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AN ETHNOBOTANICAL SURVEY OF WILD FOOD PLANTS IN SIRJAN, KERMAN, IRAN

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Wild plant species are among the most important candidates for reinforcing food safety in the world. Worldwide increases in population and food shortages have caused the rate of hunger to rise rapidly. Therefore, there is an urgent need to review indigenous knowledge on the traditional uses of wild edible plants so as to apply this knowledge in modern agricultural policies. The current study aims to investigate and document the indigenous knowledge of the diversity of wild food species in one region of Kerman province, Iran. A total of 66 local informants were interviewed using an open, semi-structured questionnaire. Ethnobotanical data for 37 plant species belonging to 35 families was analysed using the use value (UV) index. Asteraceae with 6 species was the largest family, and leaves were the most frequently used plant part. Overall, the most favourite wild food species is *Matricaria aurea* (UV 1.697), followed by *Capparis spinosa* (UV 1.515) and *Zataria multiflora* (UV 1.455). Given the widespread use of wild food species and their importance in people's daily lives, it is suggested that the conditions for the domestication and promotion of the most commonly used wild food species be further explored.

Key words: Asteraceae, ethnobotany, Iran, new crops, wild food plants

INTRODUCTION

An adequate supply of food in terms of nutrition and calories is one of the most important factors in human health and well-being. Due to rapidly increasing populations, as well as urbanisation in most developing countries, the demand for food security has attracted much attention in recent years. It is estimated that more than 700 million people worldwide are suffering from hunger and are exposed to critical levels of food insecurity (FAO 2019). This severe food crisis has led the United Nations (UN) as well as many social movements to seek appropriate solutions to this global challenge (Golay 2010). Plants as producers are the main pioneers of food chains that are used directly or indirectly by humans as food or feed. In addition to traditional crops and plant products, there are thousands of wild food plants (WFPs) that can be used as food and contribute to world food security (Cruz-Garcia 2017, Cruz-Garcia and Ertug 2014). Furthermore, many WFPs and wild leafy

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vegetables contain vitamins, minerals, secondary metabolites, antioxidants, and effective medicinal compounds that can contribute to the improvement of overall health and be used in the treatment of a variety of illnesses (Heinrich *et al*. 2005, Johns 2007, Pieroni and Quave 2006, Romojaro *et al*. 2013). Today, a large number of WFPs and crop wild relatives (CWRs) are marketed as "functional foods" or "nutraceuticals," as they have higher nutritional values and greater antioxidant capacities than corresponding cultivated species (Leonti *et al*. 2006, Pieroni and Quave 2006, Pieroni *et al*. 2002).

WFPs have considerable potential to be used in the development of new crops through domestication. New domesticated crop species can diminish the intense biotic and abiotic pressures on modern agriculture in the future (Van Tassel *et al*. 2020). The establishment of new domesticated food crops gives rise to genetic and species diversity in agricultural systems (Fernie and Yan 2019). An increase in the number of new agricultural species has led to crop rotation and increased provisioning of ecosystem services (ES) as one of the most important strategies in agricultural management (Dury *et al.* 2011, Reckling *et al*. 2015). In addition, the domestication of naturally stress-resistant plants (NSRPs) can provide food security in habitats under drought and salinity stress and also be an effective approach to counteract the negative impacts of global warming on agro-ecosystems (Zhang *et al*. 2018). Furthermore, the domestication of WFPs can improve dietary diversity, as they contain valuable supplements for a nutritionally balanced diet (Duguma 2020, Marrelli *et al*. 2020). Many rural families and farmers collect WFPs from their surroundings, i.e. farmlands, gardens, forests, and other natural ecosystems. The over-harvesting of WFP species from nature may result in a reduction of their populations and, in some cases, the extinction of valuable rare species. Therefore, ethnobotanical studies are of particular importance in the comprehensive identification and protection of wild food plants. Given the importance of WFPs and their key role during periods of food shortage, many ethnobotanical studies have been undertaken worldwide (Abdullah *et al*. 2021, Ahmad and Pieroni 2016, Berihun and Molla 2017, Cruz-Garcia 2017, Cruz-Garcia and Price 2011, Lima *et al*. 2011, Majeed *et al*. 2021, Pawera *et al*. 2017, Rigat *et al*. 2016, Sansanelli *et al*. 2017, Tena Regassa *et al*. 2014). To this day, many checklists of wild food species have been recorded in many parts of the world. For example, Tardío *et al*. (2006) documented 419 wild edible plant species in Spain. Cruz-Garcia and Price (2011) compiled a checklist of 87 wild food plants in a region of Northeast Thailand. Information on 236 WFPs used by Hungarian ethnic groups in the Carpathian Basin has been documented by Dénes *et al.* (2012). In Estonia, a list of 147WFP species was gathered by Kalle and Sõukand in 2012. During an ethnobotanical investigation, 50 WFPs were documented in Kumrat Valley in District Upper Dir, Pakistan (Ahmad *et al*. 2021).

