



Article

Ethnobotany of the Useful Native Species in Linares, Nuevo León, México

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Abstract: In Linares, Nuevo León, Mexico, there is no record of the total number of species or the uses that people make of native plants. The purpose of this study was to know the species and their uses in the municipality of Linares, Nuevo León, Mexico. Based on 180 semi-structured interviews, collection, identification, and storage of botanical specimens, the regional ethnobotanical knowledge was assessed. The ethnobotanical information and significant use of plants in Linares was studied. To identify the cultural importance of the ethnobotanical uses of the plants, three indices were calculated: the Use Value Index (UVI), the Informant Consensus Factor (ICF), and the Fidelity Level (FL). We recorded 59 plant families, 151 genera, and 152 species. The families with the largest number of genera and species with uses registered are Asteraceae, Fabaceae, Cactaceae, Araceae, and Euphorbiaceae. The most common uses recorded are ornamental, medicinal, food, and forage. The highest values for ICF were for the circulatory, endocrine, and digestive systems. At least 20 species had 100% FL index values. The species with the highest UVI values were *Equisetum laevigatum*, *Persea ameriana*, *Amaranthus palmeri*, *Lophophora williamsii*, and *Artemisia ludoviciana*. A wide use of native flora is recognized in Linares, Nuevo León, which directly influences the livelihood of people in the area.

Keywords: northeastern Mexico; semi-arid lands; traditional knowledge; cosmetics; food; forage; medicinal; ornamental; timber

1. Introduction

Traditional uses and natural resource management practices are rooted in Mexican cultures, and their permanence is directly related to their usefulness and efficiency. This is the case, for instance, of the milpa system, a polyculture that combines crops such as chili, squash, beans, and other foods, and involves multiple activities [1]. The milpa is a valuable biocultural heritage practiced by familiar groups, mostly on small surfaces, with raw technological methods, and is primarily intended for self-consumption [2]. Urban and rural gardens (both home gardens and forest gardens) used for the cultivation of vegetables, fruits, roots, leaves, medicinal, or aromatic species [3] are also valuable biocultural systems. They provide food, medicine, and other products, as well as areas of relaxation, recreation, and harmony with nature, where medicinal plants with healing properties grow [4,5]

together with ornamental plants which contribute to the aesthetic quality, recreation, social cohesion, and tranquility among other aspects [6,7]. The heterogeneity in the physiography is strongly related to the climatic heterogeneity and biological diversity, a pattern that is clear in Mexico since this country has one of the most heterogeneous reliefs on the planet [8] and is one of the four countries that host the highest diversity of vascular plants, sheltering around 23,320 species [9]. Such extraordinary diversity of plants has been used by human populations that conform one of the richest areas in culture [10,11] and biocultural diversity on earth [12].

An outstanding element of cultures is the form they use to manage natural resources. In the northeast of Mexico, the forms of use of these resources are rich and diverse, since the diversity of soils, climates, and relief allow the occurrence of multiple ecosystems [13,14]. However, the traditional use of the regional flora for medicinal, food, fuel, ornamental, forage, timber, and fiber purposes has been outstanding [15–17]. Despite the rich plant diversity of northeastern Mexico, there are relatively few studies related to its traditional uses. Some studies in the Cumbres de Monterrey National Park [13], the southern central [15], and the northern regions [15] of the state of Nuevo León, as well as the Valley of Cuatrociénegas in the state of Coahuila [17], reveal rich and valuable ethnobotanical knowledge. However, given the increasing impact on ecosystems and loss of species and cultures, it is of great importance to document this knowledge of the regional flora and to enhance its importance as part of the regional cultural identity. The objective of this work is to know the use of native plant species and, through the application of ethnobotanical indices, to know which are the main medicinal species and the importance they represent for the inhabitants of Linares, located in the low semi-arid plains of the state of Nuevo León where ethnobotanical studies have never been carried out.

2. Materials and Methods

2.1. Study Area

The municipality of Linares is in the central region of the state of Nuevo Leon (Figure 1). It is in the Northern Coastal Plain of the Gulf of Mexico, in an extensive lowland plateau at an elevation of 330 m.

The entire flat surface of the municipality of Linares is covered by the vegetation type called Tamaulipas Thorn Scrub [18]. This plant community is made up of shrubs and low trees, both unarmed and thorny, with a predominance of the latter, where *Vachellia*, *Senegalia*, *Havardia*, *Helietta*, *Diospyros*, *Forestiera*, *Eysenhardtia*, and *Fraxinus* species stand out (Arboles y arbustos de Nuevo León). The main productive sector is agriculture, where growing citrus fruits (orange, lemon, and tangerine) stands out. Livestock is managed on a smaller scale, highlighting the larger livestock such as cows, donkeys, and horses, and small livestock such as goats and sheep. Among the main industries are the manufacture of metal bodies, construction materials, an iron and steel foundry, cable assembly, clothing manufacturing, salad fruit production, candy processing, wooden furniture factories, pre-prepared food production, but also the manufacture of plastic containers and air ducts and traditional sweets and fruits.

2.2. Field Work Interviews

Interviews with the inhabitants of the area were conducted according to three phases: Firstly, a bibliographic search was conducted from February to August 2021 to review the inventory of plant resources in the study area, mainly based on the Flora of Nuevo León [19]. In the second phase, we visited the areas around Linares to recognize the main plant communities and collect plant specimens of the native flora. To collect the botanical samples, we asked permission from the local authorities and private landowners. From June to December 2021, eleven data collection events were carried out. All species recorded were photographed to create an ethnobotanical database containing all information gathered. The identification of the plant species was carried out through specific monographs for families and genera distributed in this area. On some occasions, we were accompanied

on field trips by local people who helped to identify species in situ. The collected and identified voucher specimens were stored at the CFNL herbarium [20] of the Faculty of Forest Sciences, at the Autonomous University of Nuevo León, under the Eduardo Estrada (EE) collection numbers. The third phase consisted of selecting the sampling areas to carry out the field surveys with the local inhabitants.

