Taxonomic diversity and ethnobotanical importance of adventive medicinal plants in the urban flora of Andijan city (Uzbekistan)

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Research

Abstract

Background: Urban ecosystems are characterized by intensive anthropogenic transformation that facilitates the spread of adventive plant species. Many of these species possess medicinal properties and are widely used in traditional ethnobotanical practices. However, the taxonomic diversity and ethnobotanical importance of adventive medicinal plants in urban flora remain insufficiently studied in many regions, including Uzbekistan.

Methods: Floristic surveys were conducted in different urban habitats of Andijan city (Uzbekistan) during the vegetation seasons of 2019–2023 using route (transect) methods. Plant identification was carried out based on regional floristic literature and herbarium materials. Ethnobotanical information on medicinal plant use was compiled from published scientific and ethnobotanical sources.

Results: A total of 66 medicinal plant species belonging to 61 genera and 22 families were recorded in the urban flora of Andijan city. The taxonomic spectrum showed that the majority of species belong to the families Asteraceae, Fabaceae, Brassicaceae, Lamiaceae, and Polygonaceae, which represent the dominant medicinal plant groups in the urban environment. Ethnobotanical analysis revealed that many species are traditionally used for treating digestive, respiratory, inflammatory, and skin-related diseases. However, medicinal plants growing in urban environments may accumulate heavy metals and other anthropogenic pollutants originating from transport emissions, industrial activities and contaminated soils. Therefore, the safety of medicinal plants collected from urban habitats should be carefully evaluated before their use in traditional medicine.

Conclusions: The results highlight the ecological and ethnobotanical importance of adventive medicinal plants as a significant component of urban biodiversity. The findings contribute to a better understanding of the role of adventive species in urban ecosystems and emphasize the need to consider ecological safety when using medicinal plants collected from urban environments.

Keywords: Alien plants; Urban ecosystems; Traditional medicine; Floristic diversity; Anthropogenic habitats; Uzbekistan

Background

In recent decades, the rapid acceleration of urbanization has significantly affected the floristic composition, ecological stability, and biological diversity of urban ecosystems (Hassan *et al.* 2019). Urban landscapes are characterized by the transformation of natural ecosystems, expansion of transport and construction infrastructure, and increasing anthropogenic pressure (Li *et al.* 2017). As a result, the composition of vegetation cover changes, and the proportion of alien and adventive species increases considerably (McKinney, 2006; Kowarik, 2011). Urban flora therefore represents not only a component reflecting floristic composition but also an important scientific indicator of anthropogenic environmental changes (Aronson *et al.* 2014).

Urban environments, particularly disturbed and heavily transformed habitats, create favorable conditions for the introduction and spread of adventive plant species (Hassan *et al.* 2019). Roadside habitats, abandoned ruderal areas, construction sites, irrigated green spaces, and residential surroundings serve as important ecological corridors facilitating the colonization of adventive plants (Pyšek *et al.* 2004; Richardson *et al.* 2000). Recent studies indicate that adventive plant species in urban landscapes may not only represent ecological challenges but in some cases may also be associated with certain ecosystem services (van Kleunen *et al.* 2015). At the same time, they may contribute to changes in the structure of native flora and intensify processes of biological homogenization (McKinney, 2006).

Medicinal plants occupy an important place in traditional knowledge systems and folk medicine that have developed over centuries of human history (Kosimov *et al.* 2026). Even today, millions of people worldwide rely on plant resources for the treatment of various diseases (Heinrich *et al.* 2009; Cotton, 1996). The flora of Uzbekistan is particularly rich in medicinal plant diversity, and according to available data, more than 1000 medicinal plant species have been recorded within the country (Khojimatov *et al.* 2025). However, most studies on medicinal plants have been conducted within natural ecosystems, whereas medicinal flora occurring in urban environments remains insufficiently investigated (Kosimov *et al.* 2026).

Ethnobotanical studies demonstrate that knowledge of plant use is not limited to rural areas or traditional communities but is also widely present in urban societies (Pieroni *et al.* 2017; Bussmann & Sharon, 2006). Urban residents actively use medicinal plants in everyday life, sell them in local markets, and transmit traditional knowledge across generations (Casagrande *et al.* 2023). Consequently, the field of urban ethnobotany has gained increasing attention in recent scientific research.

