Ethnobotanical uses of Plantaginaceae taxa in Türkiye

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Ethnobotany Research and Applications 33:58 (2026) - http://dx.doi.org/10.32859/era.33.58.1-24
Manuscript received: 13/02/2026 - Revised manuscript received: 05/02/2026 - Published: 06/02/2026

Review

Abstract

Background: The Plantaginaceae family comprises several genera with long-standing ethnobotanical relevance in Türkiye, particularly *Plantago, Veronica, Digitalis., Linaria, Antirrhinum*, and *Globularia*. This study synthesizes ethnobotanical data derived from theses, regional surveys, and peer-reviewed studies conducted across different phytogeographical regions of Türkiye.

Methods: The key databases used were PubMed, Google Scholar, Web of Science, Scopus, and ScienceDirect. A list of precise keywords was used to improve the literature search process. The keywords included "Plantaginaceae," "traditional medicinal plants," "herbal medicine," "folk medicine," "ethnomedicine," "ethnobotany," "ethnopharmacology," and the geographical phrases "Turkey" and "Türkiye." Published sources from 1990 to 2026 were analyzed.

Results: A total of 144 Use Reports (URs) across 22 taxa belonging to Plantaginaceae are documented including medicinal, food, veterinary, ornamental, and other traditional uses. Medicinal applications dominate the recorded uses, primarily targeting dermatological conditions, gastrointestinal disorders, respiratory ailments, inflammatory diseases, and metabolic disorders. Leaves and aerial parts are the most frequently utilized plant organs, and infusion, decoction, and poultice represent the dominant preparation methods. The prominence of *Plantago* species, particularly *Plantago major, P. lanceolata*, highlights their cultural and therapeutic importance in Turkish folk medicine.

Conclusions: This review provides a comprehensive framework for understanding traditional knowledge patterns within the Plantaginaceae family in Türkiye and underscores their potential for future pharmacological, conservation, and sustainable-use studies.

Keywords: Plantaginaceae; Traditional Medicinal Plants; Ethnobotany; Anatolia; Türkiye

Background

The Plantaginaceae family is characterized by wide ecological diversity and significant ethnobotanical importance in Anatolia. Türkiye is located at the convergence of the Mediterranean, Irano-Turanian, and Euro-Siberian phytogeographical regions (Yıldırım *et al.* 2021). This transitional region, along with considerable geographic variability and climatic gradients, has

allowed for both great species diversity and localized endemism (Davis 1971; Noroozi *et al.* 2019; Izgördü & Akan 2021). *Plantago* L.*, Veronica* L*, Digitalis* Tourn. ex L.*, Linaria* Mill and *Globularia* Tourn. ex L. are among the genera that are well-represented in a variety of habitats, from wetlands and coastal regions to grasslands and alpine places (Eker *et al.* 2016; Xu & Chang 2017). As a result of the widespread presence of these plants, there has been continuous interaction between these plants and local communities, leading to the accumulation and transmission of diverse ethnobotanical knowledge (Fakir *et al.* 2009; Günbatan *et al.* 2023).

From an ethnobotanical point of view, Plantaginaceae species are used in traditional medicine, particularly in the treatment of dermatological, gastrointestinal, respiratory, and inflammatory diseases (Baytop 1984; Tuzlacı 2006). They also play an important role in food, veterinary medicine, and cultural traditions (Batsatsashvili *et al.* 2020). The rich phytochemical components (flavonoids, mucilage compounds, iridoid glycosides, and phenylethanoid glycosides) and ecological availability of these taxa can be seen in their diverse applications (Kadereit 2004). Despite various regional ethnobotanical studies conducted in Türkiye in recent decades, including local research, theses, and floristic-ethnobotanical studies, data on the ethnobotanical uses of the Plantaginaceae family remain scattered. A comprehensive analysis of the information is crucial not only for documenting biocultural traditions but also for identifying taxa with pharmaceutical potential and guiding future research in the fields of phytochemistry, pharmacology, and conservation.

Overview of the Family Plantaginaceae

Plantaginaceae is a cosmopolitan family that is extensively dispersed throughout temperate and subtropical parts of the world, with 105 genera and over 2108 species worldwide (Davis 1982; Kadereit 2004; POWO 2026). Taxa in the Plantaginaceae family display significant morphological and ecological variety, which has contributed to their widespread geographical distribution and long-term usage by humans. Plantaginaceae is represented in Türkiye by 18 genera and 250 taxa, according to current floristic treatments and checklists of the Turkish flora (Güner *et al.* 2012; Güner 2014; Özhatay *et al.* 2019; Özhatay *et al.* 2022). Of these, a significant percentage have limited distribution ranges; around 65 taxa are known to be endemic, and they are mostly found in mountainous areas of Anatolia, including the Taurus Mountains, Eastern Anatolia, and portions of Central Anatolia (Ambarlı *et al.* 2016; Izgördü & Akan 2021). In genera like *Linaria* and *Veronica*, which exhibit high degrees of morphological differences and ecological specialization, endemism is particularly noticeable (Shehata & Loutfy 2006; Başer 2020; Doostmohammadi *et al.* 2022; Behçet 2025).

Table 1. Main Genera of Plantaginaceae family in Türkiye

Genera	Total taxa in Türkiye	Endemic taxa in Türkiye
Veronica	119 taxa	37 endemics
Linaria	34 taxa	12 endemics
Plantago	33 taxa	2 endemics
Globularia	12 taxa	5 endemics
Chaenorhinum	11 taxa	6 endemics
Digitalis	10 taxa	3 endemics
Kickxia	8 taxa	-
Callitriche	7 taxa	-
Cymbalaria	3 taxa	-
Antirrhinum	2 taxa	-

Source: POWO 2026

Although opposite or infrequently alternate phyllotaxy may occur, especially in genera like *Veronica* and *Digitalis*, members of the family are often distinguished by simple, whole to variably lobed leaves that are frequently grouped in basal rosettes. Actinomorphic or zygomorphic, flowers usually have a well-developed corolla and are frequently adaptable to various pollination techniques, such as insect-mediated pollination (Abrahamczyk *et al.* 2020). The ovary contains one to many ovules. The fruit is often an indehiscent achene or a circumscissile capsule, and the seeds possess straight embryos with endosperm. These can grow in terrestrial environments, especially in open areas, in moist or dry soils (Davis 1982; Güner *et al.* 2012).

