Research paper

Ethnobotanical survey of medicinal plants traded in herbal markets of Kahramanmaraş

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ABSTRACT

Most people in the world still use medicinal plants to treat and prevent disease. In Anatolia, studies have shown that people have used plants for centuries to treat many diseases. Herbal markets play an important role in the supply of medicinal plants and the transmission of cultural heritage. In this study, we investigated the traditional uses of medicinal plants traded in Kahramanmaraş herbal markets. We also analyzed the threats that may arise from the use of medicinal plants and the measures that can be taken to protect these plants. For these purposes, ethnomedicinal data were collected using semi-structured and open-ended questionnaires of herbalists and local people. Ethnobotanical indices (e.g., Relative Frequency of Citation, Use Value, Relative Importance, and Informant Consensus Factor) were used to quantify the use and cultural importance of medicinal plants sold at Kahramanmaraş herbal markets. We identified 62 taxa (11 imported) of plants that are used in traditional folk medicines. The top three plant taxa sold per year by herbalists at Kahramanmaraş herbal markets are Licorice (*Glycyrrhiza glabra*; 140 kg), Thyme (*Thymus* sp.; 109 kg), and Carob (*Ceratonia siliqua*; 106.5 kg). The plant parts and mode of utilization used most are leaves (28 reports) and infusion (36 reports), respectively. The highest ICF value was detected for endocrine system ailments (0.78), and the next highest two values were lymphatic system (0.75) and respiratory system ailments (0.72). We determined that *Urtica dioica*, *G. glabra*, *Thymus* sp., *Mentha* x *piperita* have widely traditional uses, with high ethnobotanical index values and use reports. In addition, according to IUCN criteria, 26 of 62 taxa identified in the research are under threat to various degrees on a global scale.

1. Introduction

Biodiversity depends not only on the diversity of living organisms and ecosystems but also on biocultural diversity (Maffi and Woodley, 2010). This biocultural diversity is described by herbalism and ethnobotany, which investigate the relationship between humans and plants (Hoffmann, 2003). Medicinal plants were first discovered and used by ancient Indians, Chinese and Europeans. Today, an increased emphasis on healthy living has promoted the use of natural plants sold at herbal markets all over the world. Herbal markets, in turn, not only supply herbal treatment for diseases but also conserve biocultural diversity by transferring traditional knowledge to future generations. Accordingly, several studies have documented traditional knowledge in herbal markets (Bussmann et al., 2007, Bussmann et al., 2016; Idu et al., 2010; Quiroz et al., 2014; Sher et al., 2014; Towns et al., 2014; Randriamiharisoa et al., 2015; Tinitana et al., 2016; Carvalho et al., 2018; Jin et al., 2018; Luo et al., 2018; Franco et al., 2020; Nanogulyan et al., 2020). Ethno-pharmacological investigation of herbal markets can also be a useful method to find new herbal recipes, which can be used to treat many diseases that cannot be treated by standard health systems (Mushtaq et al., 2018; Petrakou et al., 2020).

Herbalism has played an important role in the folk medicine of Anatolia since the 12th or 13th century (Erci, 2012; Akbulut, 2015). The floristic richness of Turkey is key to the diversity of its folk medicine and cultural heritage. This floral and cultural diversity can be largely attributed to its geographic position and the traces of

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different cultures that have lived in this region for centuries. One of the oldest settlements in Anatolia is Kahramanmaraş. Although this city and the surrounding areas have a history of 7000—7500 years, the first traces of human settlements in the region are estimated to be thousands of years older (Gökhan and Kaya, 2008). Kahramanmaraş is largely populated by two ethnic communities (90%) that live in the city center, the Dulkadir Turkmen and a tribe from Doğubayazıt (Dedeoğlu, 1996; Ozan, 2003). The majority of the people of Kahramanmaraş are Dulkadir Turkmen, one of the tribes of the Oğuz. The Turkish tribe from Doğubayazı settled in the region during the 16th century.

The close relationship between Kahramanmaraş people and plants is reflected in the use of medicinal plants. Local people of Kahramanmaraş collect medicinal plants from nature and purchase medicinal plants at herbal markets. One of the most important plants collected from nature is *Arum maculatum* L., which is called "Andırın (district of Kahramanmaraş) doctor". In addition, the fresh leaves of *Arum maculatum* are used to make "Tirşik" soup. Although *Arum maculatum* leaves are quite poisonous when consumed raw, if cooked with appropriate techniques, it has healing properties that treat digestive system disorders, kidney stones, and relieve muscle pain. The leaves of the plant are sold in bazaars in Spring and the plant is celebrated during the annual Tirşik Soup Festival. The fresh shoots of *Thymbra spicata* L. are sold extensively in bazaars in Spring and its fresh leaves are pickled and consumed in salads, especially for breakfast. This herb also has appetizing properties and is especially effective against digestive system disorders.

Although previous studies have examined the medicinal plant species sold in herbal markets of Kahramanmaraş (Çömlekçioğlu and Karaman, 2008; Akbulut and Özkan, 2016), the use values and importance of the plants have not been quantified. In this study, we document the traditional uses of medicinal plants sold in herbal markets in Kahramanmaraş using ethnobotanical indices such as Use Value (UV), Relative Importance (RI), and Informant Consensus Factor (ICF).

2. Material and methods

2.1. Study area

Kahramanmaraş is located on the foothills of Ahir Mountain between lat 37°45′N and long 34°40′E (Fig. 1) (Atalay, 2008; Polat, 2009). The center of the city is at an elevation of 568 m above sea level. Kahramanmaraş is located within the Mediterranean Biodiversity Hotspot and the transition zone between the Irano-Turanian and Mediterranean phytogeographical regions. Furthermore, it is on the crossroad of the Anatolian diagonal, which is an important center of endemism in Turkey. In addition, Kahramanmaraş contains diverse microclimates and habitats (Özhatay et al., 2011; Uzun et al., 2018). Accordingly, Kahramanmaraş hosts about 2500 flowering plants and ferns and is also rich in endemic species (20%). The vegetation types of Kahramanmaraş change depending on elevation. Generally, Maquis vegetation occurs between 500 and 1000 m, forest vegetation between 1000 and 2000 m, and high mountain steppe vegetation, rich in plant species, are observed in the alpine belt over 2000 m (Zohary, 1973; Kaya, 1996).