Although several studies have addressed urban flora and medicinal plants in Central Asia, comprehensive investigations focusing on the taxonomic composition and ethnobotanical importance of adventive medicinal plants remain limited (Pieroni

et al. 2017; Bussmann & Sharon, 2006). In particular, the diversity of adventive medicinal plants occurring in urban flora and their practical uses have not been sufficiently analyzed (Tojibaev *et al.* 2017; Beshko *et al.* 2020).

Andijan city is one of the important urban centers of the Fergana Valley, where urbanization processes are progressing intensively (Sidiqjanov, 2024). The city includes various urban habitats such as roadside, ruderal areas, irrigated green spaces, parks and gardens, as well as construction zones, all of which create favorable conditions for the establishment and spread of adventive plant species. In such urban ecosystems, the proportion of adventive plants is typically relatively high (Sidiqjanov, 2024).

Therefore, the aim of the present study was to analyze the taxonomic diversity of adventive medicinal plants occurring in the urban flora of Andijan city and to evaluate their ethnobotanical importance. During the research, adventive medicinal plant species were identified within the urban flora, and their taxonomic spectrum, distribution across urban habitats, and ethnobotanical uses were assessed. This study represents one of the first attempts to comprehensively investigate the diversity and practical significance of adventive medicinal plants in the urban flora of Andijan city.

At the same time, the use of medicinal plants growing in urban environments requires consideration of potential ecological risks. Plants growing along roadside with intensive traffic, industrial zones, and ruderal habitats may accumulate heavy metals and other anthropogenic pollutants. As a result, in addition to their medicinal properties, the ecological safety of such plants becomes an important issue. Therefore, urban ethnobotanical studies should also consider ecological limitations associated with plant use (Alloway, 2013; Kabata-Pendias, 2011). Future research should focus on the ecological safety, chemical composition, and pharmacological properties of medicinal plants occurring in urban habitats, which may represent an important direction in urban ethnobotanical studies.

Despite the growing number of studies on urban flora worldwide, the taxonomic composition and ethnobotanical importance of adventive medicinal plants in Central Asian cities remain poorly documented. In particular, the urban flora of Andijan city, located in the densely populated Fergana Valley, represents a unique anthropogenically transformed ecosystem where native and adventive species coexist. However, the medicinal plant diversity and ethnobotanical relevance of adventive species in this urban environment have not yet been systematically analyzed.

Therefore, the aim of the present study was to analyze the taxonomic diversity and ethnobotanical importance of adventive medicinal plants in the urban flora of Andijan city (Uzbekistan), as well as to evaluate their role in urban ecosystems and traditional medicinal practices.

Materials and Methods

Research area

The study was conducted in Andijan city, located in the eastern part of the Republic of Uzbekistan. Andijan is situated in the southeastern part of the Fergana Valley and represents one of the major urban centers of the region. The city is located approximately between 40°47′ N latitude and 72°20′ E longitude, occupying an alluvial plain at an elevation of 450–480 m above sea level (Fig. 1).