Plantaginaceae taxa stand out from a phytochemical perspective due to their high level of bioactive secondary metabolites. The majority of reported constituents are flavonoids, tannins, mucilage compounds, phenylethanoid glycosides (like acteoside and plantamajoside), cardenolides, bufadienolides and iridoid glycosides (such aucubin and catalpol) (Sertić *et al.*

2015; Rodríguez-Pérez *et al.* 2019; Güçlü *et al.* 2025). Numerous biological activities, including as anti-inflammatory, antibacterial, antioxidant, wound-healing, and immunomodulatory effects, are known to be shown by these substances (Kuiper & Bos 1992; Bajer *et al.* 2016; Katanić *et al.* 2017; Abate *et al.* 2022; Albalawi & Dageralbalawi 2022; Gašić *et al.* 2023; Karakoti *et al.* 2025). Specifically, the mucilage-rich tissues found in genera like *Plantago* are directly linked to their traditional uses in the treatment of respiratory, dermatological, and gastrointestinal problems (Azamat Kizi 2022; Turgumbayeva *et al.* 2022)

Figure 1. Some selected taxa of Plantaginaceae documented in ethnobotanical studies conducted in Türkiye. (A. *Plantago major* B. *Digitalis ferruginea)*

Its morphological adaptability and chemically rich metabolite profile have made the Plantaginaceae family particularly prominent in ethnobotanical uses in different cultural and ecological environments and serves as a bridge between traditional plant-based methods and current phytopharmacological studies. The aim of this study is to document the diversity of Plantaginaceae taxa used in ethnobotany, to identify their purpose and the plant parts used, to investigate the cultural and ecological contexts of their use, and to highlight conservation issues and possibilities for pharmacological validation.

Materials and Methods

This study was conducted as a structured literature review of ethnobotanical research carried out in Türkiye. Data were retrieved from ethnobotanical theses, peer-reviewed journal articles, and ethnobotanical studies. The review process followed the PRISMA 2020 guidelines for systematic reviews, including structured identification, screening, eligibility assessment, and qualitative synthesis stages (Fig. 2) (Page *et al.* 2021). Electronic searches were performed in the following databases: PubMed, Google Scholar, Web of Science, Scopus, and ScienceDirect. Also, relevant theses were identified through the Databases of National Thesis Center of the Council of Higher Education. A list of precise keywords was used to improve the literature search process. The keywords included "traditional medicinal plants," "herbal medicine," "folk medicine," "ethnomedicine," "ethnobotany," "ethnopharmacology," and the geographical phrases "Turkey" and "Türkiye."

Eligibility Criteria

Studies were included if they:

-Were conducted in Türkiye.

-Reported ethnobotanical use data of Plantaginaceae taxa,

-Provided herbarium voucher numbers for the recorded taxa,

-Were published between 1990 and 2026.

Studies lacking herbarium voucher information were excluded to ensure taxonomic reliability and scientific validity.

Data Extraction and Synthesis

All retrieved records were collated and organized in Microsoft Excel for preliminary screening and categorization. Ethnobotanical data were systematically extracted to identify:

-Plant taxa,

-Plant parts used,

-Preparation methods,

-Reported purposes of use.

Reported uses were grouped into medicinal and non-medicinal categories. Medicinal uses were further classified according to disease systems to facilitate structured analysis and comparison.

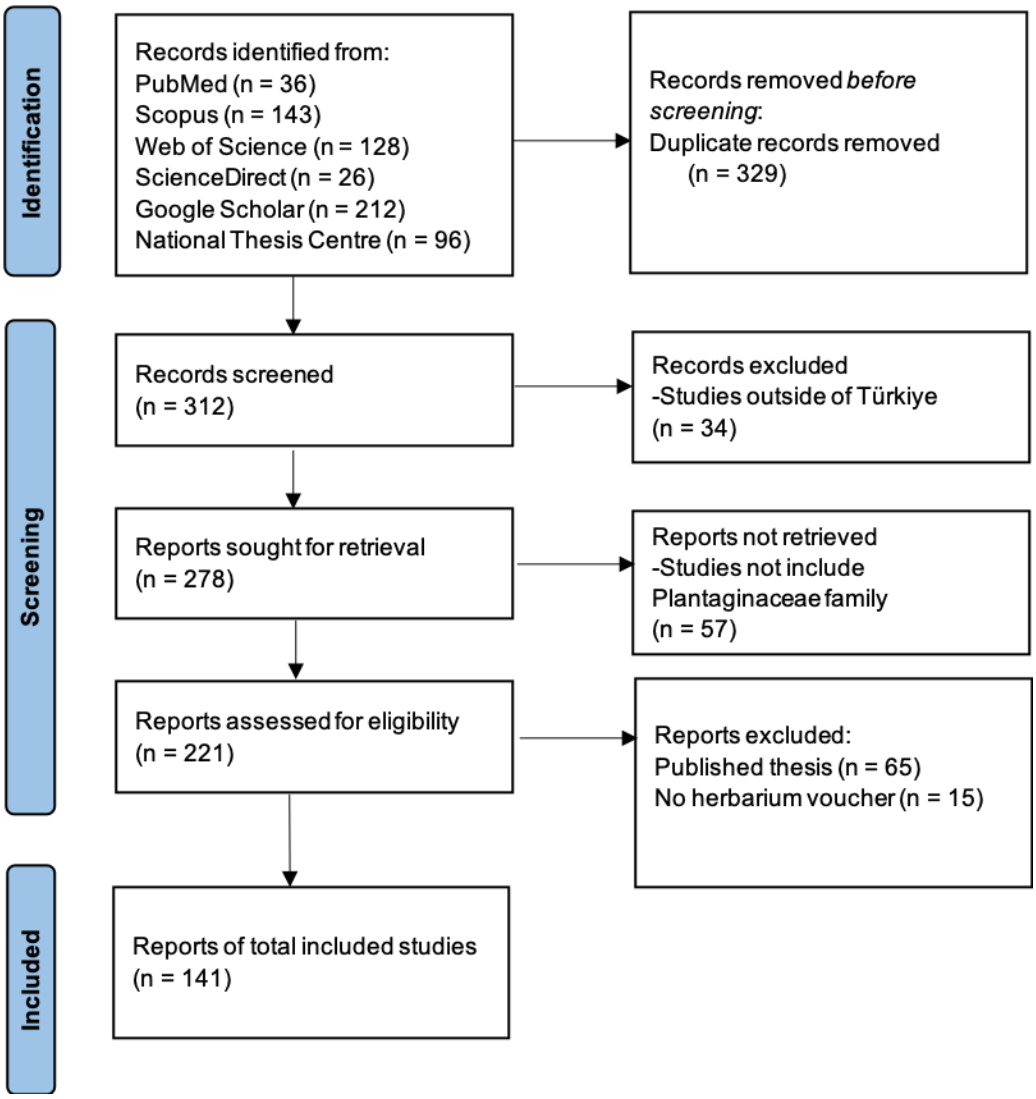

Figure 2. Diagram of data selection process

Results

Dataset Overview

A list of all ethnobotanical uses is given in the Table 6. The dataset includes 22 Plantaginaceae taxa and 144 various use reports (URs). Of them, 130 (90.3%) are medicinal, whereas 14 (9.7%) are non-medicinal (5 food, 5 veterinary, 2 fodder, 1 ornamental, and 1 handicraft).

