Botanical Sciences 101 (1): 134-148. 2023
DOI: 10.17129/botsci.3124

Received: March 2, 2022, Accepted: June 21, 2022
On line first: November 25, 2022

Ethnobotany / Etnobotánica

Ethnobotanical culture of geophytes in Sakarya province, Turkey
Cultura etnobotánica de geófitos en la provincia de Sakarya, Turquía

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Abstract

Background: Limited number of studies have been conducted to determine the ethnobotanical uses of geophytes and to scientifically document traditional knowledge associated with them.

Questions: What is the ethnobotanical usage culture of geophytes in Sakarya province?

Studied species: Geophytes.

Study site and dates: Sakarya, Turkey; 2017 to 2020.

Methods: Information in the local community was obtained through face to face or collective interviews. In addition, cultural importance index (CII) and the informant consensus factor (ICF) values were calculated.

Results: In this study, the knowledge of the local public about 115 geophytes (107 natural and eight cultivated) belonging to 26 families was revealed. The most common families are Asparagaceae (23 taxa), Iridaceae (21 taxa) and Amaryllidaceae (14 taxa). The most common genera are *Crocus* (12 taxa), *Orchis* (7 taxa) and *Allium* (6 taxa). Out of a total of 115 taxa, 226 uses are reported, including 128 folk remedies, 47 ornamental plants, 48 food and three the other uses. The most widely used plant according to cultural importance index is *Leucojum aestivum* (Gölsoğanı, CII: 2.57).

Conclusion: Our interviews revealed that the geophytes in the study area are still widely used by people in their daily lives for medicinal, food and floricultural purposes. In addition, the ethnobotanical uses of *Crocus speciosus* subsp. *sakariensis*, *Crocus keltepensis*, *Fritillaria bithynica* and *Muscari pamiryigidii* are reported for the first time in Turkey.

Keywords: Anatolia, bulbous plants, edible plants, folk medicine, ornamental plants.

Resumen

Antecedentes: Se ha realizado un número limitado de estudios para determinar los usos etnobotánicos de las plantas geófitas para documentar científicamente el conocimiento tradicional asociado con ellas.

Preguntas: ¿Cuál es la cultura de uso etnobotánico de las geófitas en la provincia de Sakarya?

Especies estudiadas: Geófitas.

Lugar de estudio y fechas: Sakarya, Turquía; 2017 a 2020.

Métodos: La información en la comunidad local se obtuvo a través de entrevistas cara a cara o colectivas. Además, se calcularon los valores del índice de importancia cultural (IIC) y el factor de consenso del informante (FCI).

Resultados: Este estudio reveló el conocimiento del público local sobre 115 geófitas (107 naturales y ocho cultivadas) pertenecientes a 26 familias. Las familias más comunes son Asparagaceae (23 taxones), Iridaceae (21 taxones) y Amaryllidaceae (14 taxones). Los géneros más comunes son *Crocus* (12 taxones), *Orchis* (7 taxones) y *Allium* (6 taxones). De un total de 115 taxones, se reportan 226 usos, incluidos 128 remedios populares, 47 plantas ornamentales, 48 alimentos y tres otros usos. La planta más utilizada según el índice de importancia cultural es *Leucojum aestivum* (Gölsoğanı, IIC: 2,57).

Conclusión: Las entrevistas revelaron que las geófitas en el área de estudio aún son ampliamente utilizados por las personas en su vida diaria con fines medicinales, alimentarios y florícolas. Además, los usos etnobotánicos de *Crocus speciosus* subsp. *sakariensis*, *Crocus keltepensis*, *Fritillaria bithynica* y *Muscari pamiryigidii* se reportan por primera vez en Turquía.

Palabras clave: Anatolia, plantas con bulbos, plantas comestibles, medicina tradicional, plantas ornamentales.

Plant resources are an integral part of the society and have been used by different cultural groups for thousands of years to promote prosperity (Xiong *et al.* 2020). Ethnobotany is an integrative, multidisciplinary science that encompasses botany, linguistics and ethnography, and deals with the traditional knowledge about plants and the natural environment (Pieroni & Quave 2014). Introduction of traditional knowledge is important, as many species used by indigenous people could potentially become a new source of medicine, food or ornamental plants. Therefore, determining the local uses of plants has an important communal benefit potential (Jain 1986, Pieroni & Quave 2014). The practices of ethnobotany can lead to the strengthening of cultural diversity and conservation, greater sustainability in the use of plant resources. It ensures that traditional knowledge about the empirical uses of plants is recorded and documented without disappearing. The recovery and documentation of traditional knowledge can contribute to the strengthening of indigenous cultures. It can result in demonstrating the value of cultural diversity in the context of processes of globalization, modernization and the integration of indigenous peoples into national societies (Hamilton *et al.* 2003).

Turkey has a rich flora due to its geographical location, geomorphological structure and the influence of various climatic types. Geophytes occupy an important place in this rich vegetation and there are approximately 2,500 species of geophytes (including petaloid and non petaloid monocots, geophytic dicots and ferns, and some hemicryptophytes) in the Turkish flora (more than 12,000; Demir & Eker 2015). Geophytes are bulbous, tuberous and rhizomatous plants whose bodies can store food by differentiating underground. In addition to being used as ornamental plants with their pleasant-looking flowers, they are used as medicinal, food and aromatic. Some geophytes traditionally used today are also being investigated in modern medicine (Davis 1984, Davis *et al.* 1988, Akan *et al*. 2005, Al-Rowaily *et al*. 2019, Sağıroğlu 2020).