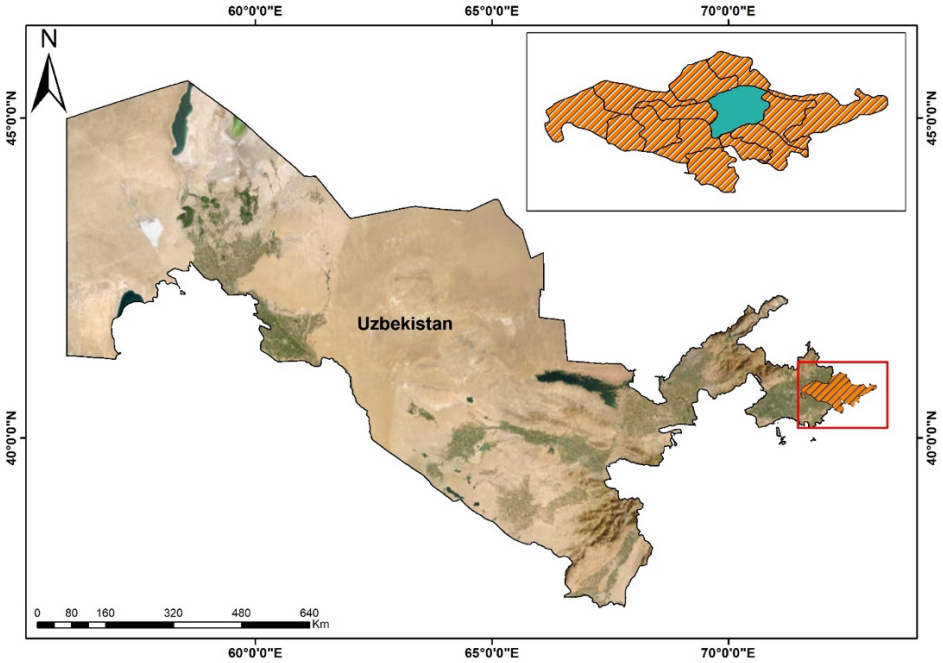

Figure 1. Geographic location of the study area (Andijan city, Uzbekistan).

The climate of the study area is sharply continental, characterized by hot and dry summers and relatively mild and short winters. The mean annual air temperature ranges between 13–14 °C. The average temperature in July reaches 27–30 °C, while in January it drops to approximately −1 to −3 °C. The annual precipitation ranges from 250 to 300 mm, with the majority of rainfall occurring during spring.

The urban territory consists of various landscape elements including residential areas, transportation infrastructure, parks and gardens, irrigated green spaces, abandoned ruderal sites, and construction areas. Such anthropogenic landscapes create favorable ecological conditions for the establishment and spread of ruderal and adventive plant species.

Floristic surveys
The main floristic material used in this study was collected during field surveys conducted in Andijan city between 2019 and 2023 across different phenological stages of the vegetation period.

During the study, the following main urban habitats were investigated:

1. Roadside habitats
2. Residential areas
3. Parks and gardens
4. Irrigated green spaces
5. Abandoned and ruderal sites
6. Construction areas

Plant species occurring within each habitat were recorded and their ecological conditions were observed. Identified species were documented in field notebooks, and herbarium specimens were collected when necessary.

Plant identification
Collected plant specimens were identified under laboratory conditions, and their taxonomic identity was verified using botanical literature and international plant databases.

The following sources were used for plant identification:

1. Flora of Uzbekistan
2. Plants of Central Asia
3. Plants of the World Online (POWO)
4. Plantarium botanical database

Species nomenclature and systematic placement were verified according to modern botanical classification systems.

Identification of adventive species
Adventive plant species occurring in the urban flora were identified using floristic and biogeographical criteria. Species that are not part of the natural flora of the region and have been introduced into new areas as a result of human activities were considered adventive (Richardson *et al.* 2000).

The following criteria were used to classify species as adventive:

1. The natural distribution range of the species lies outside Central Asia
2. Adaptation to urban and ruderal habitats
3. Ability to establish and spread under anthropogenic environmental conditions

Regional floristic studies and scientific literature on the flora of Central Asia were used to verify the adventive status of the recorded species and to confirm their distribution outside their native ranges.

Ethnobotanical data
Information on the ethnobotanical uses of adventive medicinal plants was analyzed based on existing ethnobotanical studies and relevant scientific literature. The primary floristic material was collected during field investigations conducted in Andijan city between 2019 and 2023 during different phenological stages of the vegetation period.

Data on the traditional medicinal use of adventive plants were compiled from previously published ethnobotanical studies, particularly regional ethnobotanical research (Khojimatov *et al.* 2025). Information regarding the medicinal uses of plants, the plant parts utilized (roots, stems, leaves, flowers, and fruits), and their applications in the treatment of various diseases was systematized and analyzed using available scientific sources (Kosimov *et al.* 2026).

Data analysis
The taxonomic composition of the recorded medicinal plants was analyzed. Species were grouped according to families and genera, and their proportions were calculated as percentages.

