Pres.
LV112-2018	*Pseudopodospermum phaeopappum* (Boiss.) Zaika, Sukhor. and N.Kilian	Asteraceae	Gray-pappused Viper's-grass	Al Meshe		0.75	Native/NE	6, 7
LV113-2015	*Raphanus raphanistrum* L.	Brassicaceae	Wild Radish	Fijil Barri	- Young shoot—Raw as a salad	0.60	Native/NE	2
LV114-2017	*Rapistrum rugosum* (L.) All.	Brassicaceae	Turnip Weed, Wild Turnip	Malfouf Barri	- Young shoot—Raw as a salad	0.10	Native/NE	Pres.
LV115-2014	*Reichardia dichotoma* Freyn	Asteraceae	Glaucouse Reichardia	Reikhardia	- Basal rosettes—Cooked as stew alone or in mixture mountain greens	0.20	Not Reported/NE	Pres.
LV116-2019	*Reichardia picroides* (L.) Roth	Asteraceae	French Scorzonera	Reikhardia Merreh		0.70	Medit./NE	Pres.
LV117-2015	*Rhagadiolus edulis* Gaertn.	Asteraceae	Edible Star-Hawkbit	Rhgadiolus	- Basal rosettes—Raw in salads/Cooked as a stew alone or in mixture of mountain greens	0.70	Native/NE	Pres.
LV118-2019	*Rhagadiolus stellatus* (L.) Gaertn.	Asteraceae	Star Hyoseris	Ibret El-Ajouz		0.71	Native/NE	Pres.

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TABLE 1 (Continued)

Voucher specimen	Plant taxon	Family	Common English name(s)	Common Arabic name(s)	Edible parts, consumption mode, preparation	RFC	Nativity/IUCN threat status	Citation
LV119-2016	*Rhamphospermum* arvense (L.) Andrz. ex Besser	Boraginaceae	Charlock Mustard	Khardal	- Basal rosettes—Raw in salads/Cooked as a stew alone or in mixture of mountain greens	0.70	Not Reported/NE	Pres.
LV120-2015	*Rheum ribes* L.	Polygonaceae	Syrian Rhubarb	Rhoubas	- Stem and Leaf petioles—Raw in salads	0.51	Native/NE	Pres.
LV121-2018	*Ridolfia segetum* (L.) Moris	Apiaceae	False Fennel, Corn Parsley	Kersar	- Young shoots—Raw pickled with cucumber or olives	0.22	Native/NE	Pres.
LV122-2017	*Rorippa sylvestris* (L.) Besser	Brassicaceae	Creeping Yellow Cress	Errah Barrieh	- Young shoots—Raw in salads	0.70	Not Reported/LC	Pres.
LV123-2015	*Rumex acetosa* L.	Polygonaceae	Garden Sorrel	Hemmaydeh	- Leaves—Cooked as pie (Fatayer) filling	0.60	Not Reported/NE	Pres.
LV124-2017	*Rumex acetosella* L.	Polygonaceae	Red Sorrel, Sour Weed	Hemmaydeh		0.61	Native/NE	Pres.
LV125-2019	*Rumex bucephalophorus* L.	Polygonaceae	Red Dock	Hemmaydeh		0.60	Medit./NE	6
LV126-2015	*Rumex chalepensis* Mill.	Polygonaceae	Aleppo Dock	Hemmaydeh		0.71	Native/NE	Pres.
LV127-2017	*Rumex conglomeratus* Murray	Polygonaceae	Sharp Dock, Clustered Dock	Hemmaydeh		0.62	Native/NE	Pres.
LV128-2016	*Rumex crispus* L.	Polygonaceae	Curly Dock	Hemmaydeh		0.68	Native/NE	2
LV129-2018	*Rumex nepalensis* Spreng.	Polygonaceae	Nepal Dock	Hemmaydeh		0.60	Native/NE	Pres.
LV130-2019	*Rumex pulcher* L	Polygonaceae	Fiddle Dock	Hemmaydeh		0.71	Native/NE	Pres.
LV131-2015	*Sanguisorba verrucosa* (Link ex G.Don) Ces	Rosaceae	Mediterranean Burnet	Balan	- Young leaves and Shoots—Raw in salads	0.11	Native/NE	Pres.
LV132-2018	*Scolymus hispanicus* L.	Asteraceae	Spanish Salsify	Shawket El- Far	- Basal rosettes—Cooked as stew alone or in mixture of mountain greens	0.72	Native/NE	Pres.
LV133-2017	*Scolymus maculatus* L.	Asteraceae	Spotted Golden Thistle	Shawket El- Far		0.61	Native/NE	Pres.

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TABLE 1 (Continued)

Voucher specimen	Plant taxon	Family	Common English name(s)	Common Arabic name(s)	Edible parts, consumption mode, preparation	RFC	Nativity/IUCN threat status	Citation
LV134-2019	*Scorpiurus muricatus* L.	Fabaceae	Prickly Scorpiontail	Denb el 'Aqreb	- Leaves and Young shoots—Raw in salads/Cooked as stew in mixture of mountain greens	0.15	Native/NE	6
LV105-2015	*Scorzonera alpigena* (K.Koch) Grossh.	Asteraceae	White Salsify	Dabah Alpi	- Basal rosette—Raw in salads/Cooked as a stew alone or in mixture with mountain greens	0.71	Native/NE	Pres.
LV106-2017	*Scorzonera cana* (C.A.Mey.) Hoffm.	Asteraceae	Gray Salsify	Dabah Jabali		0.72	Native/NE	1, 6
LV135-2019	*Silene vulgaris* (Moench) Garcke	Caryophyllaceae	Maidenstears	Aaluke, Silineh	- Basal rosettes—Cooked as stew alone or in mixture of mountain greens	0.51	Native/LC	2, 6
LV136-2018	*Silybum marianum* (L.) Gaertn.	Asteraceae	Milk Thistle	Showk Mariam	- Basal rosettes and Leaves—Cooked alone as in chicory (*Cichorium* sp.) after removing sharp spines	0.71	Native/LC	Pres.
LV137-2015	*Sinapis alba* L.	Brassicaceae	White Mustard	Khardal Abyad	- Leaves andYoung shoots—Raw as flavoring in salads	0.71	Native/NE	Pres.
LV138-2018	*Sisymbrium irio* L.	Brassicaceae	London Rocket	Fijel El-Jamal	- Leaves andYoung shoots—Raw as flavoring in salads	0.31	Native/NE	Pres.
LV139-2019	*Sisymbrium officinale* (L.) Scop.	Brassicaceae	Hedge Mustard	Samarah Tebbieh	- Leaves andYoung shoots—Raw as flavoring in salads	0.11	Native/NE	Pres.
LV140-2016	*Smyrnium olusatrum* L.	Apiaceae	Alexanders	Krafs Barri	- Leaves and Young shoots—Raw in salads/Cooked in soups and stews of mountain greens	0.11	Native/NE	Pres.
LV141-2018	*Sonchus asper* (L.) Hill	Asteraceae	Spiny Milk-Thistle	Merair, Libbien	- Basal rosettes and Leaves—Cooked as in chicory (*Cichorium* sp.) after removal of stiff spines	0.32	Native/NE	Pres.
LV142-2019	*Sonchus oleraceus* (L.)	Asteraceae	Common Sow-Thistle	Libbien	- Basal rosettes and Leaves—Cooked as in chicory (*Cichorium* sp.)	0.41	Native/NE	Pres.
LV143-2016	*Stellaria media* Vill.	Caryophyllaceae	Chickweed	A'chbet El-Tair	- Young leaves—Raw in salads - Young shoots—Cooked as stew in mixture of mountain greens	0.22	Native/NE	Pres.