Turkey has a great knowledge about folk medicines along with having a rich vegetation. According to data (www.tuik.gov.tr), approximately 7.5 % of the country's population lives in rural areas. The majority of people living in rural areas traditionally use plants. The widespread use among the Turkish people constitutes a potential resource for ethnobotanical studies. In recent years, many studies have been done on ethnobotanical uses (Polat *et al.* 2015, 2019, Bulut *et al.* 2017).

Turkey is a country where there are different religions and people of different ethnic groups. The official language is Turkish. In addition, languages such as Arabic, Kurdish, Zazaki, Laz, Georgian and Greek are spoken locally. Sakarya province is home to a wide variety of communities that migrated from the Balkans, Caucasus, Eastern Black Sea Region and Eastern Anatolia Region in Turkey. People from different cultures, especially from the countryside, lead their traditions from the past to a certain extent in this region, where there is a rich variety of plants. Both plant and cultural diversity have revealed a rich ethnobotanical culture, which continues in the province of Sakarya to exist from the past to the present. Sakarya province is also very rich in geophytes, and previous studies revealed that 220 taxa show natural distribution in the area (Sağıroğlu 2020). The rich diversity of plants and cultures in Sakarya province has been reflected in the ethnobotanical use of geophytes, and 115 species of geophytes have been identified having these characteristics (Uzun *et al*. 2004, Koyuncu *et al.* 2009, Sağıroğlu *et al*. 2012, 2017, Sağıroğlu 2020).

The aim of this study is to determine how the local people use geophytes in Sakarya Province and to reveal this ethnobotanical culture. To calculate the cultural importance index (CII) and the informant consensus factor (ICF) of the detected taxa, to question the similarities between the north and south of the study area, the distribution of the ethnobotanical uses of plants and plant parts.

Materials and methods

Study area. Sakarya is a province in the northeastern part of the Marmara Region, located at a latitude of 40° 17'-41°13' north and a longitude of 29° 57'-30° 53' east; covering a 4,895 km^2 area with a population of 1,042,649 (www.tuik.gov.tr). It is adjacent to Düzce in the east, Bolu in the southeast, Kocaeli in the west, Bilecik in the south and the Black Sea in the north. The province of Sakarya has 16 districts which are; Adapazarı, Akyazı, Arifiye, Erenler, Ferizli, Geyve, Hendek, Karapürçek, Karasu, Kaynarca, Kocaali, Pamukova, Sapanca, Serdivan, Söğütlü

and Taraklı (İkiel *et al*. 2018) (Figure 1). This ethnobotanical survey includes 71 villages located in 13 districts of Sakarya province.

Sakarya is located within the Euro-Siberian phytogeographic region. In the study area, the effect of the Black Sea climate is mostly seen. However, the Black Sea climate has a prominent effect in the northern part of the province, while the Mediterranean climate is seen in the south. The annual mean temperature of 14.6 °C and a mean rainfall of 842.7 mm per year (İkiel *et al*. 2018).

In Sakarya, 24 % of the total land is flat and nearly flat, 34 % is inclined slopes, and 42 % is steep slopes. The average elevation of Sakarya is 356 m, which is less than the average elevation of Turkey (1,141 m) and the Anatolian Peninsula (1,162 m), and higher than the Marmara Region (280 m). The highest point of Sakarya is Dikmen Tepe (1,729 m) on Elmacık Mountain, and the lowest place is the Black Sea coast (0 m) (İkiel & Ustaoğlu 2018). The area has a variety of habitats ranging from 0-1,729 m, such as mountainous areas, hills, valleys, wide sands, lakes, rivers, floodplains, and these habitat types host a large number of different species. About 45 % of the lands in Sakarya province are forests, 40 % are cultivated-planted areas, 10 % are meadows and pastures, about 5 % are non-agricultural areas. The vegetation is covered with natural pure or mixed forests in mountainous and hilly areas. These forests are in mixed communities with coniferous forests in the higher parts and oaks in the lower parts. In areas where the elevation approaches the sea level, maquis-pseudomaquis communities are observed with the effect of a climate similar to the Mediterranean climate (İkiel *et al*. 2018).

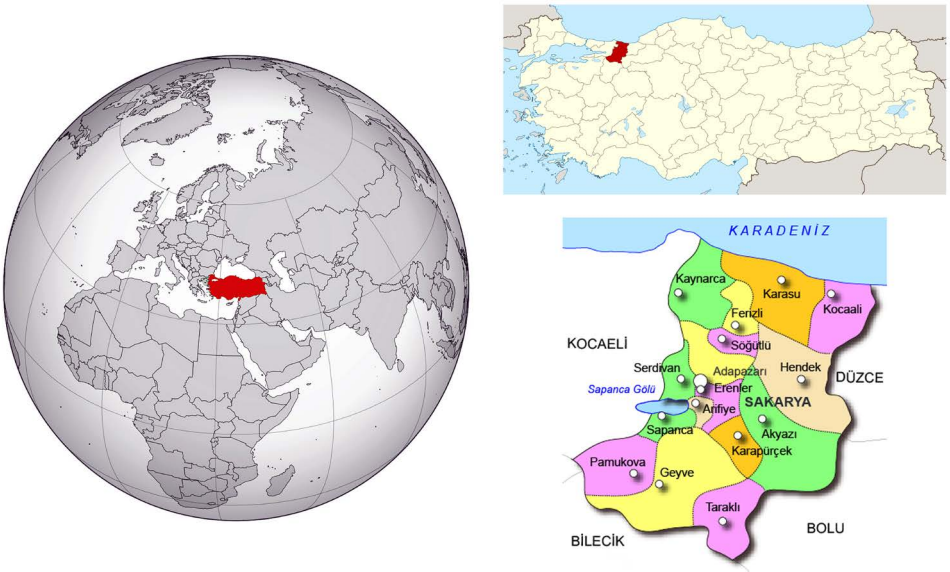

Figure 1. The location of the study area in the world and in Turkey, and the provincial and district boundaries.

