Hawthorn (*Crataegus*) as a valuable ethnobotanical resource in Armenia

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Research

Abstract

Background: Wild edible plants have historically played an important role in traditional food systems, particularly in mountainous regions characterized by rich biodiversity. In Armenian national cuisine, wild fruits and herbs have traditionally played a significant role as independent food resources, ingredients in a wide variety of dishes, and natural seasonings, contributing to dietary diversity, food security, and cultural identity. Among these resources, hawthorn (Crataegus L.) represents an important yet insufficiently documented wild food plant. This ethnobotanical study aims to identify the most commonly used *Crataegus* species in Armenia, document their traditional culinary and medicinal uses, and evaluate their cultural and ecological significance.

Methods: Ethnobotanical data were collected between 2009 and 2025 across different regions of Armenia. During field visits, structured questionnaires and interviews were conducted with 58 local informants. Information on preparation methods, storage practices, and regional consumption patterns was recorded.

Results: The results showed that 14 species of hawthorn are used as food, 20 species are used for preparing tea, 17 species are used as medicinal plants, 4 species are cultivated, and 7 species are grown as ornamental plants. Regional differences in usage reflect local ecological conditions and cultural preferences. The study highlights the renewed importance of hawthorn in contemporary Armenian diets due to increasing interest in natural and functional foods.

Conclusions: The documentation and preservation of traditional knowledge related to Crataegus are essential for safeguarding cultural heritage, supporting sustainable resource use, and promoting future ethnobotanical and food-related research.

Keywords: *Crataegus*; wild edible plants; traditional food systems; ethnobotany; Armenia.

Background

Traditional food systems based on wild plant resources have long contributed to human nutrition, health, and cultural identity, particularly in regions rich in biodiversity. The traditional Armenian diet has been shaped by the primary forms of

the population's economic and cultural life—agriculture and animal husbandry. The foundation of the diet consists of grains, dairy and meat products, as well as fruits and vegetables. This system is characteristic of the Western Asian economic-cultural type; consequently, Armenian cuisine is classified as part of the Western Asian culinary tradition (Arutyunov & Markaryan 1983). Wild plants obtained through foraging also play a significant role in the Armenian dietary system.

Armenia, located in the South Caucasus, is characterized by complex topography, diverse climatic zones, and exceptional floristic richness. Different types of vegetation occur in Armenia (Fig. 1). Despite its relatively small territory (29,740 km²), the country hosts approximately 3800 species of vascular plants, including numerous wild edible and medicinal species [2]. The Armenian flora includes about 200 species of edible plants. Wild edible plants are an integral part of traditional food systems and cultural heritage. In Armenia, the use of wild fruits has historically contributed to dietary diversity and food security. They are consumed both fresh and processed (cooked, pickled, and in other forms). Wild fruits and berries are also widely used in canned food production and serve as valuable genetic resources for obtaining economically important and high-yielding fruit varieties through the use of resistant wild relatives.

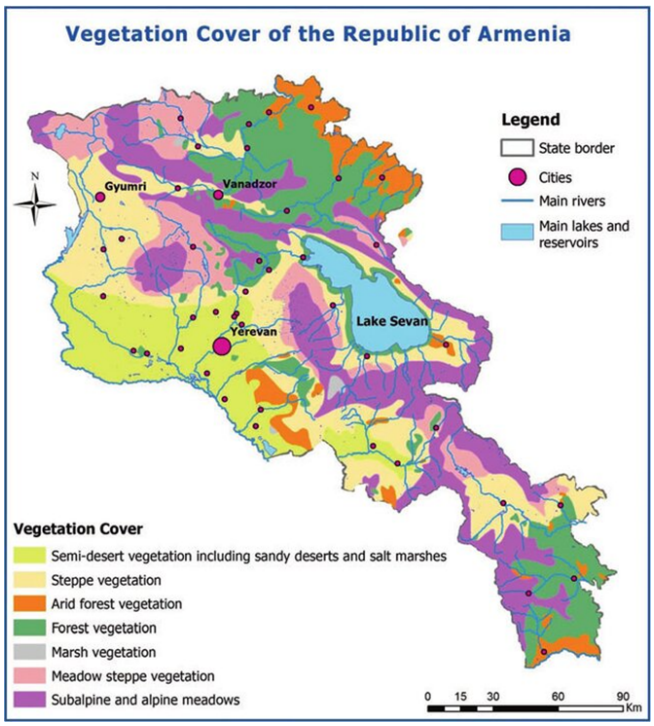


Figure 1. Distribution of main vegetation types in Armenia (Baloyan 2014)