The following indicators were used to evaluate the taxonomic spectrum:

1. Number of families
2. Number of genera
3. Number of species
4. Proportion of each family within the total flora

In addition, the ethnobotanical uses of plants (e.g., treatment of digestive, respiratory, dermatological and other diseases) and their distribution across different urban habitats were analyzed.

The classification of species into adventive and native (aboriginal) groups was performed using available floristic literature and scientific publications on invasive plants. Invasive species were identified according to regional invasive plant literature and global invasive species databases.

Results

Taxonomic composition of recorded medicinal plants

The taxonomic composition of medicinal plants occurring in the urban flora of Andijan city was analyzed. According to the results of the study, a total of 66 medicinal plant species were recorded in the urban flora, belonging to 61 genera and 22 families. The taxonomic composition of the identified species and their distribution among plant families are presented in Table 1.

Table 1. Taxonomic composition of medicinal plants recorded in the urban flora of Andijan city

Family	Total species	Native species	Adventive species	Invasive species
Asteraceae	11	5	6	4
Fabaceae	10	6	4	2
Brassicaceae	6	2	4	3
Lamiaceae	5	4	1	1
Polygonaceae	5	3	2	2

The taxonomic spectrum of medicinal plants recorded in the urban flora of Andijan city shows an uneven distribution among plant families. Several families were found to dominate the medicinal plant spectrum, particularly Asteraceae, Fabaceae, Brassicaceae, Lamiaceae, and Polygonaceae (Fig. 2). The predominance of these families can be explained by their high ecological adaptability to urban environments as well as their ability to thrive in ruderal and anthropogenically transformed habitats.

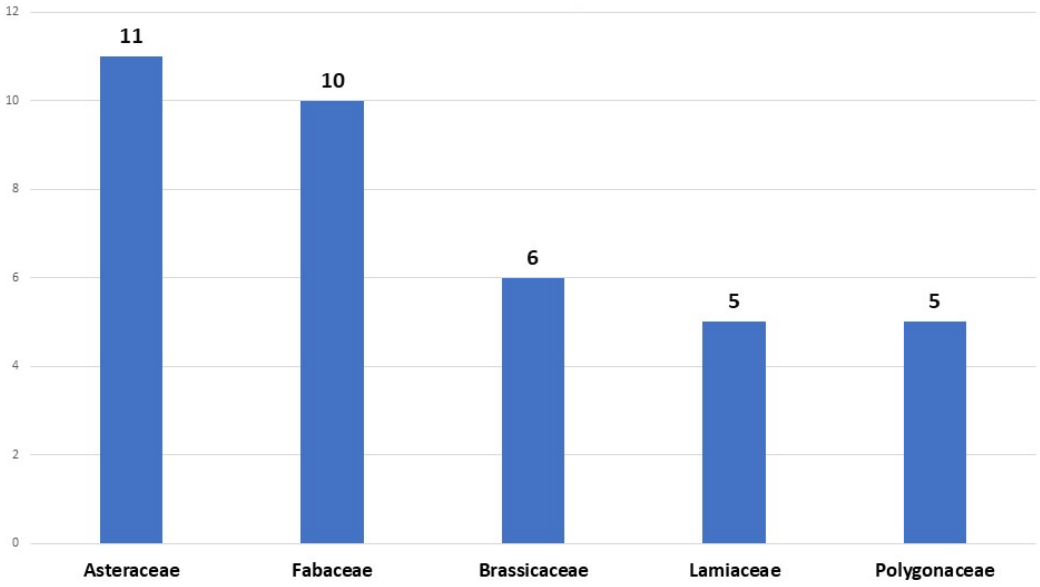

Figure 2. Taxonomic composition of medicinal plant families recorded in the urban flora of Andijan city.

The largest proportion of species belonged to the Asteraceae family with 11 species, followed by Fabaceae with 10 species. The families Brassicaceae, Lamiaceae, and Polygonaceae were represented by 6, 5, and 5 species, respectively.

Comparison of native and adventive medicinal plants

The analysis of native (aboriginal) medicinal plant species showed that the Fabaceae family contained the highest number of native species, with 6 species recorded (Fig. 3). The Asteraceae family ranked second with 5 species. In addition, 4 species were recorded in Lamiaceae, 3 species in Polygonaceae, and 2 species in Brassicaceae.

