

## Medicinal Vascular Plants Traditionally Used for Treating Respiratory Ailments in Dereboğazı Village (Erzurum, Türkiye)

Arzu ERGÜL BOZKURT<sup>1\*</sup>

<sup>1</sup> Department of Botany, Faculty of Forestry, Artvin Çoruh University, Artvin, Türkiye

\*<sup>1</sup> arzu.ergulbozkurt@artvin.edu.tr

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**Abstract:** This study was conducted to investigate the traditional medicinal plants used by local people in order to treat various types of respiratory disorders in Dereboğazı village (Erzurum). The present ethnomedical study was conducted in Dereboğazı (Palandöken, Erzurum - East Anatolia), between 2019-2020 years. Information on the ethnobotanical use of plant taxa were gathered through in-person interviews with Dereboğazı people and recorded using a questionnaire form. In order to gather ethnomedical data, 63 informants—16 men and 47 women—participated in the study. Samples of plants were prepared and placed in the Herbarium of Karadeniz Technical University Faculty of Forestry (KATO). This study reported 32 native and exotic vascular plant taxa from 13 families and 24 genera from Dereboğazı being ethnomedicinally used for treating various types of respiratory problems such as asthma, bronchitis, common cold, cough, flu and sore throat. The most common traditional method of using plants for therapeutic purposes is decoction (23 plant taxa). As a result of the study, the families with the highest number of plant taxa were Lamiaceae (9 taxa), Rosaceae (6), Asteraceae and Moraceae (3). The most commonly used plant parts by the local people were identified as aerial parts (13 taxa), fruits (8 taxa), leaves and dried fruits (7 taxa) and flowers (6 taxa). The present and similar studies, which include ethnomedical information on biological resources, will contribute to the field of pharmacy and medical science.

**Key words:** Türkiye, medicinal plants, ethnomedicine, respiratory ailments.

### Dereboğazı Köyünde (Erzurum, Türkiye) Solunum Rahatsızlıklarının Tedavisinde Geleneksel Olarak Kullanılan Damarlı Tıbbi Bitkiler

**Öz:** Bu çalışma, Dereboğazı köyünde (Erzurum) çeşitli solunum yolu rahatsızlıklarını tedavi etmek için yerel halk tarafından kullanılan geleneksel tıbbi bitkileri araştırmak amacıyla yapılmıştır. Bu etnomedikal çalışma 2019-2020 yılları arasında Dereboğazı'nda (Palandöken, Erzurum - Doğu Anadolu) gerçekleştirilmiştir. Bitki taksonlarının etnobotanik kullanımına ilişkin bilgiler Dereboğazı halkı ile yüz yüze görüşmeler yoluyla toplanmış ve bir anket formu kullanılarak kaydedilmiştir. Etnomedikal veri toplamak amacıyla çalışmaya 16 erkek ve 47 kadın olmak üzere 63 kişi katılmıştır. Bitki örnekleri hazırlanarak, Karadeniz Teknik Üniversitesi Orman Fakültesi (KATO) Herbariumuna yerleştirilmiştir. Bu çalışmada, Dereboğazı'nda etnomedikal olarak astım, bronşit, soğuk algınlığı, öksürük, grip ve boğaz ağrısı gibi çeşitli solunum problemlerinin tedavisinde kullanılan 13 familya ve 24 cinse ait 32 yerli ve egzotik vasküler bitki taksonu tespit edilmiştir. Bitkilerin tedavi amaçlı kullanımında en yaygın geleneksel yöntem kaynatmadır (23 bitki taksonu). Çalışma sonucunda en fazla bitki taksonuna sahip familyalar Lamiaceae (9 takson), Rosaceae (6), Asteraceae ve Moraceae (3) olmuştur. Yerel halk tarafından en yaygın olarak kullanılan bitki kısımları toprak üstü kısımları (13 takson), meyveler (8 takson), yapraklar ve kurutulmuş meyveler (7 takson) ve çiçekler (6 takson) olarak tespit edilmiştir. Biyolojik kaynaklar hakkında etnomedikal bilgiler içeren bu ve benzeri çalışmalar eczacılık ve tıp bilimi alanına katkı sağlayacaktır.

**Anahtar Kelimeler:** Türkiye, şifalı bitkiler, etnomedikal, solunum rahatsızlıkları.

#### 1. Introduction

Botany is the genesis of the present idea of ethnobotany; in fact, medicine and botany have always been closely related, and many contemporary medications have plant roots [1, 2]. Although medicinal plants have been used to treat illnesses since ancient times, the usage of phyto-therapeutic substances has significantly expanded in the past ten years. According to the WHO (World Health Organization), 11% of critical medications are derived from plants, and 80% of people worldwide use phyto-therapeutic substances to meet their basic health-related needs [3, 4]. In many regions of the world, using herbal treatments to treat respiratory conditions is standard practice. Approximately 53,000 plant species are utilized medicinally worldwide [5, 6]. Worldwide, respiratory ailments are a prevalent and significant cause of illness and mortality [7]. The respiratory system is most frequently

\* Corresponding author: [arzu.ergulbozkurt@artvin.edu.tr](mailto:arzu.ergulbozkurt@artvin.edu.tr). ORCID Information: <sup>1</sup> 0000-0003-0612-8120

affected by bronchitis, asthma, the common cold, coughing, flu, and sore throats. Respiratory problems are common in Erzurum due to its harsh climate and cold temperatures.

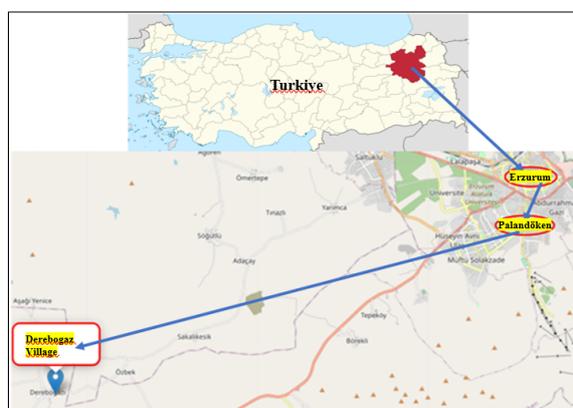
When it comes to medication design and development, ethnobotany and ethnopharmacology have proven to be effective methods for establishing folk medicinal knowledge in various regions or ethnic groups. Effective treatments for mild to moderate health issues, as well as occasionally for severe and acute conditions, have long been offered by phytotherapy. In medicine, the term “respiratory tract diseases” refers to any pathological problems that impact the lungs, bronchi, or nasal passages. These health issues include vague symptoms like dyspnea and range from acute infections like pneumonia and bronchitis to long-term illnesses like asthma and chronic obstructive pulmonary disease (COPD). Only minor respiratory infectious ailments are treated with alternative medicine these days; more serious conditions are handled in hospitals [8-11].

