

# Perceived health and medicinal properties of six species of wild edible plants in north-east Lebanon

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## Abstract

**Objectives:** Wild edible plants (WEP) play the dual role of securing food diversity and promoting health in traditional societies. Current simplified dietary habits contribute to increasing population health risks. Since WEP are integral to the diet of traditional communities, identifying their significance as foods to people provides further evidence to conserve them and promote their consumption. Six species of WEP were identified as integral to the diet of rural Lebanese communities. We investigated their patterns of consumption and knowledge regarding their health and medicinal properties.

**Design:** An ethnobotanical survey, employing a qualitative questionnaire, was conducted among thirty informants. The identified species were *Cichorium intybus*, *Eryngium creticum*, *Foeniculum vulgare*, *Malva sylvestris*, *Thymus syriacus* and *Gundelia tournefortii*.

**Results:** Most informants consumed the six plants as a regular part of their diet. Seasonal variability in consumption was evident. *C. intybus* was renowned for its digestive and blood strengthening properties. *F. vulgare* was used as a digestive stimulant. *M. sylvestris* was distinguished for its anti-inflammatory qualities. *T. syriacus* was popular for its digestive and anti-poisonous properties. *E. creticum* was attributed less pronounced health benefits. *G. tournefortii* was considered a nutritious food.

**Conclusions:** All six species were popular for their edible uses as well as their health and/or medicinal benefits. These properties are supported by scientific evidence. Our results highlight the importance of these plants for local people and support efforts for their conservation. However, we noticed a decline in indigenous knowledge. We encourage efforts to record it for other plants and in other communities.

## Keywords

Wild edible plants  
Traditional diet  
Mediterranean diet  
*Cichorium intybus*  
*Eryngium creticum*  
*Gundelia tournefortii*  
*Thymus syriacus*  
*Foeniculum vulgare*  
*Malva sylvestris*  
Health effects  
Medicinal effects

During the last century, the relationship between wild edible plants (WEP) – as part of traditional food habits – and health gained the interest of the scientific community<sup>(1)</sup>. Nowadays, the health status of populations is witnessing increasing incidences of chronic diseases, partly influenced by current dietary changes such as increases in fat, sugar and total energy<sup>(2)</sup>. In contrast, traditional food habits have been characterized by dietary diversity and have been associated with low health risks<sup>(3,4)</sup>. WEP have been identified as main components of these diets and as important contributors to their health-protective properties<sup>(5)</sup>.

Wild plants are defined as 'those that grow spontaneously in self-maintaining populations in natural or

semi-natural ecosystems and can exist independently of direct human action'<sup>(6)</sup>. Undomesticated greens have always been a main part of traditional diets, and were famous for their health and medicinal qualities among local communities and indigenous people long before their nutritious, protective and therapeutic effects were proved by science<sup>(7)</sup>. Many wild species, neglected in urban diets, are collected from the surrounding environment and consumed as part of local diets, especially in times of shortage<sup>(8,9)</sup>. Various wild greens contain high nutritional values with relatively low energy. Compared with commonly eaten vegetables, they provide the diet with greater amounts of minerals<sup>(10,11)</sup>. Additionally, several of these often-called 'famine foods' have proved

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to be important sources of high-quality protein and essential amino acids when compared with the WHO protein standard, as well as being rich in *n*-3 and *n*-6 essential fatty acids<sup>(12)</sup>. Their antioxidant property, mainly from phytochemicals, was found to be two to three times higher than that of common vegetables<sup>(10)</sup>. For these reasons, undomesticated greens are recognized as possessing a significant potential for widespread use and development, promoting global food security and nutrition<sup>(8)</sup>.

Unfortunately, it has been documented that only 0.2% of edible plant species are cultivated and consumed, while only 0.0001% contribute the most to the world population's energy needs<sup>(8)</sup>. Therefore, there is a need to reveal potential nutritious and therapeutic properties of neglected wild plants that could contribute to the health and wellness of rural communities.

Traditional knowledge and experience are a golden source for the exploration and collection of wild plants. Indigenous people are 'people who...developed ways of living, practices and belief systems which demonstrate their intimate relationship with the mountain environment and deep knowledge about the plants, wildlife, vegetation and ecosystems that surround them'<sup>(13)</sup>. This set of beliefs forms the basis for participatory approaches, with the aim of reaching economic and sustainable development in local communities<sup>(14)</sup>. Ethnobotany, the systematic study of traditional communities' botanical knowledge, permits the disclosure of various characteristics and benefits of WEP that were revealed through the ancient interaction between man and nature<sup>(15)</sup>.

In the Mediterranean basin, there seems to be a wealth in ethnobotanical studies, mostly coming from southern Europe and some Middle Eastern countries<sup>(16–22)</sup>. However, no recent studies have been conducted on traditional knowledge regarding the uses and health and medicinal properties of WEP in Lebanon.