Data collection. Our study was carried out in regular periods to cover all seasons between 2017-2020. The study was conducted following the guidelines in the "Consensus Statement on Ethnopharmacological Field Studies (Heinrich *et al.* 2018)". Ethnobotanical data were collected through face-to-face interviews with inhabitants of research area (Table 1) in Turkish, and the information obtained during interviews was recorded in the field questionnaires. A total of 204 interviews were conducted individually or in groups with the people accompanying the study and in coffeehouses, village squares or homes during the field studies (*e.g.*, Figure 2). We adhered to The International Society of Ethnobiology Code of Ethics in interviews (International Society of Ethnobiology 2006). In these interviews, the questions in the questionnaire form we prepared earlier were asked. These questions are; name and surname of the participant, age and gender of the participant, education level and occupation of the participant, telephone and add-

Table 1. Number, gender and economic activities of the informants from Sakarya province, Turkey.

District	Village	Number of reporters	Female	Male	House wives	Farmers	Cafe owners	Retired imams	Craft	Retired teachers	Retired nurses	Retired police	Medical officer	Mukhtar	Retired military officer
Hendek	6	16	10	6	10	6	-	-	-	-	-	-	-	-	-
Akyazı	5	15	11	4	-	15	-	-	-	-	-	-	-	-	-
Karapürçek	4	11	5	6	5	5	1	-	-	-	-	-	-	-	-
Arifiye	3	8	3	5	3	4	-	1	-	-	-	-	-	-	-
Ferizli	4	11	6	5	6	2	-	-	3	-	-	-	-	-	-
Karasu	7	24	17	7	11	2	2	-	-	6	3	-	-	-	-
Kocaali	5	12	5	7	-	11	-	-	1	-	-	-	-	-	-
Kaynarca	6	17	7	10	-	13	-	-	2	2	-	-	-	-	-
Pamukova	9	27	16	11	-	10	-	2	2	7	1	-	4	-	1
Geyve	8	24	7	17	-	17	-	-	-	2	-	1	2	2	-
Söğütlü	3	8	3	5	-	8	-	-	-	-	-	-	-	-	-
Taraklı	7	18	8	10	-	14	-	-	4	-	-	-	-	-	-
Sapanca	4	13	6	7	-	8	-	-	2	3	-	-	-	-	-
TOTAL	**71**	**204**	**104**	**100**	**35**	**115**	**3**	**3**	**14**	**20**	**4**	**1**	**6**	**2**	**1**

Figure 2. A) During an interview with the villagers in Geyve Kadirler Village; B) During an interview with Hüsnü SEÇKİN from Kadirler Village; C) A land survey with Kamuran TAN from the Akıncı Village of Geyve district, the plant in the photo is *Gladiolus italicus*; D) General view from Taraklı-Tuzla Village.

ress information of the participant, local name of the plant used, which parts of plants were used for what purposes, how these parts are used, what procedures were performed, dosage and side effects of plant used, what was taken into consideration while preparing them for use. Local people generally used the expressions "root" for "rhizome", and "bulb" for "tuber and corm" while describing the used parts of geophytes. These statements are included in the article with their correct scientific interpretation. Samples of plants determined to have ethnobotanical value in the region were collected (*e.g*., Figure 3) and given the specimen number, and then they were kept in the SAKU (Sakarya University Herbarium). All identifications were made using the relevant literature (Davis 1984, Davis *et al*. 1988, Güner *et al*. 2000, Demir & Eker 2015).

Turkish local names of the plants were obtained directly from the interviewed local people. The complete floristic list was set out according to the the systematic order in "Angiosperm Phylogeny Group IV (Chase *et al.* 2016)" and plants are listed in alphabetical order according to their families. Species and author names of the cited taxa were checked using IPNI database (IPNI 2021). Since the plant names in Table S1 (Supplementary material) are written with their authors, the names of the authors are not included in the text. However, scientific names in the generic and subgeneric categories that are not included in the Table S1 (Supplementary material) are given with their authors where they are first mentioned.

Calculations. The cultural importance index (CII) (Tardío & Pardo-de-Santayana 2008) allows us to compare the plants most frequently used by informants. It is calculated using the formula: CII = URs/N; Use Report (UR) = sum of total number of use reports for the species across all use categories (medicinal, food, ornamental, other), N = the total number of informants participating in the research. Each taxon referred to by a informant was counted as a use report.

According to the purpose of the medical use of the geophytes of the interviewed people, medicinal uses were grouped as gastrointestinal system diseases (i.e., digestive, wound, stomache aches, stomache pain, hemaroid, constipation), skin and subcutaneous tissue disorders (wound healing, skin burn, skin care, skin injuries, eczema, wart, psoriasis, sun burn, alopecia and itchesi abscesses and pimples), genitourinary system use (menstrual pain, lobar pain, used by women who make birth as menstrual enhancer, used for menstrual disorders, aphrodisiac), respiratory system diseases (cold, flu, expectorant, to relieve chest pains, cough, sinusits, shortness of breath, asthma, cough and throat ache), skeletal and muscular system diseases (joint pain, muscle spasm and rheumatism pain), and metabolic diseases (diabetes). Then, the informant consensus factor (ICF or FIC) was calculated for the participants using the formula ICF = (Nur – Nt) / (Nur – 1). The calculated ICF values range from 0 to 1, with '1' indicating the highest approval level. A value close to "0" indicates a low consensus among informants, in other words, that they disagree on the plants that shall be used within a disease group, whereas a value close to "1" indicates a high consensus among informants, which means that most of them identify the same plants for treating the same disease group. 'Nur' refers the number of participants providing information for any disease or disease group, and 'Nt' refers to the total number of plant species used for all the disease groups. The ICF value is used to analyze whether there is consensus among informants regarding the use of plants in the study area for various disease categories (Heinrich *et al.* 1998, Emre *et al*. 2021). The species used in the north and south of the province were evaluated according to the Jaccard similarity index [*JSI* = a/(c + b − a)]; a = number of species common to (shared by) quadrats, b = number of species present in the first community, and c = number of species present in the second community. This index is commonly used to evaluate the similarity of two groups based on presence/absence data.

