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**Competing interests**

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## ORIGINAL RESEARCH PAPER

# Gathering an edible wild plant: food or medicine? A case study on wild edibles and functional foods in Granada, Spain

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**Abstract**

A study on wild edible resources has been performed in the western part of Granada Province (Spain) using ethnobotanical methods. We document and analyze knowledge concerning wild edible plants and mushrooms and their folk medicinal uses in the study area. Several botanical features and use characteristics have been analyzed for the species included, with special attention to their medicinal uses, highlighting a large number of edible-medicinal species. Local importance of the medicinal uses for these resources has been confirmed. Up to 135 species are gathered from the wild in the study area, from which 46 can be considered folk functional foods. In addition, 45 crop plants with uncommon edible or medicinal uses are included, 29 of these being considered functional foods as well. Therefore, a total of 75 plant species are used as edible medicines which serve to treat 36 different conditions. The local concept of food and medicine regarding wild plant resources seems not to be well established. Studies on the pharmacological properties of these foods are needed in order to establish their real or potential benefits for the treated affections.

**Keywords**

Mediterranean wild edibles; ethnobotany; medicinal foods; functional foods; nutraceuticals; cultural heritage

**Introduction**

Ever since the Classical Greek period of Hippocrates (ca. 400 BC), the concept of “food as medicine and medicine as food” has been followed and practiced among the different Western cultures. In the last few decades, several studies have shown that the Mediterranean diet can improve human health [1–3], particularly in relation to: a lower prevalence of cardiovascular disease [4–9], a possible effect on body weight and obesity regulation [10–12], a lower risk of type-2 diabetes mellitus [13–15], and to longevity improvement [2,16].

Characterized mainly by a high consumption of vegetables, fruits, legumes, cereals, and other key ingredients such as olive oil, as well as a moderate consumption of wine, local differences in quantities and minor products have led to the idea of different diets, calling them collectively Mediterranean diets [17] and recognizing local diversity as a main pattern. As some authors have pointed out, one of the peculiarities of these local diets is the use of wild edible plants, fruits, and mushrooms [18–20]. Nevertheless, the local diversity of these food elements in this diet is not well known [21]. This part of the traditional knowledge is orally transmitted through generations: dietary tradition is not written. And, certainly, this knowledge is a vital part of the traditional knowledge system of a particular area. However, modern lifestyles are quickly transforming traditions, and the consumption of wild foods is not as common as it was in the past

[22,23]. Concomitantly, adherence to Mediterranean diets is in general decline, at least in the European Mediterranean countries [24,25], and today the wild plants formerly consumed are sometimes considered “famine food” [23,26].

The benefits to human health of these diets with a number of wild gathered foods can be partially explained by the following theory: because we descend from hunter-gatherer societies, as a result of evolution, our organism is more used to wild-plant consumption and thus to the best exploitation of the nutritional properties of wild foods [27]. The high percentages of fibre, unsaturated fatty acids, and antioxidants may be critical for human-body homeostasis. In recent times, during the documentation of the use of the lesser-known species that may be important in health prevention, some wild food plants and mushrooms have received much attention in the Mediterranean countries [28]. We agree with Guil-Guerrero [29] that a new food culture based on edible wild plants is expanding throughout Western countries.

A review on the gathered Mediterranean food plants documented through diverse ethnobotanical studies lists ca. 2300 taxa of plant and fungi gathered from the wild and consumed in the Mediterranean area [21]. European literature on the subject is extensive [26,28,30–34].

In a review for the Iberian Peninsula, Tardío et al. [35] recognized 419 different gathered plant species. This reaches 7.5% of the flora, considering 5537 vascular plant species occurring in the area [36]. Recent references for Spain show an increasing interest in the subject [26,37–44]. By developing the knowledge of medicinal-plant properties, these studies can serve as a basis for pharmacological ones, in order to discover their chemical compounds and properties [17,45–47], or even their possible toxicity [29].

Another factor in the popular consumption of wild edibles is that it reduces the expenses of buying plants in the market [48].

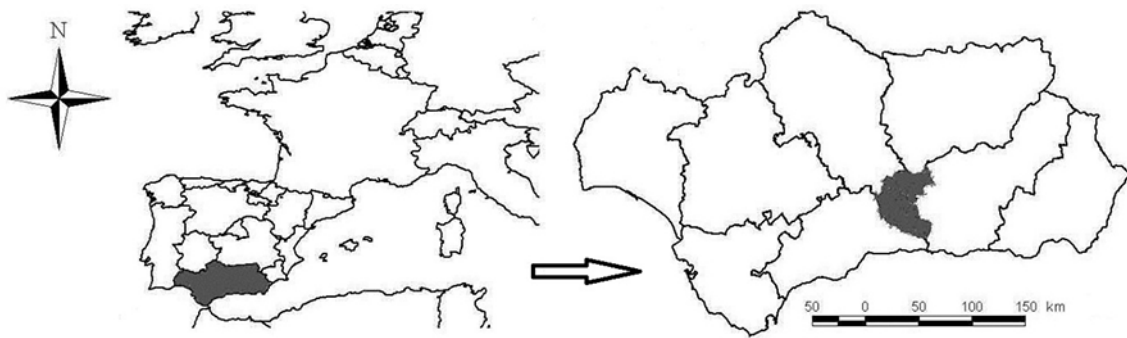
The field of functional food or nutraceuticals has clearly been attracting growing interest in the last 20 years [49]. As previously stated, “wild plants also generally contain a large spectrum of plant secondary metabolic products such as polyphenols, terpenoids, polysaccharides, etc., which make them good candidates as nutraceuticals, i.e., functional foods, which contain potentially health-promoting ingredients” [50]. Hence, we aim to determine whether wild plants are used in this way in our study area. Nutraceuticals were originally defined as “food or parts of food that provide medical or health benefits, including the prevention and treatment of disease” [51,52], but, as the term is currently somewhat controversial and frequently restricted to “products with biological functions that are derived only from foods”, in this paper we follow the definition of the term “functional foods”, as “foods normally consumed in the diet that have scientifically assessed health benefits” [53], interpreting them as foods locally consumed and considered (from an emic standpoint) to have medicinal value.

In this paper, we delve into the knowledge of the wild food resources used in a rural area with a long tradition in the use of wild plants, which is particularly rich in the knowledge of medicinal plants [54–57] and which adheres strongly to the Mediterranean diet. Our hypotheses are: (i) local people still gather many local wild resources as food; (ii) the borders between food and medicine are not well defined among wild plant gatherers; and, therefore, (iii) a number of folk functional foods should be found following ethnobotanical field methods.

## Material and methods

### Study area

The western part of Granada Province (Fig. 1) was selected as the study area for different reasons: (i) demographic factors such as low population density; (ii) environmental factors such as the Baetic ranges, constituting one of the plant-biodiversity hotspots of the Mediterranean region [58] with a high concentration of endemic plants [59]; and (iii) cultural factors such as the relatively low educational index and the same cultural tradition throughout the territory. Covering 2042 km<sup>2</sup>, the area includes the following municipalities, from north to south: Montefrío, Moclín, Íllora, Algarinejo, Zagra, Loja, Huétor-Tájar, Villanueva Mesía, Salar, Moraleda de Zafayona, Alhama de



**Fig. 1** Study area: western part of Granada Province, in Andalusia, Spain.

Granada, Arenas del Rey, Zafarraya, Ventas de Zafarraya, Santa Cruz del Comercio, Jayena, Fornes, Játar, and Cacín.

#### Data collection and data treatment

The information was collected by interviewing a total of 279 local people (56% males), with ages ranging mainly from 60 to 70 years (mean age 63; min 35, max 89), as a part of ethnobiological research conducted in the study area (see [54,55] for more details on the informants). Main results regarding the folk use of medicinal plants have been published elsewhere [54], providing more data on the environmental and social context of the study area.