(Continued)

TABLE 1 (Continued)

Voucher specimen	Plant taxon	Family	Common English name(s)	Common Arabic name(s)	Edible parts, consumption mode, preparation	RFC	Nativity/IUCN threat status	Citation
LV144-2018	*Taraxacum aleppicum* Dahlst.	Asteraceae	Aleppo Dandelion	Merrair	- Basal rosettes—Raw in salads/Cooked alone as in chicory (*Cichorium* sp.) or in mixture of mountain greens	0.63	Native/NE	Pres.
LV145-2018	*Taraxacum assemanii* C.I.Blanche ex Boiss.	Asteraceae	Assema Dandelion	Tarkhachkoon Al Samaiina		0.43	Native/NE	6
LV146-2018	*Taraxacum cyprium* H. Lindb.	Asteraceae	Cyprus Dandelion	Merrair		0.71	E. Medit./NE	Pres.
LV147-2014	*Taraxacum megalorrhizon* (Forssk.) Hand.-Mazz.*	Asteraceae	Mediterranean Dandelion, Big-rootDandelion	Merrair		0.62	Native/NE	Pres.
LV148-2017	*Taraxacum phaleratum* G. E. Haglund	Asteraceae	Shiny Dandelion	Merrair		0.50	Native/NE	6
LV149-2016	*Taraxacum* sect. *Taraxacum* F.H.Wigg.	Asteraceae	Common Dandelion	Merrair		0.80	Native/NE	Pres.
LV150-2019	*Taraxacum syriacum* Boiss.	Asteraceae	Syrian Dandelion	Merrair		0.71	Native/NE	Pres.
LV151-2014	*Thymus syriacus* Boiss	Lamiaceae	Syrian Thyme	Za'atar	- Leaves—Raw as salad with little chopped onions, tomatoes and dressed with lemon juice and olive oil	0.55	Endemic: Syr. to Irq./NE	Pres.
LV152-2019	*Tolpis virgata* (Desf.) Bertol.	Asteraceae	Tall Tolpis	Faykoua'	- Basal rosettes—Raw in salads/Cooked as in Chicory (*Cichorium* sp.)	0.12	Native/NE	Pres.
LV153-2015	*Tragopogon buphthalmoides* (DC.) Boiss.	Asteraceae	Goat's Beard	Ain El-Thwor	- Basal rosettes—Raw in salads/Cooked alone as in chicory (*Cichorium* sp.) or in mixture of mountain greens	0.81	Native/NE	2, 5, 6
LV154-2017	*Tragopogon coelesyriacus* Boss.	Asteraceae	Purple Salsify, Long-Beaked Goat's Beard	Lehyet El-Tyes, Salsify Tawil		0.71	Native/NE	6
LV155-2019	*Tussilago farfara* L.	Asteraceae	Coltsfoot	A'shbet El-Sa'aleh	- Basal rosettes—Raw in salads/Cooked as stew in mixture mountain greens	0.22	Native/NE	Pres.
LV156-2019	*Urospermum picroides* (L.) Scop. ex F.W. Schmidt	Asteraceae	Prickly Goldenfleece	Adid Merr	- Basal rosettes—Raw in salads/Cooked as in chicory (*Cichorium* sp)	0.71	Native/NE	Pres.

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TABLE 1 (Continued)

Voucher specimen	Plant taxon	Family	Common English name(s)	Common Arabic name(s)	Edible parts, consumption mode, preparation	RFC	Nativity/IUCN threat status	Citation
LV157-2018	*Urtica dioica* L.	Urticaceae	Stinging Nettle, Nettle Leaf	Kerrays	- Leaves—Cooked in stews with meat chunks and garlic as a substitute of Jew's mallow (*Corchorus olitorius*) or spinach (*Spinacia oleracea*)	0.55	Native/LC	2
LV158-2018	*Valeriana rubra* L.	Caprifoliaceae	Spanish Valerian	Assa El-Natour	- Young leaves—Raw in salads/Cooked as in *C.intybus*	0.35	Introduced/NE	Pres.

1. Baydoun et al. (2020).
2. Marouf et al. (2015).
3. Chedraoui et al. (2017).
4. Edgecombe (1970).
5. Batal and Hunter (2007).
6. Arnold et al. (2015).
7. Al Ayach (2020).

Pres., present study.
*Unplaced names that cannot be accepted, nor can they be put into synonymy.

TABLE 2 Pairwise ranking of potential threatening factors to WLVs by informants.

Factors	Score	Rank
Habitat loss (urbanization, Syrian refugee camps, expansion of agriculture, industrial establishments)	17	1
Habitat degradation (pollution, forest fires, abandonment)	15	2
Over-grazing	13	3
Over-harvesting	9	4
Invasive alien species	6	5
Climate change	4	6

informants, individual interviews with 151 informants using a semi-structured questionnaire were performed. Informants were purposively selected by a snow ball sampling method for their profound knowledge of wild edible plants and traditional food practices. They were local natives of 55–75 years' age range and consisted of a mixture of plant collectors and sellers, farmers, shepherds and traditional community members. Information collected included Arabic names, edible parts and preparations as well as information related to safety of consumption. Informants' perception on availability and threats was also collected (Tables 1, 2). Voucher specimens of the cited WLVs were collected and pressed during field walks and deposited at SBR Herbarium. Species identification was carried out using the taxonomic keys of "The New Flora of Lebanon and Syria" (Mouterde, 1966; 1970; 1983). Species naming followed the nomenclature of the International Plant Names Index (IPNI) and botanical family delimitation was based on World Checklist of Vascular Plants (v.2.0; https://wcvp.science.kew.org/) and Plants of the World Online (POWO, 2022; http://www.plantsoftheworldonline.org/).

Data analysis was performed by computing the Relative Frequency of Citation (RFC) index of every species. The RFC index expresses the number of informants who cited a specific WLV divided by the total number of informants. Values of RFC may vary from 0, for no edible plants, to 1, when all informants cite a specific species (Tardìo and Pardo-de-Santayana, 2008; Konsam et al., 2016).

2.3. Native ranges and environmental threats

Native ranges and global threat status of cited species were obtained from the POWO and IUCN Red List of Threatened Species (https://www.iucnredlist.org/), respectively. Also, the perception of four selected focus groups of informants, each consisting of six or 10 members (32 informants), on the potential

threats of WLVs was determined by pairwise ranking (Uprety et al., 2012). This involved requesting informants to select between threatening factors of a list of potential threats of plant biodiversity in Lebanon identified in the 4th National Report of Lebanon to the Convention on Biological Diversity (CBD) (MoE/GEF/UNDP, 2009) (Table 2). The number of possible pairs of potential threats was calculated using the relation $N(N-1)/2$, where N is the number of threats. This was followed by summing up the scores of threats and ranking determination. Threats that received the highest total score ranked first.