Results

Demographic characteristics of informants. In the study conducted in 71 villages belonging to 13 districts of Sakarya province, 204 people living there were interviewed (Table 1). Of the 204 people interviewed, 104 were women and 100 were men. The average age of these 204 people consulted for information is 60.5 and the age ranges are as follows; five people are in the 30-40 range, 35 people are in the 41-51 age range, 65 people are in the 52-62 age range,

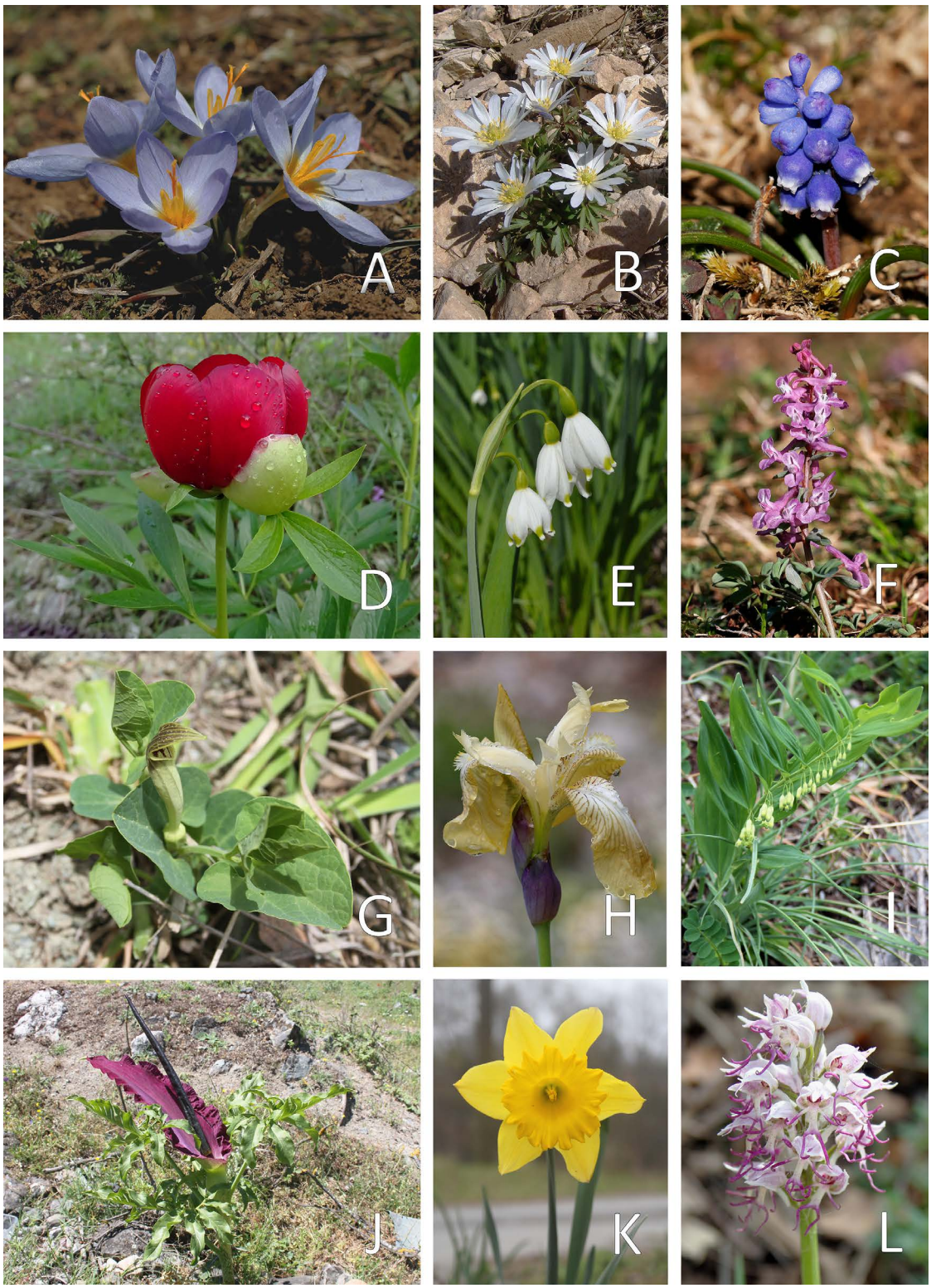

Figure 3. Some geophyte photos from the research area: A) *Crocus abantensis,*B) *Anemone blanda*, C) *Muscari pamiryigidii*, D) *Paeonia peregrina,* E) *Leucojum aestivum,* F) *Corydalis caucasica* subsp. *abantensis*, G) *Aristolochia pallida*, H) *Iris purpureobractea*, I) *Polygonatum multiflorum*, J) *Dracunculus vulgaris*, K) *Narcissus pseudonarcissus*, L) *Orchis simia* (A-F and H photographed by İ.Eker; G, I, J-L photographed by M.Sağıroğlu)

76 people are in the 63-73 age range and 23 people are over 74 years. Seventeen percent of the people interviewed had higher education. Among them are dignitaries of the public, such as mukhtars, retired teachers, retired imams, and people working in the field of health such as nurses and paramedics. Young people were observed to be less interested in traditional medicine. The main reason for this is that the young population prefers urban life instead of the village, modern medicine instead of traditional medicine (Table 1).