The city center of Kahramanmaraş reaches high temperatures (over 40 °C) in the summer months. During these summer months the Yörük Turkmen people move to higher elevations. In the city, private houses are commonly built in the highlands of the Ahir Mountain. The mountain is suitable for fruit production,

livestock, viticulture and beekeeping due to its soil structure and climate. People grow various fruit trees, grapes and vegetable plants in their backyards (Koç, 2017). In these plateau regions, local people also prepare food stocks of natural products for the winter months. A local grape variety called "Kabarcık" is prepared as a dessert called "pestil" (fruit leather), which is made from the pulp of grapes dried in sheets (Maraş İl Yıllığı, 1967). Sumac syrup "Akıt", a high-income sugar source for local people, is also made in the summer. In addition to viticulture, olive cultivation is common in the region. Kahramanmaraş is famous worldwide for its red pepper and its ice cream, which contains sahlep and goat milk.

2.2. Ethno-botanical survey and data collection

There are 36 herbal markets in Kahramanmaraş city center. We interviewed herbal market vendors (10) and customers (152) from the ten herbal markets in Kahramanmaraş city with the highest customer density and product quantity. We used semi-structured questionnaires and open-ended interviews with these vendors and customers to obtain information on the vernacular names, preparation methods, uses, and prices of herbal market products. The questionnaire consisted of two parts (Appendix I), with the first part including demographic information about the informants (Table 1). All of the herbalists were men. Four herbalists were between the ages of 18—35, five were between 36 and 50 years old, and one was over 51. Five herbalists were primary school graduates, two were secondary school graduates and three were university graduates. Of the 152 customers interviewed, 89 were female and 63 were male. Customer ages included 82 people between 18 and 35; 48 people between 36 and 50, and 22 people 51 years or older. Fifty-one customers graduated from primary school, 31 from secondary school, and 70 from university. The second part of the questionnaire for herbalists consisted of questions such as the following: how do they buy their products, what are the top-selling plant taxa, where or from whom they buy the products they sell, how often do they buy medicinal plants, and how do they get information about plants. For customers, the second part consisted of information about the name of the plant, used plant part, the method of use, and the list of diseases being treated (Appendix II).

Samples were taken from plant materials that informants reported using and then identified in the Herbarium KASOF (Kahramanmaraş Sütçü İmam University, Faculty of Forestry Herbarium) (Fig. 2). Plant parts, flowers, leaves, seeds, and other materials have been stored in the Herbarium KASOF. Field work was performed in Kahramanmaraş between January and March 2015. The study examines only plant taxa used for medicinal reasons; species were included only if the traders or informants mentioned medicinal uses. Plant products such as resins, oils and juices are not included in this study.

2.3. Classification of medicinal uses

Ailments were grouped into eleven categories according to the recommended usage. The ailment categories are circulatory system, digestive system, endocrine system, immune system, lymphatic system, central nervous system, reproductive system, skeletal system, respiratory system, urinary system, and skin or integumentary system. Informants did not specify any use of plants for the body muscular system.
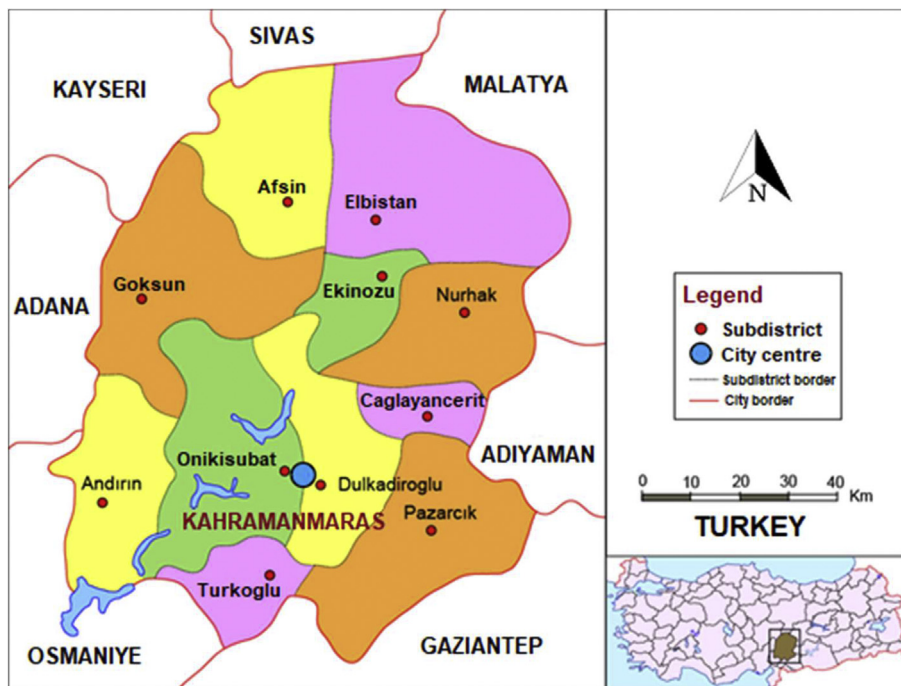
Fig. 1. Geographical location of the study area, Kahramanmaraş, Turkey.

Table 1
Demographic profile of informants.

Variables	Category	Herbalist	Customer	Total number of informants	Percentage
Age	18—35	4	82	86	53.1
	36—50	5	48	53	32.7
	51 and more	1	22	23	14.2
Gender	Male	10	63	73	45.1
	Female	0	89	89	54.9
Education	Primary	5	51	56	34.6
	Secondary	2	31	33	20.4
	Higher	3	70	73	45.0

2.4. Data analysis

2.4.1. Relative frequency of citation (RFC)

Relative Frequency Citation (RFC) has been calculated to assess the consensus amongst the informants on the reported taxa. This index shows the local importance of each taxa and is given by the frequency of citation (FC, the number of informants mentioning the use of the species) divided by the total number of informants in the survey (N) (Vitalini et al., 2013).

$$RFC = FC / N (0 < RFC < 1)$$

This index varies from 0, when no informants refer to the plant species as useful, to 1, in the case when there are a maximum number of informants that consider a plant taxon useful (Tardío and Pardo-de-Santayana, 2008).

2.4.2. Use value (UV)

The use value is an index the indicates the relative importance of locally known plant taxa, depending on the number of uses recorded for each species. It was calculated by following the formula given by Trotter and Logan (1986).

$$UV = U/n$$

where U is the number of uses mentioned by each informant for a given taxa and n is the number of informants who cited the plant species.

2.4.3. Relative importance (RI)

Relative importance (RI) determines the importance of a plant species according to the number of uses of each plant taxa and body organ systems treated by it. Relative importance was calculated as follows (Bennett and Prance 2000):

$$RI = (Rel\ PH + Rel\ BS) \times 100 / 2$$

where PH is the number of reported pharmacological properties, $Rel\ PH$ is the relative number of pharmacological properties, BS is the number of body systems treated, and $Rel\ BS$ is the relative number of body systems treated.