Wild fruits and berries comprise about 120 species, representing nearly 40% of the dendroflora of Armenia, and have historically played a vital role in local diets, particularly in rural communities. The most valuable species include walnut (*Juglans*), hazel (*Corylus*), pear (*Pyrus*), apple (*Malus*), cornelian cherry (*Cornus*), strawberry (Fragaria), raspberry and blackberry (*Rubus*), currant (*Ribes*), and numerous other species (Baloyan 2014, Batsatsashvili *et al.* 2017). Among such plants, hawthorn (*Crataegus*) occupies a special place due to its wide distribution and diverse uses.

The fruits and flowers of hawthorn are rich in organic acids, vitamins, and other bioactive compounds, making them nutritionally significant (O¨ zcan *et al.* 2004, Çalışkan 2015, Ebrahimzadeh & Bahramian 2009, Wang *et al.* 2011, Belabdelli *et al.* 2021, Yu 2022). Hawthorn is also considered one of the oldest medicinal plants and is widely used throughout the world. The leaves, flowers, and fruits of hawthorn have a long history in the traditional medicine of many cultures. Hawthorn possesses antioxidant, lipid-lowering, anticancer, immunomodulatory, and radioprotective properties. In addition, it is known to be effective in the prevention and treatment of cardiovascular diseases (Li *et al.* 2013, Šavikin *et al.* 2017, Liu *et al.* 2018). Hawthorn may also help regulate blood sugar levels; the compounds it contains can reduce the risk of diabetes by increasing insulin sensitivity (Chang *et al.* 2002, Pirmoghania 2019; Đorđevic´ & Nikolic´ 2021).

The genus *Crataegus* L. (Rosaceae) comprises approximately 240 species worldwide, of which 23 occur in Armenia (Sargsyan 2022). Hawthorn species are widely distributed across lowland, mid-mountain, and high-mountain zones, forming an

important component of forest edges, sparse woodlands, shrublands, and river valleys. Archaeobotanical and paleobotanical evidence indicates that *Crataegus* species have been present in the region since the Early Pleistocene (Gabrielyan *et al.* 2024).

In Armenia, many hawthorn species are valuable food and medicinal plants. Their tolerance to different soil and moisture conditions, high winter hardiness, and ornamental qualities makes them suitable for diverse economic uses.

Herbal medicine has been widely practiced in Armenia since ancient times. Medicinal plants of the Armenian Highlands were highly valued even in the ancient world and were included in early pharmacopoeias (Amasiatsi 1926, Vardanyan 2000). They were used not only for the preparation of medicines but also in nutritional therapy, which was one of the most developed branches of folk and medieval Armenian medicine (Vardanyan & Hakobyan 1985). Wild plants played a significant role in this context. Methods for their effective use were developed through centuries of accumulated experience and were integrated into culinary traditions, where they also performed important therapeutic functions in Armenian folk medicine.

Despite the abundance and historical importance of *Crataegus*, ethnobotanical information on its culinary use in Armenia remains fragmented. Most previous studies have focused on taxonomy, pharmacology, or chemical composition, while food-related applications have received limited attention.

The aim of this study is to document the species diversity of edible *Crataegus* in Armenia, analyze their traditional uses in food and folk medicine, and assess their role in contemporary dietary practices. By integrating ethnobotanical field data with botanical and historical sources, this research contributes to the preservation of traditional knowledge and supports the sustainable use of wild food plants.