Despite only having four taxa, *Plantago* accounts for 62.5% of all documented Use Reports (URs), according to the distribution of URs among genera (Table 2). This finding highlights the ethnomedicinal role of *Plantago* within the Plantaginaceae family in Türkiye. The taxa are used to treat many ailments such as wounds, abscesses, digestive problems, respiratory problems, hemorrhoids, and inflammations. The genus is particularly noteworthy for its various preparation methods, such as poultices, seeds, infusions, decoctions, and fresh leaves.

Veronica is the second most important genus from an ethnobotanical perspective. Despite having the most taxa in the dataset, it has a significantly lower number of URs (18.7%) than *Plantago*. This suggests less local usage or knowledge for the species. Digestive, liver, respiratory, and musculoskeletal problems, as well as minor ailments such as mouth and throat ulcers, are most frequently associated with the taxa.

The ethnobotanical profile of the *Digitalis* is known to be quite limited. Despite its well-known medicinal properties, its traditional uses in Türkiye are very limited and highly specific. It is generally used for dermatological problems such as boils, wounds, and dermatitis, as well as some internal applications such as diuretic or gastrointestinal uses. This limited usage pattern reflects local awareness of the plant's toxicity and cautious, situation-specific treatment in folk medicine.

Linaria is represented by several taxa, however there are few reported uses. Its ethnobotanical significance is limited in comparison to other genera, with just a few medicinal purposes (e.g., eczema, hemorrhoids, gum disease, sputum reduction) and a considerable inclusion of animal uses, notably fodder. This trend indicates that *Linaria* species are more commonly regarded for useful or secondary purposes than as principal medicinal plants.

Globularia, while represented by a single taxon, possesses a remarkably high level of ethnomedicinal diversity. The indicated applications include gastrointestinal, pulmonary, parasitic, dermatological, and hemorrhoidal treatments using various preparation methods. Specifically, three of the seven recorded usage reports (URs) are clearly related to the treatment of hemorrhoids using different plant parts (whole plant, leaves, roots, and above-ground parts) and preparation methods (decoction and infusion). The plant's anti-inflammatory, astringent, and circulation-modulating effects, which are compatible with the observed bioactivity of iridoid glycosides and phenolic compounds in the genus *Globularia*, may explain its popularity in hemorrhoid-related applications (Sertić *et al.* 2015; Friščić *et al.* 2016).

The ethnobotanical characteristics of *Antirrhinum* are limited. A taxon with a well-established decorative application, it has mostly limited therapeutic use for respiratory symptoms. Its cultural significance as an attractive plant reflects this dual role, while its therapeutic use is secondary and limited.

Kickxia is at the very bottom of the dataset, as there is only one report regarding the use of fodder for veterinary purposes. Overall, patterns at the genus level show considerable asymmetry in the ethnobotany of Plantaginaceae in Türkiye. Several genera, such as *Plantago* and *Veronica*, carry much of the traditional medicinal knowledge, while others are relegated to more modest or highly specialized contexts.

Table 2. Use-reports in related genera

Genera	No. of taxa	URs (n)	Share of all URs (%)
Plantago	4	90	62.5
Veronica	7	27	18.7
Digitalis	3	9	6.2
Globularia	1	7	4.9
Linaria	5	6	4.2
Antirrhinum	1	4	2.8
Kickxia	1	1	0.7

The taxonomic ranking based on total Use Reports (UR) and the number of independent sources (see Table 3 below) confirms *Plantago* species' dominance in Turkish ethnobotanical literature. *Plantago major* subsp*. major* is the most common taxon, with 35 URs reported from 94 independent sources, followed by *P. lanceolata* (26 URs; 59 sources) and *P. major* subsp*. intermedia* (19 URs; 29 sources). Although *P. media* has a considerable number of UR (10), it occurs in fewer sources (n = 5), indicating regional or restricted documentation. Apart from the genus *Plantago*, *Veronica anagallis-aquatica, Globularia trichosantha,* and *Antirrhinum majus* have significantly lower URs and citation rates, indicating either less ethnomedicinal significance or underrepresentation in published studies.

Table 3. Comparative Citation Intensity of Selected Taxa Based on UR and Source Frequency

Scientific name	Total UR	Number of sources
Plantago major subsp*. major*	35	94
Plantago lanceolata	26	59
Plantago major subsp*. intermedia*	19	29
Plantago media	10	5
Veronica anagallis-aquatica	7	8
Globularia trichosantha	7	8
Antirrhinum majus	4	5

Overall, both UR counts and citation frequency demonstrate that traditional medicinal knowledge within Plantaginaceae in Türkiye is strongly concentrated around a small number of widely recognized *Plantago* taxa.

Medicinal Uses

A detailed analysis of the therapeutic categories highlights clear patterns in the ethnobotanical use of Plantaginaceae taxa in Türkiye, reflecting both the accessibility of these plants and the dominant health concerns addressed in traditional medicine systems.

A wide range of external applications, including wounds, abscesses, eczema, boils, fungal infections of the foot, and insect bites, are among the most prevalent dermatological diseases. This group is common because many Plantaginaceae taxa have significant levels of mucilage, iridoid glycoside, and phenylethanoid glycoside. These compunds are especially present in *Plantago* species. These substances have long been considered to have wound-healing, antimicrobial, and anti-inflammatory qualities Shirley *et al.* 2017; Rahamouz-Haghighi 2023; Amalia *et al.* 2025). Fresh leaves, poultices, and decoctions are therefore frequently consumed.

The second most common category is respiratory disorders including cough, bronchitis, expectorant uses, sputum reduction, and shortness of breath. Preparations are usually given orally as infusions or decoctions, particularly from aerial parts and leaves.

Metabolic and systemic diseases—such as diabetes, hypertension, cardiac diseases, cholesterol lowering, and blood-purifying uses—demonstrate an expansion of traditional knowledge beyond acute and localized conditions toward chronic and systemic health issues. These uses show the increasing ethnomedicinal understanding of Plantaginaceae taxa as substances that impact the overall physiological balance, even if they are less frequent than other applications.

Gastrointestinal disorders are also well represented, which include stomachaches, diarrhea, abdominal discomfort. Internal preparations such as infusions and decoctions are widely used, showing a high reliance on Plantaginaceae plants to maintain healthy digestive processes. The presence of mucilage and mild astringent chemicals most likely explains its function in relieving gastrointestinal discomfort and restoring intestinal equilibrium.

Genitourinary disorders, including as urinary tract infections, diuretic use, and prostate problems, are thought to reflect the cleaning and fluid-regulating characteristics of certain taxa. Diuretic applications, for example, have been extensively recorded, fitting with the ancient notion of "purifying" the body through increased urine production.