3. Results

3.1. Taxonomic diversity and highly RFC rated species

A total of 158 WLVs were reported by 151 informants (118 women and 33 men) as still being gathered and consumed by traditional Lebanese communities (Table 1). The cited species belonged to 21 plant families, with Asteraceae, Brassicaceae and Apiaceae constituting the highest shares of representatives accounting for 77 species (48.42%), 22 species (13.83%) and 11 species (6.91%), respectively (Figure 2).

Native species constituted the majority of the cited WLVs (147 species) of which *Centaurea iberica* subsp. *hermonis* (Boiss.) Bornm., *Eryngium desertorum* Zohary, *Pseudopodospermum libanoticum* (Boiss.) Zaika, Sukhor. and N. Kilian were endemics to Lebanon and Syria. Whereas, *Cousinia libanotica* DC., *Gelasia mackmeliana* (Boiss.) Zaika, Sukhor. and N. Kilian, *Leontodon libanoticus* Boiss., and *Origanum ehrenbergii* Boiss. were narrow endemics to Lebanon. The occurrence of non-native species was restricted to six introduced species only (i.e., *Amaranthus caudates* L., *Amaranthus retroflexus* L., *Brassica juncea* (L.) Czern., *Oxalis corniculata* L., *Oxalis pes-caprae* L., and *Valeriana rubra* L.) occurring as causal and naturalized aliens, which mostly have escaped from gardens where they were initially planted. In addition, several species, such as *Helosciadium nodiflorum* (L.) W.D.J.Koch, *Chenopodiastrum murale* (L.) S.Fuentes, Uotila and Borsch, *Cichorium intybus* L., *Eruca vesicaria* (L.) Cav., *Eryngium creticum* Lam., *Malva sylvestris* L., *Portulaca oleracea* L., and *Raphanus raphanistrum* L. among others, were referred to by informants as common weeds in cereal and legume fields and vineyards or to flourish after harvesting cultivated crops.

According to RFC of the cited species, among the most popular species cited by interviewed informants were *Anchusa azurea* Mill. (0.76), *Amaranthus graecizans* L. (0.75), *Centaurea hyalolepis* Boiss. (0.78), *Chondrilla juncea* L. (0.75), *Cichorium intybus* (1.00), *Eruca vesicaria* (1.00), *Eryngium creticum* Lam. (1.00), *Foeniculum vulgare* Mill. (1.00), *Gundelia tournefortii* L. (1.00), *Malva sylvestris* (1.00), *Nasturtium officinale* W.T. Aiton (1.00), *Origanum syriacum* L. (1.00), *Portulaca oleracea* (1.00), *Pseudopodospermum molle* (M. Bieb.) Kuth. (0.75), *Pseudopodospermum phaeopappum* (Boiss.) Zaika, Sukhor. and N. Kilian (0.75), and *Taraxacum* sect. *Taraxacum* F.H.Wigg. (0.80; Table 1).

3.2. Plant parts consumed, mode of consumption and practices

Although there is a great deal of variation in flavor and culinary characteristics, most species cited in Table 1 were reported to have more than one part consumed. Considering this, young basal rosettes were used in 90 species, leaves in 73 species, and young shoots and aerial parts in 30 species. Whereas subterranean parts (roots and rhizomes), leaf petioles, stems, flowering parts (flower buds and inflorescences) and young seed pods accounted collectively for 20 species only (Figure 3).

With respect to the mode of consumption, 66 species (41.77%) were reported to be consumed in both raw and cooked preparations, while 59 species (37.34%) were favored as cooked only and 33 species (20.88%) were just preferred as raw in salads, side vegetables or snacks (Figure 4). Average of RFC values of species cited in each of the consumption modes (both raw and cooked, cooked or raw only) were 0.57, 0.54, and 0.49, respectively.

The species favored as cooked, referred to by informants as "Sleeqa," were prepared as stewed, alone or mixed with other species. Also, *Cichorium* sp., *Lactuca* sp., and other bitter taste species collectively called "Hindbe" are boiled, then strained to drain water out and seasoned as salads. Whereas, *Gundelia tournefortii* (inflorescences and young leaves) "Akoob" and *Foeniculum vulgare* (leaves) were consumed as omelets. *Gundelia tournefortii,* in particular, was used in the preparation of several delicious dishes.

In addition, the traditional use of stew mixtures of WLVs (Sleeqa) was indicated as a widespread practice. Mixtures are mainly composed of common species, such as *Cichorium intybus, Taraxacum* sect. *Taraxacum*, *Scolymus hispanicus* L., and *Reichardia picroides* (L.) Roth among other species. The addition of small amounts of *Foeniculum vulgare* to *Malva* sp. is also an interesting example.

The unique addition of little bulgur (cracked wheat) and chickpeas was frequently reported by informants in some traditional recipes. For example, a handfuls of bulgur is sometimes added to *Malva* sp. to make a delicious traditional main dish and enhance their nutritional values. Moreover, although the majority of informants (93%) recognized WLVs as highly nutritious and healthful to consume, strong safety concerns were expressed for the consumption of some species such as *Arum palaestinum* Boiss., *Cyclamen persicum* Mill., *Lactuca serriola* L., *Papaver rhoeas* L., and *Urtica dioica* L., if consumed raw.

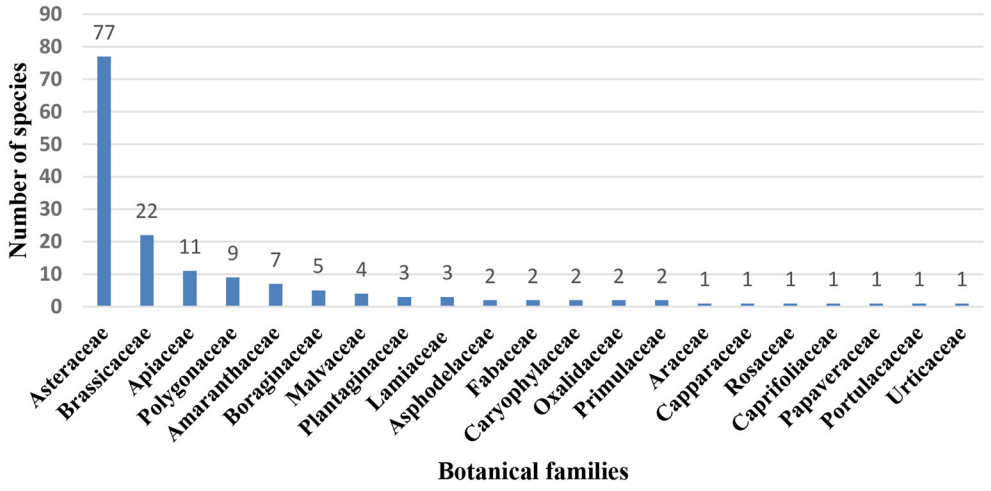

FIGURE 2
Botanical families of WLVs of Lebanon.