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With about 8,100 plant species, Iran is unique among the countries of southwestern Asia for its plant diversity and high species richness (Noroozi *et al*. 2019). Although many wild plant species of Iran have been traditionally used by indigenous people as food, food seasoning, or as wild vegetables, no focused study has yet been conducted on Iranian wild food plants. Considering the significant lack of documentation of WFPs of Iran, the main goal of the present study was to collect and analyse information on the most widely and commonly used WFPs in a region in the southeast of the country, namely Sirjan. The objectives of the present research were to: 1) record WFPs and the traditional knowledge regarding them in Sirjan, and 2) determine the most important families and plant species used as food by Sirjan locals.

MATERIAL AND METHODS

Study area – This study was conducted in Sirjan county, Kerman province, southeastern Iran, which had a population of 324,103 inhabitants in 95,357 families in 2016 (Fig. 1). Sirjan is situated in a depression between the southern Zagros Mountains to the west and the Hazaran massif to the east. It lies between 29° 30′ N and 55° 30′ E, covers an area of 16,217 square kilometres, and has an average altitude of 1,735 m. Geologically, the study area is located in the Sanandaj-Sirjan zone, a metamorphic-magmatic belt associated with the Zagros and the Alpine-Himalayan orogenic systems in Iran (Mehdipour Ghazi and Moazzen 2015). The climate of Sirjan is semi-desert with annual precipitation of 160 mm and an annual average temperature of 25 °C. The soils of this area are often saline, and the populations of halophytes such as *Salsola* spp. are predominant. Some areas, like the Kafe-Namak, lack any vegetation. In many areas, the species of *Artemisia* spp., *Astragalus* spp., *Acantholimon* spp., and *Prosopis farcta* (Banks and Sol.) J. F. Macbr form large communities; plant diversity and species richness are relatively high in the highlands and mountain areas (Fig. 2).

Ethnobotanical data collection and ethics – Sixty-six key informants (25 males and 41 females) were interviewed using semi-structured questionnaires. The interviewees, aged between 35 and 83 years, were often experts on traditional knowledge of wild edible plants. According to the code of ethics of the International Society of Ethnobiology (ISE) (Hardison and Bannister 2011), the aims of the present study were described to the informants, and their consent to participate was obtained. All interviews were conducted in their homes between April 2014 and March 2018. All ethnobotanical information was recorded in a database, including local name of plant, plant habitat, edible uses, parts of the plant used, season of plant collection, and plant processing methods.

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Plant collection and identification – The first author hereof is a native of and familiar with the study area; all wild food species were collected and herbarium specimens were prepared by the first author. Plant samples were identified using Flora of Iran (Assadi 1988–2015) and Flora Iranica (Rechinger 1965–2016), and voucher specimens were deposited in the herbarium of Shahid Beheshti University (HSBU).

Data analysis – The collected data was entered into a Microsoft Excel spreadsheet and analysed using use reports and the ethnobotanyR package (Whitney 2021). The use report (UR) is the most basic structure of ethnobotanical information and is calculated for each species using the following formula:

$$UR_s = \sum_{u=u_1}^{{}^{u}NC} \sum_{i=i_1}^{{}^{i}N} UR_{ui}$$

URs calculate the total uses mentioned by all informants (from i1 to iN) for any given species within the number-of-use category (NC) (Prance *et al*. 1987). The mode of preparation of WFPs were grouped into the following culinary-use categories: raw vegetables, flavouring, omelette, herbed rice pilaf, stew and ghatogh, pickles, drink, boiled, pastry, nuts, and herbal tea.

The use value (UV) index was applied to determine the relative importance of useful plants and calculated using the following formula:

$$UV_s = \sum_{i=i_1}^{{}^{i}N} \sum_{u=u_1}^{{}^{u}NC} UR_{ui/N}$$

where, Ui refers to the number of uses recoded for a given species and N is the total number of informants (Tardío and Pardo-de-Santayana 2008).

RESULTS

Folk knowledge about collecting WFPs – According to data provided by participants of the present study, the wild food species are mainly collected on mountain slopes, roadsides, or in agroecosystems (Table 1, Fig. 3). Half of the documented species were weeds that grow in fields or marginal farmland. Locals consider the best time to collect plants to be early March to early April to June. The perfect time to collect plants has been reported to be early March to early April; after that, the plants are not very desirable for edible use or are destroyed. These species are usually collected during the leaf maturity phase. The best time to gather a few WFPs, however, such as *Bunium persicum*, *Pistacia atlantica*, *Zataria multiflora*, *Prunus scoparia,* and *Berberis integerrima,* is June. These folk taxa are often collected during the fruiting phase.

Botanical families, growth forms, and plant part use – A total of 37 WFPs from 35 genera and 20 families were mentioned by the key informants. The species, their local names, mode of preparation, and parts used are presented in Table 1. The families with the largest representation were Asteraceae (6 species),