2.4.4. Informant consensus factor (ICF)

Informant consensus factor expresses the consensus of informants related to the use of plant taxa in treating different use categories (Heinrich et al., 1998; Khan et al., 2015; Yaseen et al., 2015; Mushtaq et al., 2018; Sargın and Büyükcengiz, 2019).
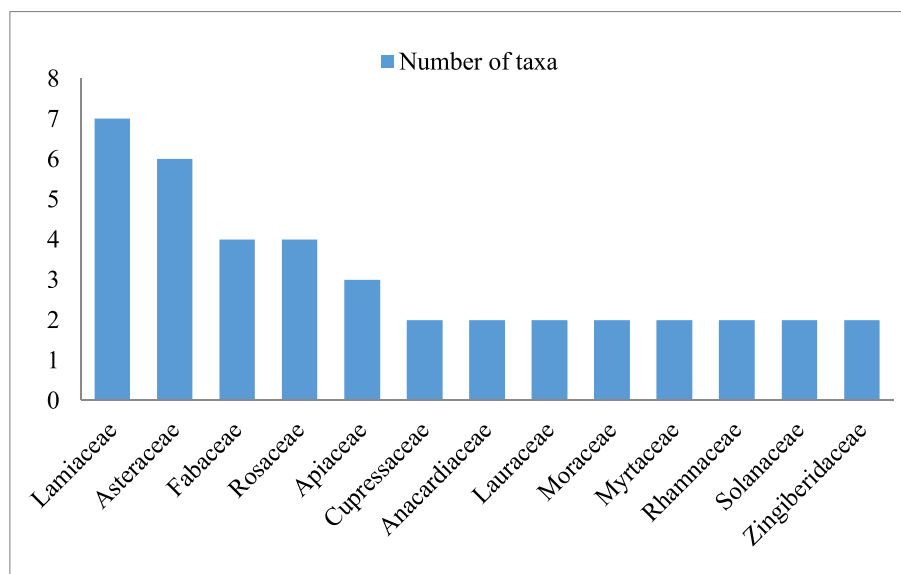
$$ICF = (Nur - Nt) / (Nur - 1)$$

Fig. 2. Richest plant families with their number of taxa.

where *Nur* is the number of uses reported for a disease category and Nt is the number of plant taxa used to treat the disease category.

3. Results and discussion

3.1. Herbal market characteristics

Herbal markets contribute to both the continuity of traditional knowledge and the local economy. In Kahramanmaraş, the average operating age of each herbal market is 29 years, the average number of employees is 1.8, the average number of products in a market is 422, and the average annual turnover of the markets is TL181,111 (US$73,622, currency in 2015). In addition, according to the statements of nine herbalists, the average monthly income from an herbal market is TL7,611 (US$3094). One herbalist did not report his income. In 2015, the per capita income in Turkey was US$11,014 (Karahan, 2017); in this study, we calculated that the annual income of herbalists was US$37,000. Some factors have increased the demand for herbal medicines, such as increased consumer preference for traditional medicines and reduced side effects of long-term herbal medicine use (Ekor, 2014). We predict that increased demand for natural medicines and the increased funding for research on herbal medicines will expand the herbal market. In China, a country with megadiversity, the total value of pharmaceutical products has reached US$123.4 billion, of which US$23.71 billion is obtained from the export of medicinal plant material (Ji et al., 2020). According to Luo et al. (2018), the medicinal market in Jianghua has grown considerably in the last 15 years. WHO indicated that, because of the diversity of regulations for traditional medicine products, it is difficult to assess the size of the herbal market across member states; however, available data suggests that the herbal market is substantial (WHO, 2013).

When asked how they gained herbal knowledge, five herbalists stated that they learned from their master, four herbalists were self-taught, and one reported that he had acquired herbal knowledge through a university education. Although many universities in Turkey have a Medicinal and Aromatic Plants program, there is no need for any certificate or qualification to open an herbal market. However, in 2016 the Ministry of Health made it compulsory to acquire a permit from the provincial health directorate of herbalists to sell medicinal plants and products. In addition, the sale of 71 objectionable medicinal plants and preparations has been prohibited in herbal markets, including *Scilla* bulbs, *Digitalis* leaves and preparations, *Atropa belladonna* L., *Ecballium elaterium* (L.) A.Rich. and *Cannabis sativa* L.(MoH, 2016).

Most herbalists interviewed buy processed products. Seven herbalists stated that they purchased their products purified and dried, four purchased powdered and packaged herbs, and two purchased herbs that had not been processed. Most herbalists reported that they bought their products from vendors. However, two herbalists reported that they also collect plants from nature. In this study, approximately 80% (51 taxa) of the 62 ethnobotanical taxa are native plants. In Turkey, the majority of medicinal plants are collected from nature, but a small number of medicinal and aromatic plants are cultivated (e.g., poppy, rose, cumin, anise, thyme, fenugreek, fennel, mint and coriander).

The frequency with which herbalists buy medicinal plants varied. Herbalists reported that they buy medicinal plants once a year (30%), every three months (20%), once a month (20%), once a week (20%), and every six months (10%). When we asked herbalists how they gather knowledge about plants, 44% stated from the books, 25% from the internet, 12% from the family, 6% from vendors, and 13% said none of these options. One herbalist stated that he gathered knowledge from his colleagues and one herbalist graduated from a school that specializes in medicinal plants.

3.2. Medicinal plant diversity

Our interviews of herbalists and customers from 10 herbal markets in the Kahramanmaraş city center identified ethnobotanical usage of 62 plant taxa belonging to 35 families. Two taxa belong to *Pteridophyta* and all others to *Anthophyta* (*Spermatophyta*). Among plant families, Lamiaceae had the highest number of taxa (7) followed by Asteraceae (6), Fabaceae and Rosaceae (each had 4),