Therefore, the leading objective of the present study was to record the traditional knowledge of local north-eastern Lebanese inhabitants concerning the use, consumption and perceived health and medicinal properties of the following six species of native WEP: *Cichorium intybus* (chicory), *Foeniculum vulgare* (fennel), *Malva sylvestris* (high mallow), *Gundelia tournefortii* (gundelia, locally 'Akkoub'), *Eryngium creticum* (eryngo) and *Thymus syriacus* (wild thyme). These plants were chosen based on their perceived importance by the population in the surveyed communities through focus group discussions. Highlighting the role of these plants as a key resource for the health and nutritional livelihood of rural communities enforces national efforts to conserve them and promote their sustainable use through community-based programmes.

The current project is a qualitative research, part of a larger nutrition study conducted at the American University of Beirut in Lebanon.

## Methodology

The study was conducted during the months of June and July 2004. Towns from the north-east of Lebanon were targeted. The research area included a total of eighteen towns/villages. The villages fall in the Bekaa Valley – the main agricultural land of Lebanon – in between the two Lebanese mountain chains.

The participants were selected through 'purposeful' or 'criterion-based' sampling<sup>(23)</sup>. This method consists of choosing participants according to predefined criteria set by the researcher to get the most information to answer the research question. In our study, 'purposeful sampling' was most useful in gathering a considerable amount of specific, detailed information. One or several contact persons helped us locate our informants in each village. Four criteria determined the choice of participants for inclusion. First, the participants had to be native and resident of the north-east region. Second, they had to be reputable – in their community – for their knowledge regarding plants and their properties. The third criterion was their self-identification as individuals who are familiar with wild plants and their uses, from personal experience, personal interest and readings, or from inheritance of the knowledge from their parents or other older members of their larger family. Personal assessment of the informant's knowledge was the last criterion for selection. This was decided during the first encounter with the candidate, after initiating a general conversation and posing several probing questions regarding their familiarity and use of WEP for both nutritive and medicinal purposes. Thus, informant's age, gender, educational level, profession and socio-economic status were not considered as criteria for either inclusion or exclusion in the study. Ethical approval from McGill University's Faculty of Agricultural and Environmental Sciences in Canada was obtained before initiating the interviews.

A structured, semi-qualitative questionnaire was used to collect data<sup>(24)</sup>. The questionnaire was divided into six identical parts, each for one plant. Each part was subdivided into two sections: the first covered the edible uses and consumption forms of the plant, while the second investigated the plant's properties and uses for health and medicinal purposes. The questionnaires were translated into Arabic and each interview took around 90 to 120 min. All interviews were conducted by the same researcher.

The information collected in the field was both quantitative and qualitative. The quantitative data consisted of the consumption patterns of the plants. The percentage of participants' responses as per the edible uses, preparation, consumption and taste preference, as well as the perceived significance and health and medicinal uses of the plant, is used to report this information. The qualitative data were obtained in the section covering the health and medicinal properties of the plants. First, responses from the question 'What are the health and medicinal

properties of the plant?' were quantified using the categorization method<sup>(23)</sup>. Categories of health/medicinal properties were devised as mentioned by the informants, and properties and patterns of health and medicinal use started emerging as participants repeatedly referred to the same use/uses of the plants. Second, results are reported as per 'the informant consensus method'<sup>(25)</sup>. This method reflects the value of each plant as per property or use by the degree of agreement between distinct, independent participants on the same property or use. In the present study, a minimum of three separate accounts of the same use or property of the plant was required in order to report it as a significant pattern in the results, similar to what has been used in other ethnobotanical studies<sup>(18,26)</sup>.

## Results and discussion

Thirty participants were interviewed. The majority were males. Participants averaged 62 years of age. They were all Lebanese, native to the north-east region.

### *Consumption patterns and uses for edible purposes*

As shown in Table 1, most informants knew and personally consumed all six plant species. Reports on population consumption patterns illustrate an increasing trend in the consumption of chicory, high mallow, wild thyme and gundelia (Akkoub). Fennel and eryngo show no salient trends. Most informants are not aware of the degree to which fennel is consumed in the population. The main explanations provided by participants in this regard are that few people know it and it is used for treatment only. As for eryngo, answers are scattered between increase, decrease or unawareness of consumption trends. The reason for these differences is that consumption trends depend on people's familiarity with the plant.

All plants are consumed mainly during the spring season, starting in late winter (i.e. February). Chicory, eryngo and Akkoub are not consumed during summer and autumn, while fennel, high mallow and wild thyme are consumed, although to a lesser extent, all year round.

Informants eat mainly the leaves and stalks of chicory, eryngo, high mallow and wild thyme. There is less consumption of fennel stalks and more consumption of its seeds as compared with the other plants. As for Akkoub, the main edible part is the stalk. Many answers fall under the category 'all of it'. We have reason to believe that this category refers to the leaves and the stalks since various informants specified it as such.