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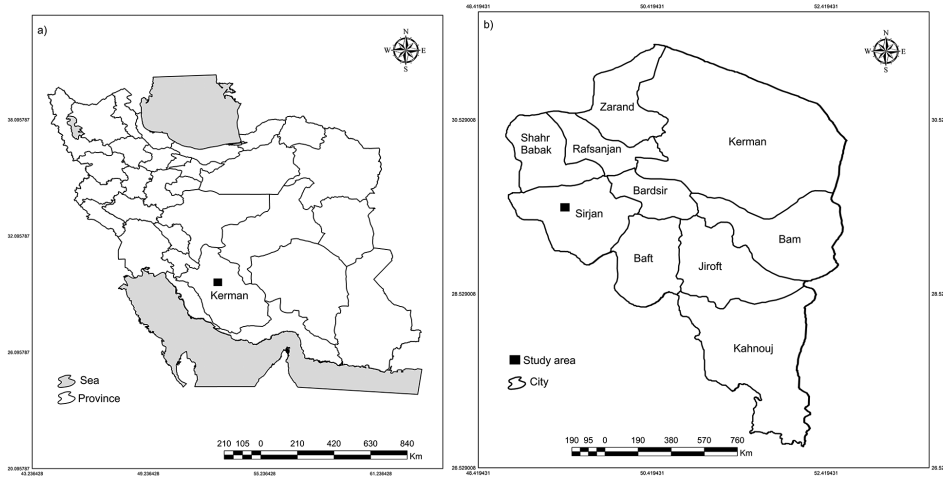

Fig. 1. Geographical location of Kerman province in Iran (a) and study site in Sirjan county in Kerman province

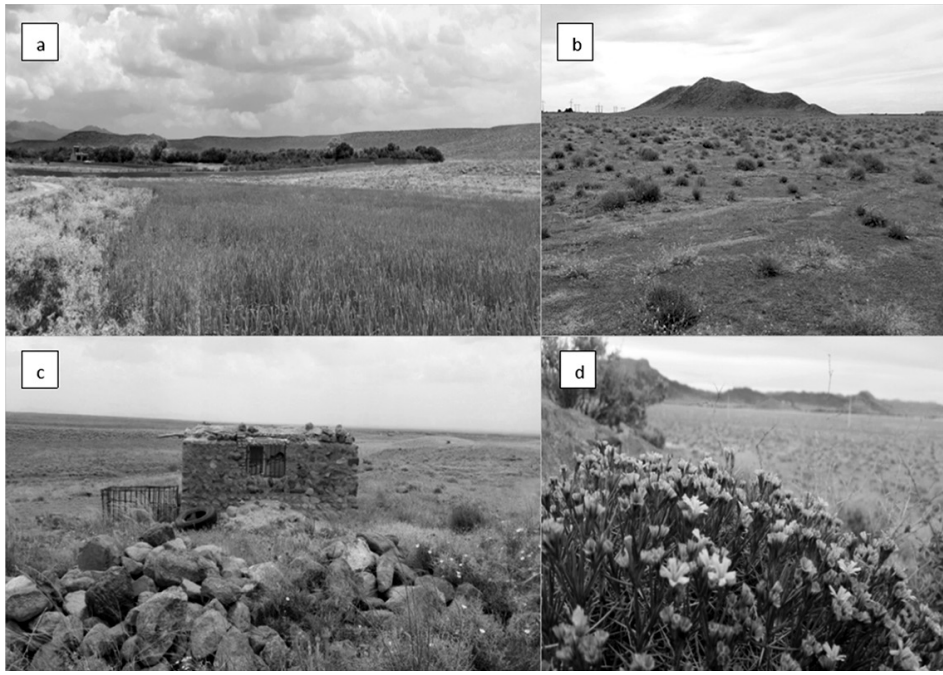

Fig. 2. The landscape of some districts of Sirjan: a) Pariz district; b) Balvard district; c) Homa shahr district; d) Khajo shahr district

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Table 1
Overall results from wild food plants in the Sirjan district, Kerman-Iran. Abreviations: M = mountain, MF = marginal farmland, R = root, RS = roadside, S = saline desert, W = fields (weed)

Family	Scientific name	Local name	Growth habit	Part used	Habitat	Culinary use	Market status (price in IRR/kg#)	Medicinal use	Voucher number	UR	NU	UV	FC
Amaranthaceae	*Atriplex patula* L.	Salmeh-Choghootu	Annual herb	Leaf	W	Pottage, omelette	Nonmarketable	–	HSBU-20191647	41	2	0.62	34
	Chenopodium album L.	Salme-Baghi	Annual herb	Leaf	W	Pottage, omelette	Nonmarketable	–	HSBU-20191648	55	2	0.83	44
	Chenopodium vulvaria L.	Salmeh-Eshteri	Annual herb	Leaf	W	Pottage, omelette	Nonmarketable	–	HSBU-20191649	41	2	0.62	41
	Suaeda aegyptiaca (Hasselq.) Zohary	Samsiloo	Annual herb	Leaf	S	Raw vegetables, flavouring, omelette	Nonmarketable	–	HSBU-20191650	78	3	1.18	56
Amarylli-daceae	*Allium schoenoprasum* L.	Sirmook	Perennial herb	Leaf	W	Herb rice pilaf	Nonmarketable	–	HSBU-20191651	36	1	0.55	37
Anacardiaceae	*Pistacia atlantica* Desf.	Beneh	Woody deciduous perennial tree	Fruit	M	Ghatogh, pickle	Marketed in Sirjan (400,000)	Memory improvement *	HSBU-20191652	80	2	1.21	62
Apiaceae	*Bunium persicum* B. Fedtsch.	Zireh	Perennial herb	Fruit	M	Herb rice pilaf, flavoring	Marketed in Sirjan (4,000,000)	Digestive problems such as bloating and stomach ache *	HSBU-20191653	95	2	1.44	64
	Ducrosia anethifolia DC.	Zardak-Biabooni	Perennial herb	Root	RS	Raw vegetables	Nonmarketable	–	HSBU-20191654	13	1	0.21	14
	Ferula assa-foetida L.	Anghozeh	Perennial herb	Leaf	M	Omelette, pickle, boiled	Nonmarketable	Worm medicine, treatment of gastritis **	HSBU-20191655	20	3	0.30	20