Apiaceae (3), and Cupressaceae, Anacardiaceae, Lauraceae, Moraceae, Myrtaceae, Rhamnaceae, Solanaceae and Zingiberidaceae (each had 2). The following families have one taxon: Aspleniaceae, Equisteaceae, Boraginaceae, Eleagnaceae, Ericaceae, Hypericaceae, Juglandaceae, Linaceae, Nitrariaceae, Papaveraceae, Plantaginaceae, Piperaceae, Portulacaceae, Lythraceae, Ranunculaceae, Santalaceae, Theaceae, Tiliaceae, Cannabaceae, Urticaceae, Verbenaceae and Zygophyllaceae. These findings are similar to a study conducted in the southern Turkish province of Adana (Akbulut, 2015) that found the most common medicinal plants were distributed in four families (Lamiaceae, 7; Fabaceae, 6; Rosaceae, 4; and Asteraceae, 4 taxa). We also found that 8 of the 10 most sold taxa annually are indigenous plants. The top four (Licorice, Thyme, Carob and Mint) taxa traded accounted for more than 65% of the total sales volume. Previous research from herbal markets in northern Peru found that native species account for 50% of all sales, whereas 16 exotic plant species contribute to more than a quarter of all sold materials (Bussmann et al., 2007). Bussmann et al. (2016) reported that, while 61% of the plants sold in Bolivian plant markets are native species, 28.8% of plants are introduced. After interviewing 214 herbalists and 933 customers in 24 provinces in Turkey, Akbulut and Bayramoglu (2013) determined that 88% of plants sold in herbal shops are native, whereas 12% are exotics. Our results are similar to this study (51 native taxa and 11 exotic taxa). Turkey exports medicinal and aromatic plants to approximately 100 countries throughout the world, ranking 18th among countries that export these products (Keykubat, 2016).

Kahramanmaraş is an important city that has preserved its cultural heritage. In addition to many Geographical Indication (GI) local products such as tarhana, ice cream, red pepper and tirşik (Dayısoylu et al., 2017), many herbal products are currently waiting to be certificated. Cultural diversity and floristic richness are the main indicators of the existence of rich traditional medicine (Yeşilada, 2002). The top-selling plants in herbal markets suggest that cultural and regional factors play a role developing traditional medicine in Kahramanmaraş. The city is located at the eastern part of the Mediterranean region and has very high summer temperatures. At the same time, the extremely rich cuisine of Kahramanmaraş is characterized by dishes that are very spicy and oily. This may explain why local people consume high amounts of dyspeptic medicinal plants such as licorice, mint, and thyme.

3.3. Medicinal plant parts used and mode of preparation

The annual average weight for the 10 top-selling plant taxa in Kahramanmaraş herbal markets are as follows: Licorice (*Glycyrrhiza glabra* L.), 140 kg; Thyme (*Thymus* sp.), 109 kg; Carob (*Ceratonia siliqua* L.), 106.5 kg; Mint (*Mentha* x *piperita* L.), 105 kg; Ginger (*Zingiber officinale* Roscoe), 82.5 kg; Linden (*Tilia platyphyllos* Scop.), 76 kg; Senna (*Senna alexandrina* Mill.), 34.5 kg; Fennel (*Foeniculum vulgare* Mill.), 28.5 kg; Sage-Mountain tea (*Salvia officinalis* L.), 28.5 kg; and Daisy (*Matricaria chamomilla* L.), 16.5 kg. Licorice is the most sold plant species (140 kg per year) in Kahramanmaraş herbal markets. During the summer licorice is consumed extensively because it quenches thirst and is good for stomach ailments. In addition, it is widely used throughout Ramadan, the Muslim holy month during which fasting is observed, because of its positive effects on an empty stomach. In Kahramanmaraş, licorice syrup is sold in bottles at bazaars and by street vendors. The second best-selling plant in the herbal markets is thyme (109 kg per year). Thyme is consumed as a spice by local people, and in the winter a thyme tea called "zahter" is widely consumed. Zahter tea is good for stomachaches, headaches and colds. Thyme is one of the main

ingredients of Maraş Tarhana (soup with dried yoghurt), which is produced in large quantities in the province in summer and is an indispensable soup for the winter months. Therefore, the sale of thyme is high in both summer and winter. Furthermore, molasses made by local people from the cones of *Juniperus drupacea* Labill. is used for food and medicinal purposes. This molasses is especially effective against diseases such as asthma and bronchitis. Because local people generally collect cones independently, herbalists do not sell large amounts of this plant.

Customers reported the uses of 94 plant parts belonging to 62 plant taxa. The part of the plant most frequently cited by customers is leaves (30%), followed by fruits (22%), roots (13%), seeds (11%), flowers (10%), shoots (8%), aerial parts (4%) and the bark (2%), respectively (Fig. 3). The most commonly used plant parts reported by previous ethnobotanical studies in Turkey have varied. Our results are similar to those of Dalar et al. (2018), which reported that the most common plant parts used by customers in Ağrı province were leaves. Our results are also similar to the study of Uzun and Kaya (2016) that showed that leaves and fruits are the two most used plant parts.

Customers reported using 12 different methods to treat ailments with plant parts. Of these, the three most commonly used preparation methods were infusion (37%), decoction (24%), and powder (18%) (Fig. 4). Infusions and decoctions are generally prepared with plant leaves; therefore, these results are consistent with our finding that the most commonly used plant parts are leaves. This finding supports those of Polat (2018), which found that the two most commonly used methods for medicinal plant preparation in Bingöl were infusion (37%) and decoction (33%).

We also determined that 10 plants are highly versatile (see bolded taxa in Table 2). Plant species with more than 6 use reports include *Urtica dioica* L., *Elaeagnus angustifolia* L., *Curcuma longa* L., *Matricaria chamomilla*, *Apium graveolens* L., *Foeniculum vulgare*, *Achillea millefolium* L., *Cichorium intybus* L., *Juglans regia* L., and *Nigella sativa* L.

3.4. Salient ailments and indices

Herbal remedies are used for many ailments in Turkey. Medicinal plants are most frequently used to treat the respiratory system (96 of the use reports), digestive system (82), skin or integumentary system (64), and urinary system (59). According to recent reports, air quality in Kahramanmaraş exceeds pollution limits set by both the WHO and EU. Also Turkish air pollution indices are 31% higher than those in Europe (UCTEA, 2019). Pollution can lead to increased respiratory disorders and allergic reactions. The use reports of other diseases treated are noted in Table 3. No customers mentioned a plant used for the body muscular system. However, customers reported that several body systems are treated with a highly diverse set of plant taxa. For instance, the plants used treat the digestive system (60 plant taxa), respiratory system (41 taxa), skin or integumentary system (23 taxa), and skeletal and urinary system (each 17 taxa) are the most diverse.