Ethnobotanical interviews were made in an open and semi-structured way, as in general Mediterranean ethnobotanical studies [60,61], following the ethical guidelines of the International Society of Ethnobiology. Most of the interviews were carried out individually and in the field, while looking for the species used. Also, interviews were performed in other places, such as private homes, public places, pensioners' centres, etc. Previously, in order to locate the informants, open questionnaires were conducted in primary schools, adult education centres, and pharmacies of the area. These questionnaires proved valuable for locating potential informants.

Voucher specimens were deposited in the University of Granada Herbarium (GDA) (some are missing for certain fungi, cultivated crops, and naturalized flora). Regional and modern floras were followed for the nomenclature in the plant identification [62,63] and the classification of families. With the information compiled, we prepared a database using Microsoft Access, including data for the plants used, their use categories, interviewees, and the literature.

References on edible plants are not standardized. Publications refer to this issue as wild food plants [48,64], gathered food plants [18,21,65], wild edibles [35,66,67], non-crop food plants [19], etc. Furthermore, the categorization of food uses is not standardized, either. If a person sucks the nectar of a flower from a cultivated allochthonous plant just for its flavour, without paying attention to its nutritional value, should this be considered a wild-food use? Some studies try to give some specifications to the terms used by including short discussions on what the authors consider a wild edible [23,42]. As we have some of these cases, we included gathered wild food plants (autochthonous or naturalized) in a table, and other crop species with folk medicinal uses in a different table.

We considered local wild food plants to include those used for any of these use categories: *(i)* foods, when ingested in any way, cooked or raw, fried, boiled, in salads, omelettes, etc., including wild fruits; *(ii)* snacks, when ingested only for their special, pleasant taste, such as nectar extraction of flowers, small fruits eaten raw without seeking any nutritional property, etc.; *(iii)* seasonings, when added to any traditional recipe; *(iv)* liqueurs, when an alcoholic beverage is prepared with a plant; *(v)* drinks, for plants prepared in infusion or decoction with water without seeking a medicinal property; and *(vi)* curds, for plants used to make homemade cheese. We should mention that the labels used to distinguish among the categories below have been chosen according

to our interviewees' perception. One of the main remarks of this classification is that the part of a plant, eaten raw, cannot be locally considered a food but a snack, either because it is seen as too small of an amount ingested, or because the intake is more valued for flavour than for its nutritional properties.

Data on local medicinal uses for the wild edibles are according to Benítez et al. [54] (including only medicinal uses with at least two use reports; collected following the same field ethnobotanical methods with the same informants and in the same study area).

## Results

### Gathered wild food resources in the study area

Tab. 1 includes the wild resources traditionally used as food, i.e., gathered food plants and mushrooms. It contains 166 food uses for 135 species: 111 vascular plants and 24 fungi. These are included in 48 families: 34 of plants and 14 of fungi. A total of 766 use reports have been recorded regarding the local use of gathered food. The main botanical families in number of species used are Asteraceae, Lamiaceae, Apiaceae, and Rosaceae. The fungi include six Ascomycetes and 19 Basidiomycetes, outstanding families being Tricholomataceae, Pleurotaceae, Helvellaceae, and Agaricaceae.

The distribution of the species according to the above defined use categories can be seen in Fig. 2. It is not surprising that more than half of the species included are used as foods, in the sense of our definition above. Snacks and seasonings are also important in this area, with a high number of plant species.

Fig. 3 shows the distribution of the parts used as edible. Leaves and fruits stand out, as expected from reading similar studies in nearby territories [37,38,68]. Aerial parts reach the fourth position, including mainly seasoning plants belonging to families Lamiaceae and Apiaceae. Underground parts also constitute a major group, due to the inclusion of several Apiaceae and Asteraceae plants roots, some of them sucked as a snack, like those from genus *Scorzonera* or *Tragopogon*, and the edible bulbs of wild garlic species. Regarding the preparation forms, the most frequent ones are raw (34.5%), cooked (33.5%), and fried (15%), followed by dried (6.5%), steeped for infusions (drinks; 5%), and macerated (5%).

### Medicinal uses of wild edible plants and mushrooms

In our study, 67 species from Tab. 1 are locally considered both an edible and a medicinal resource, representing 49.6% of the wild food species, a proportion that rises to 58.5% when only plants are considered (65 plant species with medicinal uses). A total of 171 medicinal uses have been reported for the species included, but not all of them are made by consuming the plant. For this reason, 21 of the 65 plants (those with all medicinal uses marked with an asterisk in Tab. 1) can be considered both edible and medicine in a separate way but not functional foods. Some illustrative examples are the tubers from *Bunium macuca* Boiss., which are eaten as wild snacks, and also used to remove warts by rubbing it raw on the wart; the use of *Apium nodiflorum* (L.) Lag. as antieczematous by applying the water of its decoction on the eczema (not by eating the plant); or the medicinal properties of *Celtis australis* L. leaves as a cholesterol reducer, apart from the extended edible use of its fruits. Nevertheless, most of the recorded medicinal uses for these plants were related to the edible use by the informants, and can be described as functional foods: 46 species (41.4% of wild gathered plants).

Among fungi, only two species were mentioned as medicinal, but none can be considered as a functional food since its application is not direct consumption. The most extended one is the use of the gleba or the spores of *Lycoperdon molle* Pers.: Pers. and other species of the genus as antihemorrhagic and wound healing, applying the spores directly or rubbing the gleba on wounds, a frequently mentioned use in the Spanish ethnobotanical literature [57,69–71]. At least some antibacterial and antifungal activities have been demonstrated for some Lycoperdaceae species [72]. Less extended

Tab. 1 Wild edible plants in western Granada.

Botanical family	Scientific name and voucher number	Vernacular name	Medicinal use	Category	Part used	Preparation	UR
Amaranthaceae	<i>Amaranthus retroflexus</i> L. (GDA53803)	Moco-pavo	x	Food	Leaves	C	2
Apiaceae	<i>Apium nodiflorum</i> (L.) Lag. (GDA54102)	Berra	Eczema*	Food	Leaves	C, R	3
	<i>Bifora testiculata</i> (L.) Roth. (GDA54320)	Culantro	x	Food	Leaves	C	4
	<i>Bunium macuca</i> Boiss. (GDA54106)	Macuca	Wart*	Seasoning	Leaves	R	7
	<i>Bupleurum gibraltarium</i> Lam. (GDA54110)	Crujía	Injuries*, eczema*	Snack	Tuber	R	21
	<i>Daucus carota</i> L. (GDA54097)	Caílo	x	Seasoning	Whole plant	R	2
	<i>Eryngium campestre</i> L. (GDA54112)	Cardo cuco	Circulation problems, digestive disorder, hypertension, skin disorder*, eczema*	Food	Leaves	C	2
	<i>Foeniculum vulgare</i> Mill. (GDA54111)	Hinojo	Gases, digestive disorder, gastralgia, cold	Snack	Root	R	2
	<i>Ridolfia segetum</i> Moris (GDA54104)	Nerdo	Gastralgia, digestive disorder	Food	Root	C	1
	<i>Scandix australis</i> L. subsp. <i>australis</i> (GDA54095)	Quijones	Gastralgia	Seasoning	Leaves	C, D, R	11
	<i>Scandix pecten-veneris</i> L. (GDA54098)	Aguardientina	x	Drink	Leaves	I	3
				Snack	Root	R	3
				Seasoning	Leaves	C, D	3
				Curd	Seeds	R	1
				Food	Whole plant	C	9
				Snack	Aerial parts	R	4
				Seasoning	Whole plant	R	1
				Snack	Fruit	R	3
				Food	Leaves	C	2