Chicory, eryngo, high mallow and Akkoub are consumed mainly when freshly gathered. Chicory is eaten both raw and cooked, eryngo is prepared mainly raw as a salad, and high mallow and Akkoub are usually eaten cooked. Fennel and wild thyme are consumed both fresh and preserved. When freshly collected, fennel is consumed both

raw and cooked. Its seeds are preserved by shade drying and are consumed cooked, either by boiling them and drinking their infusion or as spices added to food and desserts. When fresh, wild thyme is consumed raw in a salad. When preserved (shade- or sun-dried), it is consumed raw, ground and mixed with sesame seeds, sumac, salt and olive oil or is pickled for flavouring.

Most informants find the plants appetizing. Chicory and eryngo are described as bitter in taste. Bais and Ravishankar reported that the bitter taste of chicory is attributed to a variety of phytochemicals, namely sesquiterpene lactones, the main bitter compounds being the glucoside of fructose and catechuic acid<sup>(27)</sup>. Fennel is described as sweet and similar to aniseed in taste. Anethole, found in both fennel and aniseed, is the sweet chemical responsible for the plant's peculiar flavour<sup>(28)</sup>. Akkoub and high mallow's tastes were difficult to describe; they are mainly identified as sweet. Wild thyme is mainly sharp in taste. Thymol and carvacrol are the two main compounds found in *T. syriacus* essential oil<sup>(29)</sup>.

Regarding the average consumption in season, high mallow and Akkoub are consumed once per week, chicory and fennel are eaten twice weekly, eryngo is consumed about three times weekly, while wild thyme is the most frequently eaten plant, around five times weekly. There is no pattern of consumption of chicory, eryngo, fennel and Akkoub when out of season, while there is more reporting of out-of-season consumption for high mallow and wild thyme. High mallow is being used as needed, for medicinal purposes, by nine out of twenty-seven informants; while wild thyme is reported by eight out of seventeen respondents to be consumed, on average, four or five times weekly (data not shown).

### *Uses for health and medicinal purposes*

As for the perceived significance, health and medicinal uses of the plants (Table 2), most informants value the plants mainly for their edible use and believe that they have health and medicinal properties. Compared with the others, chicory has a noteworthy religious significance as it was mentioned for its health benefits by the prophet Mohammad in Islam according to some participants. Akkoub was referred to mainly as a nutritious food; thus it is not mentioned in the following discussion regarding the preparation, consumption and uses for health and medicinal purposes.

The parts consumed for health and medicinal properties are the same as those used for edible purposes; i.e. the leaves and stalks of all of the plants and the seeds of fennel. As for the preparation and consumption for health and medicinal uses, chicory is mainly consumed cooked or raw, and eryngo is eaten raw, as they are prepared for edible purposes. Fennel is mainly boiled and drunk, the seeds being the most common part used, with ten out of fifteen informants using them boiled/infused and drunk (data not shown). Wild thyme and high mallow are

**Table 1** Frequency data for familiarity and consumption of the six species of wild edible plants in north-east Lebanon