Ethnobotanical knowledge on geophytes in Sakarya province. Uses of geophytes.- In this study, 57 genera and 115 taxa belonging to 26 families used for ethnobotanical purposes in Sakarya province were determined and the list of these taxa is given in Table S1 (Supplementary material). The first five families and percentages of use that most benefit from ethnobotanical properties are Asparagaceae 23 taxa (20 %), Iridaceae 21 taxa (18 %), Amaryllidaceae 14 taxa (12 %), Orchidaceae 12 taxa (10 %) and Ranunculaceae five taxa (4 %). The most commonly used genus is *Crocus* L. (10 %) with 12 taxa. It is followed by *Orchis* Tourn. ex L. and Iris Tourn. ex L. (6 %) with seven taxa, *Allium* L. (5 %) with six taxa, *Ornithogalum* L. (4 %) with five taxa.

The similarity ratio of the geophytes used in Sakarya province in the north-south regions was determined as JSI = 0.44 (only north 24, only south 44 and common 47). It is known that there are different species in the north compared to the south, depending on the different climate structure and geographical characteristics. Because the northern parts are under the influence of the Euro-Siberian phytogeographic region, while the southern parts are under the influence of the Mediterranean phytogeographic region. Due to these differences, it is seen that the similarity rate is low. Out of a total of 115 taxa, 226 uses of geophytes are identified. These uses are grouped under four main headings: medicinal, ornamental, food and other. The rate of medicinal use is 56.63 % (128 uses), food is 21.23 % (48 uses), ornamental plants is 20.79 % (47 uses), others is 1.32 % (three uses). Considering the multiple ethnobotanical uses of the taxa, percentage of ethnobotanical usage and examples of taxa with high CII values are given in Figure 4. Accordingly; 34 medicinal, 15 medicinal + food, 18 food, 17 medicinal + ornamental, nine food + ornamental, 15 ornamental, four all three uses, and three other uses (dye: one, dye + medicinal: one, dye + ornamental: one).

Ruscus aculeatus, known by some people as the female of *Ruscus hypoglossum* L., are used for decoration, especially on new year eve, and it is believed that keeping it in the house during this period brought good luck to the house.

Leucojum eastivum is one of the most widely used plants by the people of Sakarya. At the same time, the leaves of the plant are harvested in Kaynarca and Karasu due to the galantamine content in its leaves and exported abroad. In addition, *Cyclamen coum* is among the most widely used plants as a therapeutic purposes, and *Ruscus* L. species both for therapeutic purposes and as ornamental plants. The use of natural sahlep (a powder obtained from the underground tubers of many species of the Orchidaceae family, and a hot drink produced by mixing milk and cinnamon into this powder) is also quite common in Sakarya. Tubers of *Anacamptis* Rich., *Dactylorhiza* Neck. ex Nevski, *Ophrys* L. and *Orchis* species are used in making sahlep. *Agave americana* subsp. *americana*, *Yucca filamentosa*, *Allium sativum*, *Allium ampeloprasum* and *Aloe vera* are the most widely used plants among the cultivated species, the first two of which are exotic. The interest of the local people in ornamental plant cultivation is high, and *Iris*, *Crocus* and *Colchicum* L. species are among the most preferred.

The names of the geophytes grown in Sakarya, their families, specimen number, their ethnobotanical uses, pharmacological properties and the CII values of each taxon are given in Table S1 (Supplementary material).

Plant parts used and methods of preparation.- The percentage distributions of the used parts of the plants are given in Figure 5. While preparing the scheme, it is divided into three main parts. In the first part, the underground organs such as bulb, corm, rhizome and root (53, 31.92 %) are located. The second part includes the stem, leaves and young sprouts (15, 9.03 %). In the third part, there are flowers, fruit and seed (10, 6.02 %). Apart from these, common plant parts; whole plant (64, 38.55%), underground parts and leaves (12, 7.22 %), aerial parts, stem and flowers, leaves and flowers, young sprout and fruit (12, 7.22 %). When the results are examined, it is seen that the whole plant is mostly used.

There are 127 different uses medicinally and the decoction rate is 29.92 % (38 uses), crushing 27.55 % (35 uses),

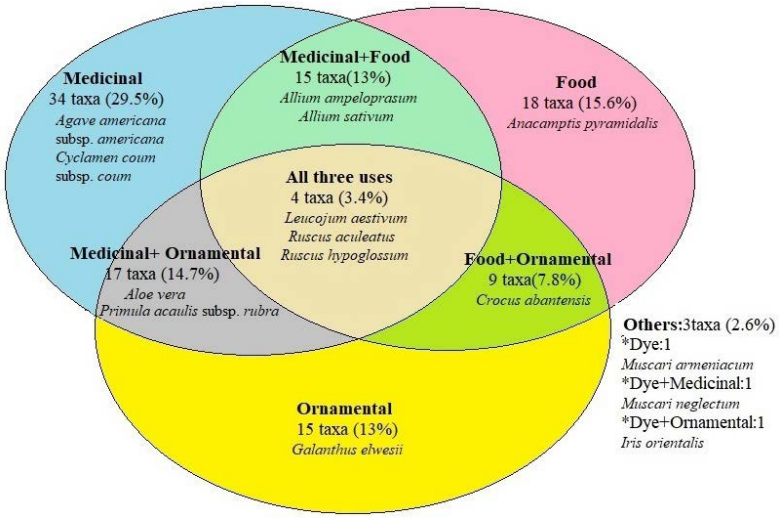

Figure 4. Distribution of ethnobotanical uses according to the number of species.