Tab. 1 Continued

Botanical family	Scientific name and voucher number	Vernacular name	Medicinal use	Category	Part used	Preparation	UR
Areaceae	<i>Thapsia villosa</i> L. (GDA54101)	Cañaaja	Digestive disorder	Food	Root	C, R	1
	<i>Chamaerops humilis</i> L. (GDAC44505)	Palmito	x	Food	Trunk	R	5
Asteraceae	<i>Bidens aurea</i> (Aiton) Sherff (GDA54144) + <i>Cichorium intybus</i> L. (GDA54174)	Té de campo Achicoria	Digestive disorder	Drink	Leaves	I	9
	<i>Crepis vesicaria</i> L. subsp. <i>haenseleri</i> (Boiss. ex DC.) P. D. Sell (GDA54151)	Almirón	Digestive disorder, diuretic, invigorative	Food	Tender shoots	C, R	7
	<i>Cynara cardunculus</i> L. (GDA54199)	Alcakil	x	Food	Root	I	3
			Fever*	Food	Leaves	C	5
	<i>Cynara humilis</i> L. (GDA54160)	Alcakil		Food	Inflorescence and leaves	C, F	6
	<i>Chondrilla juncea</i> L. (GDA54180)	Chicorias	x	Curd	Inflorescence	R	3
	<i>Helianthus tuberosus</i> L. (GDA54195) + <i>Jasania glutinosa</i> (L.) DC. (GDA54139)	Papa de caña Té de piedra	x	Food	Inflorescence	C	1
			Digestive disorders	Food	Leaves	C	4
	<i>Lactuca serriola</i> L. (GDA54154)	Lechugueta	x	Food	Tuber	C, F	6
	<i>Lactuca tenerrima</i> Pourr. (GDA54145)	Pan de pobre	x	Drink	Flowered aerial parts	I	3
	<i>Leontodon longirostris</i> (Finch & P. D. Sell) Talavera (GDA54192)	Almirones	x	Food	Whole plant	C	4
	<i>Mantisalca salmantica</i> (L.) Briq. & Cavillier (GDA54188)	Rama	Hyperglucemia*	Food	Aerial parts	C	3
	<i>Matricaria chamomilla</i> L. (GDA54138)	Manzanilla	Gastralgia, digestive disorder, dysmenorrhoea, cold, cough, gases, female genital infection, conjunctivitis*	Food	Leaves	C	2
	<i>Onopordum nervosum</i> Boiss. (GDA54200)	Toba	x	Food	Leaves	C	3



Tab. 1 Continued

Botanical family	Scientific name and voucher number	Vernacular name	Medicinal use	Category	Part used	Preparation	UR
	<i>Santolina rosmarinifolia</i> L. subsp. <i>canescens</i> (Lag.) Nyman (GDA54185)	Meaperros	x	Seasoning	Flowered aerial parts	R	1
	<i>Scolymus hispanicus</i> L. (GDA54170)	Cardillo	Gastralgia*, diarrhoea*, Malta fever*, diarrhoea with tenesmus*	Food	Stems and leaves	C, F	16
	<i>Scolymus maculatus</i> L. (GDAC14702)	Cardillo	x	Food	Stems and leaves	C, F	2
	<i>Scorzonera angustifolia</i> L. (GDA54169)	Tetilla	x	Snack	Root	R	5
	<i>Scorzonera hispanica</i> L. (GDA54168)	Escarionera	x	Snack	Root	R	7
	<i>Scorzonera laciniata</i> L. (GDA54186)	Tetilla de vaca	x	Snack	Root	R	2
	<i>Silybum marianum</i> (L.) Gaertn. (GDA54142)	Cardo borriquero	Liver disease*, Malta fever*	Food	Leaves	C	13
	<i>Sonchus oleraceus</i> L. (GDA54156)	Cerraja	Haemorrhoids*, warts*	Curd	Inflorescence	R	2
	<i>Taraxacum erythrospermum</i> Andrzej. ex Besser (GDA54149)	Almirón	x	Snack	Stems	R	1
	<i>Taraxacum vulgare</i> (Lam.) Schrank (GDA54189)	Almiron	Asthenia, kidney and liver disease	Food	Leaves	C, R	12
	<i>Tragopogon crocifolius</i> L. (GDA54141)	Teticas de vaca	x	Food	Leaves	C, R	4
	<i>Tragopogon porrifolius</i> L. (GDA54173)	Tetillón	x	Food	Aerial parts	C, R	4
Berberidaceae	<i>Berberis vulgaris</i> L. subsp. <i>australis</i> (Boiss.) Heywood (GDA53846)	Agracejo	Kidney malfunction	Food	Fruit	I	3
Boraginaceae	<i>Anchusa azurea</i> Mill. (GDA53948)	Lenguaza	Kidney stones, skin problems*	Snack	Flowers	R	2
	<i>Anchusa undulata</i> L. subsp. <i>granatensis</i> (Boiss.) Valdés (GDA53952)	Lenguaza	x	Food	Stems and leaves	C	17
	<i>Borago officinalis</i> L. (GDA53953) +	Borraja	Digestive disorder	Food	Stems and leaves	C	1
				Snack	Flowers	R	2

Tab. 1 Continued

Botanical family	Scientific name and voucher number	Vernacular name	Medicinal use	Category	Part used	Preparation	UR
	<i>Echium creticum</i> L. subsp. <i>coincyanum</i> (Lacaita) R. Fernández (GDA53951)	Falsa lenguaza	x	Food	Leaves	C	3
Brassicaceae	<i>Rorippa nasturtium-aquaticum</i> (L.) Hayek (GDA54035)	Berro	Eczema*, baldness*	Food	Stems and leaves	C, R	11
	<i>Sinapis alba</i> subsp. <i>mairei</i> (H. Lindb.) Maire (GDA54039)	Jaramago	Liver disease, menorrhagia	Food	Aerial parts	C	2
Cactaceae	<i>Opuntia maxima</i> Miller (GDA53854) +	Chumbera	Digestive disorder, cold*, cough*, pertussis*	Food	Fruit	R	4
Capparidaceae	<i>Capparis spinosa</i> L. (GDA54010)	Alcaparra	x	Food	Flowers and fruits	M	8
Caprifoliaceae	<i>Lonicera etrusca</i> G. Santi (GDA53980)	Mariselva	x	Snack	Flowers	R	2
	<i>Lonicera implexa</i> Aiton (GDA53833)	Maiselva	x	Snack	Flowers	R	2
Caryophyllaceae	<i>Silene vulgaris</i> (Moench) Garcke (GDA54027)	Collejas	x	Food	Leaves	C, F, R	13
	<i>Vaccaria hispanica</i> (Miller) Rauschert (GDA54029)	Hiel de la tierra	Malta fever*	Food	Leaves	C	2
Crassulaceae	<i>Sedum sedifforme</i> (Jacq) Pau. (GDA53819)	Uña de gato	Calluses and skin hardness*	Snack	Leaves	R	3
Cyperaceae	<i>Scirpoides holoschoenus</i> (L.) Sojak (GDA54074)	Junco	Cold, cough, fever*, warts*,	Snack	Leaves	R	7
Ericaceae	<i>Arbutus unedo</i> L. (GDA53834)	Madroño	x	Liqueur	Fruit	M	1
Fabaceae	<i>Ceratonia siliqua</i> L. (GDAC43477)	Algarrobo	Diarrhoea, haemorrhoids	Food	Fruit	R	4
	<i>Gleditsia triacanthos</i> L. +	Algarrobo bravo	x	Snack	Fruit	R	2
	<i>Glycyrrhiza glabra</i> L. (GDA46309)	Regaliz	Cold	Snack	Root	R	4
	<i>Medicago sativa</i> L. (GDA53919) +	Alfalfa	Hypercholesterolemia, hyperglucemia, kidney malfunction	Food	Aerial parts	C, R	3