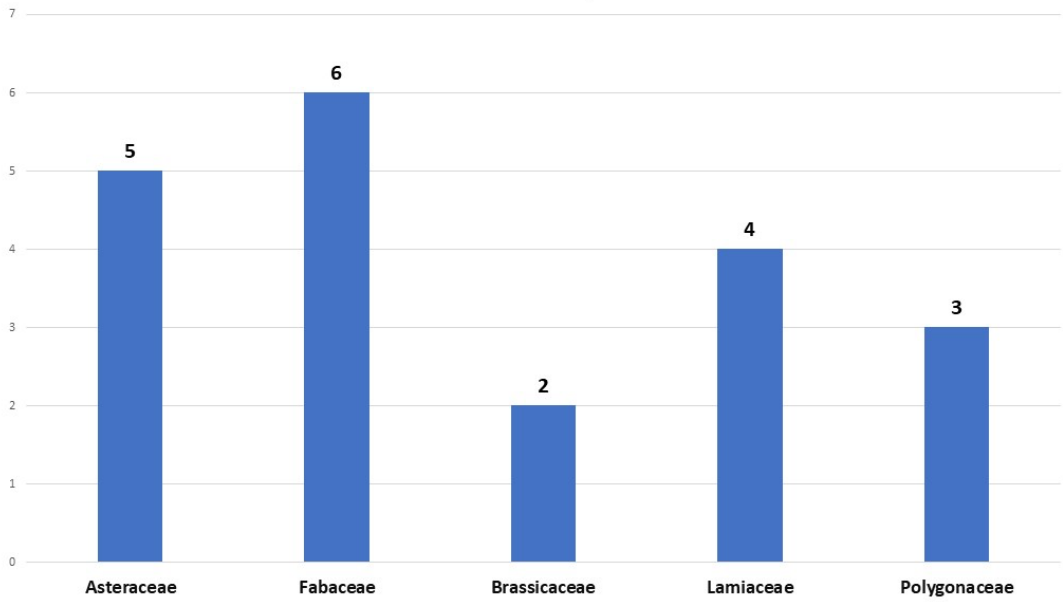

Figure 3. Distribution of native medicinal plant species among dominant plant families.

Distribution of adventive medicinal plants

The taxonomic composition of adventive medicinal plants showed some differences compared to native species (Fig. 4). Among adventive species, the Asteraceae family occupied the leading position with 6 recorded species. In addition, 4 species each were recorded in the families Fabaceae and Brassicaceae, while 2 species were found in Polygonaceae and 1 species in Lamiaceae.

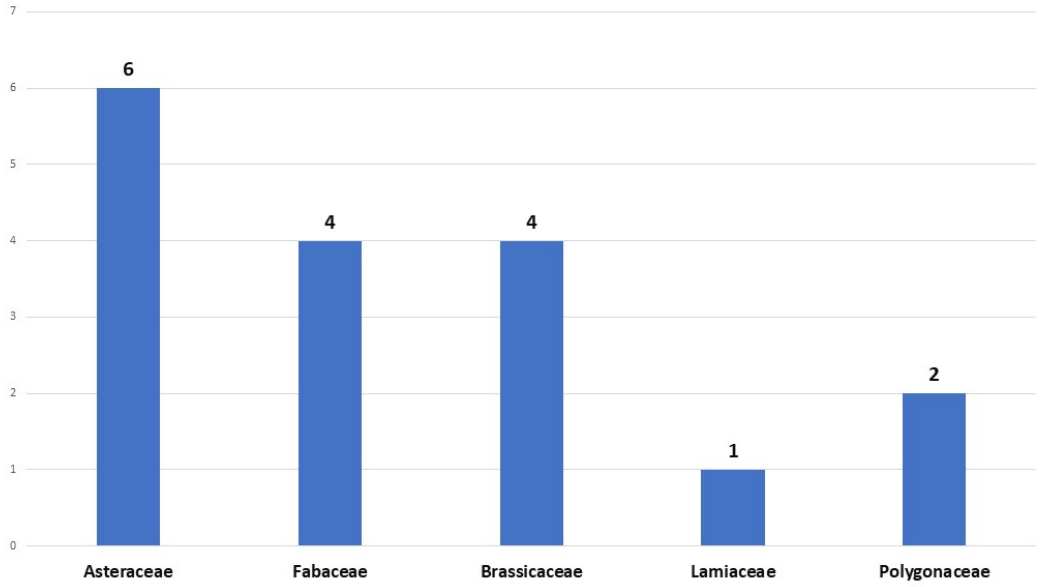

Figure 4. Distribution of adventive medicinal plant species among dominant plant families.