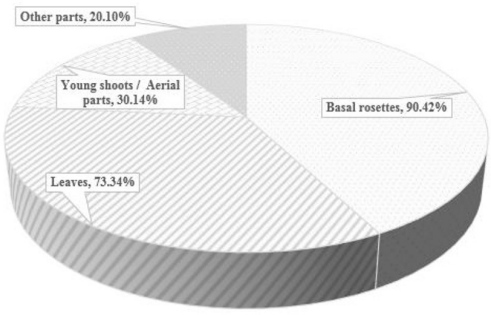

FIGURE 3
Plant parts consumed of WLVs of Lebanon.

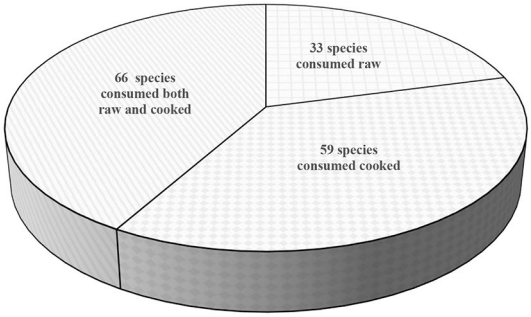

FIGURE 4
Consumption mode of WLVs of Lebanon.

3.3. IUCN threat status and informants' perception to availability and threats

According to IUCN conservation assessment criteria, six species were found as globally threatened. These species were *Gelasia mackmeliana* (EN), *Pseudopodospermum libanoticum* (EN), *Cousinia libanotica* (VU), *Leontodon libanoticus* (VU), *Origanum ehrenbergii* (VU), and *Plantago lanceolata* L. (VU). The rest are either least concern (LC; 10 species), data deficient (DD; one species only), or not evaluated (NE; Table 1).

The perception of the 32 informants of the focus groups to WLV availability indicated a decline by the majority of informants (30), while two informants only expressed no idea on availability or no perceived change. As for informants' perception on threats underlying the decline, the results of the pairwise ranking of potential threatening factors presented to informants indicated that habitat loss resulting from land use urbanization, Syrian refugee camps, expansion of agricultural lands, industrial establishments and other development activities was perceived as the top threat scoring 17 (Table 2). This was followed by habitat degradation caused by pollution, waste dumping, forest fire, and land abandonment (score = 15). While overgrazing was ranked third (score = 13) and overharvesting, especially of particular species such as *Gundelia tournefortii* and *Origanum syriacum* came fourth (score = 9). Whereas, invasive species and climate change came in the last position scoring 6 and 4, respectively.

Although not considered as a top threat according to informants' perception, overharvesting of highly favored species such as *Gundelia tournefortii* (RCF 1.00) and *Origanum syriacum* (RCF 1.00) were noted by informants. Informants attributed this practice to the organoleptic properties, delicious recipes and high commercial values of these plants.

4. Discussion

The considerable number of species cited in the results (Table 1) reflects the richness of WLVs in Lebanon and highlights the recognition of informants of the overall nutritional benefits of cited species as a source of traditional food and nutrition of indigenous community (Kumar et al., 2021).

The dominant preference of species of Asteraceae, Brassicaceae and Apiaceae families accounting for 77 species (48.42%), 22 species (13.83%) and 11 species (6.91%), respectively, is in line with the findings of several ethnobotanical studies from the Mediterranean region (Hadjichambis et al., 2008; Guarrera and Savo, 2016; Geraci et al., 2018; Senkardeş et al., 2019). This is primarily a result of the tendency of people to use plants of high availability of species of Asteraceae, Brassicaceae and Apiaceae, which are particularly abundant in the Mediterranean natural environment (Grillo et al., 2010). In addition, the palatability and widespread traditional beliefs on the health benefits of species of these families may also be considered among the drivers of their popularity. Indeed, numerous research confirmed the high content of bioactive compounds, minerals, vitamins, and antioxidants in several of the species of these families (Pinela et al., 2017; Ceccanti et al., 2018). In turn, this has motivated a small scale cultivation of some of these species, such as *Cichorium intybus*, *Crambe orientalis* L., *Eruca vesicaria* and *Foeniculum vulgare* facilitating their incorporation into the traditional food production systems. Similar cultivation efforts have also been carried out with some species from other families with a lower number of representatives, such as *Malva sylvestris* (Malvaceae), *Origanum syriacum* (Lamiaceae), and *Portulaca oleracea* (Portulacaceae) indicating the high palatability and valuable dietary potential of other families as well (Hadjichambis et al., 2008). Compared to previous studies from Lebanon (Batal and Hunter, 2007; Marouf et al., 2015; Baydoun et al., 2020), 124 WLVs are recorded for the first time in this study, reflecting considerable underutilisation. This may be attributed to the large-scale cultivation of a limited number of crops such as wheat and potatoes, lifestyle changes, diet transition, among other reasons (Pinela et al., 2017; Bou Kheir et al., 2021). The potential of such neglected and underutilized species in improving food security and nutritional value of food and improvement of livelihoods has increasingly been examined by investigators worldwide (Padulosi et al., 2011; Ulian et al., 2020). Previous preliminary findings of the authors revealed the presence of considerable levels of proteins, Fe and ascorbic acid in the dry leaves of *Amaranthus graecizans*, *Anchusa hybrida*, *Centaurea calcitrapa*, and *Scorzonera cana* confirming the high nutritional qualities of these WLV species (Baydoun et al., 2020). In addition, studies form other Mediterranean countries have also shown high levels of folates (vitamin B9) and ascorbic acid in the leaves and shoots of *Anchusa azurea*, *Cichorium intybus*, *Foeniculum vulgare*, *Malva sylvestris,* and *Portulaca oleracea* (Pinela et al., 2017). Such species are now well recognized for their high adaptive capacities to unique climatic and environmental conditions which makes their integration in agricultural production systems very important for the sustainability, climate resilience and diversification of food (Padulosi et al., 2011; Food Agriculture Organization of the United Nations (FAO), 2018; Ulian et al., 2020).