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Table 1 (continued)

Family	Scientific name	Local name	Growth habit	Part used	Habitat	Culinary use	Market status (price in IRR/kg#)	Medicinal use	Voucher number	UR	NU	UV	FC
Asphodelaceae	*Eremurus persicus* (Joub. and Spach) Boiss.	Sereshoo, Aselan	Perennial herb	Leaf, flower	M	Pottage, omelette	Nonmarketable	–	HSBU-20191656	85	2	1.28	66
Asteraceae	*Cichorium intybus* L.	Kasni	Perennial herb	Leaf	W	Drink	Nonmarketable	–	HSBU-20191657	28	1	0.42	29
	Gundelia tournefortii L.	Kangar	Perennial herb	Leaf	M	Boiled, stew	Marketed in Sirjan (200,000)	–	HSBU-20191658	46	2	0.70	54
	Matricaria aurea (Loefl.) Sch. Bip	Babooneh	Annual herb	Leaf and flower	MF	Ghatogh, herbal tea, herb rice pilaf	Marketed in Sirjan (400,000)	Insomnia and nervous disorders (sedatives), menstrual pain, kidney ache *	HSBU-20191659	112	3	1.70	66
	Scorzonera mucida Rech. f., Aell. et Esfand.	Rish-Bozu	Perennial herb	Leaf	M	Raw vegetables	Nonmarketable	–	HSBU-20191660	30	2	0.45	20
	Scorzonera paradoxa Fish et C. A. Mey.	Komal/ Dobu	Perennial herb	Corm	M	Raw vegetables	Nonmarketable	–	HSBU-20191661	8	1	0.12	8
	Tragopogon collinus DC.	Shang	Biennial	Leaf	W	Raw vegetables	Nonmarketable	–	HSBU-20191662	15	1	0.22	15
Berberidaceae	*Berberis integerrima* Bunge	Zarch	Deciduous shrub	Fruit	M	Flavoring	Nonmarketable	Hypertension and abdominal ache *, Urticaria treatment **	HSBU-20191663	16	2	0.24	16
Brassicaceae	*Descurainia sophia* (L.) Webb ex Prantl	Khakshir	Annual herb	Seed	W	Drink	Marketed in Sirjan (200,000–300,000)	Diarrhea and abdominal pain, sore throat *,**	HSBU-20191664	65	1	0.98	66
	Lepidium draba L.	Moku	Annual herb	Leaf	W	Pottage, omelette, boiled, herb rice pilaf	Nonmarketable	–	HSBU-20191665	95	4	1.44	64

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Table 1 (continued)

Family	Scientific name	Local name	Growth habit	Part used	Habitat	Culinary use	Market status (price in IRR/kg#)	Medicinal use	Voucher number	UR	NU	UV	FC
Brassicaceae	*Chorispora tenella* (Pall.) DC.	Jelengu	Annual herb	Leaf	MF	Raw vegetables	Nonmarketable	–	HSBU-20191666	56	1	0.84	21
Capparaceae	*Capparis spinosa* L.	Dahak	Perennial herb	Flower and fruit	MF	Omelette, pickle	Marketed in Sirjan (250,000–300,000)	Joint pain such as back pain and leg *	HSBU-20191667	100	2	1.51	65
Caryophyllaceae	*Dianthus crinitus* Sm.	Ghalamfer/ Mikhak	Perennial herb	Fruit	M	Pastry, flavouring	Marketed in Sirjan (500,000–600,000)	toothache, mouth odour, treat headaches and nervous disorders **	HSBU-20191668	30	2	0.45	27
Fabaceae	*Astragalus hamosus* L.	Panjeh-Kelaghu	Annual herb	Leaf		Raw vegetables	Nonmarketable	–	HSBU-20191669	28	1	0.42	28
Ixioliriaceae	*Ixiolirion tataricum* (Pall.) Herb.	Gol-Khiaro	Perennial herb	Flower	W	Raw vegetables	Nonmarketable	–	HSBU-20191671	17	1	0.25	17
Lamiaceae	*Clinopodium graveolens* Kuntze	Melangu	Annual herb	Leaf	M	Herbal tea	Nonmarketable	Cough treatment **, Abdominal pain *	HSBU-20191672	33	1	0.50	33
	Mentha longifolia (L.) Huds.	Pedeneh	Perennial herb	Leaf	M	Raw vegetables, herbal tea, flavouring	Marketed in Sirjan (200,000–250,000)	Abdominal pain *, **	HSBU-20191673	94	3	1.42	66
	Satureja bachtiarica Bunge	Alaleh	Perennial herb	Leaf	M	Herbal tea, flavouring	Nonmarketable	Flatulence *	HSBU-20191674	64	2	0.97	56
	Zataria multiflora Boiss.	Avishan	Perennial herb	Leaf	M	Herbal tea, flavouring	Marketed in Sirjan (1,000,000)	Constipation, stomach pain and menstrual cramps *, **	HSBU-20191675	96	2	1.45	61
	Ziziphora tenuior L.	Kakoti	Annual herb	Leaf	M	Herbal tea, flavouring	Marketed in Sirjan (200,000–300,000)	Abdominal pain and common cold *, **	HSBU-20191676	94	2	1.42	66