Materials and Methods

Ethnobotanical data collection and analysis

Ethnobotanical field research was conducted between 2009 and 2025 throughout all administrative regions of Armenia. The study aimed to document traditional knowledge concerning the use of *Crataegus* species, including their local names, edible and medicinal uses, plant parts utilized, harvesting practices, preparation methods, and storage and preservation practices.

A total of 58 local informants from all regions of Armenia participated in the study. The informants included 32 women (55.2%) and 26 men (44.8%). The women ranged in age from 35 to 68 years, while the men ranged from 44 to 70 years. Informants represented the local communities visited during the field surveys. The distribution of the number of men and women by regions is presented in [Table 1]. No specific permits were required for the interviews . The traditional knowledge was treated as community-held knowledge and was used solely for scientific research purposes.

Table 1. Distribution of the number of men and women participating in the survey in Armenia by regions

Region	The number of men	The number of women
Aragatsotn	2	3
Ararat	3	2
Armavir	2	4
Gegharkunik	2	2
Kotayk	4	3
Lori	3	4
Shirak	2	3
Syunik	2	3
Tavush	2	4
Vayots Dzor	4	4

The educational background of the respondents was also recorded. Older respondents generally had lower levels of formal education, whereas younger respondents were more frequently represented among those with secondary or higher education.

Informants were selected based on their familiarity with local plants and traditional practices involving wild fruit-bearing species, particularly *Crataegus*. Participation was voluntary, and oral informed consent was obtained from all participants before the interviews.

Ethnobotanical information was collected using semi-structured interviews and structured questionnaires. The questionnaire covered several principal categories: (1) local and vernacular names of *Crataegus* species; (2) recognition and identification of the plants; (3) plant parts used, including fruits, flowers, and leaves; (4) edible and medicinal applications; (5) methods of preparation and processing; (6) harvesting periods and collection practices; (7) drying, storage, and preservation methods; and (8) traditional knowledge concerning the distribution and occurrence of the species. Open-ended questions were also used to allow informants to describe traditional practices and uses that were not included in the predefined questionnaire categories.

Interviews were conducted during field visits in local communities throughout Armenia. Information provided by informants was recorded in field notebooks and subsequently organized in a standardized database. The database included the informant code, sex and age, region and locality, interview date, *Crataegus* species, local name, plant part used, purpose of use, preparation method, and harvesting or storage practice. Where the same use or practice was reported by several informants, each informant report was recorded separately and subsequently compared across regions and localities.

All reported plant species were taxonomically identified and, where applicable, confirmed by herbarium voucher specimens. For each species, the reported uses were recorded and classified into distinct use categories based on the specific information provided by the informants.

Plant species were classified as food plants when their edible parts were reported as being consumed directly or used as ingredients in traditional dishes; as tea plants when plant material was specifically reported to be prepared and consumed as tea or an infusion; and as medicinal plants when informants reported their use for the treatment, alleviation, or prevention of health conditions. The numbers presented for each category represent the number of unique plant species recorded within that category.

Thus, 14 species were recorded as food plants, 20 species as tea plants, and 17 species as medicinal plants. A species could be included in more than one category when different uses were reported for the same species; therefore, the categories are not mutually exclusive.

Herbarium and taxonomic verification

The botanical identity of *Crataegus* taxa mentioned during the interviews was verified through direct field observations and morphological examination. Importantly, voucher specimens were collected and documented for all *Crataegus* species recorded during the field studies. Voucher specimens were deposited in the relevant herbarium collections and were used to establish a direct link between ethnobotanical information and the corresponding botanical taxa. Species identification was further confirmed through comparison with authenticated herbarium specimens and relevant taxonomic literature. Photographs were taken during field surveys to document plants in their natural habitats.

In addition to interviews, local markets were visited to document the availability of *Crataegus* fruits and products and to record locally recognized forms of processing and use. Information obtained from informants was cross-checked, where possible, with field observations, voucher specimens, herbarium material, market observations, and published ethnobotanical and floristic literature.