Infectious/ENT (Ear, Nose & Throat) and oral indications—including gingivitis, tonsillitis, and mouth and throat sores—point to the antimicrobial and anti-inflammatory uses of Plantaginaceae plants in the treatment of localized infections of the oral and upper respiratory regions.

Anorectal diseases, which are only represented by hemorrhoids, are a limited yet frequently observed category. The prevalence of hemorrhoid treatments emphasizes Plantaginaceae's relevance in the management of inflammatory and vascular disorders, which are typically treated both internally and externally.

Musculoskeletal disorders, such as rheumatic pain, backache, and muscular pains, are typically treated with topical therapies such as poultices and compresses. These methods exemplify the analgesic and anti-inflammatory reputation of the family in traditional medicine.

Finally, neurological and sensory disorders, such as headache, migraine, and memory loss, are comperatively underrepresented but still prominent. The presence of them implies a greater therapeutic reach, potentially due to modest sedative or circulatory effects attributed to certain taxa.

Across the 130 medicinal URs, indications cluster into several recurring domains (terms as recorded in the dataset). Major medicinal use categories summarized in Table 4 below.

Table 4. Major medicinal use categories of Plantaginaceae in Türkiye

Therapeutic category	Examples of treated conditions	UR frequency
Dermatological disorders	Abscesses, antifungal, boils, eczema, foot fungus / fungal infections, furuncles, inflamed wounds, insect bites, skin diseases, warts, wound washing, woundcare, wounds.	27 (20.8%)
Respiratory disorders	Asthma, bronchitis, cough, expectorant, hay fever, laryngeal cancer, lung diseases, pulmonary disorders, shortness of breath, sinusitis, sputum reduction, tuberculosis.	23 (17.7%)
Metabolic & systemic diseases	Blood depurative, cancer, cardiac diseases, cholesterol lowering, diabetes, febrifuge, goiter, hypertension, liver diseases, malaria, sunstroke.	20 (15.4%)
Gastrointestinal disorders	Abdominal pain, appetizer, diarrhea, gastritis, jaundice, laxative, stomachache.	17 (13.1%)
Genitourinary disorders	Cystitis, diuretic, kidney disorders, kidney stones, mastitis, prostate ailments, urinary tract infections.	14 (10.8%)
Infectious/ENT and oral indications	Eye infection, mouth and throat sores, gingivitis, gum diseases, tonsillitis.	9 (6.9%)
Anorectal disorders	Hemorrhoids	8 (6.2%)
Musculoskeletal disorders	Backache, knee pain, muscle aches, rheumatic pain.	7 (5.4%)
Neurological & sensory disorders	Forgetfulness, headache, migraine, sedative	5 (3.8%)

Plant Parts Used

Leaves and aerial parts are the most often used plant materials, reflecting their ease of access and high concentration of bioactive substances such as mucilage, iridoid glycosides, and phenylethanoid glycosides. Whole plants are less commonly employed and are typically associated with decoctions produced for systemic illnesses such as gastrointestinal problems, jaundice, or hemorrhoids, especially in the *Digitalis* and *Globularia* taxa. Roots and seeds are infrequently utilized; nevertheless, when used, they are frequently associated with specific indications such as hemorrhoids, diarrhea, malaria, or cancer-related therapies, particularly among *Plantago* species.

Preparation Methods

Infusions and decoctions clearly dominate, reflecting that traditional medicine relies heavily on water-based extraction processes. Infusions are often made from leaves or aerial parts and are taken orally to treat gastrointestinal, respiratory, genitourinary, and metabolic problems (such as stomachache, cough, asthma, diuretic usage, and diabetes). Decoctions, which frequently include leaves, aerial parts, seeds, or the entire plant, are chosen for chronic or severe illnesses such as hemorrhoids, diarrhea, infections, hypertension, and cancer-related disorders. Topical treatments, such as poultices, crushed fresh leaves, and externally applied boiling solutions, are particularly useful for treating dermatological and musculoskeletal problems such as wounds, abscesses, dermatitis, insect bites, fungal infections, rheumatic pain, and mastitis.

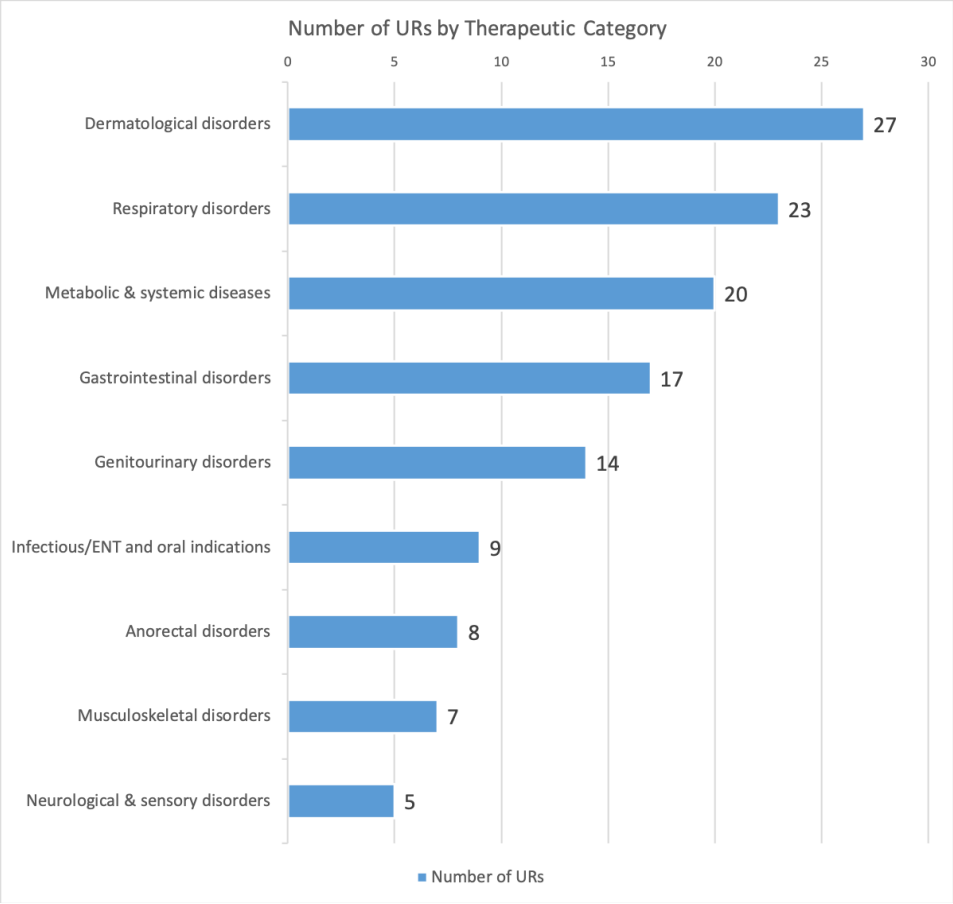

Figure 3. Number of Use Reports (URs) by therapeutic categories based on ethnobotanical records of Plantaginaceae taxa in Türkiye

Non-medicinal Uses

In addition to medicinal applications, several Plantaginaceae taxa are traditionally consumed as food or used for other purposes. Young leaves and aerial parts of *Plantago* and *Veronica* species are commonly eaten raw as salads or cooked with other ingredients. Non-food uses include veterinary applications, fodder, ornamental and traditional children's toys made from plant parts.