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Table 1 (continued)

Family	Scientific name	Local name	Growth habit	Part used	Habitat	Culinary use	Market status (price in IRR/kg#)	Medicinal use	Voucher number	UR	NU	UV	FC
Liliaceae	*Tulipa biflora* Pall.	Piazoo-Kouhi	Perennial herb	Leaf and bulb	M	Omelette, flavouring	Nonmarketable	–	HSBU-20191677	85	2	1.28	61
Malvaceae	*Malva neglecta* Wallr.	Penireku	Annual herb	Leaf and fruit	W	Omelette, boiled	Nonmarketable	Improves kidney pain *	HSBU-20191678	18	3	0.20	18
Papaveraceae	*Fumaria parviflora* Lam.	Shatereh	Annual herb	Leaf	W	Drink	Nonmarketable	Abdominal pain*, **	HSBU-20191679	60	1	0.90	60
Polygonaceae	*Rheum ribes* L.	Rivas	Perennial herb	Leaf	M	Raw vegetables, stew	Marketed in Sirjan (200,000)	–	HSBU-20191680	57	3	0.86	48
	Rumex dentatus L.	Torshak	Annual/ Biennial herb	Leaf	W	Raw vegetables	Nonmarketable	–	HSBU-20191681	35	1	0.39	26
Portulacaceae	*Portulaca oleracea* L.	Gholfeh	Annual herb	Leaf and seed	W	Pastry, pickle, raw vegetables	Marketed in Sirjan (250,000–350,000)	–	HSBU-20191682	87	3	1.31	61
Rosaceae	*Prunus scoparia* Spach	Aluk	Deciduous shrub	Fruit	M	Nuts	Marketed in Sirjan (500,000)	Prevention of hair loss (Sharifi-far *et al.* 2010)	HSBU-20191683	56	1	0.84	56
Scrophulariaceae	*Scrophularia striata* Boiss.	Mokha-leseh	Perennial herb	Leaf and stem	M	Herbal tea	Nonmarketable	–	HSBU-20191684	11	1	0.16	11

#100,000 IRR = 2.4 USD (July 1, 2021)
*Khajoei Nasab and Khosravi (2014),
**Sharififar *et al.* (2010)

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followed by Lamiaceae (5 species), Amaranthaceae (4 species), Apiaceae, and Brassicaceae (3 species each) (Fig. 4). Polygonaceae had two species, while other families were represented by only one species (Fig. 4). The majority of the WFPs were herbs (34 spp.), 17 species of which were perennial and the remaining annual or biennial. The most commonly used plant organ was the leaves (61%), followed by fruits (15%) and flowers (9%) (Fig. 5).

WFPs and their traditional uses – A. *Raw vegetables.* The results of the present survey showed that 12 species are used as raw vegetables. Among these taxa, the highest reports of consumption as raw vegetables were recorded for *Portulaca oleracea* (56), *Malcolmia africana* (56), and *Suaeda aegyptiaca* (40). *Scorzonera paradoxa* (8) and *Ducrosia anethifolia* (13) had the lowest use reports. – B. *Traditional foods.* WFPs are used in a variety of recipes for traditional cuisine, such as pottage, omelette, herbed rice pilaf, stew, and ghatogh. Ghatogh is a kind of traditional local food that is often cooked from a combination of different wild or cultivated herbs, eggs, and water and served with bread. Local pottages,