The qualitative data were coded according to predefined thematic categories, including species, region, plant part, use category, preparation method, harvesting period, and storage practice. The coded data were compared among informants and regions to identify recurrent uses, regional patterns of traditional knowledge, and the principal methods of preparation and utilization. Reports concerning food and medicinal uses were retained as separate categories to distinguish culinary practices from traditional medicinal applications. The resulting dataset was used to characterize the ethnobotanical significance and regional patterns of utilization of *Crataegus* species in Armenia.

Herbarium materials and relevant literature were examined to verify the taxonomy, identification, and distribution of Crataegus species in Armenia. Published floristic treatments, monographs, taxonomic publications, ethnobotanical studies, and reports concerning the flora and traditional plant use of Armenia were reviewed.

Plant nomenclature follows the modern taxonomic concepts of the genus *Crataegus* according to Ufimov (2013). Field collections were conducted throughout all regions of Armenia between 2009 and 2025 using route-based and stationary methods. For each recorded taxon, information on locality, habitat, altitude, and associated ecological conditions was documented. Plants were photographed in their natural habitats, and voucher specimens were collected for all Crataegus species encountered during the study.

Voucher specimens were examined and compared with authenticated herbarium material from regional and international collections, including ERCB and LE, to confirm species identification and distribution. Morphological characters were examined using binocular microscopes (MBS-2 and OLYMPUS SZX16). The voucher specimens provided the taxonomic reference framework for linking the species identified during field surveys with the ethnobotanical information obtained from local informants.

Field studies of *Crataegus* species were conducted throughout Armenia to investigate their habitats and ecological characteristics (Fig. 2). Hawthorn species were photographed.

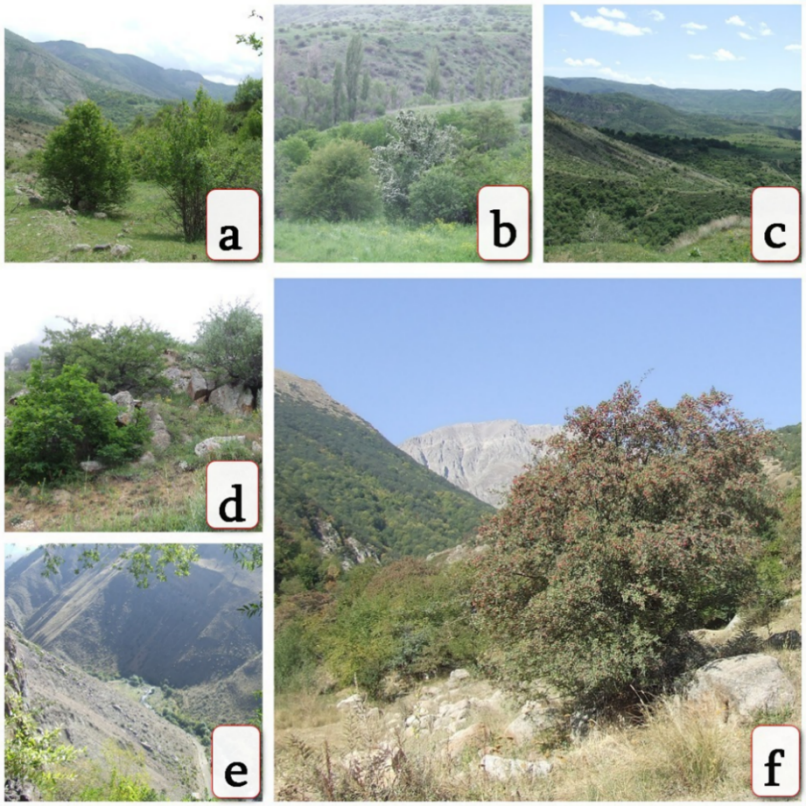


Figure 2. Habitats of *Crataegus* in Armenia: a Bush thicket; b Arid forest; c Arid woodland; d Dry stony slopes; e Mountain river gorges; f Forest edges.

Voucher specimens were collected for representative populations and deposited in the ERE herbarium under the accession numbers listed in Table 2.