The UV value represents the relative importance of plant species according to the number of uses reported for each species. In the present study, UV values ranged from 0.01 to 0.29. The highest UV value was determined for *Ziziphus jujuba* Mill. (0.29). For this taxon, 17 informants reported 5 different pharmacological properties. The lowest UV value was recorded for *Camellia sinensis* (L.) Kuntze (0.01); 77 informants reported that this taxon is used for only for one pharmacological property.
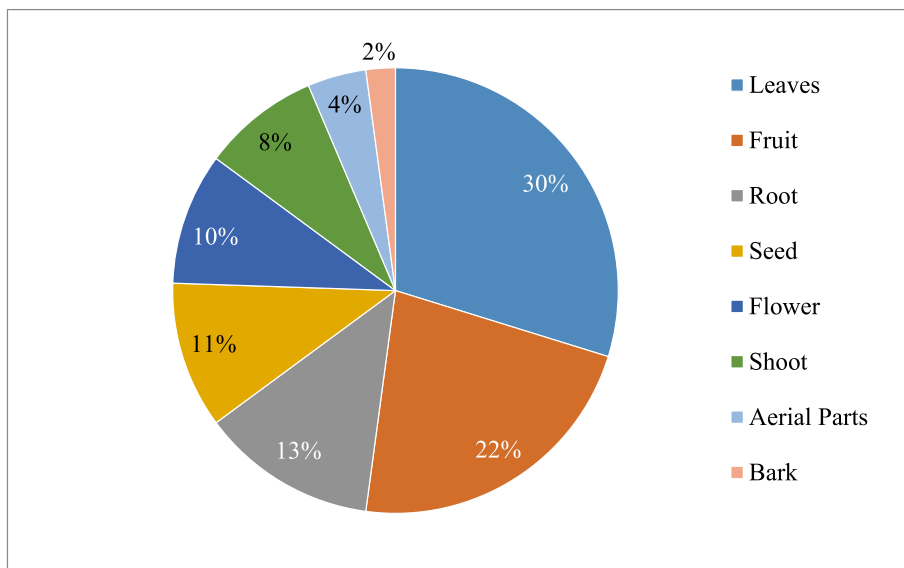
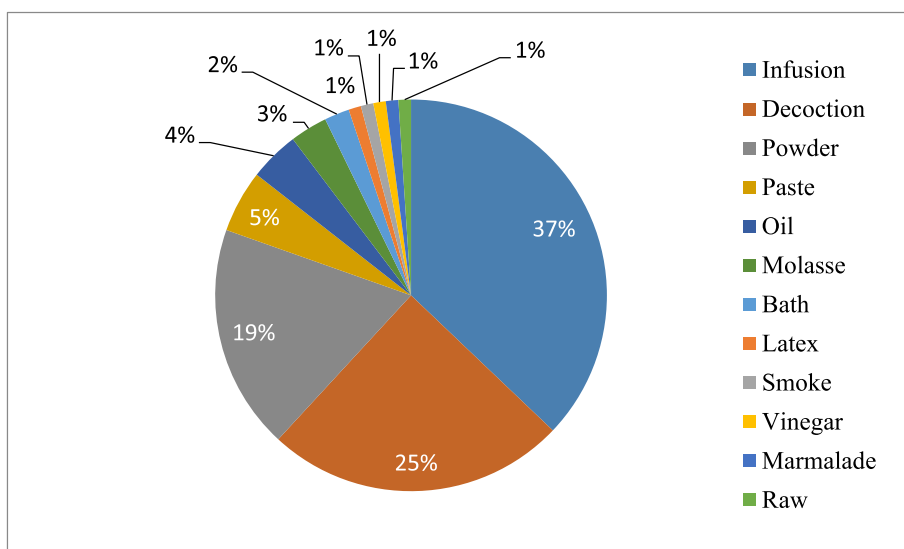**Fig. 3.** The percentage of plant parts used.

Fig. 4. The percentage of preparation methods.

RFC, which represents the relative importance of plant species, depends on the number of informants that report the use of the species. In the present study, RFC values ranged from 0.97 to 0.05. The highest RFC was found for *Mentha* x *piperita*. Other taxa with high RFC values include *Juglans regia* (0.95), *Tilia platyphyllos* (0.93), *Rosa canina* L. (0.84), and *Thymus* sp. (0.84). *Mentha* x *piperita* is widely used because of its medicinal properties as well as aromatic scent both in Turkey and the world. In addition to its widespread use as a spice in Kahramanmaraş, it is frequently used to prevent stomachaches, colds, and halitosis.

Relative Importance Index (RI) was calculated based on relative pharmacological effects and relative body systems treated by a plant species. RI values ranged from 83.33 to 9.72. The plant with the highest RI value was *Urtica dioica*. Informants reported that this

plant species is used to treat nine different ailments belonging to eight body systems. *U. dioica* is widely used both in Kahramanmaraş and surrounding provinces. Although many uses of *U. dioica* were reported by customers, the most commonly mentioned uses were as an expectorant, aphrodisiac, and anticarcinogen. High RI values were also determined for *Elaeagnus angustifolia* (63.89), *Curcuma longa* (59.72) and *Matricaria chamomilla* (59.72).

This study is based on a total of 485 disease reports that belong to 11 disease groups. High ICF values indicate that there is a consensus among informants about plants used for a particular disease group. The highest ICF value was detected in endocrine system ailments (0.78), and the next two highest values were for lymphatic system (0.75) and respiratory system ailments (0.72)

Table 2
Medicinal plants traded in Kahramanmaraş herbal markets.