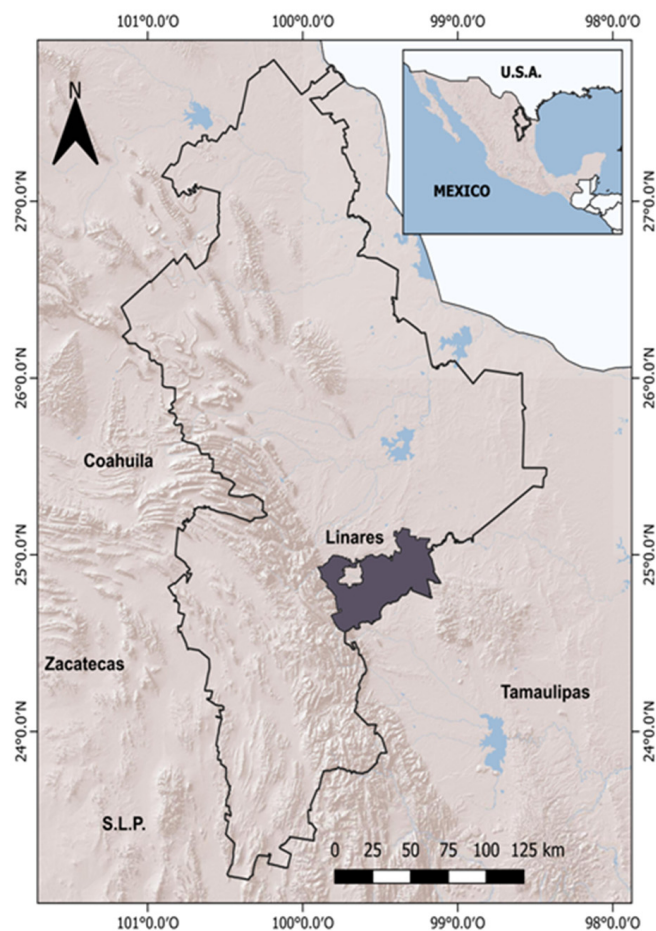


Figure 1. Location of the state of Nuevo León and the municipality of Linares.

2.3. Interviews

Based on ethnobotanical studies previously carried out in the state of Nuevo León and Coahuila [13–15,17], we conducted random interviews (except for a quarantining woman who previously informed us by the residents that she had extensive knowledge of the use of plants). Among the people interviewed, the main occupations they were engaged in included being housewives, pastors, primary school teachers, small businessmen, retirees, and bricklayers and all of them were older than 24 years, with the ages of the interviewees ranging from 25 to 81 years. Each interviewee had lived in the area for at least 20 years. To maximize data collection and allow interviewees to speak freely, we conducted semi-structured interviews [21]. The total number of randomly selected adult interviewees was 180 (114 women and 66 men). The number of individuals interviewed was defined according to the “Law of Diminishing Returns” [21]. All records were made in written form and included the following items: (a) plant name?, they were asked if they know the common name of the plant they use, (b) use?, what type of use they give to the plant (medicinal, ornamental, food, timber, fodder, craft, etc.), (c) plant part used? if they use a part (root, stem, leaves, inflorescences, flowers, seeds, etc.) of the plant for a certain purpose, and (d) how to prepare it, the way of preparing the plants or their parts for use (raw, cooked, boiled, ground, toasted, etc.); all the plants mentioned by each interviewee were registered

in a list with all the known species and their uses [14]. The interviews were conducted with the prior informed consent of each of the informants (International Society of Ethnobiology 2006; <http://ethnobiology.net/codeofethics/> accessed on 15 June 2022) [22]. When it was possible, during the interviews we showed pictures of the regional plant species to confirm the species identification by local people (ethnographic technique of visual stimuli) [23]. All interviews were recorded in Spanish. The useful species listed during the interviews were consulted in the literature to investigate their uses in other areas.

2.4. Data Analysis and Use Significance for Medicinal Species

In order to evaluate the ethnobotanical use of medicinal plants for people of Linares, we used three indexes to analyze the information gathered: (a) Fidelity Level (FL) [24,25], which is calculated as $FL(\%) = Ip/Iu (100)$, where Ip = the number of informants who independently indicated the use of a plant for the same particular illness and Iu = the number of informants who mentioned the species for any illness within a use category; (b) the Informant Consensus Factor (ICF) [17], is calculated as $ICF = nur - nt/nur - 1$, where nur = the number of uses mentioned and nt = the number of species used in each category (plants that are effective in treating certain diseases will have higher ICF values); and (c) Use Value Index (UVI) [17], which is calculated as $UVI = \sum Ui/n$, where Ui = the number of uses mentioned by each informant for a given species and n = the total number of informants.

3. Results and Discussion

3.1. Plant Species Diversity with Ethnobotanical Use

After having carried out 180 interviews and having recorded 152 plant species, the information gained was less than 15%, so it was decided to stop the interviews. We recorded, collected, and stored in the herbarium CFNL 152 species included within 131 genera and 59 families of vascular plants (Supplementary Material, and Table 1). The herbaceous species totaled 62, followed by trees (30 species), shrubs (29 species), succulents (26 species), and vines (5 species). Asteraceae, Fabaceae, Cactaceae, Araceae, and Euphorbiaceae are the families with the largest number of genera and species (Figure 2), accounting for 23% and 25% of the genera and species recorded, respectively. Fifteen plant families accounted for half (51.3% and 51.4%, respectively) of the genera and species recorded.

Table 1. Number of families, genera, and species of the different taxa with ethnobotanical use in Linares.

Taxa	Dicots.	Monocots.	Conifers	Gymnosperms and Pteridophytes	Total
Species	131	13	5	3	152
Genera	109	16	3	3	131
Families	46	7	3	3	59

These families as well as their genera and species have also been reported in ethnobotanical studies in the northeast, northwest, southwest, and southeast of Mexico [26–29]. The first three families stand out in importance due to two factors: they are among the most diverse in genera and species and because of the uses that many of their species provide to the population. Mexico is a mega-diverse country, where its rich and varied flora stands out (21,841 species), and it is the fifth greatest country in terms of diversity of flowering plants after Brazil (56,000), Colombia (35,000), China (27,000), and South Africa (23,400) [30].

The most common uses recorded in the interviews are ornamental (92 species), medicinal (49 species), food (43 species), and timber (22 species) (Figure 3).

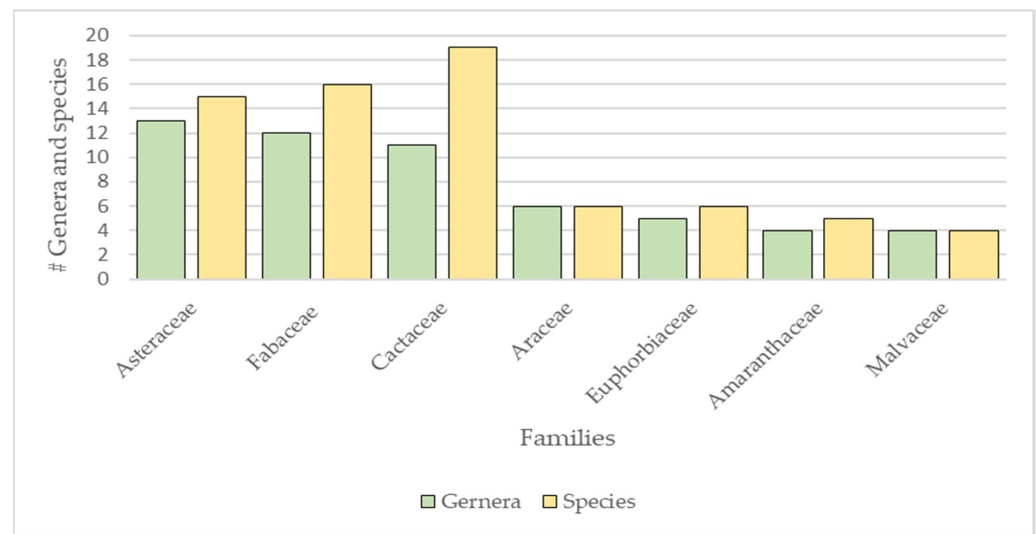


Figure 2. Families of plants with the greatest number of genera and species with ethnobotanical use in Linares, Nuevo León, México.