At a regional level, a comparison with the top six species of wild edible plants reported seven countries of the circum-Mediterranean shows a common share of 13 species of the top rated WLVs in the present study (Hadjichambis et al., 2008). Among these shared species are *Malva sylvestris* (RFC = 1.00), *Portulaca oleracea* (RFC = 1.00), *Cichorium intybus* (RFC = 1.00), *Taraxacum sect. Taraxacum* (RFC = 0.80) and *Scolymus hispanicus* (RFC = 0.72). This may reflect Lebanon's rich cultural exchange through history with other Mediterranean countries influencing its traditional use of wild edible plants and further confirming the spatial continuum between the East and Western Mediterranean recently reported by Pieroni and Cattero (2019). On the contrary, several of the most popular species reported in circum-Mediterranean countries (Hadjichambis et al., 2008), i.e., *Sonchus oleraceus* (L.), *Silene vulgaris* (Moench) Garcke, *Urtica dioica, Papaver rhoeas*, *Helminthotheca echioides* (L.) Holub, and *Capparis spinosa* L., were in the present study cited as less popular species, while some such as *Dioscorea communis* (L.) Caddick and Wilkin, *Tolpis barbata* (L.) Gaertn., and *Andryala integrifolia* L.) were not even recognized by informants as edible despite their relatively high abundance in Lebanon. These results suggest a considerable variability of WLVs between Mediterranean countries. Literature from different regions of the world shows that several factors including socioeconomic aspects, accessibility, culture, plant availability, nutritional potential, safety, sensory aspects (i.e., taste, smell, and texture), and energy value, among others influence people's decision on the selection of certain species for food (Gomes et al., 2020). More research to identify determinants of WLVs preferences in the Mediterranean basin is needed given the UNESCO recognition of Mediterranean Diet as an Intangible Cultural Heritage of Humanity (UNESCO, 2013).

The high RFC values of species such as *Cichorium intybus, Eryngium creticum*, *Gundelia tournefortii, Malva sylvestris*, and *Portulaca oleracea* reaching a full score (1.00) reflect the preference of Lebanese people of these species. Such WLVs represent a reliable alternative option to enhance dietary quality, nutrition, and health through their rich nutrient profiles and contribution to diet diversity. This potential is highly relevant in the context of addressing current food security challenges in Lebanon (World Food Programme (WFP) the World Bank (WB), 2021). Moreover, the fact that some of the highly rated WLVs are among the highest in the Mediterranean (Motti et al., 2020) and Middle East (Ali-Shtayeh et al., 2008) confirms their promising potential as a food and nutrition source not only locally but also at a regional level.

Interestingly, the average RFC values of species consumed by both raw and cooked (0.56), either cooked (0.54) or raw (0.49) reflect a general similarity in preference of consumption modes. Values also indicate a higher tendency toward cooked preparations than raw consumption. However, data collected gave no consideration of the intensity/frequency of consumption of species by means of consumption if raw or cooked. It is possible that some informants may consume a species both raw and cooked, but, with much less intensity of use of one means as compared to the other. This may be exemplified by some species that are consumed raw as appetizers, in seasoning or snacks during picnics and mountain walks. Distinction in consumption modes is very relevant in the context of nutritional values of WLVs as some authors argue that plants consumed raw can be more palatable and that raw plants are of higher nutritional value as compared to cooked ones (Aceituno-Mata et al., 2021).

Moreover, a considerable use of mixtures consisting of *Cichorium intybus*, different species of *Taraxacum*, *Scolymus hispanicus,* and *Reichardia picroides* along with other species is noted. This may stem from the need to enhance flavor and texture of prepared recipes as well as other factors associated with availability, accessibility and other factors (Guarrera and Savo, 2016).

The safety concerns expressed by informants regarding some of the cited plants is in alignment with the findings of numerous toxicological studies illustrating high contents of toxic compounds such as lactucin in *Lactuca serriola* and rhoeadine alkaloid in *Papaver rhoeas* that both act on the central nervous system (Günaydin et al., 2015; Ilgün et al., 2020). Also, *Borago officinalis* L. and *Tussilago farfara* L. which have been used since ancient times for culinary use and medicinal purposes, contain hepatotoxic pyrrolizidine alkaloids that can cause hepatic venous occlusive disease and pulmonary arterial hypertension. However, the scientific evidence of such harmful effects caused by these plants is considered weak (Avilaa et al., 2020). Other species of Apiaceae, Asteraceae and Boraginaceae also contain pyrrolizidine alkaloids (Moreira et al., 2018). Nevertheless, the traditional practice of using specific plant parts or boiling and draining water out can help destroy and remove many toxic substances.

The perceived decline in availability suggests that informants were concerned about the vulnerability of WLVs to different environmental threats potentially resulting in negative implications on the nutrition and dietary diversity of local communities. This is especially relevant as many WLVs continue to serve as a safety net for many underprivileged people particularly in times of severe economic crises such as that Lebanon is currently facing (FAO/IFAD/UNICEF/WFP/WHO, 2020). The fact that several of the cited WLVs (i.e., *Apium graveolens* L., *Crambe orientalis*, *Rhamphospermum* arvense (L.) Andrz. ex Besser, and *Lactuca serriola*) are recognized as crop wild relatives (CWRs) (Rao, 2013; D'Andrea et al., 2017) indicates that the perceived decline in availability also poses a threat to wild plant genetic resources. This can further highlight the potential of WLVs of Lebanon in the protection of these resources that are globally crucial for their potential in crop production and improvement of resilience against adverse effects of changing environment and climate (Schunko et al., 2022). These findings are supported by a recent systematic review on perceptions of wild edible plant and mushroom changes from the perspective of local communities worldwide. The review found that 92% of all perceived changes related to decreased abundance, while 76% of the perceived decreased abundance was relevant to fruits and vegetables and 23% was CWRs (Schunko et al., 2022).

The perceived decline may also pose very alarming implications on the endemic and IUCN threatened species of the cited WLVs that particularly recorded considerable RFC values in the range 0.42 and 0.70 (i.e., *Cousinia libanotica*, *Gelasia mackmeliana*, *Leontodon libanoticus, Origanum ehrenbergii, Pseudopodospermum libanoticum*). This information can facilitate the construction of a first list of priority species for conservation actions being vital toward ensuring their sustainability as a potential food and nutrition resource. Moreover, the uncertainty in the IUCN threat status noted with most cited WLV species being NE or DD (Table 1) may be considered as a hindering factor against the understanding of their threat status and conservation needs. This is especially relevant with DD species usually assumed to be threatened in the same proportions of fully evaluated species. In this context, it is important to mention the establishment of the national gene bank by the Lebanese Agricultural Research Institute (LARI) and the Royal Botanic Gardens, Kew, as a highly promising initiative toward the conservation of certain threatened WLVs and other wild plants (http://www.lari.gov.lb). Also, efforts of LARI, International Center for Agricultural Research in the Dry Areas (ICARDA; https://www.icarda.org/media/news/icarda-opens-expanded-crop-genebank-lebanon), SBR and other institutions (Atallah et al., 2011) in the conservation and development of plant propagation programmes for the cultivation of some species are also highly promising.

Further, the perceptive ranking of habitat loss as the top threats affecting WLVs reflects the high concern of traditional communities toward the negative impact of urbanization, expansion of agricultural lands, industrial establishments, Syrian refugee informal settlements, and other development activities on the natural habitats where WLVs grow. This finding is in line with the global trends of perceived threats on wild edible plants and mushrooms of communities worldwide (Schunko et al., 2022). Despite this agreement, ranking of other threats varied. For example, overgrazing and overharvesting were considered of less relative importance than land degradation when compared with global ranking. A plausible explanation of this discrepancy may be associated with the inherent difficulties scientists encounter in ranking global threats being context-dependent (Bellard et al., 2022). Conditions and nature of threats

differ among geographical locations, climatic features, habitats, and species of concern (Borelli et al., 2020). Although the present study doesn't claim a comprehensive analysis of threats to WLVs, habitat loss and land degradation being the top threats underlying the perceived decline of availability draw attention to the crucial need for the sustainable management of land use. On the other hand, threats to WLVs may be more complex and potential influenced by socioeconomic and political contexts (Borelli et al., 2020).