Botanical Names	Family	Vernacular Names	Threat Category	Parts used	Preparation Form	Medicinal Uses	FC	RFC	UV	RI
Asplenium ceterach L.	Aspleniaceae	Altın otu		Aerial parts	Infusion	Cough and expectorant, gas troubles	17	0.11	0.18	25.00
Equisetum arvense L.	Equisetaceae	Boğumlu ot		Stem and Leaves	Infusion, Bath	Diuretic, wounds, regulates menses	28	0.18	0.11	29.17
Juniperus communis L.	Cupressaceae	Ardıç	LC	Cones	Decoction, Oil	Halitosis, hemorrhoids, skin diseases	15	0.10	0.20	29.17
Juniperus drupacea Labill.	Cupressaceae	Andız	LC	Cones	Molasses, Infusion	Asthma, bronchitis, urinary burning, skin diseases	29	0.19	0.14	34.72
Rhus coriaria L.	Anacardiaceae	Sumak	VU	Leaves, Fruits	Powder, Decoction	Sore throat, diarrhea, wound healing	55	0.36	0.05	29.17
Pistacia terebinthus L.	Anacardiaceae	Menengiç	LC	Fruits, Roots	Powder, Decoction	Diuretic, expectorant	53	0.35	0.04	19.44
Apium graveolens L.	Apiaceae	Kereviz	LC	Leaves, Roots	Decoction	Urinary problems, liver problems, cough, bronchitis, enlarged prostate gland, hypertension	22	0.14	0.27	50.00
Carum carvi L.	Apiaceae	Kimyon		Fruits	Powder	Gas troubles, stomach gas, regulates menses, galactagogues	72	0.47	0.06	34.72
Foeniculum vulgare Mill.	Apiaceae	Rezene		Roots, Leaves, Seeds	Decoction, Powder	Galactagogues, gas troubles, intestinal problems, kidney stones, wounds, as heart tonic	67	0.44	0.09	54.17
Achillea millefolium L.	Asteraceae	Civan perçemi	LC	Leaves, Flowers	Infusion	Female sexual disorders, hemorrhoids, blood purification, anemia, wounds, stomach and intestinal disorders	73	0.48	0.08	54.17
Artemisia absinthium L.	Asteraceae	Pelin otu		Flowering shoots	Infusion	Expel worms from digestive tract, stomach tonic	12	0.08	0.17	15.28
Cyanus segetum Hill	Asteraceae	Gelintacı		Flowers, Leaves	Infusion	Applied on head skin to heal wounds, diarrhea, expectorant, urinary problems	22	0.14	0.23	44.44
Cichorium intybus L.	Asteraceae	Hindiba		Flowering shoots	Decoction. Infusion	Heart diseases, liver disorders, cough, bronchitis, rheumatism, indigestion	41	0.27	0.15	54.17
Matricaria chamomilla L.	Asteraceae	Mayıs papatyası		Flowers	Infusion, Powder, Bath	Insomnia, stress, rheumatism, sore throat, stomachache, wounds, anemia	93	0.61	0.08	59.72
Silybum marianum (L.) Gaertn.	Asteraceae	Deve dikeni		Flowering shoots	Infusion, Powder	Kidney stones, urine problems, rheumatism	32	0.21	0.09	25.00
Alkanna tinctoria L.	Boraginaceae	Havaciva		Roots	Infusion	Constipation, fever, wounds	27	0.18	0.11	29.17
Celtis australis L.	Cannabaceae	Çitlembik	LC	Leaves, Fruits	Infusion, Paste	Diarrhea, cough and expectorant, rheumatism	57	0.38	0.07	34.72
Elaeagnus angustifolia L.	Elaegnaceae	İğde		Fruits, Flowers, Leaves	Eaten raw, Powder	Diarrhea, urinary problems, cough, sore throat, infertility, nervous disorders, sexual disorders	43	0.28	0.16	63.89
Erica arborea L.	Erıcaceae	Funda	LC	Flowering shoots, Leaves	Infusion	Urinary problems	18	0.12	0.06	9.72
[a]*Senna alexandrina* Mill.	Fabaceae	Sinameki	LC	Leaves	Infusion	Purgative, rheumatism	50	0.33	0.04	19.44
Ceratonia siliqua L.	Fabaceae	Keçiboynuzu	LC	Flowering shoots, Leaves, Bark and Fruit	Powder, Decoction	Urinary problems, anemia, sexual disorders	93	0.61	0.03	29.17
Glycyrrhiza glabra L.	Fabaceae	Meyan		Roots	Decoction	Ulcer, laxative, antitussive, respiratory disorders	50	0.33	0.08	30.56
Ononis spinosa L.	Fabaceae	Kayışkıran		Roots	Infusion	Kidney stones, wounds	29	0.19	0.07	19.44
Hypericum perforatum L.	Hypericaceae	Kantoron		Flowers	Infusion, Oil	Fever, skin burns, Abnormal menstrual cycle, nervous system disorders	103	0.68	0.04	38.89
Juglans regia L.	Juglandaceae	Ceviz	LC	Fruit, Leaves	Infusion	Skin diseases, to purify blood, anemia, diabetes, cholesterol, bone weakness	145	0.95	0.04	50.00
([a]*Lavandula spica* L.) *Lavandula angustifolia* Mill.	Lamiaceae	Lavanta		Flowers	Infusion	Stomach gas, stomachache, nervous disorders	32	0.21	0.09	25.00

Table 2 (continued)