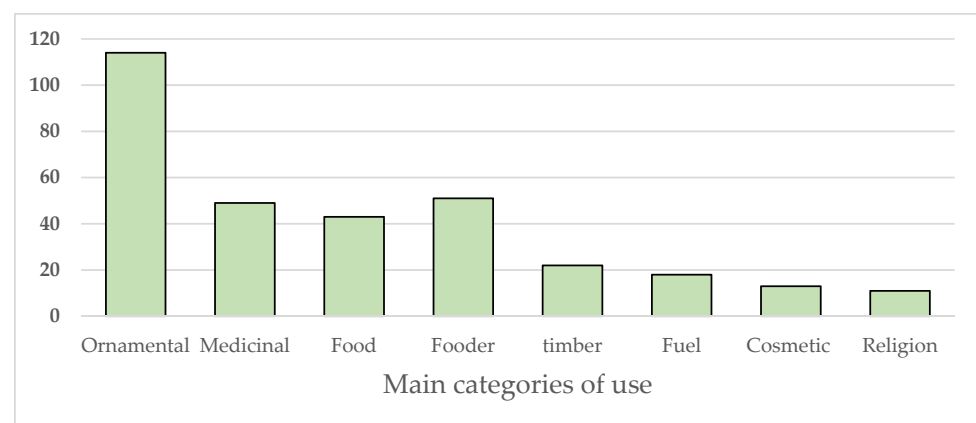


Figure 3. Main uses with ethnobotanical information registered in Linares, Nuevo León, Mexico.

3.1.1. Ornamental

The most common ornamental species are herbaceous (37), followed by trees (27), shrubs (23), succulent stems (23), and vines (4). The genus with the largest number of species used for ornamental purposes in Linares is *Mammillaria* (with seven species), followed by five genera, each with two species, *Echinocereus*, *Fraxinus*, *Pinus*, *Quercus*, and *Tradescantia*. *Mammillaria* stand out in importance due to two factors: it is the most diverse of the genera and its species are considered so charismatic by the inhabitants due to the showiness of its succulent stems and its flowers. Several studies in Mexico show the importance of ornamental species in ethnobotanical studies [31–34]. Ornamental plant species are mainly used to decorate gardens, are used in landscape design in squares, parks, streets, and sidewalks, as well as being used as indoor plants [31]. The ornamental plants, in addition to providing beauty, decoration, and aroma, fulfill other objectives such as medicinal, edible, forage, shade, and rest spaces [35]. The shape of the plant and its size have a strong influence on its selection to be used as an ornamental species, but also, as a secondary use or even as multifunctional species such as food, medicinal, forage, wood, and fuel. Herbaceous plants are by far the most used ornamental species in Linares, Nuevo León, and according to the interviews, people prefer them because of their small size, since they can have several in a small space, the variety of shapes and sizes, and the color of their leaves and flowers. According to the frequency of mentions by the interviewees, the eight most mentioned species, including (Figure 4) species of arboreal

size, are *Fraxinus americana* L. (shade), *Ehretia anacua* Terán and Berland (shade), *Carica papaya* L. (shade), *Caesalpinia mexicana* A. Gray (beauty and shade), *Bauhinia purpurea* L. (shade and beauty), *Caesalpinia pulcherrima* (L.) Sw. (shade and beauty), *Quercus virginiana* Mill. (shade), *Carya illinoensis* (Wangenh.) K.Koch (shade), *Ebenopsis ebano* (Berland.) Barneby and J.W.Grimes (shade and beauty), and *Parkinsonia aculeata* L.(shade and aesthetic). Many of them, in addition to being grown on private properties, are part of the urban landscape on the sidewalks of houses, parks, and public gardens. It was found that despite the fact that Linares and neighboring municipalities are home to a diversity of 245 native species of trees and shrubs [36], few native shrubs are used as ornamental species. Among the most mentioned are *Acanthocereus tetragonus* (L.) Hummelinck, *Agave americana* L., *Amyris madrensis* S. Watson, *A. texana* (Buckley) P.Wilson, *Cordia boissieri* A. DC., *Euphorbia pulcherrima* Willd ex Klotzsch, *Hibiscus poeppigii* (Spreng.) Garcke, *Opuntia ficus-indica* (L.) Mill., *Rhus virens* Lindh. ex A. Gray, *Leucophyllum frutescens* (Berland.) I.M. Johnst., and *Sophora secundiflora* (Ortega) DC. This small number of native shrub species used as ornamentals may be because they are slow growing, have small leaves and flowers, have thorns, and, in general, they have few morphological characteristics that are attractive to residents who prefer exotic, fast growing shrubs with denser foliage, and larger, more showy flowers. *Amyris madrensis*, *A. texana*, *Cordia boissieri*, *Euphorbia pulcherrima*, *Hibiscus poeppigii*, *Rhus virens*, *Leucophyllum frutescens*, and *Sophora secundiflora* stand out for being unarmed species, with bracts or showy flowers and are relatively easy to handle in gardens, which is why they are the native species that most people prefer to grow as ornamentals.

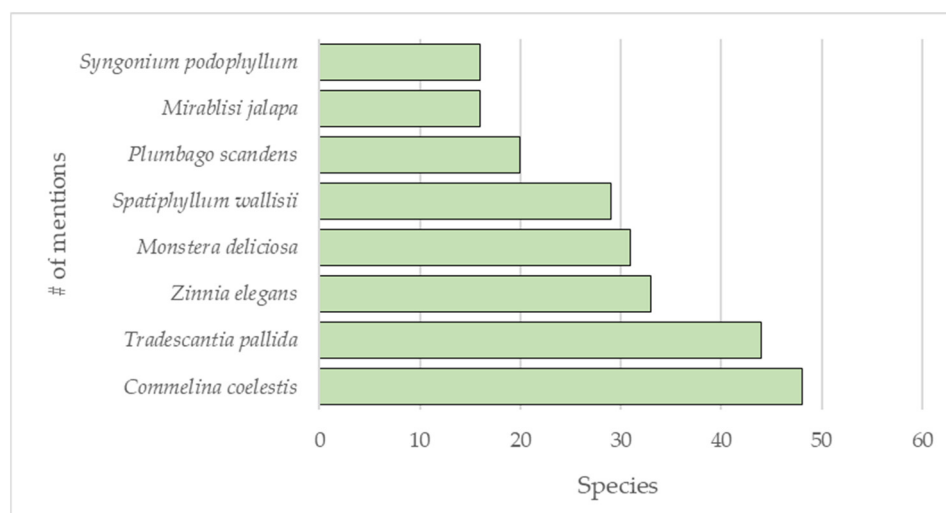


Figure 4. Ornamental species with the highest frequency of mentions in Linares, Nuevo León, México.