Ethnobotanical use categories

The analysis of ethnobotanical uses of medicinal plants revealed their application in the treatment of various diseases (Fig. 5). The largest proportion corresponded to plants used for the treatment of skin diseases, accounting for 43 species (65%).

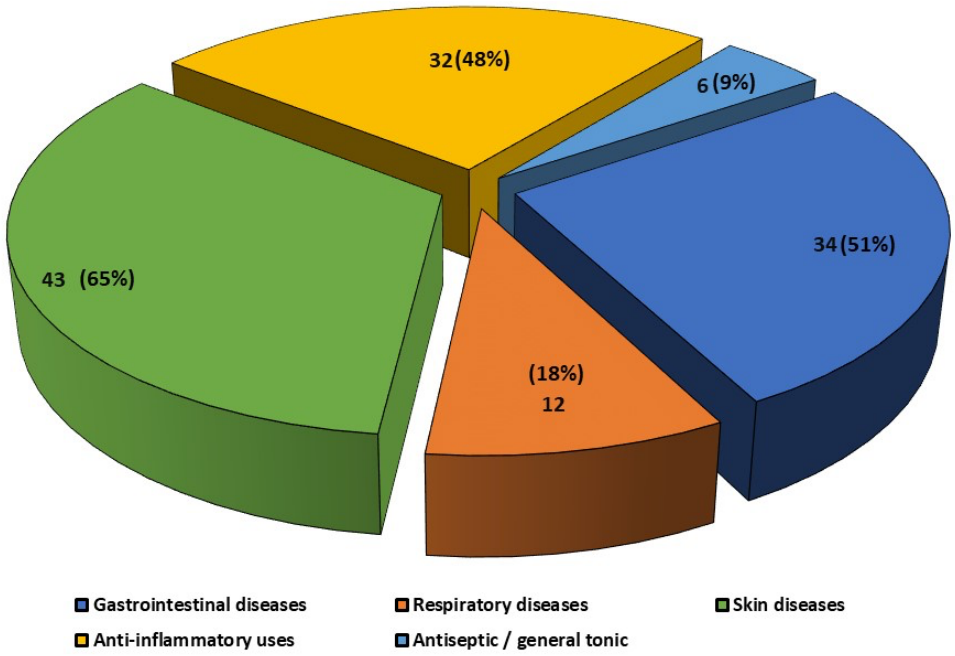

Figure 5. Ethnobotanical use categories of medicinal plants recorded in Andijan urban flora.

The second largest group included plants used for the treatment of digestive system disorders, represented by 34 species (51%). Additionally, 32 species (48%) were used as anti-inflammatory agents, while 12 species (18%) were recorded as treatments for respiratory diseases. Plants used as antiseptic agents or general tonics accounted for 6 species (9%).

Distribution across urban habitats

The distribution of medicinal plants across different urban habitats demonstrated their uneven occurrence in various anthropogenic landscapes (Fig. 6). The highest number of species was recorded along roadside habitats, where 29 species were identified.