Tab. 1 Continued

Botanical family	Scientific name and voucher number	Vernacular name	Medicinal use	Category	Part used	Preparation	UR
Fagaceae	<i>Robinia pseudoacacia</i> L. +	Acacia	x	Snack	Flowers	R	3
	<i>Vicia sativa</i> L. +	Veza	x	Food	Seeds	C	1
	<i>Quercus coccifera</i> L. (GDA53844)	Coscoja	x	Food	Fruit	R	2
Geraniaceae	<i>Quercus rotundifolia</i> Lam. (GDA53814)	Encina	Diarrhoea, diarrhoea with tenesmus, cold*	Food	Fruit	R	7
	<i>Erodium cicutarium</i> (L.) L'Hér. (GDA53870)	Alfilericos	x	Food	Leaves	R	2
Lamiaceae	<i>Acinos alpinus</i> subsp. <i>meridionalis</i> (Nyman) Greuter & Burdet (GDA53891)	Té de la sierra	Digestive, genitourinary analgesic	Drink	Flowered aerial parts	I	3
	<i>Lavandula stoechas</i> L. (GDA53886)	Cantueso	Diabetes, digestive disorder, cold	Seasoning	Leaves	D, R	3
	<i>Melissa officinalis</i> L. (GDA50985) +	Melisa	Circulatory problems, nervousness, diarrhoea	Drink	Flowered aerial parts	I	2
	<i>Mentha pulegium</i> L. (GDA53895)	Poleo	Digestive disorder, gastralgia, dysmenorrhoea, circulatory problems, cough, kidney stones, postpartum infections	Liqueur	Flowered aerial parts	I, M	5
	<i>Origanum vulgare</i> L. subsp. <i>virens</i> (Hoffmanns & Link) Letswart (GDA53884)	Orégano	Cold, cough, toothache, digestive disorder	Seasoning	Flowered aerial parts	D, R	6
	<i>Rosmarinus officinalis</i> L. (GDA54003)	Romero	Cold, cough, mouth infections, circulatory problems, gastritis, bronchitis, baldness*, rheumatism*, pain*	Seasoning	Leaves	D, R	11
	<i>Salvia lavandulifolia</i> subsp. <i>vellerea</i> (Cuatrec.) Rivas Goday & Rivas Mart. (GDA53896)	Salvia	Digestive disorder, circulatory problems, cold, baldness*, injuries*	Seasoning	Leaves	D, R	2
	<i>Salvia microphylla</i> Kunth +	Flor de mixto	x	Drink	Flowered aerial parts	D, R	3
				Snack	Flowers	R	7
				Drink	Flowered aerial parts	I	1

Tab. 1 Continued

Botanical family	Scientific name and voucher number	Vernacular name	Medicinal use	Category	Part used	Preparation	UR
	<i>Satureja obovata</i> Lag. (GDA53892)	Tomillo	x	Seasoning	Leaves	D, R	4
	<i>Thymbra capitata</i> (L.) Cav. (GDA53904)	Tomillo blanco	Cold, inflammation*	Seasoning	Flowered aerial parts	D, R	4
	<i>Thymus longiflorus</i> Boiss. (GDA53889)	Tomillo Real	x	Seasoning	Flowered aerial parts	D, R	3
	<i>Thymus mastichina</i> (L.) L. (GDA53890)	Almoradux	Cold, digestive disorder, gastralgia, bronchitis, urinary infection, injuries*	Liqueur	Flowered aerial parts	M	2
	<i>Thymus orospedanus</i> Huguet del Villar (GDA53902)	Tomillo basto	x	Seasoning	Flowered aerial parts	D, R	4
	<i>Thymus zygis</i> Loefl. ex L. subsp. <i>gracilis</i> (Boiss.) R. Morales (GDA53878)	Tomillo aceitunero	Cold, urinary infection, digestive disorder, infection, cough, hypercholesterolemia, depurative, dermatitis*	Seasoning	Flowered aerial parts	D, R, I	15
Lauraceae	<i>Laurus nobilis</i> L. +	Laurel	Gases	Seasoning	Leaves	D, R	12
Liliaceae	<i>Allium ampeloprasum</i> L. (GDA54088)	Ajo porro	Digestive disorder	Food	Bulb	C, F	12
	<i>Allium roseum</i> L. (GDA54090)	Ajo porro	Digestive disorder	Food	Bulb	C, F	4
	<i>Asparagus acutifolius</i> L. (GDA54078)	Espárrago triguero	Diuretic, kidney malfunction	Food	Tender shoots	C, F	12
	<i>Asparagus albus</i> L. (GDA54302)	Espárrago blanco	Diuretic	Food	Tender shoots	C, F	7
	<i>Smilax aspera</i> L. (GDA53853)	Zarzaparrilla	Circulatory problems, gastralgia, pain, skin problems*, injuries*	Snack	Tender shoots	R	3
Malvaceae	<i>Lavatera cretica</i> L. (GDA54122)	Malva	Gastralgia*	Snack	Fruit	R	2
	<i>Malva sylvestris</i> L. (GDA54120)	Malva	Gastralgia*, cold*, female genital infection*, constipation*	Snack	Fruit	R	8

Tab. 1 Continued

Botanical family	Scientific name and voucher number	Vernacular name	Medicinal use	Category	Part used	Preparation	UR
Moraceae	<i>Ficus carica</i> L. (GDA53804)	Higuera	Cold, cough, constipation, warts*	Food	Fruit	D, C	5
Oleaceae	<i>Olea europaea</i> L. var. <i>syvestris</i> Brot. (GDA53836)	Olivo	Hypertension*	Food	Fruit	M	3
Papaveraceae	<i>Fumaria parviflora</i> Lam. (GDA53973)	Zapaticos	Other species: gall-bladder infection*	Snack	Flowers	R	2
	<i>Papaver rhoeas</i> L. (GDA53791)	Amapola	Nervousness*	Food	Leaves	C	3
Pinaceae	<i>Pinus pinea</i> L. (GDA54018) +	Pino piñonero	Cold*	Food	Seeds	R	3
Poaceae	<i>Arundo donax</i> L. (GDA54081) +	Caña	x	Food	Rhizome	C	3
	<i>Stipa tenacissima</i> L. (GDA54052)	Esparto	Abortive, warts*	Snack	Inflorescence	R	1
Polygonaceae	<i>Rumex conglomeratus</i> Murray (GDA53839)	Espinaca silvestre	Diarrhoea*	Food	Leaves	C, R	12
	<i>Rumex induratus</i> Boiss. & Reut. (GDA53847)	Vinagrera	x	Food	Leaves	R	8
	<i>Rumex pulcher</i> L. subsp. <i>woodsii</i> (De Not.) Arcangeli (GDA53800)	Alborraza	x	Snack	Leaves	R	2
	<i>Portulaca oleracea</i> L. (GDA53822)	Verdolaga	x	Drink	Aerial parts	M	1
Portulacaceae	<i>Portulaca oleracea</i> L. (GDA53822)	Verdolaga	x	Food	Leaves	C, R	4
Rosaceae	<i>Crataegus granatensis</i> Boiss. (GDA53964)	Majoleto	Cold, circulatory problems*, hypertension*, nervousness*	Food	Leaves	C, R	15
	<i>Crataegus monogyna</i> Jacq. (GDA53965)	Majoleto	Cold, circulatory problems*, hypertension*, nervousness*	Food	Fruit	R	2
	<i>Prunus avium</i> L. (GDA53971)	Cerezo	Dysmenorrhoea, hives*	Food	Fruit	R	11
	<i>Prunus insititia</i> L. (GDA49536)	Endrino	x	Liqueur	Fruit	M	4
				Food	Fruit	R	5
				Food	Fruit	R	1
				Liqueur	Fruit	M	2