3.1.2. Medicinal

Medicinal species are the second most important use type, accounting for 49 species; from these, the herbaceous plants are the most frequently used (21 species), followed by shrubs (10), trees (7), and fleshy stems (5). Medicinal herbaceous species are quite popular in the gardens of Linares due to their compact size and easy handling, and a greater diversity of medicinal species can be cultivated in a small area. Studies in southern Mexico show a rich diversity of native species used in traditional medicine [37–42], with not only the similarity of species between regions and cultures but also the flow of information that this entails, which allows the receiving cultures to seize this new knowledge and incorporate it for their own use and benefit. Medicinal plants, together with ornamental species, have turned out to be among the most frequently used in traditional medicine registered in the states of Nuevo León [13–16] and Coahuila [17]. This pattern is also similar in other areas of central and southern Mexico, where medicinal species have been extensively studied [43–48]. The parts most frequently used in descending order are leaves (including branches), stems (including bulbs), fruits, roots, seeds, and bark (Figure 5a).

In several species, two or more parts of the same plant are sometimes used. People mix species of medicinal plants for various reasons; among which, the most notable reasons are to reinforce the healing effect with both plants, to give a pleasant flavor to the drink, and to cure more than one disease. In many ethnobotanical studies in Mexico, people have shown a preference for using leaves to alleviate many ills and diseases; it is not uncommon, because these parts are the most apparent of the plants in most of the different seasons of the year. They are easy to observe, obtain, and use directly or be dried for later use [45–48]. The main application methods of medicinal species in Linares in descending order are boiled, raw, scorched, smeared, and cooked (Figure 5b). In Linares, as in other municipalities of the state of Nuevo Leon [23–26], the method of boiling the parts of medicinal plants is the most frequently used. The method of boiling plants to cure diseases is one of the simplest methods to prepare healing drinks, mainly teas, where the heat extracts the compound from the plant and mixes it with water, and it only involves drinking the mixture. The same method is also used in areas such as Cuatrociénegas, Coahuila [17], and some other states of Mexico [43–48] and are also used by cultures as part of their traditional knowledge in the south of Mexico [43,46–48].

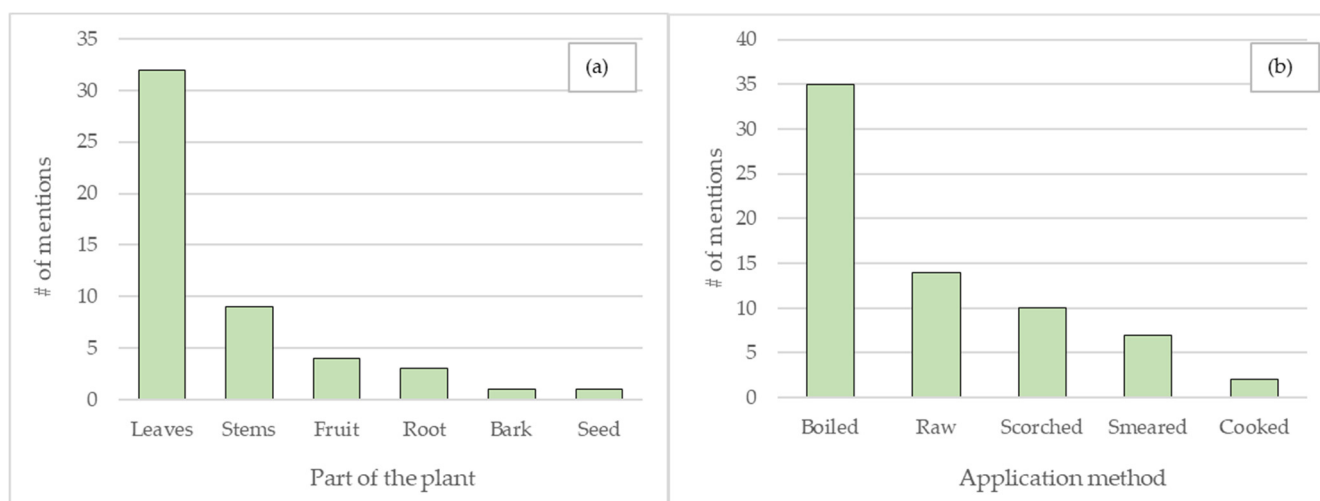


Figure 5. The main plant parts of medicinal species with ethnobotanical interest registered in Linares according to the interviews (a) and the main application method of medicinal plants with ethnobotanical interest in Linares according to the interviews (b).

According to the interviewees, the most important plant families with medicinal use are Asteraceae (5 genera and 5 species), Cactaceae (4 and 4), Lamiaceae (2 and 3), and Fabaceae (2 and 2). The Asteraceae stand out in medicinal use for being the family with the greatest diversity of plants in northeastern Mexico. Many of the species have aromatic glands or resin with a pleasant odor, and this property makes their medicinal use extensive for these purposes in Linares. Some of the respondents mentioned that they use these plants due to tradition, and they attribute healing properties to them due to the fragrance these plants produce. This attribute is sometimes related to the aromatic glands these plants have, and whose oils are released when boiled. This is especially the case of some species of the genera Asteraceae, such as *Matricaria chamomilla*, *Flourensia cernua*, *Tagetes erecta*, and *T. lucida*, all the Lamiaceae, and most of the Apiaceae. The last of the five families mentioned are frequently mentioned in several ethnobotanical studies in Mexico [37,38,40–47], since these are families with a wide distribution and abundant genera and species. The other two families used as medicine are Rutaceae and Myrtaceae. Ten species of medicinal plants had more than 80 mentions, indicating the importance of curing or healing different diseases (Figure 6).

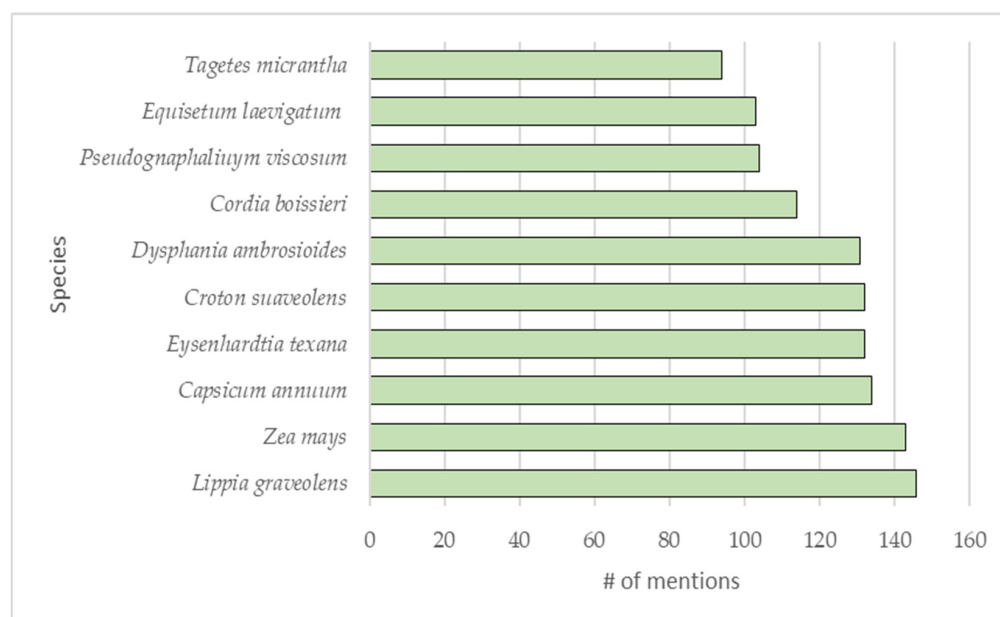


Figure 6. Medicinal species with the highest frequency of mentions in Linares, Nuevo León, México.