5. Conclusion

This study confirms a high number of WLVs (158 species) associated with a rich ethnobotanical traditional knowledge is still in use in Lebanon. Species of high citation frequency and many others have very high potential to support food security and dietary quality of traditional Lebanese communities. These species should be recognized and conserved to support the development of sustainable and diversified food systems and enhance food nutritional value and micronutrient content. Among the cited species, six were classified as globally threatened (EN or VU), five of which were endemics to Lebanon and Syria and scored relatively high rating values prioritizing them for conservation actions. Some of the highly rated species have the potential to become new crops and sources of new nutrition and food products. This is especially important in times when the number of Lebanese people facing acute food insecurity and requiring urgent nutritious assistance is growing at an alarming rate. Through the comparative discussion with other WLVs of other Mediterranean countries, a number of species of high preference and intercultural acceptance among communities was identified. Future research on the nutritional quality and safety aspects of priority species is necessary to unravel their nutritional potentials as reservoirs of micronutrients and secure their availability for future generations.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving human participants were reviewed and approved by Institutional Review Board (IRB) at Beirut Arab University. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

Author contributions

NA-A and SB conceptualized the study and designed the survey tool and led the preparation of the manuscript with input from all authors. TU contributed to preparation and editing of the manuscript. NH and HN performed data collection, analysis, and visualization with input from all authors. NA-A contributed to botanical identification of the species. SB and NH performed the funding acquisition. All authors contributed to data interpretation, read, and approved the final manuscript.

Funding

This work was co-funded by the Environmental Observatory of Leabanon and France (O-LIFE) and the MAVA Project Building the ecologic and socio-economic resilience of the Shouf Mountain Landscape by restoring and strengthening the socio-cultural fabric which sustains its biodiversity and cultural values of Shouf Biosphere Reserve, Lebanon.

Acknowledgments

The authors would like to thank O-LIFE and SBR for their support and co-funding of this study. Thanks are also due to all colleagues of authors' institutions for their support all throughout the study and informants for their hospitality and willingness to contribute to the study.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

References

Aceituno-Mata, L., Tardio, J., and Pardo-de-Santayana, M. (2021). The persistence of flavor: past and present use of wild food plants in Sierra Norte de Madrid, Spain. *Front. Sustain. Food Syst*. 4, 610238. doi: 10.3389/fsufs.2020.610238

Ahmad, S., Warne, T., Stewart, A., Byker Shanks, C., and Dupuis, V. (2022). Role of wild food environments for cultural identity, food security, and dietary quality in a rural American state. *Front. Sustain. Food Syst*. 6, 774701. doi: 10.3389/fsufs.2022.774701

Al Ayach, S. (2020). *Chemical Composition, Antioxidant and Anti-diabetic Activities of* Scorzonera phaeopappa *Boiss* [Thesis]. Faculty of Nursing and Health Sciences at Notre Dame University-Louaize.

Ali-Shtayeh, M. S., Jamous, R. M., Al-Shafie, J. H., Elgharabah, W. A., Kherfan, F. A., Qarariah, K. H., et al. (2008). Traditional knowledge of wild edible plants used in Palestine (Northern West Bank): a comparative study. *J. Ethnobiol. Ethnomed*. 4, 13. doi: 10.1186/1746-4269-4-13

Arnold, N., Baydoun, S., Chalak, L., Raus, and T. H. (2015). A contribution to the flora and ethnobotanical knowledge of Mount Hermon, Lebanon. *Flora Mediterr*. 25, 13–55. doi: 10.7320/FlMedit25.013

Atallah, S. S., El Saliby, I., Baalbaki, R., and Talhook, S. (2011). Effects of different irrigation, drying and production scenarios on the productivity, postharvest quality and economic feasibility of *Origanum syriacum*, a species typically over-collected from the wild in Lebanon. Food. Cult. *Soc*. 91, 337–343. doi: 10.1002/jsfa.4191

Avilaa, C., Breakspear, I., Hawrelak, J., Salmonde, S., and Evansc, S. (2020). A systematic review and quality assessment of case reports of adverse events for borage (*Borago officinalis*), coltsfoot (*Tussilago farfara*) and comfrey (*Symphytum officinale*). *Fitoterapia* 142, 104519. doi: 10.1016/j.fitote.2020.104519

Bailey, R. L., West, J. R. K. P., and Black, R. E. (2015). The epidemiology of global micronutrient deficiencies. *Ann. Nutr. Metab*. 66, 22–33. doi: 10.1159/000371618

Batal, M., and Hunter, E. (2007). Traditional Lebanese recipes based on wild plants: an answer to diet simplification? *Food Nutr. Bull*. 28, S303–S311. doi: 10.1177/15648265070282S209

Baydoun, S., Itani, L., Nasser, H., Chalak, L., Haydar, M., Arnold-Apostolides, N., et al. (2020). "Proximate composition and nutritional attributes of some wild edible leafy plants from Lebanon," in *ISHS Acta Horticulture 1297: XXX IHC – Proc. V International Symposium on Plant Genetic Resources: Sustainable Management and Utilization for Food, Nutrition and Environmental Security*, eds S. Gupta, et al. doi: 10.17660/ActaHortic.2020.1297.41

Beal, T., Massiot, E., Arsenault, J. E., Smith, M. R., and Hijmans, R. J. (2017). Global trends in dietary micronutrient supplies and estimated prevalence of inadequate intakes. *PLoS ONE* 12, e0175554. doi: 10.1371/journal.pone.0175554

Bellard, C., Marino, C., and Courchamp, F. (2022). Ranking threats to biodiversity and why it doesn't matter. *Nat. Commun*. 13, 2616. doi: 10.1038/s41467-022-30339-y

Borelli, T., Hunter, D., Powel, B., Ulian, T., Mattana, E., Termote, C., et al. (2020). Born to eat wild: an integrated conservation approach to secure wild food plants for food security and nutrition. *Plants* 9, 1299. doi: 10.3390/plants9101299

Bou Kheir, M., Fallows, S., and Kennedy, L. (2021). The nutrition transition's effect in Lebanon: a qualitative study exploring adolescents' perspectives in both urban and rural areas. *Am. J. Qual. Res*. 5, 243–263. doi: 10.29333/ajqr/10974

Ceccanti, C., Marco, L., Benvenuti, S., Pardossi, A., and Guidi, L. (2018). Mediterranean wild edible plants: weeds or "new functional crops"? *Molecules* 23, 2299. doi: 10.3390/molecules23092299

Chacha, J. S., and Laswai, H. S. (2020). Micronutrients potential of underutilized vegetables and their role in fighting hidden hunger. *Int. J. Food Sci*. 2020, 9408315. doi: 10.1155/2020/9408315

Chedraoui, S., Abi-Rizk, A., El-Beyrouthy, M., Chalak, L., Ouaini, N., and Rajjou, L. (2017). *Capparis spinosa* L. in a systematic review: a *Xerophilous* species of multi values and promising potentialities for agrosystems under the threat of global warming. *Front. Plant Sci*. 8, 1845. doi: 10.3389/fpls.2017.01845

D'Andrea, L., Meirmans, P., Van De Wiel, C., Guadagnuolo, R., Van Treuren, R., Kozlowski, G., et al. (2017). Molecular biogeography of prickly lettuce (*Lactuca serriola* L.) shows traces of recent range expansion. *J. Hered*. 108, 194–206. doi: 10.1093/jhered/esw078

Davis, S. D., and Heywood, V. H. (1994). *Centres of Plant Diversity. A Guide and Strategy for their Conservation. Volume 1. Europe, Africa, South West Asia and the Middle East*. Cambridge: World Wildlife Fund and World Conservation Union.