Botanical Names	Family	Vernacular Names	Threat Category	Parts used	Preparation Form	Medicinal Uses	FC	RFC	UV	RI
Melissa officinalis L.	Lamiaceae	Oğul otu		Leaves	Infusion	Gas troubles, nervous disorders, irregular heart beat	78	0.51	0.04	29.17
Mentha x piperita L.	Lamiaceae	Nane		Leaves	Infusion, Decoction	Stomachache, colds, headache, halitosis	148	0.97	0.03	34.72
Rosmanirus officinalis L.	Lamiaceae	Biberiye		Leaves, Flowering shoots	Infusion	Lung disease, headache, nervous disorders, skin pimples	68	0.45	0.06	34.72
Salvia officinalis L.	Lamiaceae	Adaçayı		Leaves	Infusion	Carminative, indigestive, tooth and throat inflammation, skin diseases, rheumatism	126	0.83	0.04	44.44
Thymus sp.	Lamiaceae	Kekik		Leaves	Infusion	Stomachache and headache, indigestive, cough, bronchitis, nervous disorders	128	0.84	0.04	40.28
Vitex agnus-castus L.	Lamiaceae	Hayıt	DD	Leaves, Fruits, Seeds	Infusion, Powder	Regulates menses, diuretic, gas troubles	65	0.43	0.05	29.17
[a]*Cinnamomum verum* J.Presl	Lauraceae	Tarçın		Bark	Powder, Infusion, Decoction	Gas troubles, antiseptic, respiratory disorders	113	0.74	0.03	29.17
Laurus nobilis L.	Lauraceae	Defne	LC	Leaves, Fruits	Decoction	Diuretic, rheumatism, digestive, colds	52	0.34	0.08	38.89
Linum usitatissimum L.	Linaceae	Keten tohumu		Seeds	Powder, Decoction	Cough, asthma, purgative, wounds	40	0.26	0.10	30.56
Punica granatum L.	Lythraceae	Nar	LC	Roots, Seeds, Flowers	Powder, Decoction	Hemorrhoids, intestinal worms, wound and skin diseases	47	0.31	0.06	25.00
Ficus carica L.	Moraceae	Yemiş	LC	Fruit, Leaves	Unprocessed fruit, Latex	Food, Hemorrhoids, laxative, latex used in skin diseases, aphrodisiac	82	0.54	0.05	34.72
[a]*Morus alba* L.	Moraceae	Dut		Fruit, Leaves	Unprocessed fruit, Decoction, Molasses	Sore throat, anemia, food	53	0.35	0.04	19.44
[a]*Eucalyptus camaldulensis* Dehnh.	Myrtaceae	Ökaliptus	NT	Leaves	Infusion, Oil	Hemorrhoids, respiratory disorders, rheumatism	22	0.14	0.14	29.17
Myrtus communis L.	Myrtaceae	Murt	LC	Leaves and Fruits	Infusion, Oil, Powder	Diarrhea, skin disorders, wounds, eczema, heart diseases	44	0.29	0.11	40.28
Peganum harmala L.	Nitrariaceae	Üzerlik		Seeds, Roots	Infusion, Paste	Hemorrhoids, eczema, nervous disorders, intestinal worms	54	0.36	0.07	34.72
Fumaria officinalis L.	Papaveraceae	Şahtere		Whole plant	Decoction	Liver disorders, diabetes	8	0.05	0.25	19.44
Plantago major L.	Plantaginaceae	Damar otu	LC	Flowers	Infusion, Paste	Asthma, sore throat, wounds, constipation	68	0.45	0.06	38.89
[a]*Piper nigrum* L.	Piperaceae	Karabiber		Seeds	Decoction, Powder	Toothache, stomachache, hyperuricemia, rheumatism,	125	0.82	0.03	38.89
Portulaca oleracea L.	Portulacaceae	Semiz otu, Soğukluk		Shoots	Decoction	Food, intestinal disorders	74	0.49	0.01	9.72
Nigella sativa L.	Ranunculaceae	Çörekotu		Seeds	Smoke, Decoction	Flu, asthma, urinary diseases, diabetes, menorrhagia, food	65	0.43	0.06	44.44
Frangula alnus Miller.	Rhamnaceae	Barut ağacı	LC	Bark of brunches	Decoction	Purgative	23	0.15	0.04	9.72
[a] *Ziziphus jujuba* Mill.	Rhamnaceae	Hünnap	LC	Fruit, Leaves	Infusion	Cough and expectorant, diarrhea, blood purification, as heart tonic	17	0.11	0.29	44.44
Crataegus orientalis L.	Rosaceae	Alıç		Fruit, Leaves	Vinegar, Infusion	Controls blood pressure and diabetes, irregular heartbeat, nervous system disorders, diarrhea	72	0.47	0.07	44.44
Cerasus mahaleb L.	Rosaceae	Mahlep	LC	Seeds	Powder	Expectorant, control blood glucose, aphrodisiac, stomach gas, diabetes	22	0.14	0.23	44.44
Mespilus germanica L.	Rosaceae	Muşmula	LC	Fruit, Leaves, Seeds	Infusion, Leaves paste	Stomach and intestinal disorders, diarrhea, flu and cold	34	0.22	0.12	30.56
Rosa canina L.	Rosaceae	Kuşburnu		Fruits	Infusion, Marmalade	Cold, diuretic, anemia, rheumatism	128	0.84	0.03	34.72
Viscum album L.	Santalaceae	Ökse otu		Leaves, Shoots, Fruits	Infusion, Paste	Cholesterol lowering, rheumatism, wounds, anticancer	33	0.22	0.12	38.89

Species	Family	Turkish name	IUCN	Preparation	Part used	Uses				
[a]Capsicum annuum L.	Solanaceae	Pul biber	LC	Powder	Fruits	Cold, rheumatism, analgesic	83	0.55	0.04	29.17
Mandragora autumnalis Bertol.	Solanaceae	Kan kurutan	LC	Infusion	Roots, Seeds	Asthma, cough, wounds, eczema	21	0.14	0.19	34.72
[a]Camellia sinensis (L.) Kuntze	Theaceae	Çay		Infusion	Leaves	Diuretic	77	0.51	0.01	9.72
Tilia platyphyllos Scop.	Tiliaceae	Ihlamur	LC	Decoction	Flowers, Leaves	Cold, sedative, insomnia	142	0.93	0.02	25.00
Urtica dioica L.	Urticaceae	Isırgan	LC	Infusion, Decoction	Whole plant	Expectorant, hair care, anti-inflammatory, wounds, cancer, diabetes, hemorrhoids, rheumatism, aphrodisiac	61	0.40	0.15	83.33
Vitis vinifera L.	Vitaceae	Asma	LC	Unprocessed fruit, Molasses	Fruits, Leaves	Laxative, diuretic, diarrhea, wounds	35	0.23	0.11	34.72
[a]Curcuma longa L	Zingiberaceae	Zerdeçal	DD	Decoction, Powder	Roots	Heal pimples and wounds, stomachache, fever, cough, constipation, anemia, anticancer,	95	0.63	0.07	59.72
[a]Zingiber officinale Roscoe	Zingiberaceae	Zencefil	DD	Powder, Decoction	Roots	Cough, pneumonia, help digestion, gastritis, control blood pressure	103	0.68	0.05	40.28
Tribulus terrestris L.	Zygophyllaceae	Deve Çökerten		Decoction	Roots and Shoots	Hemorrhoids, renal disorders	42	0.28	0.05	19.44

[a] Exotic plant taxa, not native for the Flora of Turkey.

(Table 3). When conducting surveys of customers, we found that the same medicinal plants are used to treat diabetes and cholesterol, and to increase breast milk. Therefore, we were not surprised to find the highest ICF values for endocrine system disorders. Dalar et al. (2018) found the highest ICF values for similar ailment categories (cancer-lymphatic system 0.93; diabetes-endocrine system 0.92 and respiratory system 0.92) in the Ağrı region.

3.5. Threats and conservation challenges

According to the IUCN, approximately 40—45% of the global medicinal plant flora is under threat to various degrees (Allen et al., 2014). In the present study, we identified 26 medicinal and aromatic plants used in Kahramanmaraş that are under threat on a global scale (24 taxa LC, 1 taxon NT and 1 taxon VU). Three taxa have been designated Data Deficient (DD) because there is not enough data on their area of occupancy. Twenty threatened taxa are either trees or shrubs, and among these, *Rhus coriaria* L. is the one with the highest threat category (VU). Other threatened woody taxa with versatile uses as medicinal and aromatic plants are *Juglans regia*, *Laurus nobilis* L. and *Juniperus drupacea*. The fruity shoot and leaves of *Rhus coriaria* are cut for medicinal and aromatic purposes. The use of this taxon, which is native to the Mediterranean basin and grows widely in almost all soil conditions in nature, does not pose a serious threat to the continuity of the plant. Another threatened woody taxon, *J. regia* (RI: 50.00), is widely cultivated throughout the country. *L. nobilis* (RI: 38.89) has been used since ancient Greece and Rome, and today has an important place in Turkey's foreign trade (MAF, 2016). It covers an area of approximately 131,862 ha and has an average production potential of 12.2 tons a year (Ok and Tengiz, 2018). Laurel leaf production is regulated according to both the principles of the rescript, numbered 302 of the General Directorate of Forestry and the annual production programs. According to the IUCN, *J. drupacea* (RI: 34.72), a Mediterranean tertiary relict, has a stable population on a global scale (Gardner, 2013). Mature fallen cones are collected to make molasses from these trees, which poses no threat to the species. The threatened herbaceous taxa *Capsicum annuum* L. and *Apium graveolens* are cultivated, and are therefore not threatened by intensive use as medicinal and aromatic plants.