Lippia graveolens Kunth is one of the species most used to alleviate respiratory ailments, which is one of the top four ailments reported as being treated. *Capsicum annuum* L. is used to remove phlegm. *Eysenhardtia texana* Scheele is recognized as an excellent remedy against kidney diseases. *Croton suaveolens* Torr. is rooted in the popular knowledge of the people in nuevo León [13–16], and according to the interviewees it is a plant that heals the circulatory system, is used for avoiding many diseases, and it is given to children who are lactose intolerant. *Dysphania ambrosioides* (L.) Mosyakin and Clemants (leaves) and *Zea mays* L. (styles), cultivated in home gardens, are used as an antihelminthic. *Cordia boisseiri* is used to eliminate stomach pains and reduce inflammation. *Pseudognaphalium viscosum* (Kunth) Anderb. is an excellent remedy to relieve coughs and chest pains. *Tagetes lucida* Cav. (Yerbaniz) is widely used as a tea, which is an excellent remedy for issues with the digestive system. *Equisetum laevigatum* A. Braun is one of the most used species to alleviate kidney problems. The main types of disease mentioned were for the circulatory, endocrine, digestive, respiratory, and musculoskeletal systems (Table 2).

Table 2. Types of diseases mentioned by informants from Linares, Nuevo León, Mexico. There were variations in the frequencies of mention of the categories (nt); therefore, differences were recorded in the values in the Informant Consensus Factor (ICF) index; nur = number of uses mentioned.

Medical System	Number of Species Mentioned (nt)	nur	ICF
Digestive (XI)	47	356	0.87
Endocrine (IV)	23	271	0.88
Circulatory (IX)	21	241	0.92
Respiratory (X)	18	31	0.43
Skin and subcutaneous (X)	18	47	0.63
Nervous (VI)	7	19	0.67
Musculoskeletal (XIII)	3	8	0.71
Infectious (I)	6	17	0.69
Genitourinary (XIV)	11	29	0.64

These four categories are similar, although in a different order of importance, in other municipalities of Nuevo León and Coahuila [16–18]. The nine categories of use are essentially cured with leaves of herbaceous plants through infusions. Thirty-two species are used in this way to treat ill. A second method of using medicinal plants is using all

parts of the plants, including stems and branches (*Eysenhardtia texana* and *Purshia plicata* (D. Don.) Henr.), and fruits (*Hylocereus undatus* (Haw.) Britton and Rose, *Carica papaya* L., and *Capsicum* spp.).

3.1.3. Food

This study recorded 43 species that were used as food. The most common plant parts used are fruits (19 species), flowers (6), seeds (5), leaves (4), and roots (1). In some plants two or more parts are used for different food uses (including spices). Among the main families with the largest number of genera and species, respectively, used as food in Linares are Fabaceae (5 and 5), Cactaceae (4 and 4), Amaranthaceae (2 and 2), and four families with 1 genus and two species (Asparagaceae, Juglandaceae, Lamiaceae, and Lauraceae). The Fabaceae family stands out in Linares in almost all important aspects of useful of plants, with several species of trees and herbaceous plants standing out for their use as food, such as *Ebenopsis ebano* (seeds), *Leucaena leucocephala* (immature stems), *L. pulverulenta* (immature fruits), *Pachyrrhizus erosus* (root), and *Phaseolus vulgaris* (seeds); the genera with the largest number of species most commonly used as food are *Yucca*, *Carya*, and *Hedeoma*, each with two species. It is believed that Mexico has at least 2051 species with food use [49]. These species are an important part of the cultural traditions and subsistence of ancient and current cultures [50] in the south of Mexico. Quelites are edible plants that provide leaves, young stems, branches, and flower buds as food. These are a rich source of vitamins, minerals, and fiber for the people's diet [51]. Edible fruits, especially the fleshy ones, are cultivated in orchards, but are also abundantly distributed in all the plant communities in Mexico, where they are consumed raw and directly or through some transformation process [52–54]. At least 762 species with edible fruits are recognized for Mexico [48]. In Linares the edible fruits of several wild species are commonly consumed; for example, *Opuntia ficus-indica* (raw fruits), *Celtis pallida* (raw or as jam), *Ebenopsis ebano* (immature fruits called mahuacatas), *Sideroxylon celastrinum* (Kunth) T.D.Penn. which, in the opinion of the interviewees, is one of the most delicious regional seasonal wild fruits, *Yucca filifera* Chabaud (called palma china, the fruits are called dátiles; are eaten raw), and the fruits of *Hylocereus undatus* (called fruto del dragón or pitaya), the young pods of *Leucaena leucocephala* (Lam.) de Wit (called dormilón) are boiled and prepared in salads or mixed with vegetables, the fruits of *Prosopis laevis* (Willd.) M.C. Johnst. are widely used raw, and the fruits of *Casimiroa pringlei* (S. Watson) Engl. (called manguito for its resemblance to mango, but of smaller size). Eight varieties of chili are used in Linares (morrón, jalapeño, japonés, serrano, de arbol, chilaca, poblano, and piquín), but piquín is the only wild chili (*Capsicum annum* var. *glabriusculum*). This last one is widely collected for personal consumption or sale, with its price ranging between MXN 250 and 300 (USD 12.0–15.0) per kilogram, most of these species has been reported for the municipalities adjacent to, or nearby, Linares [13–16]. Fruits of the cultivated species are by far the most consumed and marketed. Several ethnobotanical studies in northern and southern Mexico have shown the importance and uses of these families [13–16].