Tab. 1 Continued

Botanical family	Scientific name and voucher number	Vernacular name	Medicinal use	Category	Part used	Preparation	UR
Gomphidiaceae	<i>Chroogomphus rutilus</i> (Sch.: Fr.) O. K. Miller (GDA54330)	Pie de perdiz	x	Food	Mushroom	C, F	2
Helvellaceae	<i>Helvella acetabulum</i> (L. Fr.) Quélet (GDA54332)	Orejitas rubias	x	Food	Mushroom	C, F	3
	<i>Helvella leucomelaena</i> (Pers.) Naunfeldt (GDA54333)	Orejitas morenas	x	Food	Mushroom	C, F	3
	<i>Helvella leucopus</i> Pers. (GDA54334)	Negritos	x	Food	Mushroom	C, F	1
Hygrophoraceae	<i>Hygrophorus agathosmus</i> (Fr.) Fr. (GDA54335)	Llanegas	x	Food	Mushroom	C, F	1
Lycoperdaceae	<i>Bovista</i> sp.	Peo de lobo	x	Food	Mushroom	C, F	1
	<i>Lycoperdon molle</i> Pers.: Pers. (GDA54337); <i>Lycoperdon</i> sp. pl.	Peo de lobo	Wounds*	Food	Mushroom	C, F	3
Morchellaceae	<i>Morchella esculenta</i> Pers. ex. St.-Amans (GDA54341); <i>Morchella</i> sp. pl.	Colmenillas	x	Food	Mushroom	C, F	6
Pezizaceae	<i>Sarcosphaera coronaria</i> (Jaquim) Boud. (GDA54345)	Orejicas	x	Food	Mushroom	C, F	2
Pleurotaceae	<i>Pleurotus eryngii</i> (DC. Fr.) Quélet (GDA54342)	Seta de cardo	x	Food	Mushroom	C, F	10
Pleurotaceae	<i>Pleurotus eryngii</i> var. <i>ferulae</i> Lanzi (GDA54343)	Seta de cañaaja	x	Food	Mushroom	C, F	5
	<i>Pleurotus ostreatus</i> (Jacq.: Fr.) Quélet	Seta de chopo	x	Food	Mushroom	C, F	8
Rhizopogonaceae	<i>Rhizopogon roseolus</i> (Corda) TH. (GDA54344)	Seta esponja	x	Food	Mushroom	C, F	1
Russulaceae	<i>Lactarius deliciosus</i> (L.) Gray	Guiscano	Pain*	Food	Mushroom	C, F	8
Terfeziaceae	<i>Terfezia arenaria</i> (Moris) Trappe; <i>Terfezia</i> sp.	Criadillas de tierra	x	Food	Truffle	C, F	5
Tricholomataceae	<i>Clitocybe odora</i> (Bull.: Fr.) Kummer (GDA54330)	Seta anisada	x	Seasoning	Mushroom	C, F	2

Tab. 1 Continued

Botanical family	Scientific name and voucher number	Vernacular name	Medicinal use	Category	Part used	Preparation	UR
	<i>Lepista nuda</i> (Bull.: Fr.) Cooke (GDA54336)	Moraica	x	Food	Mushroom	C, F	3
	<i>Melanoleuca polioleuca</i> (Fr.) Kühner & Maire (GDA54340)	Seta harinera	x	Food	Mushroom	C, F	1
	<i>Melanoleuca excissa</i> (Fr.) Singer (GDA54339)	Seta harinera	x	Food	Mushroom	C, F	1
	<i>Tricholoma terreum</i> (Sch.: Fr.) Kummer (GDA54346)	Seta de estepa	x	Food	Mushroom	C, F	4

Legend: “+” – naturalized plants in the study area; “-” – medicinal uses not made by consuming the plant; x – without medicinal uses in the study area; R – raw (including salads); C – cooked; F – fried; D – dried; I – infusion; M – macerated; UR – use reports.

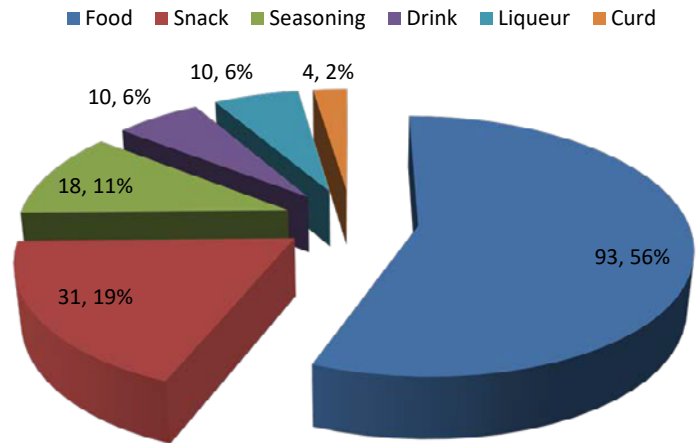


Fig. 2 Distribution of species number and percentages in the use categories.

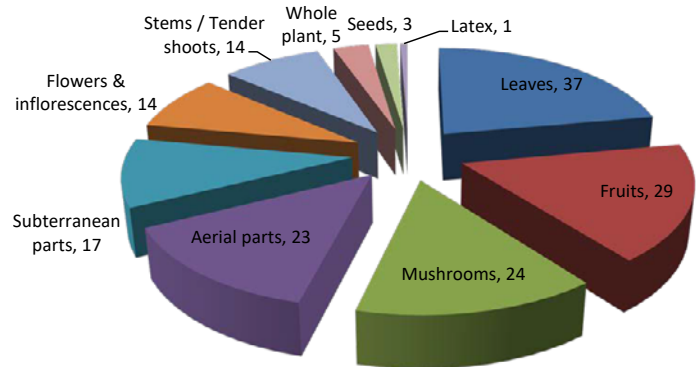


Fig. 3 Distribution of the parts used. Some categories are joined: aerial parts include flowered aerial parts; Subterranean parts include bulbs, rhizomes, roots and tubers; stems / tender shoots also include trunk; mushrooms include truffle.

is the medicinal use of *Lactarius deliciosus* (L.) Gray against cough after drinking the product of its maceration on water for several days, even after it starts to rot. It bears mentioning that some of its bioactive constituents have been reported to be antitumoural and antioxidant [73–75].

#### Medicinal uses of crop plants

Tab. 2 contains a list of 45 edible cultivated or purchased plants (e.g., coffee or cinnamon) from 24 botanical families for which some parts are also popularly used for medicinal purposes. Most of them can be both cultivated or purchased in the study area and the informants can obtain them from any source (plants marked with letter P in superscript in the table are always purchased in markets). Up to 105 medicinal uses have been recorded for them. As before, we must separate the plants used as functional foods and those used as medicine and food in different ways. Examples include the extended topical use of cabbage leaves on contusions and skin ulcers, or the use of melon seeds against diarrhoea, whereas people usually do not eat the seeds when consuming the fruit. There are also some cases of superstitious uses that are excluded. For example, it is quite widespread the belief that by putting some nuts or chestnuts in



Tab. 2 Crop plants used as functional foods in western Granada.

Botanical family	Scientific name	Vernacular name	Medicinal use	Category	Part used	Preparation	UR
Alliaceae	<i>Allium cepa</i> L.	Cebolla	Cold, hypertension, inflammation, kidney malfunction, obesity, depurative, hypercholesterolemia, diuretic, cough	Food	Bulb	C, F, R	2
	<i>Allium sativum</i> L.	Ajo	Cold, helminthiasis, bone pain, rheumatism, warts	Food Seasoning	Bulb Bulb	C, F, R R	3 6
Apiaceae	<i>Apium graveolens</i> L.	Apio	Digestive disorder, digestive depurative	Food	Leaves	C, F, R	2
	<i>Cuminum cyminum</i> L. <sup>P</sup>	Comino	Gases	Seasoning	Seeds	R	2
	<i>Petroselinum crispum</i> (Miller) A. W. Hill	Perejil	Diabetes, amenorrhoea, halitosis, abortion, anaemia, kidney stones, hypertension	Seasoning	Leaves	C, R	9
	<i>Pimpinella anisum</i> L.	Anís	Gases, gastralgia, digestive disorder	Liqueur Seasoning Drink	Fruit Fruit Flowered aerial parts	M R I	3 2 4
Asparagaceae	<i>Asparagus officinalis</i>	Espárrago	Diuretic, kidney malfunction	Food	Tender shoots	C, R, F	8
	<i>Cynara scolymus</i> L.	Alcachofa	Kidney malfunction, hypercholesterolemia	Curd Food	Inflorescence Stems and leaves	R C, F	3 10
Brassicaceae	<i>Helianthus annuus</i> L.	Girasol	Injuries*	Food	Seeds	R, F	1
	<i>Brassica oleracea</i> L. var. <i>capitata</i> L.	Col	Contusion*, cutaneous ulcer*	Food	Leaves	C, R	1
Cannabaceae	<i>Raphanus sativus</i> L.	Rábano	Cough	Food	Tuber	C, R	1
	<i>Cannabis sativa</i> L.	Cáñamo	Nervousness*	Food	Seeds	R	1
Convolvulaceae	<i>Ipomoea batatas</i> (L.) Lam.	Batata	Chilblains*	Food	Root	C, F	3
	<i>Citrullus lanatus</i> (Thunb.) Matsum. & Nakai	Melón	Diarrhoea*	Food	Fruit	R	1