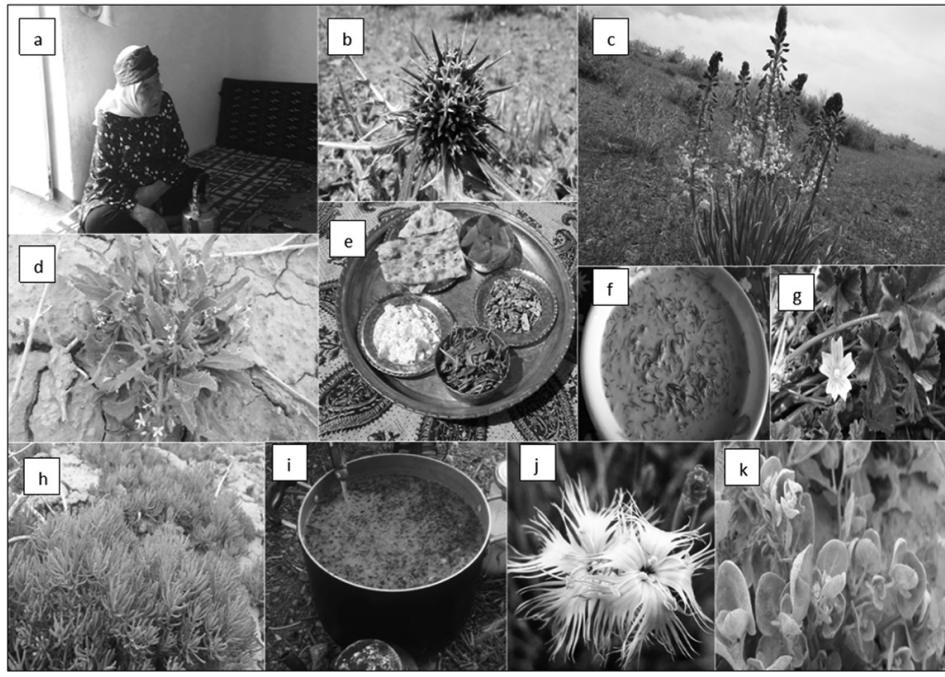

Fig. 3. Ethnobotanical data collection of some wild food plants used by people of Sirjan: a) one key informant; b) *Cichorium intybus* L.; c) *Eremurus persicus* (Joub. and Spach) Boiss.; d) *Malcolmia africana* (L.) Botsch.; e) a delicious breakfast using cheese and leaves *Malcolmia Africana*; f) combination of yogurt and leaves of *Suaeda aegyptiaca* (Hasselq.) Zohary; g) *Malva neglecta* Wallr.; h) *Suaeda aegyptiaca*; i) a combination of *Lepidium draba* leaves, flour, beans and curd as a local pottage; j) *Dianthus crinitus* Sm.; k) *Chenopodium vulvaria* L.

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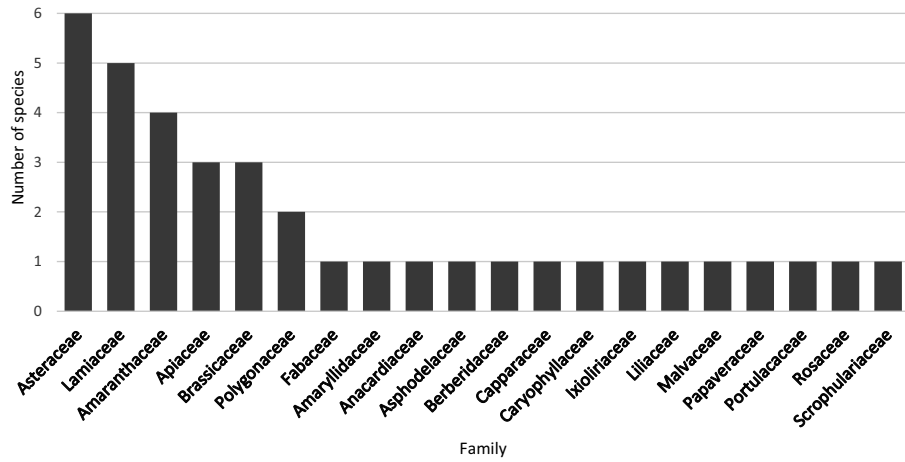

Fig. 4. Botanical families of wild food plants traditionally consumed in Sirjan

also known as "omach", are especially popular in winter and early spring. The bulk of this type of food usually comprises wheat flour and vegetables such as *Atriplex patula*, *Chenopodium album*, *Ch. vulvaria*, *Eremurus persicus,* and *Lepidium draba.* – C. *Herbal teas and drinks.* A total of six species used in herbal teas were recorded in the survey. The present study shows that *Scrophularia striata* and *Clinopodium graveolens* are used much less than other species. According to locals, these plants were widely used in the past, but today their consumption has declined sharply. *Descurainia sophia, Cichorium intybus,* and *Fumaria parviflora* are still used as popular drinks for preventing overheating in summer. – D. *Flavouring and pickles.* Nine species were reported as flavourings; they are often aromatic species and used in a variety of foods, dough, cheese, etc. Four species, namely *Ferula assa-foetida*, *Portulaca oleracea*, *Capparis spinosa,* and *Pistacia atlantica,* are used in the preparation of pickles. – E. *Pastries and nuts.* The fruits of *Dianthus crinitus* and the seeds of *Portulaca oleracea* are used to make two types of sweets. Locals also said that most of the nuts they use are obtained from cultivated plants; the only wild herb used as a nut is obtained by processing *Prunus scoparia* seeds, locally known as "alook".