Türkiye is the richest country in Europe in terms of plant species diversity and richness with approximately 12,000 plant taxa. In addition, since about 4000 of these plant taxa are endemic, it has a very rich flora in terms of endemism rate. Due to this diversity and richness, people in Türkiye have widely used plants for various purposes (for making, fuel, food, clothing and treatment) for centuries. In recent years, due to the increasing dependence on synthetic drugs and the high number of side effects of these drugs, people's orientation towards nature has come back to the spotlight. Erzurum is a city with an extreme weather conditions (of -37 °C in winter and 36 °C in summer). Therefore, the inhabitants (humans, plants and animals) of Erzurum must be able to tolerate a temperature range of up to 73°C. Cold weather conditions cause widespread cold-related illnesses in the region. Many medicinally significant plants have been utilized for millennia to treat respiratory conditions in the region, particularly by the rural populace [12, 13]. This study aims to evaluate the effectiveness of plant taxa in treating respiratory ailments and to document the traditional medicinal uses of plants in Dereboğazı (Palandöken, Erzurum). Respiratory ailments are common in the study area due to extreme climatic conditions. It is thought that this research will contribute the future studies in the region.

## 2. Materials and Methods

### 2.1. Study Area

Erzurum is a city at an elevation of 1850 meters and Palandöken is located in the 2200-3176 meter altitude zone. The Palandöken Mountains span an area approximately 70 km in length and 25 km in width. The Eastern Anatolia Region, where Palandöken is situated, has a continental climate. Erzurum experiences a long-term average annual temperature of 5.7°C, with harsh winters and extreme seasonal variations ranging from -37°C in winter to 36°C in summer. Snow remains on the ground for 113 days in a year, and there is an average of 429 mm of precipitation per year [13, 14]. In the Eastern Anatolia Region of Türkiye, Palandöken is one of the major districts that make up the city center of Erzurum. Among the three villages of the Palandöken district (Dereboğazı, Güzelyurt, Yukarıyenice), Dereboğazı is the largest in terms of population and residential area. In Erzurum, which became a metropolitan city in 1993, Dereboğazı gained the status of a rural neighborhood in Palandöken district of Erzurum province when villages became neighborhoods due to the metropolitan law. Dereboğazı is situated between 39° 49' 12" North and 41° 01' 30" East GPS (Global Positioning System) coordinates [15] (Figure 1).



**Figure 1.** The map showing the location of Dereboğazı in Türkiye (Adapted from [16, 17]).

Photographs of the research area taken from the field are shown in Figure 2 in winter days.



**Figure 2.** Photographs of the research area during cold winter days.

The harsh climatic conditions and significant altitude variations in Palandöken contribute to the unique floristic composition of the region, which has historically supported the local use of medicinal plants.

## 2.2. Gathering And Analyzing Data

This study was carried out between 2019-2020 years. Snowball method was applied to determine which plants people living in the research area use for the treatment of respiratory ailments. The Snowball approach's primary objective is to identify subject-matter experts, and this study was conducted with rural residents of Dereboğazi, Erzurum, to achieve this goal. Locals were interviewed in-person to gather information on the applications of these plants, and a survey form was used to document the information. In addition to giving knowledge on plants, the locals offered to show samples of plants in their natural habitat. Before each interview began, an oral Prior Informed Consent (PIC) was obtained. Information including the respondents' age, gender, degree of education, and occupation were all included in the survey form. "Flora of Turkey and the East Aegean Islands" [18] was used to identify plant taxa. Samples of plants were prepared and placed in the Herbarium of Karadeniz Technical University Faculty of Forestry (KATO). The demographic data of the informants is showed in Table 1.

**Table 1.** The demographic data of the informants.

| Characteristics |                  | The quantity of informants | Percentage (%) |
|-----------------|------------------|----------------------------|----------------|
| Gender          | Male             | 16                         | 25.40          |
|                 | Female           | 47                         | 74.60          |
| Education level | Illiterate       | 11                         | 17.46          |
|                 | Primary school   | 17                         | 26.98          |
|                 | Secondary school | 10                         | 15.87          |
|                 | High school      | 15                         | 23.81          |
|                 | University       | 10                         | 15.87          |
| Age ranges      | 20-30            | 5                          | 7.94           |
|                 | 31-41            | 9                          | 14.29          |
|                 | 42-52            | 6                          | 9.52           |
|                 | 53-63            | 13                         | 20.63          |
|                 | >64              | 16                         | 25.40          |
| Employment      | Housewife        | 32                         | 50.79          |
|                 | Artisan          | 3                          | 4.76           |
|                 | Worker           | 4                          | 6.35           |
|                 | Farmer           | 4                          | 6.35           |
|                 | Student          | 5                          | 7.94           |
|                 | Self-employment  | 3                          | 4.76           |
|                 | Retired          | 7                          | 11.11          |
|                 | Teacher          | 3                          | 4.76           |
| Engineer        | 2                | 3.17                       |                |

Use-value (UV) was calculated for the plants in the research region. The frequency with which people use plants in their daily lives can be measured using UV ( $UV = U / N$ , U: the quantity of reports about plant utilization, V: the quantity of informants) [19-21]. Use-Value (UV) is a quantitative measure of the relative importance of plant species based on their frequency of use by the informants. It helps identify the most culturally and medicinally significant plants in the study area.

While preparing the questionnaire applied in the field, specifically it was sought to answer the following questions:

1. Which types of plants are most frequently used to treat respiratory ailments?
2. What are the local names of the plants you use for medicinal purposes?
3. In ethno-preparations, which plant parts are most frequently used?
4. Which methods of preparation are frequently employed for creating medical recipes?
5. Which utilization method you use?
6. Which respiratory ailments (asthma, bronchitis, common cold, cough, flu and sore throat) is this herb good for?
7. Which mixture types of medicinal plants are most frequently used to treat respiratory ailments?

It may providing answers to these questions would aid in determining the plant taxa might be investigated further in the domains of medicine and pharmacy.

### 3. Results And Discussion

In-person surveys of 63 residents in the study area revealed that 75% of respondents identified as female and 25% as male. As a result of the study, it was concluded that women were generally more knowledgeable about medicinal plants and more willing to share this information. It is thought that this situation is due to the various responsibilities (childcare, cooking responsibilities, efforts to cure diseases, etc.) that women have assumed in societies from past to present. In this study, the vascular plant taxa and their traditional uses for treating respiratory conditions by local people were documented (Table 2).