Table 5. Non-medicinal ethnobotanical uses of Plantaginaceae in Türkiye

Use category	Examples
Food **(5 URs)**	Cooked greens, pastry stuffing, salads, sarma
Veterinary **(5 URs)**	Abscess, anti-inflammatory, diarrhea, skin infections, wounds
Fodder **(2 URs)**	Fodder for livestock
Other **(2 URs)**	Children's toys, ornamental use

Geographical Distribution and Potential Bias

There is a noticeable disparity in region when the geographic distribution of the reviewed sources is investigated. The literature is not equally distributed among the three main phytogeographic areas of Türkiye, which are the Mediterranean, Euro-Siberian, and Irano-Turanian. The highest percentage of sources is found in Eastern Anatolia (30.4%), which is followed by the Black Sea (17.0%), Inner Anatolia (16.3%), and Marmara (16.3%). On the other hand, the Aegean (6.7%), Mediterranean (11.1%), and especially Southeastern Anatolia (2.2%) are relatively underrepresented.

This pattern implies that rather than representing a uniform ethnobotanical setting, the observed distribution of usage reports may partially reflect academic interest and the intensity of research. Eastern Anatolia's dominance corresponds with the Irano-Turanian phytogeographic zone, which is distinguished by a strong continuity of traditional plant knowledge and a high floristic diversity (Baykan *et al.* 2023; Doğan 2024; Yeşil and Yılmaz 2025; Kolaç *et al.*2026). Notwithstanding their

acknowledged botanical diversity, the Mediterranean and Aegean areas have been significantly underrepresented, which suggests possible gaps in the documented record.

Furthermore, given the region's rich cultural and historical heritage within its broader Mesopotamian context, the underrepresentation of Southeastern Anatolia highlights a serious research need. These findings are further contextualized when compared to neighboring regions: eastern Anatolia shows ecological and cultural similarities with the Irano-Turanian zone that extends into Iran and Central Asia, while western Türkiye (Marmara-Aegean) shares ethnobotanical affinities with the Balkans.

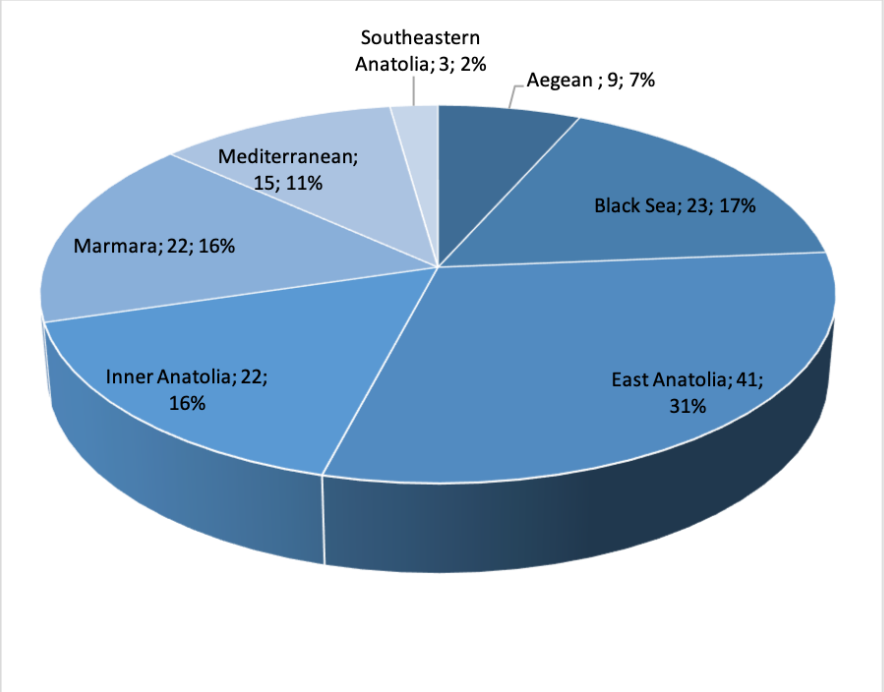

Figure 4. Regional distribution of ethnobotanical sources included in the review.

Discussion

The current study emphasizes the Plantaginaceae family's significant ethnobotanical relevance in Türkiye and shows that traditional usage recorded across varied locations is mainly compatible with the phytochemical composition and pharmacological activity. *Plantago, Veronica, Digitalis, Linaria, Globularia*, and *Antirrhinum* species dominate traditional medicine due to their widespread geographical distribution and diverse secondary metabolite profiles.

Correlation Between Ethnobotanical Uses and Phytochemical Composition

One of the most significant findings of this analysis is the prevalence of leaf and aerial-part-based treatments, which are typically administered as infusions, decoctions, or topical poultices. This pattern is consistent with phytochemical studies indicating that certain plant sections are notably high in iridoid glycosides (e.g., aucubin, catalpol), phenylethanoid glycosides (e.g., acteoside/verbascoside), flavonoids, tannins, and mucilage chemicals (Vrchovská *et al.* 2008; Cheriet *et al.* 2015; Gašić *et al.* 2023; Çifci *et al.* 2024; Utlu and Ercil 2024). These compounds are widely known for their anti-inflammatory, antibacterial, antioxidant, wound-healing, and gastroprotective properties, which are directly related to the most commonly documented therapeutic categories, such as dermatological, gastrointestinal, and respiratory problems.

Plantago species, in particular, are widely used to treat wounds, abscesses, eczema, insect bites, and inflammatory skin disorders due to their high mucilage content and the presence of iridoid glycosides and phenolic compounds. Studies have shown that aucubin and catalpol have strong anti-inflammatory, antimicrobial, and tissue-regenerative properties, supporting the comprehensive topical use of fresh or crushed leaves as reported in ethnobotanical records (Shirley *et al.* 2017; Rahamouz-Haghighi 2023; Amalia *et al.* 2025). Similarly, phenylethanoid glycosides such as verbascoside, which are frequently identified in *Plantago* and *Veronica* taxa, have been demonstrated to have high antioxidant and antibacterial properties, supporting its application in wound care and infection-related disorders (Alipieva *et al.* 2014; Nigro *et al.* 2020; Saha *et al.* 2024; Bufan & Drobac 2025).