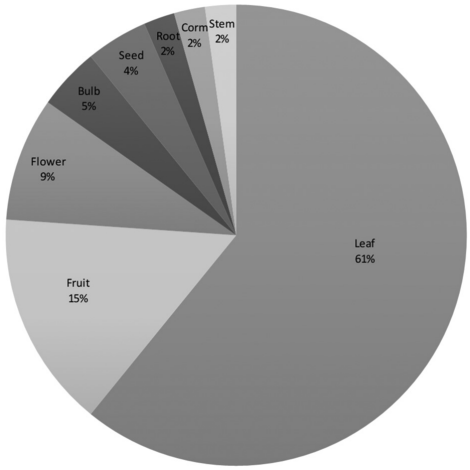

Fig. 5. Plant parts used of wild food plants by the locals of Sirjan

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Quantitative ethnobotanical analysis – The eight species with the highest use reports (URs) were *Matricaria aurea* (112), *Capparis spinosa* (100), *Zataria multiflora* (96), *Bunium persicum* (95), *Lepidium draba* (95), *Mentha longifolia* (L.) Huds. (94), *Ziziphora tenuior* (94), and *Portulaca oleracea* (87). *Scorzonera paradoxa* (8), *Scrophularia striata* (11), and *Ducrosia anethifolia* (13) had the lowest use reports. *Lepidium draba* had the highest number of uses (NU) (4 culinary uses), followed by *Matricaria aurea*, *Ferula assa-foetida, Malva neglecta*, *Portulaca oleracea*, *Rheum ribes*, *Mentha longifolia*, and *Suaeda aegyptiaca* (3 culinary uses each). The use-value (UV) shows the rate of popularity and the relative significance of a wild food plant among the locals of Sirjan. Overall, the most favourite wild food species is *Matricaria aurea* (UV 1.697), followed by *Capparis spinosa* (UV 1.515), *Zataria multiflora* (UV 1.455), *Bunium persicum* (UV 1.44), *Lepidium draba* (UV 1.44), *Mentha longifolia* (UV 1.42), and *Ziziphora tenuior* (UV 1.42) (Table 1). *Scorzonera paradoxa* (UV 0.12), *Scrophularia striata* (UV 0.16), and *Ducrosia anethifolia* (UV 0.19) attained the minimum value of the index. Thus, these species were the least popular for consumption among the local people.

DISCUSSION

Folk knowledge about collecting WFPs – The current findings indicate that spring and early summer are the best seasons for species collection, and WFPs are not found and collected in autumn or winter. The region's cold and dry climate in autumn and winter prevents the growth and germination of these plants. Previous ethnobotanical studies in some parts of neighbouring areas, such as the Pakistani–Afghan border region and Pakistan, have shown that the time period for collecting WFPs in these areas is from March to October (Abdullah *et al*. 2021, Ahmad and Pieroni 2016). The cold and dry climate of Sirjan and its very low average annual rainfall are the most important reasons for the short growing season of plants compared to the Pakistani–Afghan border region and Pakistan. In addition, most WFPs are present as weeds in agroecosystems and anthropogenic environments. Weeds contain valuable nutritional and bioactive secondary compounds and are a great dietary component of many people throughout the world (Khajoei Nasab and Esmaeilpour 2019, Vibrans 2016). This follows a similar pattern to that detected in different parts of the world (Ahmad *et al*. 2019, Aziz *et al*. 2021, Rigat *et al*. 2016). Moreover, edible weeds can play a principal role in food security and achieving sustainable development goals (Harris and Mohammed 2003, Mavengahama *et al*. 2013, Ojelel and Kakudidi 2015, Ong and Kim 2017). It seems that the traditional diet of local people is highly dependent on the climatic conditions of the region. The arid and desert climate of the region as well as recent droughts do not allow many edible species to grow and germinate, so people often use plants that grow in pistachio and almond orchards as well as wheat fields.

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Botanical families, growth forms, and plant part use – The results showed that the most common family of wild food plants was Asteraceae. The current findings are in line with previous ethnobotanical studies that have reported Asteraceae as the dominant family of WFPs (Dogan *et al*. 2013, Kadioglu *et al*. 2020, Sansanelli *et al*. 2017). Moreover, the leaves of WFPs were the most frequently used parts in traditional food, a finding similar to those of other ethnobotanical studies (Ali-Shtayeh *et al*. 2008, Majeed *et al.* 2021, Polat *et al*. 2017). Because most of the documented plants are herbaceous and the fruit and other parts of them are often inedible, it is natural that the leaves are the most used plant organs in this area. As previously mentioned, Sirjan is an arid to semi-arid region whose plains and rangelands are often covered with annual plants, the growth of which depends on the amount of annual rainfall. For example, in years when the average rainfall in February and especially March is good, species such as *Suaeda aegyptiaca*, *Chenopodium vulvaria*, *Malcolmia africana,* and *Descurainia sophia* grow well in plains and rangelands in the spring of the following year. Only three deciduous shrubs or trees, i.e. *Prunus scoparia*, *Pistacia atlantica,* and *Berberis integerrima*, were documented. The habitat of these three plants is the mountain ecosystem in the study area, where large *Prunus scoparia-Pistacia atlantica* communities are found.

WFPs and their traditional uses – *Malcolmia africana* is one of the most popular traditional vegetables in the studied area. This species is an annual plant of the Brassicaceae family, known locally as Jelengu. The local people of Sirjan recognise this plant by it being less hairy than a similar plant, i.e. *Chorispora tenella*. They argue that the *Chorispora tenella* with the local name "Jelengu-e Khari" is not suitable for human consumption and has a bitter taste. Moreover, the locals know it to prevent the growth of their favourite plant *Malcolmia africana* in years when in winter rain falls only once or twice. Despite the fact that this plant is not always available, with its unique taste, it is one of the most popular vegetables in the region. *Portulaca oleracea* is another favourite vegetable in Sirjan, which is easily accessible. Its medicinal properties and deliciousness have made it popular among the people. The low use of some species, such as *Scorzonera paradoxa* and *Ducrosia anethifolia*, can be because of their limited distribution in the region. The severe droughts of recent years have greatly limited the distribution of these species, so due to the lack of access to these plants, their use as food has been forgotten, and the relevant knowledge has not been passed down to new generations.