**Table 2.** Traditional medicinal plants used in Dereboğazi, Palandöken (Erzurum) to treat respiratory ailments.

| Family       | Botanical name                                      | Local name            | Plant parts              | Uses/ailments treated        | Preparations                              | Utilization method                 | UV   | Herbarium No (KATO) |
|--------------|---|-----------------------|--------------------------|------------------------------|---|------------------------------------|------|---------------------|
| Aceraceae    | <i>*Acer negundo</i> L.                             | Akçağaç               | Seed                     | Cough                        | Decoction                                 | Drinking                           | 0.07 | 22474               |
| Asparagaceae | <i>Asparagus persicus</i> Baker                     | Meroji, Zazık         | Aerial parts             | Respiratory ailments, Asthma | Infusion                                  | Drinking                           | 0.17 | 22478               |
| Asteraceae   | <i>Anthemis cretica</i> L.                          | Papatya               | Flowers                  | Cold, Sore throat            | Decoction                                 | Drinking                           | 0.80 | 22489               |
|              | <i>Tanacetum coccineum</i> (Willd.) Grierson        | Sendel otu            | Aerial parts,<br>Flowers | Respiratory ailments         | Infusion                                  | Drinking                           | 0.71 | 22460               |
|              | <i>Taraxacum bessarabicum</i> (Hornem.) Hand.-Mazz. | Karahindiba           | Flowers                  | Cold                         | Decoction                                 | Drinking                           | 0.50 | 22468               |
| Boraginaceae | <i>Alkanna orientalis</i> (L.) Boiss.               | Hevaju                | Leaves                   | Sore throat                  | Decoction                                 | Drinking                           | 0.33 | 22490               |
| Fumariaceae  | <i>Fumaria asepala</i> Boiss.                       | Şahtere               | Aerial parts             | Respiratory ailments         | Fresh                                     | Eating                             | 0.14 | 22487               |
| Juglandaceae | <i>Juglans regia</i> L.                             | Ceviz                 | Fruits, Seeds            | Respiratory ailments         | Fruit and seeds soaked in water overnight | Drinking                           | 0.07 | 22493               |
| Lamiaceae    | <i>Mentha aquatica</i> L.                           | Pungi, Pune, Sunanesi | Aerial parts, Flowers    | Cough, Sore throat, Asthma   | Decoction, Dried                          | Drinking, Adds to soups as a spice | 0.58 | 22494               |
|              | <i>M. longifolia</i> (L.) L.                        | Yarpuz, pungi         | Aerial parts, Flowers    | Cough, Sore throat, Asthma   | Decoction, Dried                          | Drinking, Adds to soups as a spice | 0.61 | 22491               |
|              | <i>Micromeria fruticosa</i> (L.) Druce              | Taş nanesi, Daş anığı | Aerial parts             | Cold, Flu                    | Decoction                                 | Drinking                           | 0.36 | 22485               |
|              | <i>Origanum acutidens</i> (Hand.-Mazz.) Ietsw.      | Anih                  | Aerial parts             | Cold, Bronchitis             | Infusion                                  | Drinking                           | 0.77 | 22467               |

Continuation of Table 2.

| Family         | Botanical name                          | Local name               | Plant parts   | Uses/ailments treated                  | Preparations                                 | Utilization method                            | UV   | Herbarium No (KATO) |
|----------------|---|--------------------------|---|--|--|---|------|---------------------|
|                | <i>O. rotundifolium</i> Boiss.          | Anih                     | Aerial parts  | Cold, Bronchitis                       | Infusion                                     | Drinking                                      | 0.71 | 22475               |
|                | <i>Salvia nemorosa</i> L.               | Adaçayı                  | Aerial parts  | Respiratory ailments                   | Decoction                                    | Drinking                                      | 0.87 | 22486               |
|                | <i>Satureja hortensis</i> L.            | Kara anuk                | Aerial parts  | Cold, Sore throat, Asthma              | Decoction, Cooked                            | Drinking, Eating                              | 0.82 | 22465               |
|                | <i>Thymus fallax</i> Fisch. & C.A.Mey.  | Kekik                    | Aerial part   | Cough, Sore throat, Flu                | Decoction                                    | Adds to soups as a spice                      | 0.82 | 22481               |
|                | <i>T. sipyleus</i> Boiss.               | Catri, Kekik             | Aerial part   | Cough, Cold, Flu                       | Decoction, Dried                             | Drinking, Adds to soups as a spice            | 0.88 | 22461               |
| Malvaceae      | <i>Alcea apterocarpa</i> (Fenzl) Boiss. | Dolik                    | Flowers   | Cold, Bronchitis                       | Decoction                                    | Drinking                                      | 0.25 | 22477               |
|                | <i>Malva sylvestris</i> L.              | Dolik, Tollik, Ebegümeci | Leaves  | Respiratory ailments                   | Infusion                                     | Drinking                                      | 0.31 | 22472               |
| Moraceae       | <i>Ficus carica</i> L.                  | İncir                    | Dried fruits, Fruits  | Sore throat                            | Decoction with milk, Fresh                   | Drinking, Eating                              | 0.30 | 22495               |
|                | * <i>Morus alba</i> L.                  | Tui, Dut                 | <sup>a</sup> Dried fruit, <sup>b</sup> Leaves, <sup>c</sup> Fruit | Sore throat, Respiratory ailments, Flu | <sup>a,b</sup> Decoction, <sup>c</sup> Fresh | <sup>a,b</sup> Drinking, <sup>c</sup> Eating, | 0.84 | 22479               |
|                | * <i>M. nigra</i> L.                    | Tui, Dut                 | <sup>a</sup> Dried fruit, <sup>b</sup> Leaves, <sup>c</sup> Fruit | Sore throat, Respiratory ailments, Flu | <sup>a,b</sup> Decoction, <sup>c</sup> Fresh | <sup>a,b</sup> Drinking, <sup>c</sup> Eating, | 0.84 | 22464               |
| Plantaginaceae | <i>Plantago lanceolata</i> L.           | Bağa yaprağı, Bağa otu   | Leaves  | Respiratory ailments, Bronchitis       | Decoction                                    | Drinking                                      | 0.57 | 22480               |
|                | <i>P. major</i> L.                      | Bağa yaprağı, Bağa otu   | Leaves  | Respiratory ailments                   | Decoction                                    | Drinking                                      | 0.57 | 22484               |
| Polygonaceae   | <i>Rumex crispus</i> L.                 | Evelik                   | Leaves  | Cold, Bronchitis                       | Cooked                                       | Eating  | 0.80 | 22463               |

Continuation of Table 2.

| Family                             | Botanical name                              | Local name | Plant parts                                     | Uses/ailments treated | Preparations   | Utilization method                            | UV   | Herbarium No (KATO) |
|------------------------------------|---|------------|---|-----------------------|--|---|------|---------------------|
| Rosaceae                           | <i>Crataegus orientalis</i> Pall.ex M.Bieb. | Aluç, Aliç | <sup>a</sup> Fruit,<br><sup>b</sup> Dried Fruit | Cough                 | <sup>a</sup> Marmalade,<br><sup>a</sup> Fresh,<br><sup>b</sup> Decoction | <sup>a</sup> Eating,<br><sup>b</sup> Drinking | 0.61 | 22476               |
|                                    | <i>Rosa canina</i> L.                       | Kuşburnu   | Fruit   | Cold, Cough, Flu      | Decoction, Marmalade   | Drinking, Eating                              | 0.93 | 22470               |
|                                    | <i>R. dumalis</i> Bechst.                   | Kuşburnu   | Fruit   | Cold, Cough, Flu      | Decoction, Marmalade   | Drinking, Eating                              | 0.90 | 22466               |
|                                    | <i>R. spinossisima</i> L.                   | Kuşburnu   | Fruit   | Cold, Cough, Flu      | Decoction, Marmalade   | Drinking, Eating                              | 0.90 | 22482               |
|                                    | <i>Rubus caesius</i> L.                     | Böğürtlen  | Fruit   | Cold, Cough           | Fresh, Marmalade   | Eating  | 0.82 | 22492               |
|                                    | <i>R. idaeus</i> L.                         | Böğürtlen  | Fruit   | Cold, Cough           | Decoction, Marmalade,  | Drinking, Eating                              | 0.82 | 22483               |
| Urticaceae                         | <i>Urtica dioica</i> L.                     | Isırgan    | Aerial parts                                    | Respiratory ailments  | Decoction<br>Cooked  | Drinking,<br>Eating                           | 0.41 | 22469               |
| *Exotic and/or cultivated species. |   |            |   |                       |  |   |      |                     |

The plants that had the highest UV values were *Rosa canina* L. (0.93), *R. dumalis* Bechst. and *R. spinossisima* L. (0.90), *Thymus sipyleus* Boiss. (0.88), *Salvia nemorosa* L. (0.87), *Morus alba* L., and *M. nigra* L. (0.84). The plants with the lowest UV values were *Acer negundo* L. and *Juglans regia* L. (0.07), *Fumaria asepala* Boiss. (0.14) and *Asparagus persicus* Baker (0.17) (Table 2). The most commonly used utilization method is drinking (28 plant taxa) (Table 2).