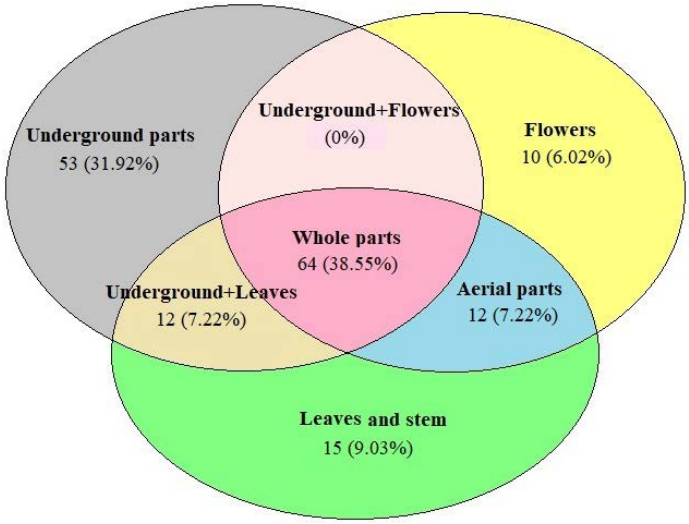

Figure 5. Distribution of plant parts used.

infusion 12.59 % (16 uses) and others 30.70 % (39 uses). The people in the studied region store the plants after drying, thus they could use them as decoctions or infusions in all seasons of the year. Some prescriptions are obtained by keeping, mixing or boiling the medicinal plant in milk, honey, butter and oil for a while. As an example, 5-6 roots of *Dracunculus vulgaris* used for psoriasis are ground like flour, roasted in water or milk. A person with psoriasis applies this paste to his entire body after bathing and cleaning. After a day, the patient takes a bath again and the paste is rubbed again. This process is repeated until it is fully healed. *Leopoldia comosa* is used for alopecia and itching. The stem and inflorescence of the plant are kept in jam with olive oil and under sunlight for 1 month and the oil is extracted. Then regularly applied on to the problematic area.

Data analysis.- Looking at the cultural importance index (CII) of plants, the ranking is as follows; *Leucojum aestivum* (2.57), *Allium ampeloprasum* (2.32), *Allium sativum* (2.03), *Ruscus aculeatus* (1.63), *Agave americana* subsp. *americana* (1.42), *Cyclamen coum* subsp. *coum* (1.38), *Ruscus hypoglossum* (1.36), *Aloe vera* (1.25), and *Muscari neglectum* (1.18), *Primula acaulis* subsp. *rubra* (1.16), *Colchicum speciosum* (1.15), *Asparagus acutifolius* (1.05), *Polygonatum multiflorum* (1.01), *Iris purpureobractea* (0.95) and *Aristolochia pallida* (0.93).

Based on the ICF data, a total of six main disease groups were determined. In the calculations, the highest ICF value was determined as 0.93 for gastrointestinal system diseases, 0.89 for skin and subcutaneous tissue diseases, 0.86 for genitourinary system and respiratory system diseases, 0.82 for skeletal and muscular system diseases, and 0.24 metabolic diseases.

Discussion

Up to the present, no study has been done on the ethnobotany of all geophytes of a city in Turkey, like our work. However, similar to our study, the ethnobotanical properties of 60 geophyte taxa growing around Alaşehir (Manisa) were given in a study (Sargın *et al*. 2013). In the related study, it was reported that geophytes are most commonly used internally to treat stomach ailments and diabetes, and also are used externally in hemorrhoids and rheumatic diseases. *Allium ampeloprasum*, *Arum italicum* and *Asparagus acutifolus*, among the species examined in the study, were reported to be used as food and medicine, similar to our study. While *Scilla bifolia* and *Iris germanica* were reported to be used as ornamental plants, they were found to have ornamental and medicinal uses in our study. While *Muscari neglectum* was used as an ornamental and medicinal plant, in our study it was determined that it has dye and medicinal uses. Although the general usages are similar to our study, the usage culture differs depending on the regional differences.

In the study conducted by Uzun *et al*. (2004) in Sakarya, the medicinal uses of 139 plants were given. Five of the plants were geophytes (*Acorus calamus* var. *calamus*, *Arum maculatum*, *Geranium asphodeloides* subsp. *asphodeloides*, *Allium cepa* L., *Allium sativum*). The medicinal uses of these plants are also given here, and there is an agreement with the aforementioned study in terms of the medicinal uses of these plants in our study. In a study on geophytes of the Alpu (Eskişehir-Turkey) region, the ethnobotanical characteristics of 28 species were given. When we sort them according to their purpose of usages: It is understood that the usage as food (50 %) is in the first place with 14 taxa. It is followed by 12 taxa (43 %) reported to be used for pharmaceutical purposes, one taxon reported to be harmful (4 %), and one taxon (4 %) for ornamental use. In Bozkurt & Terzioğlu (2018), similar to our study, *Dactylorhiza romana*, *Dactylorhiza saccifera* and *Orchis pallens* were used as sahlep, while *Muscari neglectum* was reported to be used in rheumatic diseases (Bozkurt & Terzioğlu 2018).

In another study, it has been reported that the species belonging to the Hyacinthaceae family are mostly used in the treatment of rheumatism, heart, urinary tract infections, dermatological, stomach, hemorrhoids and prostate diseases. In this study, 25 taxa were examined. Looking at the intended use of plants; 32 % is used as food, 22 % as medicinal plants, 21 % for medical purposes, 7 % as dye and 7 % as ornamental plants. Five percent of registered plants are reported to be toxic (Demirci Kayıran & Eroğlu Özkan 2017).