Table 2. Vouchers of species of *Crataegus* housed in the ERE herbarium

Species	**ERE**
Crataegus atrosanguinea	ERE 165719; 165720; 165721
C. caucasica	ERE 168203; 168206; 170506; 173340; 170580
C. meyeri	ERE 168216; 169643; 179507; 170508
C. eriantha	ERE 173344; 164678
C. rhipidophylla	ERE 84144; 166454; 166453; 36201; 170559
C. pseudoheterophylla	ERE 173346; 165890; 170554; 169653
C. microphylla	ERE164686, 164687, 164688; 166431
C. pallasii	ERE 165613; 165619; 165620
C. stevenii	ERE 84633, 84634

C. zangezura	ERE 169664; 169655; 169656
C. armena	ERE 170503; 171305; 169630; 166425; 166427
C. ulotricha	ERE 169665; 169666
C. razdanica	ERE170320; 170322
C. pentagyna	ERE168245; 168246; 169669
C. atrofusca	ERE169634; 169635; 169632; 169633
C. susanykleinae	ERE 170336; 170334
C. orientalis	ERE 191190; 194413; 198958; 166433
C. szovitsii	ERE 164142; 164143
C. tournefortii	ERE 168259; 166439
C. gabrielianae	ERE170318; 170319
C. pojarkoviae	ERE 85214; 167525
C. pontica	ERE139716; 139906; 139907

Results

Diversity and Distribution of *Crataegus* Species in Armenia

The population of Armenia is well acquainted with hawthorn, which has long been known both as a food and medicinal plant. The development of botany in Armenia was historically closely connected with medicine, particularly pharmacology, and early botanical works were largely descriptive in nature. Traditional healers relied on botanical knowledge when preparing medicinal remedies.

In historical sources, hawthorn is mentioned under the name “Mamu tandz”, accompanied by descriptions, illustrations, and the Latin name *Crataegus monogyna* Willd. *Crataegus orientalis* is recorded under the name “Sindz”, “wild apple“ (Alishan 1895), “Momu lilik“ (Torlakyan 1981). Other vernacular names include alochi, aloch, tsrptkin, mamu tandz, tivrik, sindz, and sndzeni (Gabikian 1968). It is also noted that *C. orientalis*, which is edible and palatable, can be consumed fresh, whereas the fruits of *C. meyeri* are traditionally eaten only after frost. According to folk belief, a rich hawthorn harvest predicts a long and harsh winter.

To better understand which hawthorn species are used by people in different regions of Armenia, we studied the occurrence of species near populated areas and analyzed their altitudinal distribution. In Armenia, settlements are mainly located in the lower and middle mountain zones. Traditionally, local populations collected plants growing in nearby natural habitats for personal use, utilizing them for food, medicine, and other purposes. Knowledge of the medicinal properties of these plants has been preserved through generations.

Most species of the genus *Crataegus* recorded in Armenia are also found in these zones. Two species of *Crataegus* are found in the foothill zone up to 800 m, 14 species in the lower mountain zone (800-1200 m), 20 species in the mid-mountain zone (1200-1800 m), 9 species in the upper mountain zone (1800-2000 m), and three species in the subalpine zone (2000-2500 m).

These species are primarily distributed in forest edges, sparse woodlands, and mid-mountain zones, where ecological conditions favor fruit development and accessibility.

The fruits of hawthorn typically ripen in early autumn, primarily during the period from September to October. During this stage of development, the fruits acquire their characteristic red to dark-red coloration and undergo physiological and biochemical maturation, resulting in an increased concentration of biologically active compounds. (Fig. 3). These properties contribute to the wide use of hawthorn fruits in both nutritional and pharmacological applications. Some collectors sell their harvest to intermediaries who travel from village to village purchasing hawthorn fruits at lower prices and later resell them in urban markets.