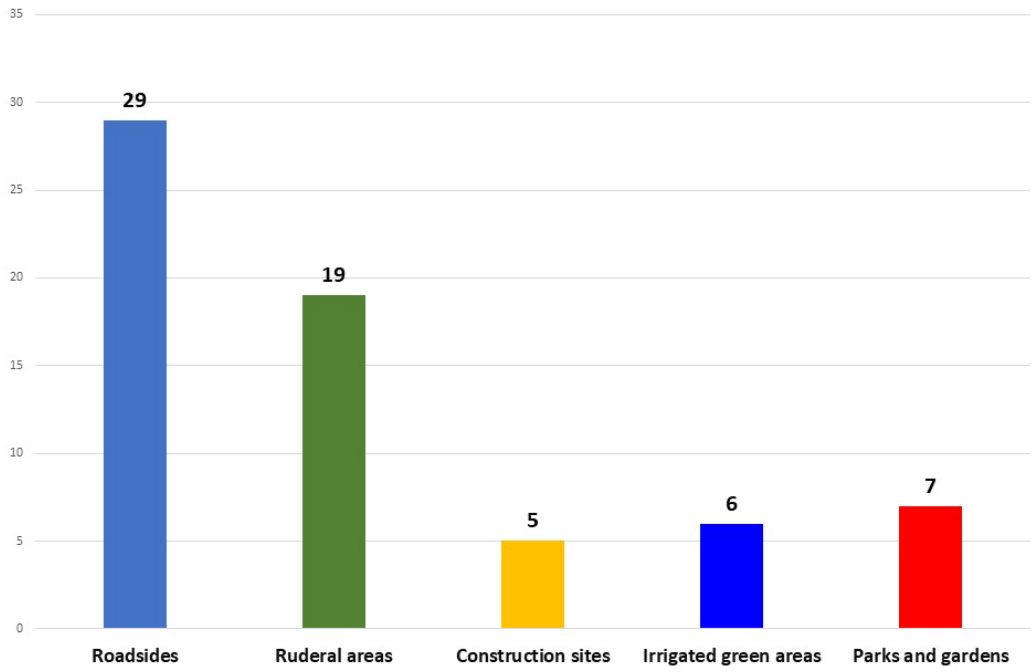

Figure 6. Distribution of medicinal plants across different urban habitats.

The second most species-rich habitats were abandoned ruderal sites, where 19 species were recorded. Additionally, 7 species were found in parks and gardens, 6 species in irrigated green areas, and 5 species in construction sites.

Discussion

The results of this study demonstrate that the taxonomic composition and ethnobotanical importance of adventive medicinal plants occurring in the urban flora of Andijan city are closely associated with the anthropogenic transformation of urban landscapes. Among the recorded medicinal plants, the dominance of the families Asteraceae and Fabaceae was observed. Such results are consistent with numerous studies on urban flora, which report that representatives of these families possess high ecological adaptability and are capable of rapidly colonizing disturbed or anthropogenically influenced habitats (Pyšek *et al.* 2004; Kowarik, 2011).

The predominance of the Asteraceae family in urban floras represents a common floristic feature reported for many cities worldwide. Species belonging to this family are characterized by high ecological plasticity and a strong ability to spread in ruderal and anthropogenically disturbed habitats. Moreover, many representatives of Asteraceae possess effective seed dispersal mechanisms that facilitate their wide distribution in urban landscapes (Aronson *et al.* 2014). Similarly, species of the Fabaceae family also show good adaptation to urban environmental conditions. Their ability to fix atmospheric nitrogen allows them to survive under various soil conditions, increasing their ecological stability in disturbed habitats.

The results of this study also indicate that the distribution of medicinal plants across urban habitats is closely related to the degree of anthropogenic disturbance. The highest number of species was recorded along roadside and in ruderal habitats. This finding highlights the important role of transport infrastructure and urban disturbance processes in the spread of adventive plants. Roadside habitats often function as dispersal corridors for plant seeds and facilitate the introduction of plant species from different regions through transportation networks (Richardson *et al.* 2000).

The ethnobotanical analysis also revealed that medicinal plants represent an important component of urban flora. According to the results of the study, the majority of species are used in the treatment of skin diseases and digestive system disorders. These results are consistent with ethnobotanical studies conducted in other regions. Numerous studies indicate that medicinal plants are widely used as anti-inflammatory agents, antiseptics, and remedies for digestive system disorders (Heinrich *et al.* 2009; Bussmann & Sharon, 2006).