Photographs of the plant taxa, which were identified in the research area, taken from the field are shown in Figure 3, Figure 4 and Figure 5.

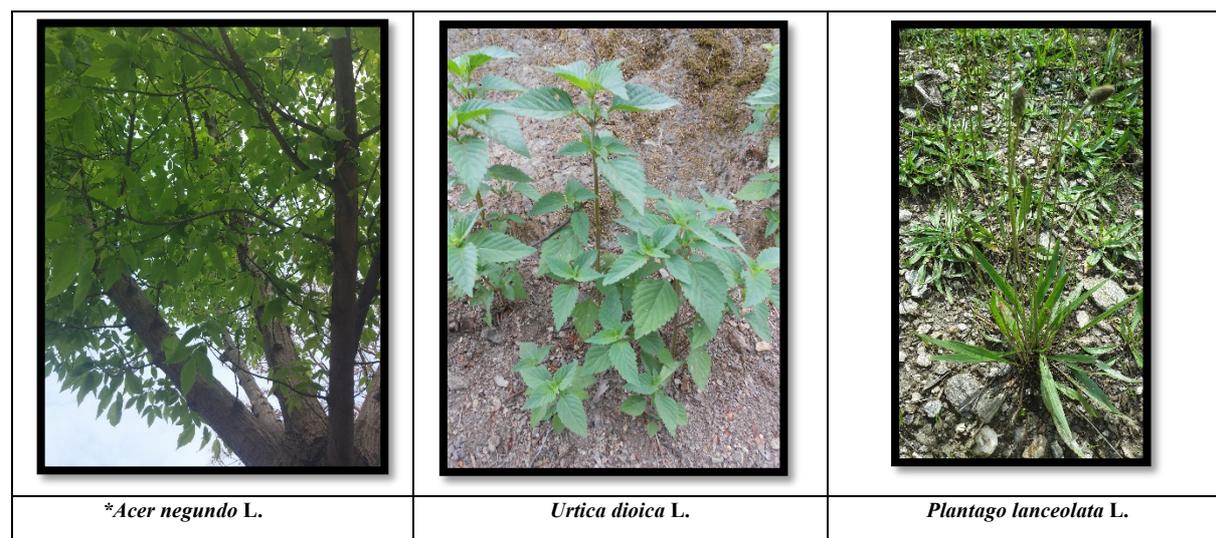
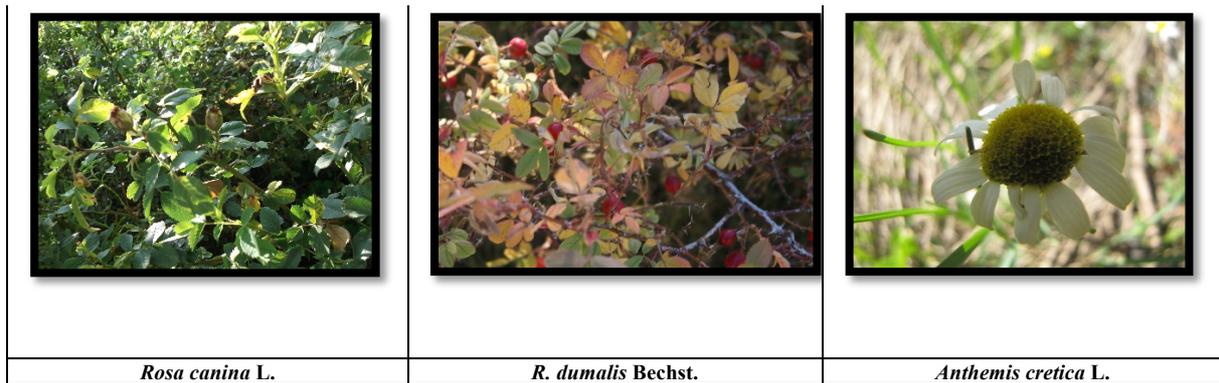


Figure 3. Field photographs of medicinal plant taxa in this study.

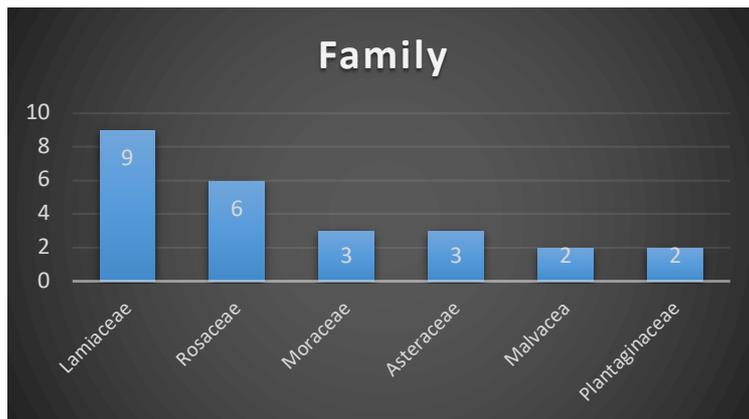
|   |   |   |
|---|---|---|
|    |    |    |
| <i>Taraxacum bessarabicum</i> (Hornem.)<br>Hand.-Mazz.                              | <i>Mentha longifolia</i> (L.) L.  | <i>Juglans regia</i> L.   |
|   |   |   |
| <i>Salvia nemorosa</i> L.   | <i>Rumex crispus</i> L.   | <i>Thymus sipyleus</i> Boiss.   |
|  |  |  |
| <i>Ficus carica</i> L.  | * <i>Morus nigra</i> L.   | <i>Plantago major</i> L.  |
|  |  |  |
| <i>Tanacetum coccineum</i> (Willd.) Grierson  | <i>Thymus fallax</i> Fisch. & C.A.Mey.  | <i>Rubus idaeus</i> L.  |

Figure 4. Field photographs of medicinal plant taxa in this study, continued.

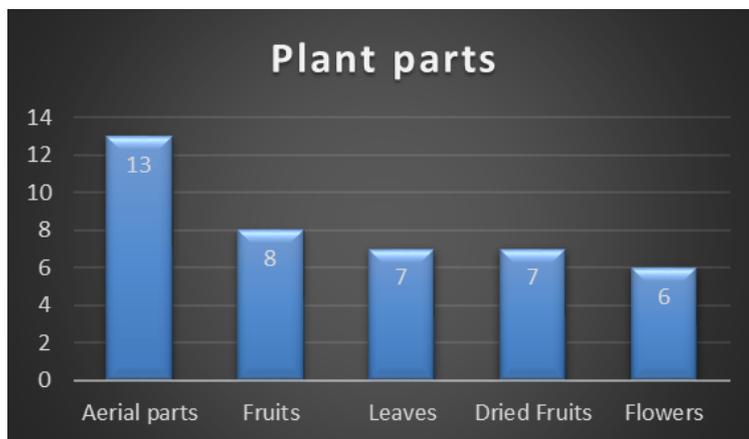


**Figure 5.** Field photographs of medicinal plant taxa in this study, continued.

The Lamiaceae (9 plant taxa), Rosaceae (6 plant taxa), Asteraceae, and Moraceae (3 plant taxa) were the most frequently used families among the 32 plant taxa documented (Figure 6). The plant taxa with medicinal importance in the families identified in the research area are thought to have a widespread use depending on the density of their presence in the region. Aerial parts (13 plant taxa) were most frequently used in the preparations and applications, followed by fruits (8 plant taxa), leaves (7 plant taxa), and flowers (6 plant taxa) (Figure 7). Decocision was found to be the most commonly used traditional medicine making method (23 plant taxa) (Figure 8).