Traditional culinary uses of hawthorn

Historically, hawthorn was not widely used in traditional Armenian cuisine for preparing complex dishes; it was mainly consumed fresh during the harvesting season (Sarkisyan 1932). Children in particular collected and consumed large quantities of hawthorn fruits. In some settlements, hawthorn fruits were stored similarly to wild pears and apples in order to be consumed fresh during winter (Hovsepian 1957). Hawthorn fruits and flowers were also dried and used for preparing

teas and tinctures. The dietary use of hawthorn was associated not only with the treatment of cardiovascular diseases but also with preventive health practices.

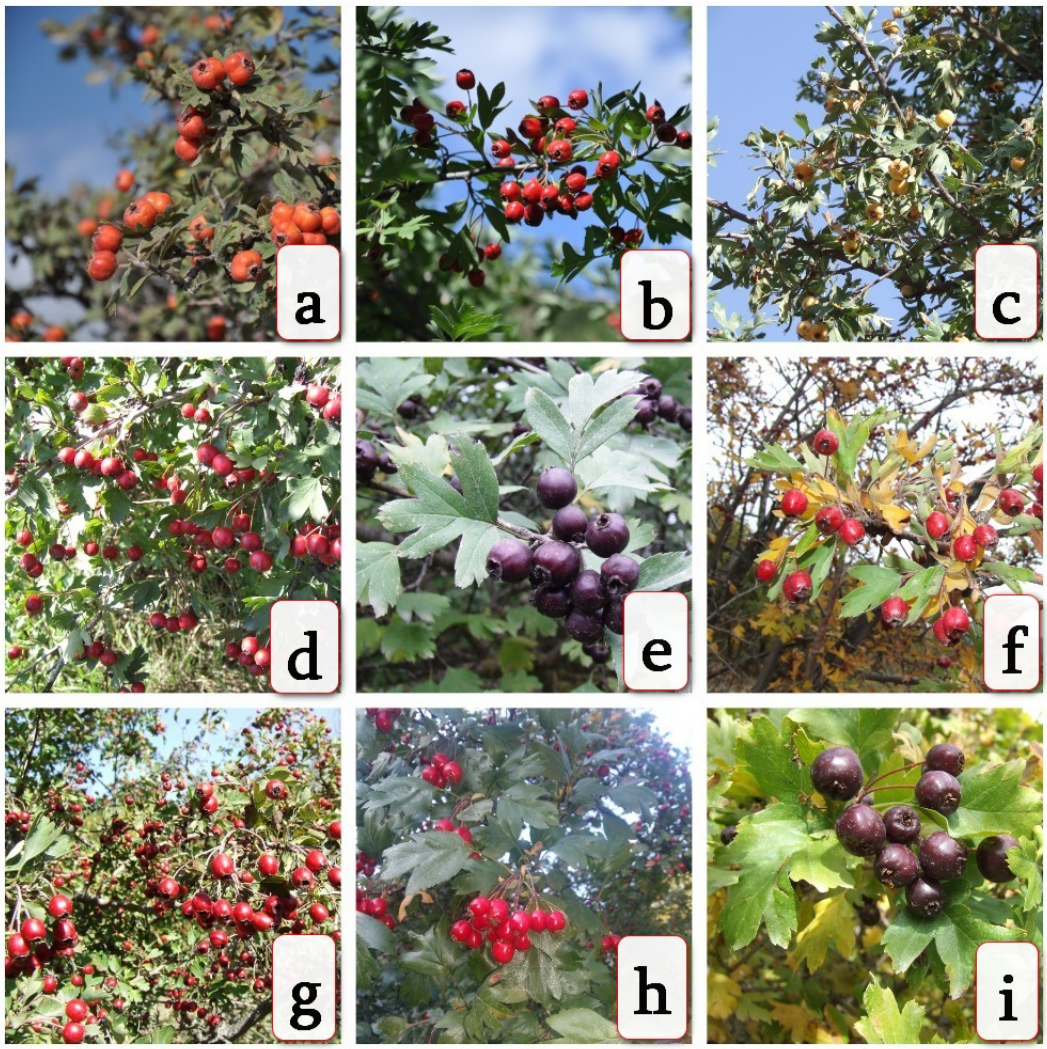


Figure 3. Fruiting specimens of several *Crataegus* species: a *Crataegus orientalis*; b *C. meyeri*; c *C. pontica*; d *C. pseudoheterophylla*; e *C. atrofusca*; f *C. armena*; g *C. rhipidophylla*; h *C.gregorianii*; i *C. susanykleinae.*