3.1.4. Forage

Nearly 18% of the plants recorded (27 species) are used as forage for domestic cattle; mainly goats, horses, and cows. The most common plants used as forage are herbaceous (10 species) since they are the most diversified in the Linares region and it is easy to obtain them from abandoned cultivated areas, which are rich in fast-growing herbaceous species that available almost all year round. These are followed by trees (9 species), shrubs (5 species), and succulent plants (3 species). The families with the largest number of genera and species, respectively, used as forage are Fabaceae (5 and 6), Cactaceae (3 and 4), Amaranthaceae (2 and 3); Poaceae (2 and 2), and Fagaceae (1 and 4). The most important genera in terms of the number of species used are *Quercus* (4 species; its acorns are widely used as seasonal fodder for livestock, especially pigs), and *Amaranthus*, *Opuntia*, *Cucurbita*, *Leucaena*, and *Vachellia*; each of which have two species. Different parts of herbs, shrubs, and

trees, mostly leaves, edible twigs, and fruits, are used as supplementary food for animals. Among the most common species in the area are the so-called quelites (*Amaranthus*), especially *Amaranthus palmeri*, a weedy plant found in many parts of the world [55]. This species grows in abandoned farm plots and places with disturbances, and it was one of the most mentioned species by the interviewees. This species is one of the most frequent weeds in abandoned cultivation areas in Linares, its presence is abundant in warm seasons, and it is used extensively by local ranchers.

Plants are simply cut and provided to cattle inside pens. Several herbaceous species, which generally includes sunflowers (*Helianthus annuus* L.) and several species of grasses, especially corn (*Zea mays*), are also cut, stacked, left to dry for several days, baled, and are then provided to the cattle ad libitum. A very frequent use in the Linares region is to feed the cattle with the bagasse of oranges that have been used to obtain juice. The pulp and peel of oranges is mixed with other herbaceous species and a mixture is prepared to feed cattle. *Cucurbita pepo* L. is used as fodder for livestock. People grow pumpkins in their gardens and on patios, and they cut them into pieces to feed cattle. This form of use is also performed in Nayarit, Mexico [56]. Along with oranges, prickly pears (*Opuntia*) are an important source of fodder for livestock in Linares. Many households grow prickly pears in their gardens and on patios, especially *Opuntia ficus-indica*, a spineless, easily manageable prickly pear, which are cut and given directly to the cattle. This use has been reported for other municipalities in the state of Nuevo León and in the tropics and subtropics of the world [13,57–59]. Two species widely used as forage are *Vachellia farnesiana* (L.) Wight and Arn. (huizache) and *Quercus canbyi* Trel. (encino). The first one is widely distributed in Mexico [60] and forms an important part of the secondary vegetation of the state of Nuevo León and northern Mexico; *Quercus canbyi* is distributed mainly in the mountain slopes near Linares [60]. The leaves and fruits of *Vachellia farnesiana* are widely used by poor villagers to feed livestock; the leaves are cut and deposited at the base of the trees, together with the fruits that have fallen, to lure the cattle under the tree to feed them with this fodder while the cattle shelter from the sun. When fruits of oaks fall and accumulate on the ground under the canopy cover, the residents bring cattle and pigs to feed on them. It has been described as “one of the best honey plants” where it grows abundantly, especially in the more arid regions.

3.1.5. Timber

Twenty-two species of trees and three species of shrubs, belonging to twelve families are used as timber to build corrals, roofs for cabins, fences, columns to support walls, and for furniture. Three families stand out, Fabaceae, Fagaceae, and Pinaceae (Figure 7).

The wood of the *Quercus canbyi* and *Q. polymorpha* Schltdl. and Cham. is widely used by the residents of Linares, and among the main uses are construction of country houses, work tools such as hoes' handles, machetes, handsaws, chairs, rocking chairs, and beams. These uses are similar to those reported for other municipalities of Nuevo León [13–16]. Due to the diversity of shrub and tree species and their quantity in the scrublands surrounding Linares, the family Leguminosae (Fabaceae) is the most widely used family in Linares for timber use. The most abundant species are *Ebenopsis ebano*, *Eysenhardtia texana*, *Havardia pallens* (Benth.) Britton and Rose, *Parkinsonia aculeata* L., *Prosopis laevigata*, *Senegalia berlandieri* (Benth.) Britton and Rose, *Senegalia coulteri* (Benth.) Britton and Rose, *Senegalia roemeriana* (Scheele) Britton and Rose, *Vachellia farnesiana*, and *Vachellia rigidula* (Benth.) Seigler and Ebinger. According to some of the interviewees, the beauty of the grain, the hardness, and the resistance of the *Ebenopsis ebano* wood makes it an excellent medium for the manufacture of tables and chairs of great commercial value. One table and six chairs reach prices of MXN 60,000 (USD 3000); however, regardless of its great economic potential, the main current use is the production of artisanal charcoal fence posts, shade trees, and as a honey species. The most important timber species in Linares, and in almost all the lowlands (below 500 masl) of Nuevo León, are huizache (*Vachellia farnesiana*) and two species of mesquite (*Prosopis glandulosa* and *P. laevigata*). These species predominate in

the landscapes of the state, especially those subject to disturbance, and its wood is widely used for construction, charcoal, and handicrafts [60–62]. *Prosopis* wood is widely used for the same purposes in other arid lands of Mexico [63].

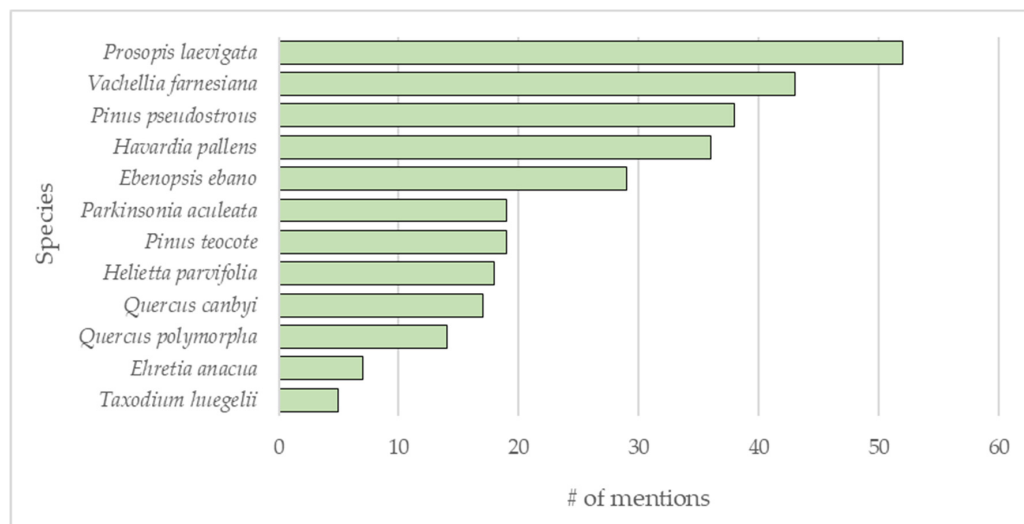


Figure 7. Timber species with the highest frequency of mentions in Linares, Nuevo León, México.