	Chicory		Eryngo		Fennel		High mallow		Wild thyme		Akkoub	
	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>
Familiarity	100.0	30	86.7	26	96.7	29	100.0	30	100.0	30	93.3	28
Personal consumption pattern	<i>(n 30)</i>											
Consume it	96.7	29	92.3	24	79.3	23	100.0	30	96.7	29	96.4	27
Population consumption trend	<i>(n 30)</i>											
Increase	56.7	17	34.8	8	24.1	7	73.3	22	85.7	24	81.5	22
Decrease	20.0	6	17.4	4	20.7	6	3.3	1	7.1	2	14.8	4
No change	13.3	4	13.0	3	13.8	4	16.7	5	—	—	3.7	1
Don't know*	10.0	3	34.8	8	41.4	12	6.7	2	7.1	2	—	—
Consumption by season	<i>(n 29)</i>											
January	10.3	3	9.1	2	26.8	6	27.6	8	42.3	11	3.8	1
February	17.2	5	22.7	5	39.1	9	37.9	11	46.1	12	11.5	3
March	72.5	21	90.9	20	60.9	14	79.3	23	76.9	20	65.4	17
April	86.2	25	86.4	19	69.7	16	93.1	27	88.5	23	84.6	22
May	24.1	7	40.9	9	43.5	10	79.3	23	73.1	19	46.1	12
June	3.1	1	—	—	30.4	7	48.3	14	57.7	15	3.8	1
July	—	—	—	—	21.7	5	27.6	8	38.5	10	3.8	1
August	—	—	—	—	21.7	5	27.6	8	38.5	10	3.8	1
September	—	—	—	—	21.7	5	27.6	8	38.5	10	3.8	1
October	—	—	—	—	21.7	5	27.6	8	38.5	10	3.8	1
November	6.9	2	4.5	1	21.7	5	27.6	8	38.5	10	3.8	1
December	10.3	3	4.5	1	17.4	4	24.1	7	38.5	10	3.8	1
Parts consumed	<i>(n 29)</i>											
Leaves	69.0	20	79.2	19	65.2	15	96.3	26	88.5	23	14.8	4
Stalks	55.2	16	83.3	20	30.4	7	59.2	16	53.8	14	92.6	25
Flower	3.4	1	4.2	1	4.3	1	—	—	—	—	3.7	1
Seeds	—	—	—	—	30.4	7	—	—	—	—	—	—
Roots	3.4	1	4.2	1	4.3	1	—	—	—	—	3.7	1
Plant's head	—	—	—	—	—	—	—	—	11.5	3	—	—
All of it	31.0	9	12.5	3	4.3	1	7.4	2	7.7	2	7.4	2
Form consumed	<i>(n 29)</i>											
Fresh	86.2	25	75.0	18	30.4	7	74.1	20	—	—	93.0	25
Preserved	—	—	4.2	1	26.1	6	—	—	18.5	5	—	—
Both	13.8	4	20.8	5	43.5	10	25.9	7	81.5	22	7.0	2
Preparation of fresh	<i>(n 29)</i>											
Raw	13.8	4	56.5	13	17.7	3	—	—	86.4	19	15.4	4
Cooked	6.9	2	4.3	1	35.3	6	74.0	20	4.5	1	50.0	13
Both	79.3	23	39.1	9	47.0	8	26.0	7	9.1	2	34.6	9
Ways of preservation	<i>(n 4)</i>											
Shade-dried	75.0	3	33.3	2	43.7	7	100.0	7	65.4	17	—	—
Sun-dried	—	—	—	—	25.0	4	14.3	1	38.5	10	—	—
Pickled	50.0	2	50.0	3	32.3	5	—	—	46.0	12	—	—
Distilled	—	—	16.7	1	—	—	—	—	3.8	1	50.0	1
Frozen cooked	—	—	—	—	—	—	—	—	—	—	50.0	1
Frozen raw	—	—	—	—	6.3	1	—	—	—	—	—	—
Roasted	—	—	—	—	6.3	1	—	—	—	—	—	—
Preparation of preserved	<i>(n 4)</i>											
Raw	—	—	75.0	3	—	—	—	—	58.8	10	50.0	1
Cooked	100.0	4	25.0	1	100.0	12	100.0	7	17.6	3	50.0	1
Both	—	—	—	—	—	—	—	—	23.5	4	—	—
Taste preference	<i>(n 29)</i>											
Like	100.0	29	91.3	21	92.3	24	92.6	25	96.4	27	100.0	26
Dislike	—	—	4.3	1	7.7	2	7.4	2	3.6	1	—	—
Neutral	—	—	4.3	1	—	—	—	—	—	—	—	—
Taste description	<i>(n 29)</i>											
Sweet	—	—	4.3	1	24.0	6	29.6	8	—	—	34.6	9
Sour	—	—	4.3	1	—	—	3.7	1	7.1	2	3.8	1
Bitter	86.2	25	56.5	13	4.0	1	3.7	1	7.1	2	11.5	3
Bland	—	—	—	—	—	—	11.1	3	—	—	3.8	1
Don't know*	6.9	2	26.1	6	12.0	3	37.0	10	7.1	2	46.2	12
Sharp/hott	6.9	2	8.7	2	20.0	5	3.1	1	78.6	22	—	—
Like aniseed†	—	—	—	—	40.0	10	—	—	—	—	—	—
Mucilaginous†	—	—	—	—	—	—	11.1	3	—	—	—	—
Consumption in season	<i>(n 29)</i>											
Times/week ( <i>n</i> )	2.1	23	2.9	11	2.2	10	1.1	15	5.2	12	1.0	7

\*Don't know' includes imprecise answers and/or responses outside the question.

†These categories are specified by the informants for the 'specific flavour' choice of answer provided in the question.

**Table 2** Frequency data for perceived significance, health and medicinal uses\* of the six species of wild edible plants in north-east Lebanon