Quantitative ethnobotanical analysis – The majority of folk taxa with the highest number of reports of edible uses was often known as food-medicine plants, which may explain their high consumption compared to other species in the region. For example, to treat colds and severe throat infections, the natives cook a local cuisine called Ghatogh-e Babouneh, which is made from a combination of *Matricaria aurea*, onion, a small amount of wheat flour, and

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water. To treat colds and flu, a local pottage called Omach-e Moku, cooked with *Lepidium draba*, wheat flour, lentils, beets, garlic, water, and curd, is very common among the local people. Ghatogh-e Babouneh and Omach-e Moku are also two common traditional medicinal foods used by the locals to heal Coronavirus disease (COVID-19). The powders of *Bunium persicum* and *Zataria multiflora* are used in most foods in this area, and locals assert that their use prevents bloating and stomach pain. When a person suffers from severe joint pain in this area, s/he is advised to frequently eat *Capparis spinosa*, a mixture of onion, oil, egg, and capers. According to previous studies (Khajoei Nasab and Khosravi 2014, Sharififar *et al.* 2010), more than half of the wild edible plant species have medicinal properties, and 21 of them (56%) are used in the treatment of various diseases (Table 1). Most of these plants are used as traditional treatments for gastrointestinal diseases, followed by muscle aches, kidney stones, and diseases of the respiratory and nervous systems. In addition to having a delicious taste and medicinal properties, most of these plants are often fragrant, which has made people more inclined to use them. The use of folk edible plants as food medicines has also been mentioned in previous ethnobotanical studies (Ali-Shtayeh *et al*. 2008, Ahmad and Pieroni 2016, Aziz *et al*. 2021, Majeed *et al*. 2021).

Religious beliefs and folk edible plants – The current findings showed that most people in the studied area are Shiite Muslims, and there is a link between religion and the use of edible plants in this area. According to the interviewees, some types of ghatogh must be cooked for religious ceremonies. For example, on the night of the 21st of Ramadan, ghatogh-e adas (lentil) served along with barley bread is the main food in this city. Indigenous people also forbid the use of nuts on days of mourning for the Imams; their use is considered a sin. In the past, the natives of Sirjan believed that eating nuts on the mentioned days caused the wrath of God and paralysis of the mouth. On the Day of Arafat, a food called Shir Berenj (rice pudding) made from a mixture of milk, rice, and black beans is usually cooked. Also in the past, the natives would put fodder in the grooves of the walls on the Day of Arafat, believing that on said day, Imam Ali's horse would cross the streets and eat it. According to the heartfelt belief of the ancient people of this area, this deed brings divine reward and mercy.

WFPs known in other parts of the world – A number of wild edible species in this study, including *Cichorium intybus*, *Rumex dentatus*, *Mentha longifolia*, *Chenopodium album*, *Malva neglecta*, *Portulaca oleracea*, *Allium schoenoprasum*, and *Capparis spinosa,* are used in a variety of foods in other parts of the world (e.g., Pakistan, Armenia, Czech Republic, Spain, Italy, Iberian Peninsula, Palestine, Turkey, and Iraq) (Abdullah *et al*. 2021, Ahmad *et al*. 2019, Ali-Shtayeh *et al*. 2008, Bulut *et al*. 2019, Dogan *et al*. 2013, Kadioglu *et al*. 2020, Pawera *et al*. 2017, Pieroni *et al*. 2019, 2020, Rigat *et al*. 2016, Sansanelli *et al.* 2017, Tardío *et al.*

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2005, Yeşil *et al*. 2019). These species are "cosmopolitan weeds" that are often used in many parts of the world because of their easy access, high population frequency, and the fact that they grow every year.

Conservation concerns regarding WFPs – Of the wild food species, 13 species (35%) are sold at local markets. Some of these species, such as *Gundelia tournefortii*, *Rheum ribes*, and *Capparis spinosa,* are often marketed fresh in the spring. Other species are made available in dried form throughout the year in local markets or are sold by vendors. Some species, such as *Zataria multiflora* and *Bunium persicum*, command high prices at market, which can be a good source of income for local people. Based on the VUs index, the favourite plants of the people of Sirjan comprise species which, in addition to their medicinal properties, are aromatic plants that add a special taste and aroma to foods. However, uncontrolled harvesting of these valuable plant species could cause them to disappear over time (Khajoei Nasab and Khosravi 2014). Numerous medicinal properties have been reported for most of the species sold, encouraging indigenous peoples to harvest them indiscriminately (Khajoei Nasab and Khosravi 2014, Sharififar *et al.* 2010). Therefore, collecting information about the species mentioned in this study on the local markets and estimating annual harvests could help gauge the pressure of harvests in this region.

CONCLUSIONS

The study provides, for the first time, ethnobotanical data on wild food species in Sirjan of southeast Iran. In this study, an ethnobotanical dataset on 37 wild food plant species belonging to 35 botanical families was collected. A high consensus was derived from interviews with the 66 informants, comprising a total number of uses reports of 2,119. This indicates that there is a high level of traditional knowledge regarding uses for plants in the study area, and plants play an important role in the diet of the natives. Wild food species were reported to be used in a wide range of various foods and drinks, including pickles, pottages, pastries, nuts, and teas. Given the widespread use of wild food species and their importance in people's daily lives, it is suggested that the conditions for the domestication and promotion of the most commonly used species be further explored. Domestication and promotion of these species could reinforce food security and also lead to commercialisation. Most importantly, such actions may prevent the extinction of these species and the destruction of their ecosystems.

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