3.1.6. Firewood

Several species of shrubs and trees recorded in the lowland scrublands of the state of Nuevo León [60], are widely used as firewood, especially hardwood species, such as mesquite (*Prosopis laevigata*), oaks (*Quercus laeta* Liebm., *Q. mexicana* Bonpl., *Q. polymorpha* Schltdl. and Cham., and *Q. virginiana* Mill.), pine (*Pinus montezumae* Lamb., *P. pseudostrobus* Lindl., and *P. teocote* Schied. ex Schltdl. and Cham.), huizache (*Vachellia farnesiana*), barreta (*Helietta parvifolia* (A. Gray) Benth.), coma (*Syderoxylon lanuginosum* Michx.), brasil (*Condalia hookeri* M.C. Johnst.), walnut (*Carya illinoensis* (Wangenh.) K. Koch and *Juglans mollis* Engelm.), avocado (*Persea americana* Mill.), and ebony (*Ebenopsis ebano*) [13–16]. Although most homes in Linares have gas stoves for cooking, firewood is used daily for preparing roast meat, a tradition in northeastern Mexico. Another daily use, especially in the ejidos and ranches, is to sweep the patio, collect the garbage, add a little firewood, and burn it. In areas without gas stoves, people use firewood to cook food and heat water in wood-burning bath boilers in the winter.

3.1.7. Cosmetics

At least five families, five genera and six species, are used as cosmetics: mainly for skin and hair care. These are used as spreadable solutions or creams (for body, face, hands, feet, and hair), hair gel, natural deodorant, and body essences and tonics. The native species used for this purpose are *Capsicum annuum*, *Cissus incisa* (Nutt.) Des Moul. ex S. Watson *Ebenopsis ebano*, *Jatropha dioica*, and *Persea americana*. For *Persea americana* (fruit pulp and stone), the ground stone is mixed with the raw pulp of the fruit and is spread directly on the face to eliminate the wrinkles of aging; for *Capsicum annuum* and *C. chinense* Jacq. (fruit pulp), the fruit of both species are boiled in water and the solution is applied directly to the hair to give it shine and prevent it from falling out; for *Cissus incisa*, its fruits are ground and the pulp is spread directly to remove impurities and fat and to give softness to the skin of the face; and *Ebenopsis ebano* (flowers) are mixed in alcohol and used as an aromatic essence for the skin. The branches and stems of *Jatropha dioica* Sessé are placed in water for two days, and the solution is used as a hair dye; additionally, a piece of branch or stem is chewed and the sap that is released is rubbed on the gums to strengthen them and prevent tooth loss.

3.1.8. Plants Used by Witch Doctors and Healers

Eleven species related to religious images and beliefs, respect for deceased relatives, purification of the body, protection of homes and people, healing against witchcraft, and the celebration of religious holidays were recorded. Plants are used freshly cut in most cases or dry. Among the families, the most frequently used for religious images and beliefs are *Araceae* (*Anthurium* and *Spathiphyllum*) and *Asteraceae* (*Dahlia*, *Helianthus*, and *Tagetes*). The respect for deceased relatives in Linares (and in most parts of Mexico) is manifested in many homes through small altars or a photograph of the deceased surrounded by lighted candles along with plants of these species. A national Mexican tradition is the annual visits to the pantheons, especially on the day of the dead (November 2); prayers are made, and flowers are placed on the graves. In Linares, the most common species to celebrate this day are *Tagetes erecta* (inflorescences and leaves), *Dahlia coccinea* (mainly inflorescences), *Begonia* spp. (leaves and flowers), *Spathiphyllum wallisii* (leaves, bracts, and flowers), *Helianthus annuus* (inflorescences), *Begonia* spp. (leaves and inflorescences), and *Euphorbia pulcherrima* Willd. ex Klotzsch (leaves and bracts). The most common species used to purify the body and cleanse the soul against witchcraft are *Tagetes erecta* L., *Capsicum annuum*, and *Leucophyllum frutescens* (Berland) I.M. Johnst.

3.1.9. Compost

Compost is an important source of nutrients and organic matter and, for agriculture, plays a crucial role in maintaining soil biodiversity [64]. Six families, eight genera and ten species used to make compost were registered. The main parts used are fruits (four species), leaves (two species), stems (two species), bracts (one species), and root (one species). The leaves and bracts of *Zea mays* are used together with recycled paper to mix with the fruits and give the compost a more solid texture. The mixed leaves and fruits of *Vachellia farnesiana* and *Leucaena leucocephala* mixed with the fleshy stems of *Opuntia ficus-indica* and *Acanthocereus tetragonus* are frequently part of the compost produced in Linares. According to some interviewees, when there is an excess of growth of the species with fleshy stems, especially *Opuntia*, *Acanthocereus*, and *Agave* in private gardens, these are cut and mixed with fruit bagasse, fleshy fruit peels, and grasses to form compost and use as plant fertilizer.

3.1.10. Particular Uses of Some Species

Several particular uses of some species were registered; the wood of *ebano* (*Ebenopsis ebano*) and *dormilón* (*Leucaena leucocephala*) are used regionally to make handicrafts. The branches of *Baccharis salicifolia* (Ruiz and Pav.) Pers., *Cordia boissieri*, *Ehretia anacua* (Terán and Berland.) I.M. Johnst., *Sideroxylon celsatrinum*, *Ebenopsis ebano*, *Parkinsonia aculeata*, *Eysenhardtia texana*, and *Havardia pallens* are frequently used as support for clotheslines. The raw fruits of the coyotillo or tullidora (*Karwinskia huboldtiana* (Schult.) Zucc.) are macerated and the resulting pulp is applied topically to the part of the body where splinters are buried, and the wound is covered with a bandage.

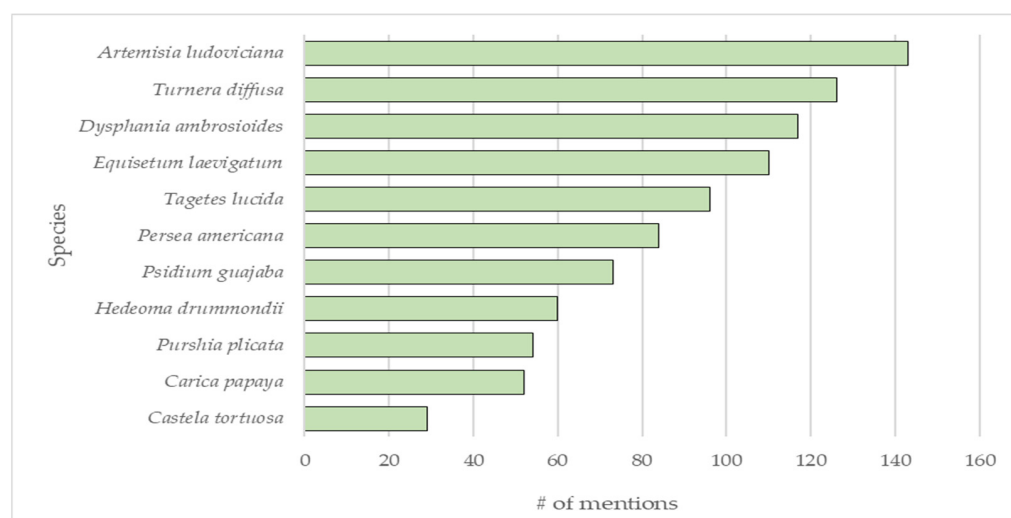
3.2. Quantitative Ethnobotanical Indices (IFC, UVI, and FL)

The Use Value Index (UVI) corresponds to the potential use of a species that can be used to alleviate, cure, or reduce certain types of ailments. Based on this, the higher the values, the greater the frequency of use of the taxa or the local relevance of each species [27] (Table 3). Regionally, these species are widely used in traditional medicine in the cure of diseases of the circulatory, digestive, and endocrine systems [13–16].