**Figure 6.** The most numerous plant taxonomic families.

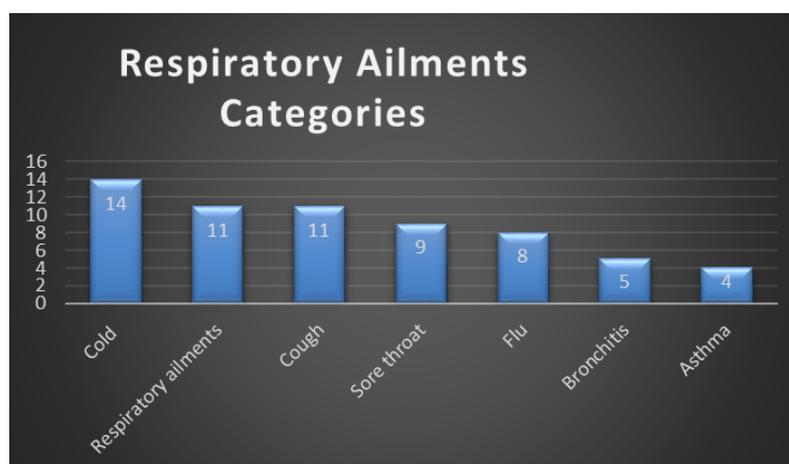


**Figure 7.** The plant sections that are most commonly utilized.



**Figure 8.** Methods for making traditional medications.

When it came to the treatment of illnesses, local people most commonly used medicinal plants for cold There are fourteen plants: eleven for coughing and respiratory conditions, nine for sore throats, eight for the flu, five for bronchitis, and four for asthma (Figure 9). Plants used for the treatment of Cough are, *\*Acer negundo* L., *Mentha aquatica* L., *M. longifolia* (L.) L., *Thymus fallax* Fisch. & C.A.Mey., *T. sipyleus* Boiss., *Crataegus orientalis* Pall.ex M.Bieb., *Rosa canina* L., *R. dumalis* Bechst., *R. spinosissima* L., *Rubus caesius* L. and *R. idaeus* L. The following plants are used to treat Respiratory conditions: *Asparagus persicus* Baker, *Tanacetum coccineum* (Willd.) Grierson, *Fumaria asepala* Boiss., *Juglans regia* L., *Salvia nemorosa* L., *Malva sylvestris* L., *\*Morus alba* L., *\*M. nigra* L., *Plantago lanceolata* L., *P. major* L. and *Urtica dioica* L. Plants that are used to cure Asthma include *Asparagus persicus* Baker, *Mentha aquatica* L., *M. longifolia* (L.) L. and *Satureja hortensis* L. Among the plants used to treat colds are *Anthemis cretica* L., *Taraxacum bessarabicum* (Hornem.) Hand.-Mazz., *Micromeria fruticosa* (L.) Druce, *Origanum acutidens* (Hand.-Mazz.) Ietsw., *O. rotundifolium* Boiss., *Satureja hortensis* L., *Thymus sipyleus* Boiss., *Alcea apterocarpa* (Fenzl) Boiss., *Rumex crispus* L., *Rosa canina* L., *R. dumalis* Bechst., *R. spinosissima* L., *Rubus caesius* L. and *R. idaeus* L. Plants that are used to heal sore throats include *Anthemis cretica* L., *Alkanna orientalis* (L.) Boiss., *Mentha aquatica* L., *M. longifolia* (L.) L., *Satureja hortensis* L., *Thymus fallax* Fisch. & C.A.Mey., *Ficus carica* L., *\*Morus alba* L. and *\*M. nigra* L. The following plants are used to treat flu: *Micromeria fruticosa* (L.) Druce, *Thymus fallax* Fisch. & C.A.Mey., *T. sipyleus* Boiss., *\*Morus alba* L., *\*M. nigra* L., *Rosa canina* L., *R. dumalis* Bechst. and *R. spinosissima* L. Among the plants used to cure bronchitis are *Origanum acutidens* (Hand.-Mazz.) Ietsw., *O. rotundifolium* Boiss., *Alcea apterocarpa* (Fenzl) Boiss., *Plantago lanceolata* L. and *Rumex crispus* L.



**Figure 9.** The number of respiratory ailments categories.

There are no existing studies specifically on respiratory diseases in Erzurum region. However, taking into account the ethnobotanical studies conducted in the region, a comparison was made between the data obtained from the current study and previous studies (Table 3). Ergül Bozkurt [22] reported 63 plant taxa from Aziziye district, Erzurum, Türkiye. It has been quoted nine plant taxa with the same uses viz. *Acer negundo* L., *Taraxacum bessarabicum* (Hornem.) Hand.-Mazz., *Fumaria asepala* Boiss., *Micromeria fruticosa* (L.) Druce, *Satureja hortensis* L., *Thymus fallax* Fisch. & C.A.Mey. *T. sipyleus* Boiss., *Alcea apterocarpa* (Fenzl) Boiss., *Crataegus orientalis* Pall.ex M.Bieb. and twelve plant taxa with different use viz. *Juglans regia* L., *Mentha longifolia* (L.) L., *Salvia nemorosa* L., *Plantago lanceolata* L., *P. major* L., *Rumex crispus* L., *Rosa canina* L., *R. dumalis* Bechst., *R. pimpinellifolia* L., *Rubus caesius* L., *R. idaeus* L., *Urtica dioica* L. with 19.05% of new uses reported in present study. Karakaya et al. [23] reported 77 plant taxa from Aziziye district, Erzurum. They have quoted nine plant taxa with the same uses viz. *Anthemis cretica* L., *Mentha aquatica* L., *Origanum rotundifolium* Boiss., *Malva sylvestris* L., *Morus alba* L., *Rumex crispus* L., *Plantago major* L., *Rosa canina* L., *Urtica dioica* L. and seven plant taxa with different use viz. *Alkanna orientalis* (L.) Boiss., *Mentha longifolia* (L.) L., *Juglans regia* L., *Morus nigra* L., *Plantago lanceolata* L., *Crataegus orientalis* Pall.ex M.Bieb., *Rosa pimpinellifolia* L. with 9.09% of new uses reported in present study. Karakaya et al. [24] reported 94 plant taxa from South of Erzurum, Türkiye. They have quoted eight plant taxa with the same uses viz. *Tanacetum coccineum* (Willd.) Grierson, *Mentha aquatica* L., *M. longifolia* (L.) L., *Origanum acutidens* (Hand.-Mazz.) Ietsw., *O. rotundifolium* Boiss., *Malva sylvestris* L., *Morus alba* L., *Rosa canina* L. and nine plant taxa with different use viz. *Anthemis cretica* L., *Alkanna orientalis* (L.) Boiss., *Alcea apterocarpa* (Fenzl) Boiss., *Ficus carica* L., *Morus nigra* L., *Plantago lanceolata* L., *P. major* L., *Rumex crispus* L., *Rosa pimpinellifolia* L. with 9.58% of new uses reported in present study. Özgen et al. [25] reported 70 plant taxa from Ilica District of Erzurum, Türkiye. They have quoted three plant taxa with the same uses viz. *Acer negundo* L., *Mentha longifolia* (L.) L., *Urtica dioica* L. and nine plant taxa with different use viz. *Fumaria asepala* Boiss., *Thymus fallax* Fisch. & C.A.Mey., *T. sipyleus* Boiss., *Plantago major* L., *Rumex crispus* L., *Rosa canina* L., *R. dumalis* Bechst., *R. pimpinellifolia* L., *R. idaeus* L. with 12.86% of new uses reported in present study.