Recent urban ethnobotanical studies suggest that the traditions of medicinal plant use remain preserved even in urban environments. Urban populations actively use medicinal plants in daily life, sell them in local markets, and transmit traditional knowledge across generations (Pieroni *et al.* 2017). From this perspective, adventive plants occurring in urban flora can be considered not only as ecological components but also as useful biological resources for local communities.
However, the presence of adventive medicinal plants in urban flora has a dual ecological significance. On the one hand, they may contribute to increasing biological diversity in urban ecosystems and may serve as useful plant resources. On the other hand, some adventive species may possess invasive characteristics and negatively affect the composition of native flora. Therefore, studying adventive plants in urban environments is important for biodiversity management and sustainable development of urban ecosystems (van Kleunen *et al.* 2015).

Overall, adventive medicinal plants recorded in the urban flora of Andijan city represent an important floristic component of urban ecosystems. Their taxonomic composition and ethnobotanical significance are closely related to the anthropogenic transformation of urban landscapes, and these species may function as important elements of urban biodiversity.

At the same time, the use of medicinal plants growing in urban environments requires consideration of ecological safety factors. Plants growing along roadside or in areas with intensive transport activity may accumulate atmospheric pollutants such as dust particles and heavy metals (e.g., lead, cadmium, and zinc). In addition, plants growing in abandoned or ruderal habitats may absorb various anthropogenic contaminants present in the soil. Such conditions highlight the need for caution when using medicinal plants collected from urban environments in traditional medicine. Therefore, when medicinal plants collected from urban habitats are used for therapeutic purposes, their ecological conditions and potential pollution levels should be carefully considered (Alloway, 2013; Kabata-Pendias, 2011).

Conclusion

The present study made it possible to analyze the taxonomic composition and ethnobotanical importance of medicinal plants occurring in the urban flora of Andijan city. The results showed that medicinal plants are unevenly distributed among plant families, with the highest diversity recorded in the families Asteraceae, Fabaceae, Brassicaceae, Lamiaceae, and Polygonaceae. The predominance of these families can be explained by their high ecological adaptability and their ability to survive in anthropogenically disturbed environments.

The findings indicate that urban environments represent important habitats for medicinal plants, particularly adventive species. Most medicinal plant species were recorded along roadside and in ruderal habitats, demonstrating that transport infrastructure and anthropogenic factors play a significant role in the distribution of plant species in urban flora.

Ethnobotanical analysis showed that the majority of medicinal plants are used for the treatment of skin diseases, digestive system disorders, and inflammatory conditions. These results confirm that traditional knowledge related to medicinal plant

use remains preserved even in urban environments and that medicinal plants represent an important biological resource for local populations.

At the same time, the use of medicinal plants growing in urban environments requires consideration of ecological safety factors. Plants growing along roadside or in areas with high anthropogenic pressure may accumulate various pollutants. Therefore, when medicinal plants collected from urban habitats are used for medicinal purposes, their ecological conditions and potential contamination should be carefully evaluated.

Overall, this study highlights the taxonomic diversity and ethnobotanical importance of adventive medicinal plants occurring in urban flora and provides a scientific basis for urban biodiversity management and the sustainable use of medicinal plant resources.

Declarations

Ethics approval and consent to participate: The ethnobotanical data used in this study were derived from previously conducted ethnobotanical research. In particular, data published in regional scientific studies and ethnobotanical databases were analyzed and synthesized. These data were originally collected and published in accordance with internationally accepted ethical guidelines for ethnobotanical research (Martin, 1995). In the present study, these sources were used exclusively for scientific analysis and comparative purposes.
Consent for publication: No additional individual consent is required for the publication of the data presented in this manuscript.
Availability of data and materials: The ethnobotanical information used in this study was compiled from previously published scientific sources. The floristic observation data collected during the study are retained by the authors and may be made available upon reasonable scientific request.
Competing interests: The authors declare that they have no competing interests.
Funding: The primary field data used in this study were collected during floristic surveys conducted in Andijan city between 2019 and 2023 as part of the author's doctoral research. The study was carried out in connection with the scientific activities of the state research program "Digital Nature" (2025–2029) implemented by the Institute of Botany, Academy of Sciences of the Republic of Uzbekistan. In addition, part of the ethnobotanical information used in this study is based on scientific results generated within the applied research project A-FA-2021-144 (2021–2024).
Authors' contributions: All authors contributed to the conceptualization of the study, field investigations, data analysis, and preparation of the manuscript. All authors read and approved the final version of the manuscript.

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