Similar to global trends, environmental pollution and other ecological challenges have stimulated interest in ecologically clean food sources in Armenia. Since the 1990s, the large-scale collection of wild plants and their commercialization have increased their importance as vitamin-rich and environmentally safe food resources (Grigulevich 1996). Wild plants are widely used as preventive and health-supporting products in the diet. Socio-economic changes in the post-Soviet period led to renewed interest in wild edible plants and increased the use of hawthorn in both household nutrition and local markets. Today, hawthorn products are increasingly perceived as functional foods that combine nutritional value with preventive health benefits.

Field ethnographic materials collected between 2009 and 2025 indicate that nutritional therapy has gained increasing importance. One of the main reasons for this trend was the difficult socio-economic situation that emerged in Armenia following the collapse of the Soviet Union. In rural areas, economically disadvantaged groups began to actively collect wild plants during the 1990s in order to support their household needs. As a result, wild plants became more widely used both in the food system and in folk medicine.

The economic crisis also stimulated broader interest in wild plants. In addition to traditional knowledge passed down through generations, people increasingly began to rely on books, television, and the Internet to obtain information about the uses of

wild plants. Migration processes and interethnic contacts also contributed to the exchange of knowledge regarding plant use.

In the post-Soviet period, the use of hawthorn expanded considerably. With the development of trade relations, collectors began selling hawthorn products, allowing broader segments of the population to access them. In addition to consuming fresh fruits and preparing teas and tinctures from dried flowers and fruits, hawthorn also began to be used in the preparation of sweets, juices, and other processed products.

Our surveys with local populations indicate that collectors increasingly travel to more distant areas, including higher mountain zones, to harvest hawthorn fruits and flowers for sale. Their experience allows them to select species and forms that are most demanded in markets, particularly those with larger and more palatable fruits (Table 3).

Table 3. Fruit size of *Crataegus* species in Armenia

Species	**Length in mm**	**Diameter in mm**
Crataegus atrosanguinea	14 - 18	15 - 18
C. caucasica	10 - 12	8 - 10
C. meyeri	12 - 15	8 - 10
C. eriantha	10 - 12	6 - 8
C. rhipidophylla	8 - 15	6 - 12
C. pseudoheterophylla	7 - 12	5 - 9
C. microphylla	8 - 12	6 - 8
C. pallasii	8 - 12	6 - 8
C. stevenii	10 - 12	6 - 8
C. zangezura	8 - 10	6 - 9
C. armena	8 - 12	6 - 8
C. ulotricha	10 - 12	8 - 12
C. razdanica	10 - 12	12 - 15
C.gregorianii	13-15	10-12
C. pentagyna	8 - 10	6 - 8
C. atrofusca	10 - 12	8 - 12
C. susanykleinae	13 - 18	15 - 18
C. orientalis	10 - 15	12 - 18
C. szovitsii	12 - 14	10 - 12
C. tournefortii	10 - 12	10 - 12
C. gabrielianae	12 - 14	13 - 15
C. pojarkoviae	15 - 18	12 - 16
C. pontica	14 - 18	15 - 22

Local populations generally do not distinguish hawthorn species based on detailed morphological characteristics. Instead, they classify them according to fruit color. In Armenia, hawthorn fruits occur in several color forms, including red, black, yellow, and orange (Fig. 4).



Figure 4. Fruit colors of hawthorn (*Crataegus*) species growing in Armenia: a *Crataegus armena*; b *C. zangezura*; c *C. pseudoheterophylla*; d *C. meyeri*; e *C. eriantha*; f *C. razdanica*; g *C. pojarkoviae*; h *C. orientalis*; i *C. pontica*; j *C. atrofusca*; k *C. pentagyna*; l *C. susanykleinae*.