**Table 3.** Similarity and differences between study area and Erzurum province.

| Reference             | Study Area                 | Reported species number | Number of partner species | Similarly used species | Differently used species | Percentage of new uses reported in the current study |
|-----------------------|----------------------------|-------------------------|---------------------------|------------------------|--------------------------|--|
| Ergul Bozkurt, 2024   | Yakutiye district, Erzurum | 63                      | 21                        | 9                      | 12                       | 19.05  |
| Karakaya et al., 2020 | Aziziye district, Erzurum  | 77                      | 16                        | 9                      | 7                        | 9.09   |
| Karakaya et al., 2019 | South of Erzurum, Türkiye  | 94                      | 17                        | 8                      | 9                        | 9.58   |
| Özgen et al., 2012    | Ilica District, Erzurum    | 70                      | 12                        | 3                      | 9                        | 12.86  |

It was attempted to identify the plant taxa with common usage by contrasting the current study with research on respiratory tract conditions carried out globally. Kayani et al. [26], in their study (Gallies- Abbottabad, Northern Pakistan), found that 120 plant taxa were used for the treatment of respiratory tract disorders. *Juglans regia* L. and *Plantago lanceolata* L. taxa were used for the same purpose in the present study and the study by Kayani et al. [26]. Although the species are different, when the studies are compared in terms of genera, *Salvia lanata* Roxb., *Salvia moorcroftiana* Wall. ex Benth, *Thymus serpyllum* L., *Ficus benghalensis* L., *F. palmata* Forssk., *F. religiosa* L., *Plantago ovata* Forssk., *Rumex dentatus* L. species are used in the publications of Kayani et al. [26], while *Salvia nemorosa* L., *Thymus fallax* Fisch. & C.A.Mey., *T. sipyleus* Boiss., *Ficus carica* L., *Plantago major* L., *Rumex crispus* L. species are used in current study. In their study of the eastern Catalan Pyrenees (Iberian Peninsula), Rigat et al. [11] discovered that 99 plant taxa were used to treat respiratory tract conditions. Both this study and the one by Rigat et al. [11] used the same taxa: *Malva sylvestris* L., *Ficus carica* L., *Plantago lanceolata* L., *P. major* L., and *Urtica dioica* L. Even though the species are different, the publications of Rigat et al. [11] use species of *Anthemis arvensis* L., *Mentha pulegium* L., *Origanum majorana* L., *Origanum vulgare* L., *Satureja calamintha* (L.) Scheele subsp. *ascendens* (Jord.) Briq., *Thymus serpyllum* L. subsp. *chamaedrys* (Fries) Celak.,

*T. serpyllum* L. subsp. *nervosus* (GayexWillk.) Nyman., *T. vulgaris* L., *Rosa tomentosa* Sm., *Rubus ulmifolius* Schott, *Urtica urens* L., whereas the current study uses species of *Anthemis cretica* L., *Mentha aquatica* L., *M. longifolia* (L.) L., *Origanum acutidens* (Hand.-Mazz.) Ietsw., *O. rotundifolium* Boiss., *Satureja hortensis* L., *Thymus fallax* Fisch. & C.A.Mey., *T. sipyleus* Boiss., *Rosa canina* L., *R. dumalis* Bechst., *R. pimpinellifolia* L., *Rubus caesius* L. and *R. idaeus* L. In his study of the Saudi Arabia (A review), Dailah, [27] discovered that 41 plant taxa were used to treat respiratory tract conditions. Both this study and the one by Dailah, [27] used the same taxon: *Mentha longifolia* (L.)L. Even though the species are different, the publications of Dailah, [27] use species of *Origanum majorana* L., *Thymus vulgaris* L., *Malva parviflora* L., *Rumex nervosus* Vahl, *Rosa abyssinica* R.Br. On the other hand the current study uses species of *Mentha aquatica* L., *Origanum acutidens* (Hand.-Mazz.) Ietsw., *O. rotundifolium* Boiss., *Thymus fallax* Fisch. & C.A.Mey., *T. sipyleus* Boiss., *Malva sylvestris* L., *Rumex crispus* L., *Rosa canina* L., *R. dumalis* Bechst. and *R. pimpinellifolia* L. Bussmann and Glenn [28] found that 91 plant species were used to treat respiratory conditions in Peru. The identical taxon, *Plantago major* L., was employed in this study as the one conducted by Bussmann and Glenn [28]. Other taxa from the same genus were compared with the plant taxa in the current study and the study by Bussmann and Glenn [28]. While the current study employs species of *Juglans regia* L., *Salvia nemorosa* L., *Satureja hortensis* L., *Thymus fallax* Fisch. & C.A.Mey. *T. sipyleus* Boiss., *Alcea apterocarpa* (Fenzl) Boiss., *Malva sylvestris* L., *Plantago lanceolata* L., *Rubus caesius* L. and *R. idaeus* L., Bussmann and Glenn (2010) used species of *Juglans neotropica* Diels, *Salvia discolor* H.B.K., *S. officinalis* L., *S. sagittata* R. & P., *Satureja pulchella* (H.B.K.) Briquet, *Thymus vulgaris* L., *Alcea rosea* (L.) Cavanilles, *Malva parviflora* L., *Plantago linearis* H.B.K. and *Rubus robustus* C. Presl. In Mauritius, 55 plant species were utilized to cure respiratory ailments, according to Suroowan and Mahomoodally [29]. In this study, the same taxon, *Morus alba* L., was used as in the one by Suroowan and Mahomoodally [29]. The plant taxa in the current study and the work of Suroowan and Mahomoodally [29] were compared with other taxa from the same genus. Suroowan and Mahomoodally [29] employed species of *Mentha piperita* L. and *Thymus vulgaris* L., while the current study uses species of *Mentha aquatica* L., *M. longifolia* (L.) L., *Thymus fallax* Fisch. & C.A. Mey., *T. sipyleus* Boiss., and *Morus nigra* L. According to Haile et al. [30], 96 plant species were utilized in Ethiopia to treat respiratory ailments. There were no shared plant taxa between the current study and Haile et al. (2022). The plant taxa in the present study and the work by Haile et al. [30] were compared with other taxa from the same genus. Haile et al. [30] employed species of *Asparagus africanus* Lam, *Mentha spicata* L., and *Rumex nepalensis* Spreng, while the current study uses species of *Asparagus persicus* Baker, *Mentha aquatica* L., *M. longifolia* (L.) L. and *Rumex crispus* L. In the Moroccan Rif region, 41 plant species were used to cure respiratory conditions, according to Chaachouay et al. [31]. The present study and Chaachouay et al. [31] did not share any plant taxa. Other taxa from the same genus were compared with the plant taxa in this study and the research done by Chaachouay et al. [31]. While the current study employs species of *Mentha aquatica* L. and *M. longifolia* (L.) L., Chaachouay et al. [31] used species of *Mentha suaveolens* Ehrh., *M. saturoioides* R.Br., *M. × citrata* Ehrh, and *M. × rotundifolia* (L.) Huds. According to Fatiha et al. (2017), 66 plant species were used to treat respiratory ailments in the Oum Rbai region. In the current study and Fatiha et al. (2017), the plant taxa *Malva sylvestris* L., *Ficus carica* L., and *Plantago major* L. are prevalent. The plant taxa in this study and the research conducted by Fatiha et al. [32] were compared with other taxa from the same genus. Fatiha et al. [32] employed species of *Mentha pulegium* L. and *Origanum majorana* Moench., while the current study used species of *Mentha aquatica* L., *M. longifolia* (L.) L., *Origanum acutidens* (Hand.-Mazz.) Ietsw., *O. rotundifolium* Boiss., *Plantago lanceolata* L., and *Plantago psyllium* L. In the Oum Rbai region, 82 plant species were used to cure respiratory conditions, according to Kala [33]. There are no species in common between Kala's [33] study and this one. Other taxa from the same genus were compared with the plant taxa in this study and Kala's [33] research. While the current study used species of *Origanum acutidens* (Hand.-Mazz.) Ietsw., *O. rotundifolium* Boiss., *Malva sylvestris* L., and *Ficus carica* L., Kala (2020) used species of *Origanum vulgare* L., *Malva verticillata* L., *Ficus benghalensis* L., *F. racemosa* L., and *F. religiosa* L.