In a study (Mwafongo *et al*. 2010) examining the ethnobotanical uses of geophytes in Malawi regions, it was re-

ported that plants are most commonly used in diseases of the digestive system, skin diseases and respiratory system diseases. In our study, it was similarly determined that geophytes were mostly used in diseases of the gastrointestinal system and skin diseases. The use of many geophytes as food may be the reason why geophytes are more preferred in digestive system diseases.

The study named 'Ethnomedicinal uses of Colchicaceae and Liliaceae Taxa in Turkey (Bozyel *et al.* 2021)' was conducted with nine taxa belonging to two families. two *Colchicum* taxa belonging to the Colchicaceae and three *Fritillaria* Tourn. ex L., two *Lilium* Tourn. ex L. and two *Tulipa* L. taxa belonging to the Liliaceae were examined. Considering used parts of plants for medical purposes; subterranean structures take the first place with ratio of 53 %, and followed by leaves (13 %), flowers (13 %), aerial part (7 %) and seed (7 %). Looking at their use for health purposes, wound treatment ranks first with a rate of 21 %. It is followed by rheumatism with 13 %. Also, usage ratio for skin care is 8 %. In Bozyel *et al*. (2021), it was observed that *Orchis* sp. and *Anacamptis pyramidalis* were used as sahlep, similar to our study.

In our study, it was found that the local people used 11 herbs for stomach ailments, nine for wound healing, nine for rheumatism, eight for flu and cold, six for constipation and five herbs to facilitate digestion. Our study is the first detailed study on ethnobotanical uses of all geophytes of a province. The current study differs from other studies both in terms of the number of recorded taxa and covering a whole city in Turkey. The ethnobotanical properties of 115 geophyte species in total have been recorded and it has been determined that these plants are used in a wide area (Supplementary material, Table S1).

In addition to being a potential resource for pharmacological studies, ethnobotanical studies are of great importance in revealing the hidden properties of plants used regionally. Some of the plants mentioned in our study have some similarities with the literature in terms of their ethnobotanical uses. Çakılcıoğlu *et al.* (2011) reported that *Helleborus orientalis* is used as an anti-inflammatory. Also, in both studies, *Dactylis glomerata* subsp. *glomerata* and *Orchis italica* have been seen to be used for similar diseases. As a result, achieving similar results like this may contribute as follows; if a plant is used in different parts of the world to treat the same disease, its pharmacological effect can be noticed.

In our study, *Leucojum aestivum*, *Allium sativum*, *Allium ampeloprasum*, *Hordeum bulbosum*, *Helleborus orientalis*, *Ruscus aculeatus*, *Aloe vera*, *Smilax aspera*, *Iris* and *Cyclamen* L. species were observed to be the best known plants by the public. The cultural importance index (CII) is used to determine that a plant is culturally significant because it is mentioned by a large number of information sources and/or has multiple uses. When the CII values are examined at the generic level, *Allium* (5.17), *Iris* (3.49), *Crocus* (3.47), *Orchis* (3.29) and *Ruscus* (3.13) are the genera with the highest value in the region. Species of high CII values are *Leucojum aestivum* (2.57), *Allium ampeloprasum* (2.32), *Allium sativum* (2.03), *Ruscus aculeatus* (1.63), *Agave americana* subsp. *americana* (1.42). It was determined that CII values of *Crocus* and *Orchis* genera, which were not included in the top 15 at the species level, had high CII values on the basis of genera. The use of species with restricted distribution may also be more limited. This situation explains the lower CII values of some species at the species level when compared across the province. The total usage records prepared according to the usage category of the species with the highest CII values are given in Figure 6.

The CII value does not just specify the frequency of use for each species. It also demonstrates the versatile variety of uses of the species used. When the 15 species with the highest CI value were examined, *Agave americana*, *Cyclamen coum* subsp. *coum* and *Polygonatum multiflorum* had only medical use and similar uses were noted by a large number of people. On the other hand, a wide variety of uses of *Leucojum aestivum*, *Ruscus aculeatus*, *Ruscus hypoglossum* and *Iris purpureobractea* are available. What could be the reasons for using plants with high CII values? When we look for the answer to the question, we can come to the following conclusion. Among the 10 plants with the highest CII values, four species are cultivated plants. The fact that these plants are well known and cultivated by the public has increased their use. While all of the species with the highest CII values are used medicinally, the use of three of the first five plants as food is another factor that increases the CII values. *Leucojum aestivum*, which has the highest CII value, is extensively found in the north of the province and its consumption both as an ornamental and medicinal plant, and also as a tea due to its relaxing and pleasing effect are factors that increase its use. *Allium*