	Chicory		Eryngo		Fennel		High mallow		Wild thyme		Akkoub	
	%	n	%	n	%	n	%	n	%	n	%	n
Significance of the plant												
Social	13.8	4	4.3	1	8.7	2	13.8	4	14.3	4	3.6	1
Religious	20.7	6	8.7	2	8.7	2	6.9	2	7.1	2	—	—
Edible use	65.5	19	86.9	20	82.6	19	79.3	23	82.1	23	96.4	27
Health and medicinal significance												
Yes	96.6	28	91.3	21	83.3	20	100.0	30	96.6	28	67.9	19
No	3.4	1	8.7	2	16.7	4	—	—	3.4	1	32.1	9
Personal use for health and medicinal properties												
Yes	96.4	27	80	12	100.0	20	96.3	26	96.1	25	72.7	8
No	3.6	1	20	3	—	—	3.7	1	3.9	1	27.3	3
Parts used for health and medicinal properties												
Leaves	50.0	14	53.9	7	47.9	9	96.7	29	85.1	23	28.6	2
Stalk	50.0	14	53.9	7	31.6	6	79.3	23	59.2	16	71.4	5
Seeds	—	—	—	—	57.9	11	3.3	1	—	—	—	—
Roots	—	—	—	—	5.3	1	—	—	—	—	—	—
Flower	—	—	—	—	5.3	1	6.7	2	—	—	—	—
Thorns	—	—	—	—	—	—	—	—	—	—	28.6	2
All of it	50.0	14	35.7	5	10.5	2	3.3	1	11.1	3	43.0	3
Preparation/consumption for health and medicinal properties												
Raw, eaten	75.0	21	64.3	9	27.8	5	6.7	2	11.1	3	42.9	3
Pressed juice used	10.7	3	—	—	5.5	1	—	—	—	—	—	—
Rubbing with soft leaves	—	—	—	—	5.5	1	—	—	—	—	—	—
Dried and eaten	—	—	7.1	1	—	—	—	—	—	—	14.3	1
Raw poultice	—	—	—	—	—	—	26.7	8	—	—	—	—
Cooked, eaten	50.0	14	14.3	2	16.7	3	23.3	7	—	—	14.3	1
Boiled and drank	10.7	3	21.4	3	66.7	12	70.0	21	74.1	20	14.3	1
Infused and drank	3.6	1	7.1	1	16.7	3	6.7	2	14.8	4	14.3	1
Boiled and water used	3.6	1	—	—	—	—	36.7	11	—	—	—	—
Cooked poultice	—	—	—	—	—	—	26.7	8	—	—	—	—
Exposed to vapour	—	—	—	—	—	—	6.7	2	—	—	—	—
Distilled	3.6	1	7.1	1	—	—	—	—	7.4	2	14.3	1
Frequency of preparation for prevention												
Liberaly	7.1	2	—	—	—	—	6.7	2	—	—	—	—
Daily	14.3	4	—	—	—	—	—	—	14.8	4	—	—
Weekly	14.3	4	25.0	3	5.3	1	6.7	2	7.4	2	—	—
Weekly or monthly	—	—	—	—	5.3	1	—	—	—	—	—	—
Monthly	3.6	1	—	—	—	—	6.7	2	—	—	25.0	1
When available	3.6	1	16.7	2	—	—	—	—	—	—	—	—
Not applicable	57.1	16	58.3	7	89.5	17	80.0	24	77.8	21	75.0	3
Mixture with other herbs for various medicinal properties												
Yes	32.1	9	42.9	6	62.5	10	30.0	9	44.4	12	16.7	1
No	67.9	19	57.1	8	37.5	6	70.0	21	55.6	15	83.3	5
Dosage of plant used for treatment												
Liberaly	42.1	8	10.0	1	—	—	3.8	1	—	—	—	—
2 cups raw	10.5	2	—	—	13.3	2	—	—	—	—	—	—
1 cup raw	26.3	5	60.0	6	13.3	2	46.1	12	—	—	—	—
½ cup cooked	10.5	2	—	—	—	—	—	—	—	—	—	—