Tab. 2 Continued

Botanical family	Scientific name	Vernacular name	Medicinal use	Category	Part used	Preparation	UR
Chenopodiaceae	<i>Cucumis sativus</i> L.	Pepino	Digestive disorder, dysmenorrhoea	Liqueur	Fruit	R	5
	<i>Cucurbita</i> sp. pl.	Calabaza	Helminthiasis*	Food	Fruit	C	3
	<i>Beta vulgaris</i> L.	Acelga	Anaemia	Food	Leaves	C, F, R	2
	<i>Spinacia oleracea</i> L.	Espinaca	Anaemia	Seasoning	Root	C	1
	<i>Phaseolus vulgaris</i> L.	Judías	Diabetes	Food	Leaves	C, R	2
	<i>Vicia faba</i> L.	Haba	Burns*	Food	Fruit	C	2
	<i>Castanea sativa</i> Miller	Castaña	Toothache*	Food	Fruit	C, F, R	1
	<i>Juglans regia</i> L.	Nogal	Prostatism*, hypercholesterolemia*, toothache*	Food	Fruit	R	5
	<i>Crocus sativus</i> L. <sup>P</sup>	Azafrán	Dysmenorrhoea	Liqueur	Fruit	R	3
	<i>Mentha spicata</i> L.	Hierbabuena	Digestive disorder, helminthiasis	Seasoning	Styles	R	3
Juglandaceae	<i>Mentha × piperita</i> L.	Menta piperita	Headache, aphrodisiac	Drink	Leaves	I	4
	<i>Cinnamomum zeylanicum</i> (Breyne) Nees <sup>P</sup>	Canela	Abortive, postpartum depurative	Seasoning	Stems and leaves	D, R	5
Oleaceae	<i>Olea europaea</i> L. var. <i>europaea</i>	Olivo	Constipation, food poisoning, warts*, erysipela*, hoarseness*, sores*, burns*, hernia*, psoriasis*, hypertension*	Drink	Flowered aerial parts	I	2
	<i>Piper nigrum</i> L. <sup>P</sup>	Pimienta	Toothache	Drink	Bark	I	2
Poaceae	<i>Triticum</i> sp. pl.	Trigo	Cold	Seasoning	Bark	D	3
				Food	Fruit	M	6

Tab. 2 Continued

Botanical family	Scientific name	Vernacular name	Medicinal use	Category	Part used	Preparation	UR
	<i>Zea mays</i> L.	Maiz	Kidney stones and malfunction*, diuretic*, urinary infection*	Food	Seeds	C	1
Rosaceae	<i>Cydonia oblonga</i> Miller	Membrillo	Respiratory problems*	Food	Fruit	R	3
	<i>Eriobotrya japonica</i> (Thunb.) Lindl.	Nispero	Constipation*, hyperglucemia*, aphonia*	Food	Fruit	R	1
	<i>Fragaria vesca</i> L. <sup>P</sup>	Fresa	Gout*	Food	Fruit	R	1
	<i>Prunus cerasus</i> L.	Guindo	Dysmenorrhoea	Liqueur	Fruit	M	3
	<i>Prunus domestica</i> L.	Ciruelo	Constipation	Food	Fruit	R	3
	<i>Prunus dulcis</i> (Miller) D. A. Webb	Almendro	Diarrhoea, constipation, hypercholesterolemia, hyperglucemia*, kidney stones*, toothache*	Food	Fruit	C, F, R	6
Rubiaceae	<i>Coffea arabica</i> L. <sup>P</sup>	Café	Halitosis	Snack	Resin	R	2
Rutaceae	<i>Citrus limon</i> (L.) Burm. Fil.	Limón	Cold, cough, hypertension, rheumatism*, calluses*, eczema*	Drink	Seeds	D	5
	<i>Citrus sinensis</i> (L.) Osbeck	Naranja	Constipation, cough, nervousness*, hypertension*	Seasoning	Fruit	R	3
Solanaceae	<i>Capsicum frutescens</i> L.	Guindilla	Rheumatism*	Food	Fruit	R	2
	<i>Lycopersicon esculentum</i> Mill.	Tomate	Calluses and skin hardness*, pimples*	Seasoning	Fruit	R	4
	<i>Solanum melongena</i> L.	Berenjena	Hypercholesterolemia, Haemorrhoids	Food	Fruit	C, D, R	1
	<i>Solanum tuberosum</i> L.	Patata	Contusion*, burns*	Food	Tuber	C, R	1
						C, F	2

Tab. 2 Continued

Botanical family	Scientific name	Vernacular name	Medicinal use	Category	Part used	Preparation	UR
Verbenaceae	<i>Aloysia citriodora</i> (Cav.) Ort.	Hierbaluisa	Gastralgia, digestive disorder, headache, insomnia	Seasoning	Leaves	R, D	1
Vitaceae	<i>Vitis vinifera</i> L.	Parra	Helminthiasis, cold	Liqueur	Flowered aerial parts	R, D	2

Legend: \* – medicinal uses not made by consuming the plant; R – raw (including salads); C – cooked; F – fried; D – dried; I – infusion; M – macerated; UR – use reports; P – exclusively purchased plants.

your pocket, a toothache disappears. In Tab. 2, up to 29 species can be considered functional foods, while 16 of them cannot (whose medicinal uses are all marked with an asterisk in the table).

## Discussion

### Edible wild plants

In the category “food” plants, the most frequently reported ones are the leaves and stems of *Anchusa azurea* Mill., widely consumed fried and locally considered as a substitute for fish in famine times, regarding its taste. The leaves’ midrib and sometimes the stems of the thistle *Scolymus hispanicus* L., as well as young leaves of fennel (*Foeniculum vulgare* Mill.), consumed mainly in cooked dishes, also stand out (Fig. 4). Other frequently consumed wild resources include the leaves from *Portulaca oleracea* L., *Silene vulgaris* (Moench) Garcke (frequently consumed in omelette; Fig. 5), *Sonchus oleraceus* L., several thistles like *Silybum marianum* (L.) Gaertn. or *Cynara cardunculus* L. (mainly the midrib), or several species from genus *Rumex*, bulbs of several wild *Allium* species, or tender shoots of *Asparagus* species, plants also frequently quoted in the Spanish literature on the subject [28,35]. Apart from these used parts, up to 16 different wild fruits have been consumed, mostly from the Rosaceae.

Within the 93 species in this category, only three were not previously included in the mentioned works consulted from Spain: *Leontodon longirostris* (Finch & P. D. Sell) Talavera, *Amaranthus retroflexus* L., and *Thapsia villosa* L., which, to our knowledge, are local edible resources not known from other surrounding territories.