Table 3. Plant species with ethnobotanical medicinal use that obtained the highest UVI values in Linares, N.L., Mexico. “E” = Exotic, “N” = Native.

Scientific name	UVI	Origin
<i>Equisetum laevigatum</i> A. Braun	2	N
<i>Persea americana</i> Mill.	1.8	N
<i>Amaranthus palmeri</i> S. Watson	1.7	N
<i>Lophophora williamsii</i> (Lem. ex Salm-Dyck) J.M. Coult.	1.6	N
<i>Artemisia ludoviciana</i> Nutt.	1.58	N

These systems were registered as the most frequently mentioned and relate to the main health problems recognized by the World Health Organization (WHO) [65]. According to the interviewees, *Croton suaveolens*, and *Persea americana* are among the species most used to cure diseases of the circulatory system. The most common medicinal species mentioned by interviewees and used to cure diseases of the endocrin system are *Equisetum laevigatum*, *Annona muricata* L., *Opuntia ficus-indica*, and *Persea americana*. *Persea americana* has been proven to have relatively low lipid and sugar content [66], so this fruit is recommended for people with diabetes. Its natural antioxidants, flavonoids, and polyphenols have benefits such as a reduction in the risk of suffering from inflammatory diseases [67]. Most of these species are used in the form of infusions and are used to improve the efficiency of the endocrine system. The digestive system had the greatest number of mentions for medicinal species to cure related ills (Figure 8).

**Figure 8.** Species with the highest frequency of mentions to heal digestive problems in Linares, Nuevo León, Mexico.

Among these, *Artemisia ludoviciana*, *Turnera diffusa*, and *Dysphania ambrosioides*, stand out as the most frequently used as tea to cure general digestive ailments. Traditionally, *Dysphania ambrosioides* is and has been widely used in Mexican culture [14–17] as a vermifuge since this property has been chemically demonstrated by distilling its oils [68]. According to the interviewees, another species widely used in Linares to eliminate amoebas and flatworms is *Castela texana* (bisbirinda), and *Tagetes micrantha*, *Persea americana*, and *Psidium guajaba* leaves are widely used regionally [13–15] to alleviate gastric ailments. FL estimates the relative importance of each medicinal species based on the degree of consensus among informants in a use category; in this way, several medicinal species are used to cure the ills of certain systems. Table 4 shows the most important species to specifically cure the ills of that system. Nineteen species stood out with the highest FL values to cure diseases of the different systems (Table 4).

Table 4. Plant species with ethnobotanical medicinal use that obtained FL = 100% value in Linares, Nuevo León, Mexico.

Plant Species	System	Ip = Iu
<i>Croton suaveolens</i> Torr.	Circulatory system	132
<i>Piper auritum</i> Kunth	Respiratory system	49
<i>Acalypha lindheimeri</i> Müll.Arg.	Endocrine system	48
<i>Flourensia cernua</i> DC	Respiratory system	41
<i>Opuntia leptocaulis</i> (DC.) F.M.Knuth	Digestive system	17
<i>Lippia graveolens</i> Kunth	Respiratory system	146
<i>Zea mays</i> L.	Genitourinary system	143
<i>Hedeoma drummondii</i> Benth.	Digestive system	159
<i>Carica papaya</i> L.	Digestive system	51
<i>Eysenhardtia texana</i> Scheele	Genitourinary system	85
<i>Castelea erecta</i> var. <i>texana</i> (Torr. and A.Gray) Cronquist	Digestive system	14
<i>Bougainvillea glabra</i> Choisy	Respiratory system	73
<i>Cordia boissieri</i> A. DC	Respiratory system	63
<i>Larrea tridentata</i> (Sessé and Moc. Ex DC.) Coville	Genitourinary system	51
<i>Purshia plicata</i> (D.Don) Henr.	Digestive system	28
<i>Capsicum annum</i> var. <i>annuum</i>	Digestive system	26
<i>Prosopis laevigata</i> (Willd.) M.C.Johnst.	Digestive system	59
<i>Pseudognaphalium viscosum</i> Kunth	Respiratory system	32
<i>Guaiacum angustifolium</i> Engelm.	Skin and subcutaneous system	18

4. Conclusions

Linares stands out as an area where plants have a wide ethnobotanical use, and the biocultural richness of this knowledge is manifested by the wide and varied use that is given to its native plants. Of the 3175 species registered for Nuevo León, about 78% are native species, and the 152 species of registered useful native plants represent about 21%. The preponderant use of ornamental plants over other ethnobotanical uses in Linares reveals the importance that people give to these species. The great diversity of species recorded in Linares is not entirely due to the diversity of the native vegetation of the scrub surrounding Linares but is also due to the presence of other native species introduced from southern Mexico and, today, are part of the relatively recent personal heritage and culture of the inhabitants. Medicinal plants play an important role in the Linares tradition, where the use of herbaceous native species play a predominant role together with some exotic species. The presence of “yerberías” (herb shops) where plants are sold undoubtedly increases these numbers, since many people frequent these places in search of new plants for old treatments that have not been cured with native plants. In Linares, there is a rich tradition of using native plants for food, which includes everything from nuts and raw leaves to roots, stems, leaves, and fruits of exotic species. Native species from Mexico brought from other states can be synthesized, in part, as the introduction of products from other regional cultures, creating new knowledge and taking advantage of them, and increasing the biocultural richness. We show the local and cultural medicinal relevance that species have for their use, somehow satisfying the health needs of local residents. The native medicinal species are quite important for the cure of certain ills, which mainly shows that the ancestral knowledge of the effectiveness of these plants has been maintained within popular knowledge through time. Two relevant ethnobotanical uses stand out in Linares, the use of species to make compost and the use of abundant species for making cosmetic products, and partially shows that its use is becoming traditional in individuals of the population and that over time it may be part of a regional biocultural tradition. The regional tradition of Linares, the witches of La Petaca, is still maintained, although with less relevance than before. There are still brujas (healers), or the descendants of the famous iconic witches, who serve the public; however, the tradition of the “curanderas” today is hardly relevant in society and is nothing more than a product of the fame that precedes it.

The results obtained in this study, and the methodology used, allowed us to know the use of native species in the municipality of Linares and its relationship with other regions of Mexico and abroad regarding the diversity and uses of the species.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/su151511565/s1>, Table S1. Families, genera, species and their uses in Linares, Nuevo León, Mexico. In the first column, the collection number after the scientific name belongs to Eduardo Estrada.

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