Table 2 Continued

	Chicory		Eryngo		Fennel		High mallow		Wild thyme		Akkoub	
	%	n	%	n	%	n	%	n	%	n	%	n
½ cup raw	—	—	—	—	—	—	11.5	3	—	—	—	—
≤ ½ cup	—	—	—	—	—	—	15.4	4	30.4	7	—	—
2 tbsp	—	—	—	—	—	—	—	—	52.2	12	—	—
1 tbsp	—	—	—	—	33.3	5	—	—	26.1	6	—	—
1 tsp	10.5	2	20.0	2	20.0	3	—	—	13.0	3	—	—
Frequency of preparation of treatment	(n 19)		(n 9)		(n 16)		(n 28)		(n 25)		(n 4)	
Daily until treated	42.1	8	55.6	5	56.3	9	28.6	8	—	—	—	—
Daily ≤ 15 d	15.8	3	—	—	37.5	6	17.8	5	—	—	—	—
Daily < 5 d	—	—	—	—	—	—	25.0	7	12.0	3	—	—
When needed	5.3	1	—	—	18.8	3	21.4	6	44.0	11	—	—
Side-effects of over-consumption	(n 28)		(n 16)		(n 21)		(n 28)		(n 25)		(n 12)	
Yes	10.7	3	—	—	19.1	4	57.1	16	40.0	10	8.3	1
No	82.1	23	100.0	16	71.4	15	39.3	11	56.0	14	91.7	11
Don't know	7.1	2	—	—	9.5	2	3.6	1	4.0	1	—	—
Anaemia	—	—	—	—	—	—	17.9	5	—	—	—	—
Diarrhoea	—	—	—	—	—	—	10.7	3	—	—	—	—
Hypotension	—	—	—	—	—	—	—	—	12.0	3	—	—
Age groups using it for health and medicinal properties	(n 28)		(n 9)		(n 18)		(n 30)		(n 26)		(n 4)	
Infants	14.3	4	11.1	1	22.2	4	53.3	16	34.6	9	75.0	3
Children	75.0	21	55.5	5	77.8	14	93.3	28	88.5	23	100.0	4
Adults	96.4	27	77.8	7	100.0	18	100.0	30	100.0	26	100.0	4
Elderly	92.8	26	55.5	5	100.0	18	96.7	29	96.1	25	100.0	4
Others	3.6	1	22.2	2	—	—	—	—	—	—	50.0	2
Use for men and women	(n 28)		(n 15)		(n 20)		(n 30)		(n 27)		(n 10)	
Both	100.0	28	100.0	15	100.0	20	100.0	30	100.0	27	100.0	10
Differences in uses between men and women	(n 28)		(n 15)		(n 21)		(n 30)		(n 27)		(n 10)	
Yes	7.1	2	6.7	1	4.8	1	10.0	3	7.4	2	10.0	1
No	92.9	26	93.3	14	95.2	20	90.0	27	92.6	25	90.0	9
Avoidance by any group	(n 28)		(n 15)		(n 18)		(n 28)		(n 26)		(n 10)	
Yes	7.1	2	6.7	1	22.2	4	32.1	9	30.8	8	—	—
No	82.1	23	86.7	13	72.2	13	64.3	18	53.8	14	90.0	9
Don't know	10.3	3	6.7	1	5.6	1	3.6	1	15.4	4	10.0	1
Causes anaemia	—	—	—	—	—	—	—	—	—	—	—	—
Suffering from gastrointestinal problems	—	—	—	—	—	—	—	—	—	—	—	—
Source of knowledge about the plants	(n 30)		(n 30)		(n 30)		(n 30)		(n 30)		(n 30)	
Inherited parental knowledge	50.0	15	—	—	—	—	—	—	—	—	—	—
Books	23.3	7	—	—	—	—	—	—	—	—	—	—
Personal experience	33.3	10	—	—	—	—	—	—	—	—	—	—
Others: knowledge from Arabic medicine	6.7	2	—	—	—	—	—	—	—	—	—	—

\*Detailed explanations of answers regarding the preparation of the plants are provided in the text. Informants either replied with a 'No' or gave no answers because the question was ambiguous to them.

mostly boiled and drunk. More specifically, we noticed a wide variation in the preparation and use of high mallow for health and medicinal purposes. The plant can be cooked and eaten as it is prepared for its edible consumption. For external applications, high mallow is prepared as a raw and/or a cooked poultice. Similarly, it is boiled and its water is used to wash injuries and inflamed tissues (female genitalia, pimples), or even as a gargle for throat inflammations.

When informants were asked if they prepare the plants for prevention purposes against sickness, the response rate was very low. Reasons could be that people either did not relate to the question or did not regard consuming these plants for prevention against ailments, rather they consumed them as popular traditional dishes while benefiting from their health and medicinal properties when needed.

As for mixing the plants with other herbs for better or different health results, the majority of informants do not mix chicory and high mallow with other herbs. Eryngo and wild thyme could be either prepared alone or with other herbs, and fennel is mostly mixed with other herbs. For all of the plants, there is no consistency as to mixing the plant with a specific herb for the treatment of a particular ailment. However, among various herbs mentioned throughout all questionnaires, we found that six were mentioned at least three times by three different informants. The plants are the following: *Centaurea* spp., *Chamaemelum nobile* (chamomile), *Rosmarinus officinalis* (rosemary), *Prunus dulcis* (almond), *Althea* spp. and *Adenocarpus divaricatus* (also known as *Adenocarpus complicatus*). These plants are worth further investigation for their health and medicinal value among rural communities.

Responses regarding the dosage of the plant for medicinal uses were difficult to categorize since the quantities were not measured; therefore we had to estimate doses used. An amount of one cup of raw chicory or a liberal quantity (until satiety) is consumed. Mostly one raw cup of eryngo and high mallow is used. Fennel and wild thyme are used in tablespoon amounts.

As for the frequency of preparation for treatment, the main salient category for chicory, eryngo, fennel and high mallow is their daily consumption until the symptoms are relieved. A daily consumption not exceeding a certain period of time (usually ranging from few days up to two weeks) is noticed for high mallow and fennel. Wild thyme is mostly consumed as needed.