Edgecombe, W. S. (1970). *Weeds of Lebanon*, 3rd ed., Revised and Enlarged. Beirut, Lebanon: American University of Beirut.

FAO/IFAD/UNICEF/WFP/WHO. (2020). *The State of Food Security and Nutrition in the World 2020. Transforming Food Systems for Affordable Healthy Diets*. Rome: FAO.

FAO/WHO. (2006). *Joint FAO/WHO Food Standards Programme, CODEX Alimentarius Commission, CODEX Classification of Foods and Animal Feeds*. Available online at: http://www.fao.org/tempref/codex/Meetings/CCPR/ccpr38/pr38CxCl.pdf (accessed March 25, 2019).

Flyman, M. V., and Afolayan, A. J. (2006). The suitability of wild vegetables for alleviating human dietary deficiencies. *S. Afr. J. Bot*. 72, 492–497. doi: 10.1016/j.sajb.2006.02.003

Food and Agriculture Organization of the United Nations (FAO). (2018). *Future Smart Food: Rediscovering Hidden Treasures of Neglected and Underutilized Species for Zero Hunger in Asia*, eds X. Li, and K. H. M. Siddique. Bangkok: Food and Agriculture Organisation of the United Nations.

Garcia-Herrera, P., Morales, P., Fernandez-Ruiz, V., Sanchez-Mata, M. C., Camara, M., Carvalho, A. M., et al. (2014). Nutrients, phytochemicals and antioxidant activity in wild populations of *Allium ampeloprasum* L., a valuable underutilized vegetable. *Food Res. Int*. 62, 272–279. doi: 10.1016/j.foodres.2014.03.004

Geraci, A., Amato, F., DiNoto, G., Bazan, G., and Schicchi, R. (2018). The wild taxa utilized as vegetables in Sicily (Italy): a traditional component of the Mediterranean diet. *J. Ethnobiol. Ethnomed*. 14, 14. doi: 10.1186/s13002-018-0215-x

Gomes, D. L., dos Santos Ferreira, R. P., da Costa Santos, E. M., Vasconcelos da Silva, R. R., and de Medeiros, P. M. (2020). Local criteria for the selection of wild food plants for consumption and sale in Alagoas, Brazil. *Ethnobiol. Conserv*. 9, 10. doi: 10.15451/ec2020-04-9.10-1-15

Grillo, O., Mattana, E., Venora, G., and Bacchetta, G. (2010). Statistical seed classifiers of 10 plant families representative of the Mediterranean vascular flora. *Seed Sci. Technol*. 38, 455–476. doi: 10.15258/sst.2010.38.2.19

Guarrera, P. M., and Savo, V. (2016). Wild food plants used in traditional vegetable mixtures in Italy. *J. Ethnopharmacol*. 185, 202–234. doi: 10.1016/j.jep.2016.02.050

Guerrero, J. L. G., Martinez, J. J. G., and Isasa, M. E. T. (1998). Mineral nutrient composition of edible wild plants. *J. Food Compos. Anal*. 11, 322–328. doi: 10.1006/jfca.1998.0594

Günaydin, Y. K., Dündar, Z. D., Çekmen, B., Akilli, N. B., Köylü, R., and Cander, B. (2015). Intoxication due to *Papaver rhoeas* (corn poppy): five case reports. *Case Rep. Med*. 321360. doi: 10.1155/2015/321360

Gupta, S., Lakshmi, A. J., Manjunath, M. N., and Prakash, J. (2005). Analysis of nutrient and antinutrient content of underutilized green leafy vegetables. *LWT—Food Sci. Technol*. 38, 339–345. doi: 10.1016/j.lwt.2004.06.012

Hadjichambis, A. C. H., Paraskeva-Hadjichambi, D., Della, A., Giusti, M. E., De Pasquale, C., Lenzarini, C., et al. (2008). Wild and semi-domesticated food plant consumption in seven circum-Mediterranean areas. *Int. J. Food Sci. Nutr*. 59, 383–414. doi: 10.1080/09637480701566495

Ilgün, S., Küpeli Akkol, E., Ilhan, M., Çiçek Polat, D., Baldemir Kiliç, A., Coşkun, M., et al. (2020). Sedative effects of latexes obtained from some *Lactuca* L. species growing in Turkey. *Molecules* 25, 1587. doi: 10.3390/molecules25071587

International Society of Ethnobiology. (2006). *International Society of Ethnobiology Code of* Ethics (with 2008 additions). Available online at: http://ethnobiology.net/code-of-ethics/

Jomaa, I., Abi Saab, M. T., Sleiman, S., Nisrine, H., and Massaad, R. (2019). Variability in spatial distribution of precipitation overall rugged topography of Lebanon, using TRMM images. *Clim. Atmos. Sci*. 09, 369–380. doi: 10.4236/acs.2019.93026

Khoury, C. K., Bjorkman, A. D., Dempewolf, H., Ramirez-Villegas, J., Guarino, L., Jarvis, A., et al. (2014). Increasing homogeneity in global food supplies and the implications for food security. *Proc. Natl. Acad. Sci. U.S.A*. 111, 4001–4006. doi: 10.1073/pnas.1313490111

Konsam, S., Thongam, B., and Handique, A. K. (2016). Assessment of wild leafy vegetables traditionally consumed by the ethnic communities of Manipur, northeast India. *J. Ethnobiol. Ethnomed*.12, 9. doi: 10.1186/s13002-016-0080-4

Kumar, A., Kumar, S., Komal, Ramchiary, N., and Singh, P. (2021). Role of traditional ethnobotanical knowledge and indigenous communities in achieving sustainable development goals. *Sustainability* 13, 3062. doi: 10.3390/su13063062

Lowe, N. M. (2021). The global challenge of hidden hunger: perspectives from the field. *Proc. Nutr. Soc*. 80, 283–289. doi: 10.1017/S0029665121000902

Marouf, M., Batal, M., and Moledor, S. N., Talhouk, S. (2015). Exploring the practice of traditional wild plant collection in Lebanon. *Food Cult. Soc.* 18, 355–378. doi: 10.1080/15528014.2015.1043103

MoE/GEF/UNIP/ELARD. (2015). *Lebanon's 5TH National Report to the Convention on Biological Diversity*. Available online at: https://www.cbd.int/doc/world/lb/lb-nr-05-en.pdf (accessed October 30, 2022).