Table 6. Traditional uses of Plantaginaceae family in Türkiye

Scientific name	Vernacular name	Plant part	Use purpose	Source
Antirrhinum majus L.	**Aslanağzı, dil damak çiçeği, kuş ağzı**	All plant, leaves	**Medicinal**; bronchitis, cough, expectorant, **Ornamental**	Ayandın 2010, Güler *et al.* 2015, Metin 2009, Polat and Satıl 2012, Tütenocaklı 2014
Digitalis davisiana Heywood	**Has yüksükotu, yüksükotu, yüsük otu**	Whole plant	**Medicinal**; boils, woundcare	Sargın 2015
Digitalis ferruginea L.	**Arıkovanı, kesikotu yüksükotu, pasrenkli yüksükotu**	Leaves, whole plant	**Medicinal**; diuretic, eczema	Saraç *et al*. 2013; Tuzlacı and Aymaz 2001
Digitalis lamarckii İvanina	**Sarılık otu, soğan otu, yüksükotu**	Aerial parts, leaves, whole plant	**Medicinal**; abdominal pain, gum diseases, hemorrhoid, jaundice, laxative	Şimşek *et al.* 2004; Vural *et al.* 1997
Globularia trichosantha Fisch. et Mey.	**Ahu, arı çiçeği, köseyayılımı, küre çiçeği, mayasıl otu, tüylü çiçek, tüylü küre çiçeği**	Aerial parts, leaves, root, whole plant	**Medicinal**; antifungal, bronchitis, eye infection, hemorrhoids, parasites, stomachache **Veterinary;** diarrhea	Akbulut and Zengin 2023, Arslan and Şenkardeş 2025, Babacan *et al.* 2022, Doğan 2014, Gürhan and Ezer 2004, Kadıoğlu *et al.* 2021, Korkmaz and Alpaslan 2014, Sezik *et al.* 1991
Kickxia elatine (L.) Dumort.	**Fukaraotu, rezil otu,**	Aerial parts	**Fodder**	Olcay *et al.* 2022
Linaria genistifolia subsp. *genistifolia*	**Geyşenik, meryem otu, som nevruzotu**	Aerial parts	**Fodder**	Arı *et al.* 2015
Linaria genistifolia subsp. *confertiflora* (Boiss.) P.H. Davis.	**Çok nevruzotu, geyşenik, meryem otu**	Flowers, leaves	**Medicinal**; eczema	Arı *et al.* 2015
Linaria kurdica subsp. *kurdica*	**Sarı nevruzotu**	Aerial parts	**Medicinal**; gum disease, hemorrhoids	Doğan 2014
Linaria simplex (Willd.) DC	**Yalın nevruzotu**	Aerial parts	**Medicinal**; gum disease	Doğan 2014
Linaria vulgaris Mill.	**Nevruzotu**	Flowers	**Medicinal**; sputum reduction	Ulcay and Senel 2024
Plantago major subsp. *major*	**Bağayaprağı, babadeşen otu, balarzağı, belghavis, beş damar otu, damar otu, havisok, hevizar, kalp otu, kersim, kırksinir otu, palhavez, pavri, pelhawes, pelhevez, pelonbaş, pupuli, omınwaş, omulwaş, sinir otu, sinirli ot,**	Aerial parts, leaves, seeds	**Medicinal**; abscess, asthma, blood depurative, cancer, cardiac diseases, cough, cholesterol, cystitis, diabetes, diarrhea, diuretic, eczema, febrifuge, foot fungus, gastritis, gingivitis, goiter, hemorrhoids, heart diseases, hypertension, insect bites,	Akalın ve Alpınar 1994, Akbulut and Özkan 2014, Akbulut and Zengin 2023, Aktan 2011, Arasan 2022, Arı *et al.* 2015, Arıtuluk 2010, Arslan 2005, Arslan and Şenkardeş 2025, Babacan *et al.* 2022, Baykal 2015, Baykan *et al.* 2023, Bilgiç 2023, Bozkurt 2021, Bozkurt 2024, Bulut ve Tuzlacı 2015, Bulut *et al.* 2016, Bulut *et al.* 2017, Bulut *et al.* 2018, Cakilcioglu *et al.* 2011, Dalar *et al.* 2018, Demir and Üzgüç 2026, Demirci and Özhatay 2012, Doğan 2014,

	siğil otu, umınwaş, yara otu, yedi damarlı ot		laryngeal cancer, malaria, pain treatment, rheumatic diseases, sedative, skin infections (antifungal), stomachache, warts, wounds **Food**; pastry stuffing, salad, sarma **Veterinary;** anti-inflammatory, skin infections	Doğan 2024, Doğan and Doğan 2025, Ecevit-Genç ve Özhatay 2006, Eksik and Akan 2023, Ezer ve Arısan 2006, Fujita *et al.* 1995, Gözcü *et al.* 2024, Güler *et al.* 2021, Güneş and Özhatay 2011, Güneş *et al.* 2017, Günbatan *et al.* 2016, Günbatan *et al.* 2025, Gürbüz *et al.* 2021, Gürdal ve Öztürk 2021, Güzel *et al.* 2015, Han and Bulut 2015, Hayta *et al.* 2014, Karahüseyin ve Sarı 2019, Karakaya *et al.* 2020, Karaköse *et al.* 2019, Karaköse 2022, Karaköse 2026, Karakurt 2014, Karcı *et al.* 2017, Kayabaşı *et al.* 2023, Kazan 2007, Keskin 2011, Kılıç *et al.* 2020, Kılıç *et al.* 2025, Kızılarslan ve Özhatay 2012, Koçyiğit ve Özhatay 2006, Köysal 2020, Kültür 2007, Kültür and Sami 2009, Mükemre *et al.* 2015, Nadiroğlu *et al.* 2019, Olgun 2019, Özdemir-Nath and Kültür 2022, Polat and Satıl 2012, Polat *et al.* 2013, Polat *et al.* 2015, Polat 2019, Sağıroğlu *et al.* 2012, Saraç *et al.* 2013, Sarper *et al.* 2009, Sarıoğul *et al.* 2017, Sezik *et al.* 1997, Sezik *et al.* 2001, Şen *et al.* 2022, Sener *et al.* 2023, Şenkardeş 2014, Şenkardeş *et al.* 2022, Tabata *et al.* 1994, Tekin 2011, Tetik *et al.* 2013, Tuzlacı 2016, Tuzlacı ve Bulut 2007, Tuzlacı ve Doğan 2010, Tuzlacı ve Şenkardeş 2011, Tuzlacı ve Tolon 2000, Tuzlacı *et al.* 2010, Uzun 2015, Varlıbaş 2020, Yazgı and Bulut 2024, Yeşil and Akalın 2009, Yeşil and İnal 2021, Yeşilada *et al.* 1993, Yeşilada *et al.* 1995, Yeşilada *et al.* 1999, Yiğit and Gözcü 2024
Plantago major subsp. *intermedia* (Gilib.) Lange	**Bağa yarpağı, belhavıs, belgeves, çıban otu, damar otu, hava yaprağı; hawes (k), kırkbayır otu, kırkdamar otu, siğilotu, sinir otu, sinirli ot, sünitka, yedi damarotu, yılan dili**	Leaves, seeds	**Medicinal**; abscess, asthma, cancer, cardiac diseases, eczema, expectorant and antitussive, fungus, hay fever, hemorrhoid, insect bites, gynecological disorders, knee pain, lung diseases, prostate ailments, sinusitis, stomachache, tuberculosis, urinary tract infections, wounds	Akalın 1993, Aktan 2011, Altundağ-Çakır 2017, Arı *et al.* 2015, Aydın and Yeşil 2018, Bilgiç 2023, Bulut and Tuzlacı 2015, Bulut *et al.* 2018, Demir 2020, Geylani 2024, Günbatan *et al.* 2016, Karcı *et al.* 2017, Kartal 2021, Koçyiğit and Özhatay 2006, Kolit 2022, Kültür 2007, Mart 2006, Mükemre *et al.* 2015, Özdemir-Nath and Kültür 2022, Özüdoğru *et al.* 2011, Sargın 2013, Sarper *et al.* 2009, Şenkardeş 2010, Şenkardeş 2014, Şenkardeş *et al.* 2022, Tuzlacı and Şenkardeş 2011, Ulcay 2024, Uysal *et al.* 2010, Uzun 2015