High mallow and wild thyme are the only two plants mentioned to have side-effects due to over-consumption. Three informants stated a hypotensive effect of thyme. In rat models, Aftab *et al.* reported a dose-dependent hypotensive and a cardio-relaxant property of thymol, isolated from a herb that was traditionally used for its blood-pressure-reducing effects<sup>(30)</sup>. As for high mallow, three respondents mentioned diarrhoeal effects and five pointed out that it caused anaemia. The plant's leaves

contain a mucilage responsible for its anti-inflammatory properties<sup>(31)</sup>. Mucilage has been also shown to induce an increased bowel movement in rat models<sup>(32)</sup>. A similar question investigated groups of people who should avoid use of the plant. The purpose of this question, asked at a later stage, was to stimulate the memory of the participant for similar information that might have been forgotten or missed in the previous question. Three informants said that wild thyme should be avoided by people suffering gastrointestinal disturbances. In fact, thymol, which is a major compound of thyme's essential oil, is known to 'irritate the gastric mucosa'<sup>(28)</sup>. Four informants mentioned that high mallow should be avoided by anaemic patients. To our knowledge, there are no scientific reports referring to the anaemia-causing effects of high mallow or other *Malva* species. Further investigation into this aspect would help shed light on the plant's toxicity level.

The plants are used by all age groups, with high mallow and wild thyme being employed more than the others for infants. They are also used by both men and women, with no differences in administration of the plant depending on gender.

Informants' knowledge is mainly inherited from their parents and ancestors. Some developed their understanding by personally experimenting with the plants, and knowing about ancient traditional medicine from personal reading about Arabic herbal medicine and the medicine of the Prophet. One informant mentioned getting his knowledge about plants from Bedouins passing through the village.

Table 2 summarizes the perceived health and medicinal properties of the six WEP. This table mainly includes answers to the question: 'What are the health/medicinal effects of this plant? Please specify'. Another question, 'Does any specific category of patients require this plant?', intended to revive the memory of participants as to who might benefit from the therapeutic effects of the plant. The results are discussed below.

#### *Chicory*

Previously, traditional reports have described chicory as having antipyretic, anti-colic, hypoglycaemic and hepatic properties<sup>(17,27,33,34)</sup>. In Lebanon, chicory is commonly known as 'Hindbeh', and is renowned for its digestive properties as a laxative and its blood properties in terms of treating anaemia. As for its effects on the blood, chicory is mainly reported to 'treat anaemia' and to 'strengthen blood', which we believe also implies 'treating anaemia'. In fact, five of the informants who had mentioned that it strengthens the blood specified later on during the interview that it treats anaemia. Looking at its nutritional profile, chicory stands out as a rich source of folate, containing 110 mg of folate per half cup of chopped raw chicory<sup>(35)</sup>. Therefore, an increased consumption of chicory might explain its reported properties in cases of folate-deficiency related anaemia in the community.

As for reports on its digestive properties, chicory is described to be bitter in taste and bitter plants have been used to treat digestive tract disturbances among various traditional communities<sup>(36)</sup>, relieving gastrointestinal pains<sup>(37)</sup>. Several sesquiterpene lactones found in chicory confer the bitter taste to the plant<sup>(27)</sup>. The laxative effect of chicory can be explained by its high content of dietary fibre, having 3.6 g of dietary fibre per half cup of chopped raw chicory<sup>(35)</sup>. Moreover, inulin, an indigestible carbohydrate, is found to some extent in the stalk of the plant<sup>(38)</sup>. Inulin, like other dietary fibres, increases bowel movement<sup>(39)</sup> and is thus responsible for the laxative and digestive-stimulant properties referred to by informants in the current study. Other reports of hepato-protective activity<sup>(40,41)</sup> and hypoglycaemic effects<sup>(41–43)</sup> of chicory are well supported by previous scientific literature. Particularly, Salvatore and colleagues<sup>(44)</sup> highlighted the total antioxidant capacity of *C. intybus*, analysed after being traditionally prepared for edible purposes by boiling, suggesting that chicory's abundant  $\beta$ -carotene and phenolic acids may confer health-protective properties to the plant.

#### Fennel

In other different traditions, fennel is known for its laxative properties. It is also used as a muscle relaxant as well as to treat urinary disorders<sup>(17,34,45)</sup>. In Lebanon, fennel, known as 'Shumar', is used for its therapeutic effects on the gastrointestinal system as a pain reliever as well as for its diuretic properties. Experimental as well as human studies demonstrated that fennel oil had anti-spasmodic and relaxing effects on smooth muscles<sup>(46–48)</sup>. This activity is due to the similarity found between anethole, the major component in fennel oil, and the neurotransmitter dopamine<sup>(48)</sup>. In animal studies, fennel was proved to have significant diuretic effects<sup>(49)</sup>, which explains our informants' narratives.