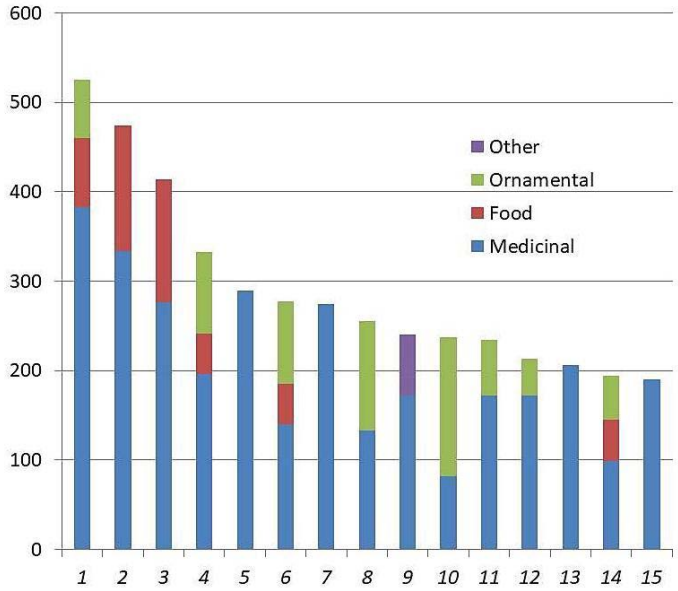

Figure 6. Total usage records (UR) of species with high CII value according to usage categories; 1: *Leucojum aestivum*, 2: *Allium ampeloprasum*, 3: *Allium sativum*, 4: *Ruscus aculeatus*, 5: *Agave americana* subsp. *americana*, 6: *Cyclamen coum* subsp. *coum*, 7: *Ruscus hypoglossum*, 8: *Aloe vera*, 9: *Muscari neglectum*, 10*: Primula acaulis* subsp. *rubra*, 11: *Colchicum speciosum*, 12: *Asparagus acutifolius*, 13: *Polygonatum multiflorum*, 14*: Iris purpureobractea*, 15: *Aristolochia pallida*.

sativum and *A. ampeloprasum* are widely used plants. In addition to being used as food, these plants are used together with foods in various ways due to their antimicrobial effects. *Agave americana* and *Aloe vera*, which are among the cultivated plants, are used extensively as ornemantal. Also, the intensive use of these plants in skin and skin-related ailments is emerging as an important factor.

In this study, it was determined that the most commonly used part of geophytes are the underground parts (31 %). Anderson & Lake (2016) similarly reported that Native American societies in California made extensive use of the the underground parts of geophytes. This is probably due to the fact that geophytes accumulate food, water and various minerals in the underground parts. In geophytes, the areal parts dry out and die in a short time after the growth is completed. On the other hand, bulb-like storage organs under the ground continue to live. Access to bulb-like structures, whose location is known and recognized, is constantly happening, and the fact that access is continuous may also have increased usage. In particular, *Allium* species, which are known to have antimicrobial-antioxidant properties in the literature, are frequently added to foods as raw vegetables by the people of Sakarya. It was seen that *Orchis* tubers were consumed as sahlep and *Crocus* species as vegetables. With this study, the use of *Dracunculus vulgaris* for psoriasis is reported for the first time in Turkey, while *Crocus speciosus* subsp. *sakariensis, Crocus keltepensis*, *Fritillaria bithynica* and *Muscari pamiryigidii* are reported to be used for ethnobotanical purposes for the first time in the world. *Allium ampeloprasum*, *Allium sativum*, *Yucca flamentosa*, *Aloe vera*, *Anemone blanda*, *Pancratium maritimum*, *Iris* spp. and *Narcissus* L. spp. are used as ornamental species in the study area. While it was noted in a previous study that *Ranunculus brutius* Ten. has toxic properties (Aksan & Yazlık 2021), the ethnobotanical use of this plant in Turkey is reported for the first time in our study. *Helleborus orientalis*, which was reported to have anti-inflammatory and antinociceptive activities in a previous study (Erdemoğlu *et al*. 2003), is reported to be used for stomach pain and flu in animals by this study. *Leucojum aestivum*, which is frequently used in our study area, is widely used in the Balkans, especially in the production of Alzheimer's medicine in Bulgaria. It has alkoloid content and therefore has an important use in the treatment of polio (Heinrich 2010, Nedelcheva & Draganov 2014).

ICF calculations were made under six different headings: gastrointestinal system, skin and subcutaneous tissues, genitourinary system, respiratory system, metabolic tissues, skeletal and muscular system. The high values in the results of these calculations indicate that the informants agree on the subject they provide information. When the ICF values were examined, it was found that gastrointestinal system diseases had the highest value with 0.93. This situation shows us that people living in the region suffer from gastrointestinal diseases more and one of the ways they resort to treatment is the use of plants. The widespread use of plants in the region as food may be another factor that increases their use in gastrointestinal system diseases.

As in previous ethnobotanical studies, it has been shown in this study that one of the first resources that society uses against diseases is traditional folk medicine. In addition to their medicinal uses, plants are still widely used by people in their daily lives as food, ornamental plant and for other purposes. It is seen that intergenerational knowledge transfer is important and however this knowledge transfer is decreasing day by day. This creates the risk of traditional knowledge being lost. In this respect, it is extremely important to gather information about traditional medicinal plants before they disappear in the society.

Considering that herbs used by the indigenous people are the source of some of our most important pharmaceutical products (*Allium*, *Cyclamen*, *Leucojum aestivum*, etc.), this study could form a basis for future pharmacological and phytochemical studies that may lead to the development of new drugs.

Acknowledgements

The authors would like to thank for their help Dr. Sezgi Arman, Kamuran Tan President of the Association for the Protection of Geyve Natural Assets, Şenol Ertürk from Akıncı Village, Şükrü Acar from Karasu, Erdal Özbek from Hendek, Mesut Bakla from Pamukova, İsmail Doğan from Taraklı, Varol Kocaman from Hacılar Village, Hüsnü Seçkin, Şükran Seçkin, İbrahim ER, Emine ER, from Kadirler Village, Muammer KURT from Geyve-Kulfallar. The authors would also like to thank Dr. Gizem Emre for her proofreading of the article and providing suggestions for the development of the article.

Supplementary material

Supplemental material for this article can be accessed here https://doi.org/10.17129/botsci.3124.

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Associate editor: Alejandro Casas

Author contributions: MS, planned and executed the research; İE, performed analysis and compiled of the database, field work and plant identification; ABS, compiled of the literature, performed the analysis and participated in field work; DK, participated in field work and compilation of the database.