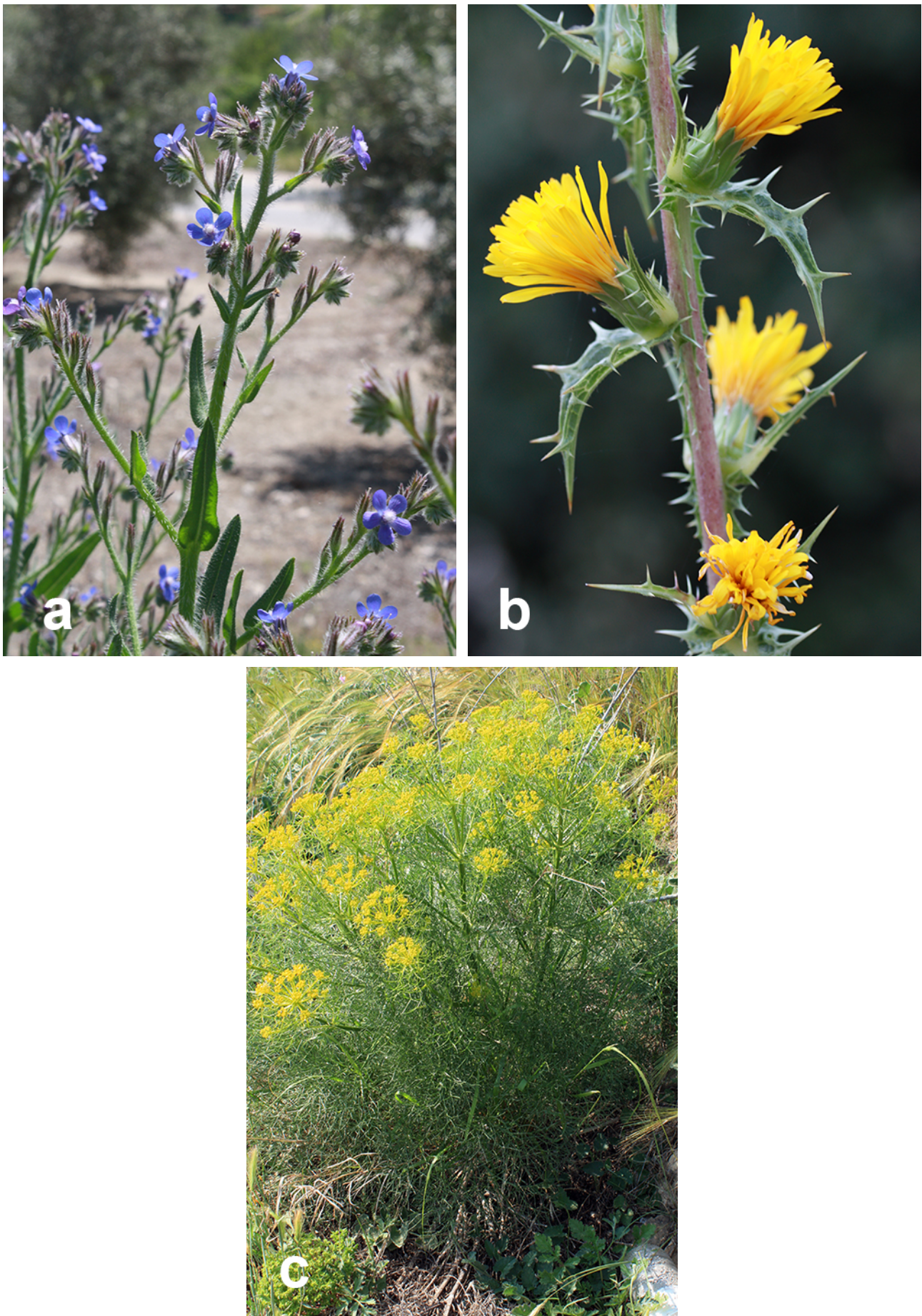
Wild snacks also make up a large group in our study area. Most of the plants included offer flowers with nectar, sucked by local people during their field walks, such as those from different wild species of genus *Lonicera* and *Linaria*, from *Borago officinalis* L. and *Anchusa azurea*, plants commonly found near orchards, or *Salvia microphylla* Kunth and *Gleditsia triacanthos* L., cultivated in gardens. Also, a large number of roots are eaten raw where collected, not for nutrients but as a snack, such as several species of *Scorzonera* and *Tragopogon*, or the widespread use of the roots from *Glycyrrhiza glabra* L., a well-known medicinal plant. Some of them are still consumed for nostalgia regarding older and less prosperous times.

Tubers from the species *Bunium macuca* deserve a special comment. While being a well-known and appreciated local resource (the most common reported snack) its consumption is currently very low. According to our informants, this is due to modern agricultural practices: when crop fields were ploughed less deeply with animals the plant was common, and children used to look for tubers walking behind farm animals. Since mechanized ploughing goes deeper, this plant has become less common in cultivated areas and people have to look for it in wild places, resulting in a substantial decrease of its consumption. Several species of the genus and of the relative *Conopodium* are consumed in different Spanish and European areas [23,35] and it seems to be a very old edible wild resource, as it was known as such in England during the Bronze Age [76].

Wild seasoning plants are also important in the study area, where many people often collect their own seasonings. With respect to this, the Lamiaceae family is very important: 10 species (55.5%) belong to this family, including several species of thyme and some thyme relatives (genera *Satureja* and *Thymbra*) together with rosemary, sage, oregano, and lavender. The high importance of the family in this category has been highlighted many times [32,35,37,56,77,78]. There is also a high incidence of Apiaceae plants, of which two are commonly used locally: *Bifora testiculata* (L.) Roth. and *Ridolfia segetum* Moris, whose leaves are used to prepare a local dish. However, apart from thyme, the most reported seasoning was the laurel leaves, usually collected from cultivated trees in farms or gardens.

Regarding plants used in homemade liqueurs, the “sarsaparilla” *Smilax aspera* L. is the most frequently reported, providing one of the essential compounds of





**Fig. 4** Most frequently reported food plants: *Anchusa azurea* (a), *Scolymus hispanicus* (b), *Foeniculum vulgare* (c).





**Fig. 5** Omelette with the leaves of *Silene vulgaris*.

a very famous seasonal and local alcoholic beverage called *arresol*. The homemade liqueur fruits of *Prunus spinosa* L. are also appreciated for the preparation of *pacharán*, a traditional alcoholic drink in the northern territories of the Iberian Peninsula [44], for which some people prefer the larger fruits of *Prunus insititia* L., while in other parts of the province it is prepared with fruits of the endemic *Prunus ramburii* Boiss., not present in our study area. Homemade liqueurs are also made with cherries and walnuts and, to a minor extent, with plums and strawberry tree fruits, as well as with the flowering aerial parts of pennyroyal and chamomile. Non-medicinal drinks and curds include a minor number of plant species, but some of them use, for instance, *Bidens aurea* (Aiton) Sherff leaves as a non-stimulant tea, or the local use of *Ridolfia segetum* seeds for curd.

#### Gathered edible wild mushrooms

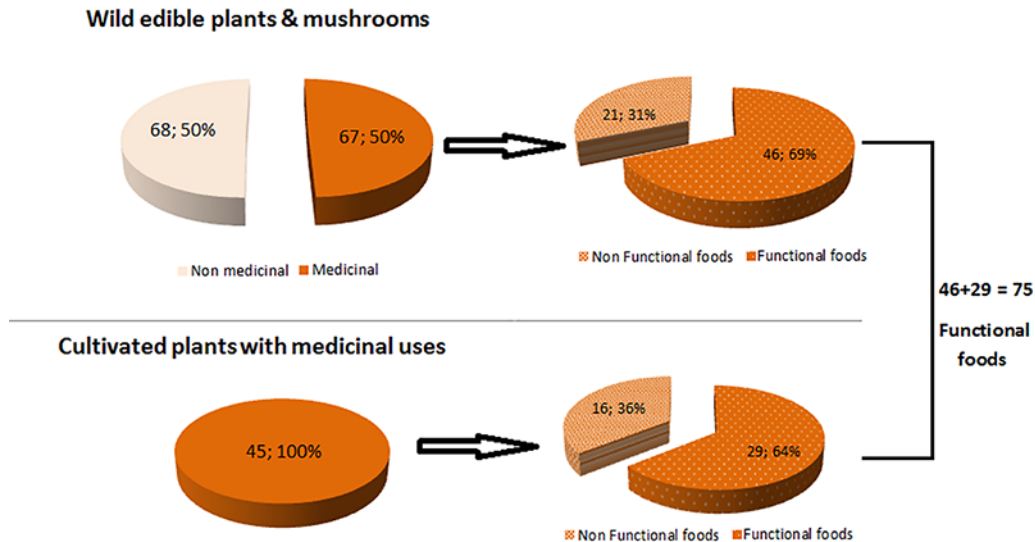
The fungi best known by local people are *Pleurotus* sp. pl., *Agrocybe aegerita* (Brig.) Sing., *Lactarius deliciosus*, *Morchella* sp. pl., and *Helvella* sp. pl. Particularly high is the consumption of *Pleurotus eryngii* (DC: Fr.) Quélet, the most valued one. The gathering of the other species appears to depend more on the mycological knowledge of the collector. It is important to highlight that Andalusia has always been considered mycophobic [79,80], but currently mushroom consumption habits are changing. Lately, people have more information and resources in order to identify mushrooms and local knowledge on edible mushrooms has increased in recent decades, due mainly to the help of mushrooms field guides and mycological associations. The increase in the number of the main consumed species (those marked as edible in the main field guides) and the small number of reports for some formerly collected ones [such as *Sarcosphaera coronaria* (Jaquim) Boud. or *Rhizopogon roseolus* (Corda) TH., consumed only by elderly people and usually not marked as edible in these kinds of guides] are clear consequences of these external information resources. More research is needed on ethnomycology in Spain as only a few references are available [71,81] and scattered information in ethnobotanical works.