#### High mallow

A review of the literature revealed that high mallow has been traditionally used as a laxative and an anti-inflammatory agent<sup>(17,34)</sup>. Known as 'Khebayzeh' to our informants, the majority agreed on high mallow's anti-inflammatory properties. Gonda *et al.* isolated a polysaccharide from mallow's leaves showing an anti-complement activity, thus modulating the inflammatory response<sup>(31)</sup>. Moreover, nutrient analysis of a different species of *Malva* eaten in Turkey highlighted the plant as an important vegetable source of Zn, necessary for a healthy immune system<sup>(11)</sup>. As previously recounted, the laxative effects of high mallow could be attributed to its high mucilage content. Another species of *Malva*, used in traditional medicine as a laxative, contains polysaccharide moieties<sup>(50)</sup> similar to those found in *M. sylvestris*.

#### Wild thyme

There are no previous reports regarding the traditional medicinal uses of *T. syriacus*. However, reports of other

species in the same genus, such as *Thymus bovie* and *Thymus capitatus*, highlight the traditional therapeutic uses of thyme. For instance, *T. bovie* was reported to facilitate digestion, while *T. capitatus* was known for its relief of respiratory distress and urinary infections, its stimulation of gastric function<sup>(17)</sup> and its utilization as a cardiac and anti-tussive agent<sup>(16)</sup>.

Commonly known as 'Zaatar' in the Lebanese dialect, the main health patterns characterizing *T. syriacus* were its beneficial effects regarding gastrointestinal disturbances and its anti-poisonous properties. Previous literature has acknowledged the bactericidal properties of *Thymus vulgaris*<sup>(51)</sup>, mainly due to its content of two active ingredients – thymol and carvacrol<sup>(52)</sup> – which have demonstrated high bacterial growth inhibition<sup>(53)</sup>. These compounds are also two of the main components of *T. syriacus* essential oil<sup>(29)</sup>. This property of thyme might help in treating mild food poisoning and relieving its symptoms. Remarks regarding the disinfectant properties of thyme (eight out of twenty-eight informants), with four out of eight respondents specifying that it kills germs and microbes, further rationalize this salient pattern.

As for thyme's therapeutic effects regarding the respiratory tract, informants' accounts correlate with previously reported activities of *Thymus* species, namely *vulgaris* and *serpyllum*, to be effective in clearing respiratory phlegm and relieving coughs<sup>(51)</sup>.

#### Eryngo

Previous traditional reports stressed the use of eryngo as an antidote for scorpion poison, as well as for its hypoglycaemic effects<sup>(17,34)</sup>. Commonly known in Lebanon as 'Qors Anneh', eryngo had varied, less pronounced, health properties. Accounts of its hypoglycaemic effects are actually supported by animal studies. Extracts of the aerial parts of *E. creticum* confirmed their hypoglycaemic effect in rat models<sup>(54)</sup>. Similarly, reports regarding its anti-poisonous property have been previously tested. In fact, the leaf extract from *E. creticum* possessed potent antidote activity<sup>(55)</sup>. As for claims on its blood properties, further analysis of this plant might clarify this effect.

#### Akkoub

Traditionally, *G. tournefortii* is known for its hypoglycaemic, laxative properties<sup>(17,34,56,57)</sup>. Commonly known as 'Akkoub', *G. tournefortii* was reported mainly as a nutritious food by our informants. Nutrient analysis per 100 g of raw Akkoub highlighted its abundance in Ca (642 mg) and Fe (2.79 mg)<sup>(11)</sup>.

### Conclusion and future prospects

By comparison with previous scientific literature, the present results either add to the previous body of knowledge or report new findings that it is hoped will set the stage for further experimental investigations into

these plants' properties and highlight them as sources for widespread use and development. The investigated plants are renowned for their edible uses among informants in north-eastern Lebanese communities. Each plant has health and medicinal properties that add to its value for the participants and these properties are supported by scientific evidence. The plant parts used for food or for health and medicinal benefits are mostly the same, and the consumption of the plants in both cases follows a similar pattern. Thus the therapeutic effects of the plants can be derived from normal consumption as food. The fact that the field work was conducted in the summer instead of the spring season is a limitation to our study. Had it been in the spring, we would have been able to measure the quantities reported by the informants, since the plants were available in the wild and the informants were willing to go with us to the field.

Nevertheless, our findings highlight the importance of these six species of WEP for local diet and health, and support efforts for promoting the conservation and use of these specific plants, and WEP in general, within rural communities.

Another crucial finding of our study is that traditional knowledge within these communities is vanishing. When asked about persons knowledgeable in plants and their properties, inhabitants of the villages said that such informants had either died without transmitting their knowledge to their children, or that this topic does not interest people anymore and thus the knowledge is becoming scarce and forgotten with time.

Therefore, there is an urgent need to conserve this knowledge, record it and disseminate it within the communities.

The current project serves as a preliminary study in only one region of Lebanon. Rich ethnobotanical knowledge in a diversified, albeit small, country such as Lebanon warrants future in-depth ethnobotanical research in various communities. Similar studies in other Lebanese rural communities are encouraged to capture the diversity of the local knowledge within and between different communities. Focus groups with various community members would also help in identifying plants that are valuable to the communities and that serve as potential resources for future investigations.

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