Plantago lanceolata L.	**7 damar otu, bağa otu, bağa yaprağı, damarlı ot, damarlıca, damar otu, gıyamambel, giyabirin bağaotu, kırkdamar, kırkdamar otu, kırksinir, kırksinir otu, pelhevez, pelhewes, pelhevis, pelonbaş, sinir otu, sivrisilik**	Leaves, seeds	**Medicinal**; abscess, antipyretic, asthma, bee and insect bites, cancer, cough, diabetes, diarrhea, diuretic, foot fungus, gastritis, hemorrhoids, liver diseases, mastitis, pain treatment, prostate ailments, pulmonary disorders, rheumatic diseases, sedative, toothache, stomachache, warts, wounds **Food**; salad **Veterinary;** abscess, wounds	Aktan 2011, Akbulut and Özkan 2014, Arıtuluk 2010, Arslan and Şenkardeş 2025, Babacan *et al.* 2022, Bozkurt 2024, Bulut *et al.* 2017, Demir 2020, Demirci and Özhatay 2012, Doğan 2014, Doğan 2024, Doğan and Doğan 2025, Eksik and Akan 2023, Emre *et al.* 2021, Genç and Özhatay 2006, Geylani 2024, Gözcü *et al.* 2024, Güler *et al.* 2020, Güler *et al.* 2021, Güneş *et al.* 2017, Günbatan *et al.* 2025, Güldaş 2009, Güzel *et al.* 2015, Hayta *et al.* 2014, Karahan and Kara 2022, Karahüseyin and Sarı 2019, Karakaya *et al.* 2020, Karaköse 2022, Karcı *et al.* 2017, Kargıoğlu *et al.* 2010, Kayabaşı *et al.* 2023, Kazan 2007, Keskin 2011, Kılıç *et al.* 2020, Koçyiğit and Özhatay 2006, Kültür 2007, Kültür and Sami 2009, Nacakçı 2015, Nadiroğlu *et al.* 2019, Olcay *et al.* 2022, Özcan Arslan 2005, Özdemir and Alpınar 2015, Polat *et al.* 2013, Polat 2019, Sarper *et al.* 2009, Sener *et al.* 2023, Selvi *et al.* 2023, Şen *et al.* 2022, Şenkardeş 2014, Şenkardeş *et al.* 2022, Somuncu 2024, Tabata 1994, Tuzlacı 2010, Tuzlacı and Aymaz 2011, Tuzlacı *et al.* 2010, Uğulu 2011, Uysal *et al.* 2010, Uzun 2015, Yıldırım 2015
Plantago media L.	**Bağa yaprağı, belgheviz, gılıçotu, kılıçotu, orta sinirli ot, sinirli ot**	Leaves	**Medicinal**; asthma, bronchitis, cardiac diseases, hemorrhoids, inflamed wounds, mouth sore, urinary tract infections, gynecological conditions, wounds and abscess. **Handicraft**; toy basket	Demir and Demir 2022, Karakurt 2014, Korkmaz *et al.* 2016, Mükemre *et al.* 2015, Tekin 2011
Veronica anagallis-aquatica L.	**Bağla, camak, gerdeme, muhabbet çiçeği, sugedemesi, su teresi, yarpuz, yavşan**	Aerial parts, leaves, shoots	**Medicinal**; abdominal pain, liver diseases, rheumatic pain, shortness of breath, stomachache, sunstroke **Food**; salad	Bağcı *et al.* 2016, Doğan 2014, Erdoğan 2011, Fujita *et al.* 1995, Gençay 2007, Günbatan *et al.* 2016, Kılıç 2021, Yıldırımlı 2015
Veronica chamaedrys L.	**Yavşan otu**	Aerial parts, flowering branches	**Medicinal**; liver diseases, mouth and throat sores, stomachache	Arslan and Şenkardeş 2025; Tuzlacı and Aymaz 2001
Veronica multifida L.	**Deli kekik, deve sabunu, ıshalotu**	Aerial parts	**Medicinal**; diarrhea	Özdemir and Alpınar 2015

Veronica orientalis Mill	**Binevşok, çıban out, gözmuncuğu çiçeği, mavi çiçek, yavşan otu**	Aerial parts, flowers	**Medicinal**; backache, cough, kidney disorders, kidney stones, pulmonary disorders	Altundağ-Çakır 2017; Dalar *et al.* 2018; Özgen *et al.* 2012; Saday 2009.
Veronica officinalis L.	**Çıban otu , yavşan otu**	Leaves	**Medicinal**; appetizer, cholesterol lowering, forgetfulness, wounds and furuncles	Ugulu *et al.* 2009
Veronica pectinata L.	**Bodur mahmut**	Aerial parts	**Medicinal**; stomachache, wound washing	Özdemir-Nath and Kültür 2022
Veronica persica Poiret	**Bal bardağı, cırcamuk, mineçiçeği,**	aerial part, leaves	**Medicinal**; headaches, migraine, muscle aches, tonsillitis **Food:** chopped, cooked in olive oil together with bulgur, eaten.	Kızılarslan and Özhatay 2012; Sağıroğlu *et al.* 2017; Ulcay and Şenel 2024.