Clearly, the part of the fungi used is the fruiting body, called mushroom in all cases with the exception of the species of the underground genus *Terfezia*, a truffle-forming fungus. Truffles from genus *Tuber* also grow in the study area, but data on the exact growing sites and collection times are jealously preserved by the few people who exploit this resource. All the fungi included are popularly considered a source of wild food, i.e., cooked as an ingredient in several dishes. It is curious that *Clitocybe odora* (Bull.: Fr.) Kummer is not usually considered food but seasoning, since it is not used as an ingredient but just to give an aniseed flavour, mainly in rice dishes.



## Functional foods and medicinal uses

In all wild gathered and crop plants, the total number of folk functional foods in the study area reaches 75 species. Fig. 6 reflects the summary of the number of species of medicinal plants and functional foods within the groups of wild and naturalized flora and plants cultivated as edibles.



**Fig. 6** Number of species of edible medicinal plants and functional foods.

**Tab. 3** Conditions treated with two or more folk functional foods and number of used species.

Condition	Sp.
Digestive disorder	19
Cold	15
Circulatory problems	8
Cough	7
Gastralgia	7
Diarrhoea	5
Diuretic	5
Dysmenorrhoea	3
Gases	3
Kidney malfunction	3
Asthenia	2
Bronchitis	2
Hypercholesterolemia	2
Hyperglucemia	2
Kidney stones	2
Urinary infection	2

These plants are consumed to treat up to 36 different conditions, mainly common diseases of digestive and respiratory systems, such as digestive disorders, gastralgia, cold, and cough or circulatory disorders, but also some more specific ailments, including kidney and liver disease, genital infections, menorrhagia, or nervousness. Tab. 3 shows the conditions treated with functional foods in the study area (those not marked with an asterisk in Tab. 1 and Tab. 2) arranged by the number of plant resources which can be used to treat them.

However, because our study area is not so vast, and the fact that some of the plants included are used as medicinal plants in nearby areas, the number of local functional foods could be higher. This is the case of *Daucus carota* L., *Scandix pecten-veneris* L., *Santolina rosmarinifolia* subsp. *canescens* (Lag.) Nyman, *Satureja obovata* Lag., *Rumex induratus* Boiss. & Reut., *R. pulcher* subsp. *woodsii* (De Not.) Arcang., *Rubus ulmifolius* Schott., *Ulmus minor* Mill., *Thymus orospedanus* Villar, *T. longiflorus* Boiss., *Erodium cicutarium* (L.) L'Hér., or *Onopordum nervosum* Boiss., used as edible plants in this area but also as medicinal plants in nearby territories of the Granada, Murcia, Jaén, and Córdoba provinces [57,82–86].

Besides this, animal products are also used in the area for medicinal purposes, and some are consumed, even animals not generally included in the European diet such as snakes, as has been previously analyzed [87].

## Conclusions

In this research, we conclude that local traditions linked to plants persist in this study area, particularly the custom of using edible wild plants. The high number of edible resources in western Granada reflects an extensive local knowledge on the subject: up to 135 species are gathered from the wild. Of them, 93 plant species are used as food, mainly in salads as green vegetables as well as for cooked dishes. This data shows some differences in comparison with other Iberian areas such as the Basque Country, where the main categories of eaten plants are fruits

and masticants [42,44]. Despite these differences, the clear prevalence of directly edible plants is shared with several studies in different Spanish areas such as the province of Madrid [68], the region of Castile la Mancha [18], or the Catalanian Pyrenees [40]. We also agree with Pardo-de-Santayana et al. [37] that the patterns of wild edible plant usage appear to depend mainly on sociocultural factors rather than on biological ones, such as climate or richness of the wild edible flora.

As in the rest of Spain and most of Europe [23,35], most of the wild edible plants are considered famine food, highly consumed in times of scarcity, as during the Spanish Civil war and post-war period, as was described by many of our informants. Therefore, many of these plants are not commonly gathered nowadays. Nevertheless, the tradition of gathering some of the plants described is still alive and some of them (the ones most commonly cited) are frequently consumed in the study area. The fact that Andalusia has historically been one of the most depressed areas in Spain may have some influence on this current consumption. Moreover, some wild plants, such as *Asparagus acutifolius* L., *Portulaca oleracea*, *Silene vulgaris*, *Scolymus hispanicus*, *Foeniculum vulgare*, or *Cynara* spp., are also marketed in the area.

However, as some researchers have pointed out, wild plants that are eaten may not always be healthy [29,88] and some of the plants can even be toxic when eaten frequently or in high quantities. Some examples of the ones included in this research are *Rumex* species, with oxalates, some Apiaceae such as *Bifora testiculata*, *Ridolfia segetum*, or *Thapsia villosa*, which contain coumarines and terpenoids in their essential oil that can be toxic, or some alkaloidic plants such as *Borago officinalis* or *Stipa tenacissima* L.. Probably, some of them should be regulated in regional or national laws to avoid poisoning.

Moreover, the number of snacks recorded for the study area is very high (31 plant species), reflecting perhaps the important linkage of local people with their environment. A full knowledge of important resources such as edible plants is important for survival in famine times, but an ample knowledge of snacks eaten only for flavour, as on recreational hikes through the countryside, has meaning in the general rural lifestyle in this territory. The strong tradition of gathering is also demonstrated by the high number of wild plants used as a seasoning in addition to the typical spices from the market: 18 different plants gathered and used for cooking.

Apart from this, the local importance of functional foods has been demonstrated: 75 plant species of wild and crop plants to treat up to 36 health conditions. Most of the diseases treated with edible wild or crop plants are common ones: digestive disorders, cold, cough, circulatory problems, gastralgia, diarrhoea, etc. However, there are some examples of treatments for more specific diseases such as hypertension, dysmenorrhoea, menorrhagia, hypercholesterolemia, hyperglycaemia, or as a postpartum depurative. Interest in the medicinal properties of these plants has grown recently, and many researchers have tested their antioxidant or biological activities [45,89,90]. However, more studies on the pharmacological properties of these foods are needed, in order to establish their real or potential benefits for the afflictions treated.

It has been said that the interest in the study of wild edible plants is interdisciplinary, covering from field ethnobotanical studies to production, agricultural, bromatological, or pharmacological studies. In this sense, apart from the aforementioned pharmacological studies, the nutritional composition of some of the most commonly gathered plants in Spain has been studied [46,47]. Therefore, in our opinion, ethnobotanical fieldwork is the basis and stimulus for other subsequent studies, and therefore documenting and publishing these results is extremely important to improve the scientific knowledge on the use of edible and medicinal plants.

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