Sbai-Jouilil et al. [34] reported that 98 plant species were used to treat respiratory disorders in the Seksaoua Region (Western High Moroccan Atlas). This study and the one by Sbai-Jouilil et al. [34] do not share any species. The plant taxa in this study and the research of Sbai-Jouilil et al. [34] were compared with other taxa from the same genus. Sbai-Jouilil et al. [34] used species of *Mentha pulegium* L., *Mentha suaveolens* Ehh., *Origanum compactum* Benth., *Thymus broussonnetii* Boiss, and *Thymus saturoioides* Coss., whereas the current study used species of *Mentha aquatica* L., *M. longifolia* (L.) L., *Origanum acutidens* (Hand.-Mazz.) Ietsw., *O. rotundifolium* Boiss., and *Thymus fallax* Fisch. & C.A. Mey.

The present investigation was contrasted with earlier research from a medical and pharmacological perspective. At the end of the study came to the conclusion that traditional plant applications are consistent with pharmacological and medical research (Table 4).

**Table 4.** Pharmacological and Medical importance of the plant taxa in the region.

| Botanical name                                      | Medicinal Importance   | Pharmacological Properties  |
|---|--|---|
| <i>*Acer negundo</i> L.                             | Treatment of eye illness, rheumatism, bruising, hepatic diseases, discomfort and detoxification [35]   | Antioxidant, hepatoprotective, anti-inflammatory, anti-tumor, antidiabetic and anti-obesity properties [35].  |
| <i>Asparagus persicus</i> Baker                     | Treating rheumatic pain and inflammation [36]  | Antinociceptive, anti-inflammatory and acute toxicity effects [36]  |
| <i>Anthemis cretica</i> L.                          | Treatment of gastrointestinal diseases, hemorrhoids, coughs, stomachache and kidney stones [37-41]   | Their antioxidant qualities are responsible for numerous biological actions, including antibacterial, anticarcinogenic and antiproliferation effects [41, 42]                                 |
| <i>Tanacetum coccineum</i> (Willd.) Grierson        | Treatment for a variety of conditions, including ringworm, diabetes, migraine, cholecystitis, dyspepsia, nausea, diarrhea, hypertension, bloating and stomach discomfort and sexually transmitted infections [43-47]   | Immunomodulatory, cytotoxic, antidiabetic, antibacterial, and antioxidant properties [47-53]  |
| <i>Taraxacum bessarabicum</i> (Hornem.) Hand.-Mazz. | Treatment for hepatitis, anorexia, spleen and liver issues, heartburn, dyspepsia and boost immunity against upper respiratory tract infections, bronchitis or pneumonia [54-56]  | Diuretics, cholergics, analgesics, anti-inflammatory, anti-oxidative, anti-carcinogenic, anti-hyperglycemic, anti-coagulatory and prebiotic components [56]                                   |
| <i>Alkanna orientalis</i> (L.) Boiss.               | Utilized to treat a range of infectious illnesses [57-62]  | Antimicrobial and antiviral activity [57-61]. Having cytotoxic and antioxidant properties and deactivating the poisons produced by microbes [62-67]   |
| <i>Fumaria asepala</i> Boiss.                       | Utilized as a raw ingredient to cure skin conditions and is also recognized for its ability to repel insects [68-70]   | Antimicrobial, Antioxidant, Antifungal, antibacterial and anti-inflammatory activities [70-73]  |
| <i>Juglans regia</i> L.                             | Preparations have numerous applications in the treatment of cardiovascular conditions, type II diabetes mellitus, lipid-lowering drugs, anti-inflammatory, anti-microbial, anti-fungal, anti-hypertensive, hepatoprotective, anticoagulation and anticancer [74]               | Antihypertensive, anticancer, antibacterial, antipyretic and analgesic/anti-inflammatory activities [74]  |
| <i>Mentha aquatica</i> L.                           | Natural cure for lung conditions, gastrointestinal issues, and even mental illnesses like depression and epilepsy. And used for diabetes management, prevention of chronic diseases like cardiovascular conditions, neurodegenerative disorders and inflammatory diseases [75] | Antioxidant, antimicrobial, and anti-inflammatory effects [75,76]   |
| <i>M. longifolia</i> (L.) L.                        | Used for respiratory and digestive benefits [77]. Remedy for menstruation issues, respiratory issues, inflammatory issues, infectious infections and gastrointestinal issues [78]  | Keratoprotective, hepatoprotective, anti-inflammatory, anti-parasitic, antimicrobial, anti-insect, antimutagenic, antinociceptive, antioxidant, anti-diarrhea and spasmolytic properties [78] |
| <i>Micromeria fruticosa</i> (L.) Druce              | Used for various inflammatory conditions and in wound healing [79, 80]   | Anti-inflammatory, antioxidant, anti-diabetic, cytotoxic and antitumor activity [80-84]   |
| <i>Origanum acutidens</i> (Hand.-Mazz.) Ietsw.      | Utilized in traditional medicine to treat conditions like headaches, lightheadedness, coughing, flu, gastrointestinal disorders, bronchitis, high blood sugar, diabetes, stomach discomfort, high blood pressure and toothaches [85, 86]                                       | Antimicrobial, antibacterial, natural antiseptic and antioxidant properties [86-89]   |
| <i>O. rotundifolium</i> Boiss.                      | Utilized as an antiseptic, stimulant, stomachic, expectorant, sudofiric, and emmenagogic to treat a variety of illnesses [90,91]   | Antioxidant and antimicrobial activities [91-96]  |
| <i>Salvia nemorosa</i> L.                           | Used for the treatment of Alzheimer's disease, diabetes mellitus and oxidative damages [97], [98]  | Antioxidant, anti-Alzheimer and anti-inflammatory activity [98], [99]   |
| <i>Satureja hortensis</i> L.                        | utilized to treat cholesterol, diabetes, heart disease, cancer, infections, and Alzheimer's disease [100]. Treatment of respiratory diseases, such as coughs and asthma [101]  | Antioxidant, cytotoxic, anti-inflammatory, antiallergic, antifungal, antiseptic, anti-diabetic, antimicrobial and antibacterial activity [100-109]  |