Some traded and threatened herbaceous plants, such as *Achillea millefolium*, *Plantago major* L. and *Urtica dioica*, are collected directly from the nature. *U. dioica* and *A. millefolium* are among the 10 plants with the most versatile use (RI: 83.33 and 59.72 respectively). In addition, *U. dioica* is among the plants with the highest consumption level. It is essential to do more research on these extensively used herbaceous plants and to identify and manage their critical habitats. Ecological studies should be brought to the forefront to protect the traditionally used medicinal plants and their in-situ conservation. Additionally, the sustainable use of these plants requires supplementing wild plant collection with an increased number of medicinal and aromatic plant gardens throughout the country. Our interviews revealed that people have limited information about both the highly consumed plants and the plants with high ethnobotanical index values (UV, RI, RFC). Both customers and herbalists have limited information about medicinal plants. Given the demand for herbal medicine, the low educational level of herbalists is a major concern. Other studies performed in Turkey by Başer et al. (1986), Adıgüzel and Kızılaslan (2016), Akbulut (2015) reported that most herbalists in have low educational levels. Our interviews also indicated that only one herbalist received a university education related to medicinal and aromatic plants; in contrast, the other herbalists learned from masters or were self-taught. Some herbalists stated that they do not have sufficient

Table 3
Informant Consensus Factor (ICF) for the categorized ailments.

No	Ailment Category	Number of Use Report	Number of taxa	ICF
1	Circulatory system	17	9	0.50
2	Digestive system	81	43	0.48
3	Endocrine system	46	11	0.78
4	Immune system	20	14	0.32
5	Lympatic system	9	3	0.75
6	Body's muscular system	0	0	0.00
7	Nervous system	28	14	0.52
8	Reproductive system	21	11	0.50
9	Skeletal system	44	17	0.63
10	Respiratory system	96	28	0.72
11	Urinary system	58	19	0.68
12	Skin or Integumentary system	64	22	0.67

knowledge about the collection, drying, and offering of plants for sale. Also, storage methods of plants varied among herbal markets. It was not possible to discover whether products were collected by herbalists or vendors. Information on collection time and expiry date of the products were not included on the product labels. We recommend that provincial health directorates conduct regular detailed inspections of herbal markets to ameliorate these deficiencies. In addition, brochures or booklets containing important, easy-to-understand information about plants should be prepared and distributed to both herbalists and customers. These materials should describe the characteristics of the plant, which disease it is good for, as well as when it should not be used. Workshops or informative meetings should be organized to increase the confidence and self-esteem of herbalists, supplement their current knowledge, and provide information about the laws.

It is of great importance to record local traditional ecological information, which is defined as the knowledge, practices, and beliefs that arise over time from the relationship between people and their environment (Berkes et al., 2000). Scientific ethnobotanical research and national/international projects that record traditional ecological knowledge should be continued and disseminated. For this purpose, in 2017 the Turkish Ministry of Agriculture and Forestry launched the "Project of Recording Traditional Information Based on Biodiversity". This project compiles previous scientific publications and interviews that record traditional information on plant diversity in Turkey. Importantly, interviews focus on elderly populations that live in villages greatly influenced by geographical features, historical background, and cultural heritage. The project aims to complete field studies in all provinces by 2023 (MAF, 2020). In order to protect the natural habitats and traditional uses of medicinal plants, developmental agencies, universities, forest regional directorates, and local governments should collaborate on research projects.

4. Conclusions

The results of the study are consistent with the use of medicinal plants by local people. The plants that are frequently used by the local people have always been in the top ranks in both sales and ethnobotanical indices. Results identified 62 plant taxa traded in herbal markets of Kahramanmaraş, 11 of which are imported. Some imported plants were even among the top 10 taxa sold by herbalists (such as *Zingiber officinale*, *Senna alexandrina*). We found that medicinal plants were most commonly used to treat the digestive

system. Of the 62 plant taxa evaluated in the study, 43 were used for digestive system ailments. This study is the first to use ethnobotanical indices to evaluate data on herbal markets and the uses of medicinal plants by local people in Kahramanmaraş city. The use of these ethnobotanical indices (e.g., UV, RI, RFC, and ICF) helped identify important plant species that have traditional uses previously unknown to researchers. The average ICF value was high (0.60), which indicates that the participants agreed on medicinal plants used for the ailments.

In recent years, environmental challenges and modern diseases have diversified the reasons people use medicinal plants, which has led to increased consumption. This increased demand brings with it both overuse and misuse due to lack of knowledge. Therefore, people should be informed about the correct usage and dosage of medicinal plants and, most importantly, try to spread the awareness that these are exhaustible resources. Creating this awareness is especially important for younger generations both in terms of sustainable use of plants and protection of traditional knowledge. This study was carried out to protect the information about the local uses of plant species, to transfer them to future generations, and to provide preliminary information for future studies.

Author contributions

Seyran Palabaş Uzun designed the study, performed botanical identification of plant species, data analysis and writing of the manuscript. Cennet Koca performed traditional medicinal plants surveys and preparation of herbarium samples.

Declaration of competing interest

The authors hereby declare that they have no conflict of interest.

Appendix I

First Part.

1. Age of herbalist
2. Gender of herbalist
3. Education level of herbalist
4. How they obtained the knowledge of herbalism
5. Active years at herbal market, number of employees, number of products, annual turnover
6. Monthly earnings of herbalist

Second Part.

7. How they buy their products?
8. Top-selling plant species.
9. Where or from whom they buy the products they sell?
10. How often they buy medicinal plants?
11. How they get information about plants?

Appendix II

Date: —— Informants name:—— Age: ——
1. Local name of plant: —— 2. Part of plant:—— 3. Diseases being treated:—— 5. How to use it (powder, pulp, tea, etc.) —— Internal □ External □

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