Gastrointestinal and Metabolic Indications

Gastrointestinal disorders are one of the most frequently treated categories found in our analysis, especially for *Plantago* and *Veronica* species. Traditional usage for stomachache, diarrhea, abdominal pain, hemorrhoids, and laxative effects is congruent with pharmacological findings demonstrating spasmolytic, ulcer-preventing, and anti-diarrheal properties of Plantaginaceae extracts (Adom *et al.* 2017; Nazarizadeh et al. 2013; Samuelsen 2000). Tannins and flavonoids help to prevent diarrhea by precipitating proteins and protecting the intestinal mucosa, while iridoids have been shown to influence inflammatory pathways in the gastrointestinal tract (Fraga-Coral *et al.* 2021; Palombo 2006; Yuan *et al.* 2020; Zheng *et al.* 2025).

Furthermore, the documented use of *Plantago* taxa for diabetes, hypertension, cholesterol reduction, and blood purification indicate a larger involvement in metabolic and systemic control. Recent pharmacological research has indicated that some *Plantago* taxa have hypoglycemic, antihyperlipidemic, and cardioprotective properties, which are mostly related to their polyphenolic content and antioxidant activity (Gonçalves and Romano 2016; Adom *et al.* 2017; Ji *et al.* 2019; Zhang *et al.* 2021). These findings provide scientific validation for traditional behaviors that may have emerged via extensive empirical observation.

Respiratory and Infectious Diseases

Respiratory indications such as cough, bronchitis, asthma, expectorant use, and sputum reduction are commonly linked to the species of *Plantago*, *Veronica*, *Antirrhinum*, and *Globularia*. Many Plantaginaceae taxa are mucilaginous, which might explain why they have demulcent and soothing effects on the respiratory mucosa. Furthermore, iridoid glycosides and phenolic acids have been demonstrated to have anti-inflammatory and antibacterial properties, which may help to alleviate symptoms of respiratory infections (Abate *et al.* 2022; Rodríguez-Pérez *et al.* 2019; Turgumbayeva *et al.* 2022).

The usage of these plants in diseases such as tonsillitis, gingivitis, mouth and throat sores, and eye infections adds to the antibacterial potential of Plantaginaceae species. Several in vitro investigations have shown that extracts from the *Veronica* and *Globularia* species exhibit antibacterial and antifungal properties, which corresponds to their traditional use in oral and ocular illnesses (Rodríguez-Pérez *et al.* 2019; Güçlü *et al.* 2025).

Cancer-Related and Gynecological Uses

Although fewer cases have been reported, several *Plantago* and *Linaria* species have been used to treat nonspecific malignancies, uterine cancer, goiter, and gynecological problems. While traditional cancer-related applications should be read with caution, recent research has found cytotoxic, antiproliferative, and apoptosis-inducing properties in extracts high in iridoids and phenylethanoid glycosides (Villasenor 2007; Wang *et al.* 2020; Ndongwe *et al.* 2023). These findings suggest that some ethnomedicinal claims may reflect genuine bioactivity, necessitating more focused pharmacological and clinical studies.

Genus-Level Ethnobotanical Patterns

At the genus level, *Plantago* clearly emerges as the most adaptive and culturally established taxon, accounting for the bulk of usage reports and having the greatest therapeutic range. This dominance is reflected in the vast phytochemical and medicinal literature on *Plantago* species, which greatly outnumbers that accessible for other genera within the family. In contrast, genera such as *Globularia* and *Digitalis* have a more specific medicinal profile, with a small number of taxa linked with various therapeutic applications. This suggests that certain species have developed a strong therapeutic reputation despite their limited range.

Toxicity

In terms of their safety characteristics, the taxa in review are often heterogeneous. While current European monographs have limited information regarding the use of *Plantago* species (e.g., *P. lanceolata*) during pregnancy and lactation, they are generally considered safe. These species are regarded as low-risk when used within conventional dose ranges and may cause gastrointestinal problems or rare allergic reactions (EMA, 2025). Taxa rich in mucilage may hinder the absorption of concurrently administered drugs if ingested simultaneously.

Conversely, *Digitalis* species constitute a high-risk category owing to cardiac glycoside concentration and their well-established narrow therapeutic index. Improper dosage, misidentification, or uncontrolled internal administration may lead to significant cardiotoxic effects, including arrhythmias and potentially lethal consequences (Barold 2018; Gruenwald *et al.* 2007; Yang *et al*, 2012; Lehmann *et al.* 2021).

Globularia trichosantha has limited toxicological data; yet, instances of hepatotoxicity in similar species indicate that internal applications should be undertaken with caution (Hanchi *et al.* 2025).

Veronica anagallis-aquatica, as a semi-aquatic species, may raise further issues about environmental pollution and heavy metal deposition, while direct clinical toxicity information is limited (Kroflič *et al.* 2016).

In conclusion, although the majority of Plantaginaceae taxa reviewed exhibit low intrinsic toxicity, most ethnobotanical sources do not report dosage, duration, preparation standardization, adverse effects, or contraindications; therefore, safety appraisal relies on external monographs and toxicology literature rather than primary ethnobotanical data, and this constitutes a considerable limitation from a health science viewpoint, requiring cautious interpretation of traditional use reports.

Implications for Future Research and Conservation

The Plantaginaceae family stands out as a remarkable reservoir of medicinally important species due to its great concordance with traditional applications and experimentally proven bioactivities. However, the reliance on wild populations, particularly for taxa with limited ranges or endemism, raises questions about sustainability. Future studies should focus on phytochemical standardization, bioactivity-guided fractionation, and conservation-oriented ethnobotanical investigations, particularly for understudied endemic plants.

Conclusion

To summarize, the ethnobotanical knowledge described for Plantaginaceae in Türkiye is not only comprehensive, but also well supported by phytochemical and pharmacological data. This integrated viewpoint emphasizes the value of traditional knowledge as a guiding framework for modern drug development, as well as the necessity to protect both biological variety and cultural legacy linked with medicinal plant use.

Declarations

List of abbreviations: ENT - Ear, Nose and Throat; UR - Use Report

Ethics approval and consent to participate: Ethics approval not applicable, and all authors gave their consent before starting the study.

Consent for publication: The authors declare that they have no conflict of interest.

Availability of data and materials: Not applicable.

Competing interests: The authors declare that they have no conflict of interest.

Funding: Not applicable

Author contributions: RFT and ŞD collected the data. ŞD analyzed the data, and wrote the manuscript. YY conceptualized the study, reviewed and edited the final version of the text. The authors declare that the AI tool was used solely for language polishing and reference formatting and did not influence the scientific content or conclusions of the study.

Acknowledgements

The authors would like to thank the reviewers for their time and valuable comments.

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