Continuation of Table 4.

| Botanical name                              | Medicinal Importance  | Pharmacological Properties   |
|---|---|--|
| <i>Thymus fallax</i> Fisch. & C.A.Mey.      | Utilized for menstrual issues, digestive disorders, and whooping and convulsive coughs [110-116]  | Antioxidant, antispasmodic, anti-flatulence, digestion, anti-spasm, anti-inflammatory, antimicrobial, antiseptic, antibacterial, antifungal, antitussive, expectorant and analgesic properties [117-124]   |
| <i>T. sipyleus</i> Boiss.                   | Used for the treatment of wound healing, cough, bronchitis, pertussis and gastrointestinal disorders [125, 126]   | Antioxidant, carminative, expectorant, antitussive antibacterial and anti-inflammatory activities [126-128]  |
| <i>Alcea apterocarpa</i> (Fenzl) Boiss.     | Utilized to treat kidney stones, skin disorders, wound, urinary system and pulmonary disorders [129, 130]   | Antioxidant activity [130]   |
| <i>Malva sylvestris</i> L.                  | Utilized in traditional medicine to cure a number of conditions, including constipation, diarrhea, coughs, colds, dysentery, hypertension and skin diseases [131, 132]  | Antioxidant, antimicrobial, hepatoprotective, laxative, anti-inflammatory, antinociceptive, anti-carrageenan, antibacterial and antiproliferative properties [132-135]   |
| <i>Ficus carica</i> L.                      | Utilized to treat a number of illnesses, including skin conditions, ulcers, cancer, anemia, diabetes, leprosy, liver disease, paralysis, digestive, endocrine, reproductive and respiratory systems disorders, gastrointestinal tract and urinary tract infection [136] | Antipyretic, anti-inflammatory, antispasmodic and antiplatelet, antihelminthic, hepatoprotective, anticonstipation effect, hypoglycemic, hypocholesterolemic activity, hypolipidemic activity, anticancer effect, cytotoxic, antiviral, antimutagenic, anti-angiogenic activity, erythropoietic effect, haemostatic effect, antimicrobial activities, antioxidant activity, free radical scavenging activity, immunostimulant, antiwarts activity and Irritant potential [136] |
| * <i>Morus alba</i> L.                      | utilized to reduce blood pressure, strengthen joints, prevent liver damage, treat fever and diabetes, enhance vision and ease urine discharge [137-139]   | Anxiolytic, anti-inflammatory, anti-hyperlipidemic, anti-platelet, antimicrobial, skin-whitening, cytotoxic, anti-inflammatory, antidepressant, cardioprotective and immunomodulatory properties [139]   |
| * <i>M. nigra</i> L.                        | Demonstrated therapeutic and protective effects on the female reproductive system, gastrointestinal tract, liver, kidney and central nervous system (140)   | Skin-whitening, antidiabetic, anti-hyperlipidemic, anti-atherosclerotic, anti-obesity, cardioprotective, cognitively enhancing, hepatoprotective, anti-platelet, anxiolytic, anti-asthmatic, anti-inflammatory, anticancer, antimicrobial, antifungal, immunomodulatory, antidepressant and anthelmintic properties (139-142)  |
| <i>Plantago lanceolata</i> L.               | Cures a range of conditions affecting the skin, reproductive system, digestive system, circulation, cancer, pain management and infections [143]  | Anti-inflammatory, antibacterial, wound-healing, cytotoxic and antiulcerogenic properties [143]  |
| <i>P. major</i> L.                          | Used for the treatment of colds, wounds, diabetes, Kidney pain, Urinary tract infection, Stomatitis, Asthma, bronchitis, Ear ache, influenza and hepatitis [144-151]  | Antiinflammatory, antimicrobial, antioxidant and antitumor properties [151-153]  |
| <i>Rumex crispus</i> L.                     | Utilized to treat vascular disorders, wounds, internal bleeding and helminths [154, 155]  | Anticancer, anthelmintic, analgesic, antibacterial, anti-inflammatory and antiviral properties [155-157]   |
| <i>Crataegus orientalis</i> Pall.ex M.Bieb. | Used to treat heart conditions such as congestive heart failure, angina, hypertension, and arrhythmias [158-160]  | Antinociceptive, antiinflammatory and antioxidant activities [160]   |
| <i>Rosa canina</i> L.                       | Used for the treatment of osteoarthritis, rheumatism and common cold [161]  | Anti-bacterial, antioxidant, anti-cancer, anti-diabetic, anti-obesity, antimutagenic and anticarcinogenic activities [161], [162]  |
| <i>R. dumalis</i> Bechst.                   | Used to treat diarrhea, stomach problems dry cough, abdominal pain, immunity, arthritis, gout, pharyngitis, chills, cardiac insufficiency, blood vessels and urinary issues [163-165]   | Antimicrobial, antioxidant and cytotoxic activities [165, 166]   |
| <i>R. spinosissima</i> L.                   | Used to treat digestive system disorders, the blood, spleen, stomach ailments, abdominal fullness and irregular menstruation [167]  | Antioxidant activity [167]   |
| <i>Rubus caesius</i> L.                     | Used to treat diabetes [168]  | Hypoglycemic effect and antidiabetic activity [168]  |
| <i>R. idaeus</i> L.                         | utilized to stop polyuria, strengthen the kidney, feed the liver and enhance vision [169]   | Hypoglycemic and hypolipidemic, anti-Alzheimer, anti-osteoporosis, hepatoprotective, anti-cancer, skin care, neuroprotective and anti-bacteria properties [169]  |
| <i>Urtica dioica</i> L.                     | used in the treatment of prostatic disease, arthritis, rheumatism, cardiovascular disease and allergic rhinitis [170, 171]  | Antiviral, antiproliferative, anti-infectious, hypotensive, antiulcer, anti-inflammatory, antibacterial, analgesic, antioxidant, anti-cancer and anti-Alzheimer properties [170,171]   |

Humans have relied on nature for their basic necessities throughout history, including the production of food, shelter, clothes, transportation, fertilizers, scents, and, last but not least, medications. The foundation of complex traditional medical systems that have existed for thousands of years and continue to offer humanity new treatments is plants [172]. The global, cross-cultural spread of plant medicine is evidence of its long history. Since its beginnings in prehistory, the use of medicinal plants has progressively expanded throughout the world due to both independent discovery and cultural diffusion. Anthropologists and ethnobotanists from every nation and ethnic group investigated to date have described systematic, organized collections of traditional herbal treatments [173-177]. For this reason, each study supports previous studies and sheds light and opens new horizons for future studies. Possible reasons for overlap or differentiation in plant uses include cultural, climatic or ecological factors. However, this is not an obstacle to the spread of plant use from generation to generation. Due to improved transportation conditions, people are born and raised in different conditions, but continue their lives in different conditions and regions. This provides the opportunity to disseminate ethnobotanical knowledge and to establish links between different geographies and cultures.

#### 4. Conclusion

In addition to offering baseline data for preliminary screening of prospective plants used in respiratory ailments, this work will be useful for phytochemical research using ethnobotanical indices. Given both the positive and negative impacts of these plants, use of herbal therapies could be very important in the healthcare industry. The likelihood of commercializing these plant products is further could be increased by the availability of scientific proof.

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