Moreira, R., Pereira, D. M., Valentão, P., and Andrade, P. B. (2018). Pyrrolizidine alkaloids: chemistry, pharmacology, toxicology and food safety. *Int. J. Mol. Sci.* 19, 1668. doi: 10.3390/ijms19061668

Motti, R., Bonanomi, G., Lanzotti, G. V., and Sacchi, R. (2020). The contribution of wild edible plants to the mediterranean diet: an ethnobotanical case study along the coast of Campania (Southern Italy). *Econ. Bot.* 74, 249–272. doi: 10.1007/s12231-020-09504-1

Mouterde, P. (1966; 1970; 1983). *Nouvelle flore du Liban et de la Syrie. Tome I, Tome II and Tome III*. Beyrouth, Liban: El Machreq Distribution of Librairie Orientale.

Ogle, B. M., Johansson, M., Tuyet, H. T., and Johannesson, L. (2001). Evaluation of the significance of dietary folate from wild vegetable in Vietnam. *Asia Pac. J. Clin. Nutr.* 10, 216–221. doi: 10.1046/j.1440-6047.2001.00261.x

Padulosi, S., Heywood, V., Hunter, D., and Jarvis, A. (2011). "Underutilized species and climate change: current status and outlook," in *Crop Adaptation to Climate Change*, eds S. S. Yadav, R. J. Redden, J. L. Hatfield, H. Lotze-Campen, and A. E. Hall, 1st ed (New York, NY: John Wiley and Sons, Ltd), 507–521.

Pawera, L., Khomsan, A., Zuhud, E. A. M., Hunter, D., Ickowitz, A., Polesny, Z., et al. (2020). Wild food plants and trends in their use: from knowledge and perceptions to drivers of change in West Sumatra, Indonesia. *Foods* 9, 1240. doi: 10.3390/foods9091240

Pieroni, A., and Cattero, V. (2019). Wild vegetables do not lie: comparative gastronomic ethnobotany and ethnolinguistics on the Greek traces of the Mediterranean diet of southeastern Italy. *Acta Bot. Brasilica* 33, 198–211. doi: 10.1590/0102-33062018abb0323

Pinela, J., Carvalho, A. M., and Iferreira, C. F. R. (2017). Wild edible plants: nutritional and toxicological characteristics, retrieval strategies and importance for today's society. *Food Chem. Toxicol.* 110, 165–188. doi: 10.1016/j.fct.2017.10.020

POWO (2022). Plants of the World Online. *Facilitated by the Royal Botanic Gardens, Kew*. Available online at: http://www.plantsoftheworldonline.org/ (accessed November 15, 2022).

Rao, N. K. (2013). Crop wild relatives from the Arabian Peninsula. *Genet. Resour. Crop Evol.* 60, 1709–1725. doi: 10.1007/s10722-013-9972-5

Rivera, D., Obon, C., Heinrich, M., Inocencio, C., Verde, A., and Fajardo, J. (2006). Gathered Mediterranean food plants ethnobotanical investigations and historical development. *Forum Nutr.* 59, 18–74. doi: 10.1159/000095207

Saleh, B., and Safi, S. (1988). Carte de la Végétation du Liban. *Ecol. Mediterr.* XIV, 123–142. doi: 10.3406/ecmed.1988.1209

Schunko, C., Xiaoyue, L. I., Klappoth, B., Lesi, F., Porcher, V., Porcuna-Ferrer, A., et al. (2022). Local communities' perceptions of wild edible plant and mushroom change: a systematic review. *Glob. Food Sec.* 32, 100601. doi: 10.1016/j.gfs.2021.100601

Senkardeş, I., Bulut, G., Dogan, A., and Tuzlaci, E. (2019). An ethnobotanical analysis on wild edible plants of the Turkish Asteraceae taxa. *Agric. Conspec. Sci.* 84, 17–28.

Smith, E., Ahmed, S., Dupuis, V., Crane, M. R., Eggers, M., Pierre, M., et al. (2019). Contribution of wild foods to diet, food security, and cultural values amidst climate change. *JAFSCD*. 9, 191–214. doi: 10.5304/jafscd.2019.09B.011

Tardío, J., Pardo-De Santayana, M., and Morales, R. (2006). Ethnobotanical review of wild edible plants in Spain. *Bot. J. Linn. Soc.* 152, 27–71. doi: 10.1111/j.1095-8339.2006.00549.x

Tardìo, J., and Pardo-de-Santayana, M. (2008). Cultural importance indices: a comparative analysis based on the useful wild plants of Southern Cantabria (Northern Spain). *Econ. Bot.* 62, 24–39. doi: 10.1007/s12231-007-9004-5

The World Bank. (2021). Available online at: https://data.worldbank.org/indicator/SP.POP.TOTL?locations$=$LB (accessed September 28, 2022).

Turan, M., Kordali, S., Zengin, H., Dursun, A., and Sezen, Y. (2003). Macro and micro mineral content of some wild edible leaves consumed in Eastern Anatolia. *Acta Agric. Scand. B Soil Plant Sci.* 53, 129–137. doi: 10.1080/09064710310095

Ulian, T., Diazgranados, M., Pironon, S., Padulosi, S., Davies, L., Howes, M. J., et al. (2020). Unlocking plant and fungal resources to support food security and promote sustainable agriculture. *Plants People Planet* 2020, 421–445. doi: 10.1002/ppp3.10145

UNESCO. (2013). *Mediterranean diet: mediterranean diet: Cyprus, Croatia, Spain, Greece, Italy, Morocco and Portugal Inscribed in 2013 (8.COM) on the Representative List of the Intangible Cultural Heritage of Humanity*. Available online at: https://ich.unesco.org/en/RL/mediterranean-diet-00884 (accessed September 28, 2022).

UNHCR/Government of Lebanon. (2017). *Lebanon Crisis Response Plan 2017–2020*. Available online at: www.3rpsyriacrisis.org/wp-content/uploads/2017/01/Lebanon-Crisis-Response-Plan-2017-2020.pdf (accessed November 23, 2021).

Uprety, Y., Poudel, R. C., Shrestha, K. K., et al. (2012). Diversity of use and local knowledge of wild edible plant resources in Nepal. *J. Ethnobiol. Ethnomed.* 8, 16. doi: 10.1186/1746-4269-8-16

World Food Programme (WFP) and the World Bank (WB). (2021). *Lebanon m-VAM Vulnerability and Food Security Assessment March April 2021*. Available online at: https://docs.wfp.org/api/documents/WFP-0000129566/download/ (accessed May 20, 2017).

World Health Organization (WHO). (2000). *Nutrition for Health and Development: A Global Agenda for Combating Malnutrition*. Document WHO/NHD/00.6. Geneva: WHO.

Zohary, M. (1973). "The Mediterranean territories in the middle east," in *Geobotanical Foundations of the Middle East*, Vol. 1 (Stuttgart: Gustav Fischer Verlag and Amsterdam: Swets and Zeitlinger), 137—151.