Culinary uses of hawthorn today

Hawthorn fruits are mainly consumed fresh, dried, or processed into jams, compotes, syrups, and herbal teas, while the flowers are predominantly used for the preparation of infusions (Fig. 5).

In autumn, when the fruits ripen, they are often strung on threads, forming traditional strings of fruits that are especially popular among children and are considered a favorite seasonal dessert. In some regions, these strings of fruits are stored and consumed during winter.

After harvesting, the fruits are cleaned of leaves and branch residues, spread in a thin layer in a shaded and well-ventilated place, and dried for 12-15 days. The dried fruits are stored in glass containers or in bags made of cotton fabric. Regional differences in culinary practices reflect variations in species availability (Table 4).

In the northern and southern regions of Armenia, species growing in forest clearings and forest undergrowth are commonly used, including *Crataegus pentagyna*, *C. rhipidophylla*, *C. caucasica*, and *C. atrosanguinea*. In central Armenia, where arid plains prevail, drought-resistant species are more common, including *Crataegus orientalis*, *C. meyeri*, *C. rhipidophylla*, and *C. pallasii*.

Compotes prepared from hawthorn fruits with added sugar are particularly popular. The fruits impart a delicate taste and a distinctive aroma to these beverages.

The study identified *Crataegus orientalis*, *C. meyeri*, *C. pontica*, *C. atrosanguinea*, *C. rhipidophylla*, *C. armena*, *C. pentagyna*, and *C. susanykleinae* as the most commonly used species in Armenian traditional food systems.



Figure 5. Uses of hawthorn in food: (a-c) jam; (d-f) compote; g pastila.

Table 4. Processing of various types of hawthorn into food products in Armenia

Species (*Crataegus*)	Traditional methods of use
Crataegus orientalis	Fresh fruit, jam, pastila, infusion
C. pontica	Fresh fruit, jam, fruit drinks, pastila
C. meyeri	Fresh fruits, jams, compotes, infusions
C. armena	Compotes, infusions
C. susanykleinae	Fresh fruit, jam, pastila, drying for winter storage
J	jam, infusions
C.atrosanguinea	Fresh fruits, jams, compotes, infusions
C. pentagyna	compotes, infusions

Hawthorn fruits are sold fresh and dried in city markets (Fig. 6). In local markets, sellers often explain the beneficial properties of hawthorn and share methods of preparation with buyers. Such interactions between sellers and buyers are a characteristic feature of traditional Armenian markets.

During the interviews, it was reported that in the past, when wheat supplies were scarce, ground hawthorn fruit pulp was added to flour during bread preparation. For this purpose, the ripe fruits of Hawthorn were crushed, the seeds were removed, and the resulting pulp was mixed with wheat flour to prepare the dough. Bread baked using this method had a slightly sweet taste due to the natural sugars present in the fruit. This practice served as a way to economize wheat flour while also imparting additional flavor to the bread. Today, however, this tradition is no longer practiced.

In total, 14 hawthorn species are used as food in different regions of Armenia. These species have fleshy fruits suitable for consumption in both fresh and processed forms.



Figure 6. Hawthorn fruits in markets: a *Crataegus atrosanguinea*; b *C. susanykleinae*; c *C. pentagyna*; d *C. orientalis*.

Use of *Crataegus* Flowers for Tea

In Armenia, hawthorn flowers are widely used as raw material for herbal tea. The flowers are collected during the flowering period and dried for later use. From late May to June, local residents actively collect hawthorn flowers, dry them in the shade, and store them in glass containers. The flowering period of most hawthorn species lasts approximately 15-20 days, while the lifespan of an individual flower is only 2-3 days.

Petals and fruits of 20 hawthorn species are collected for tea preparation. These include *Crataegus meyeri*, *C. caucasica*, *C. atrosanguinea*, *C. armena*, *C. zangezura*, *C. pseudoheterophylla*, *C. orientalis*, and *C. szovitsii*, among others (Fig. 7).

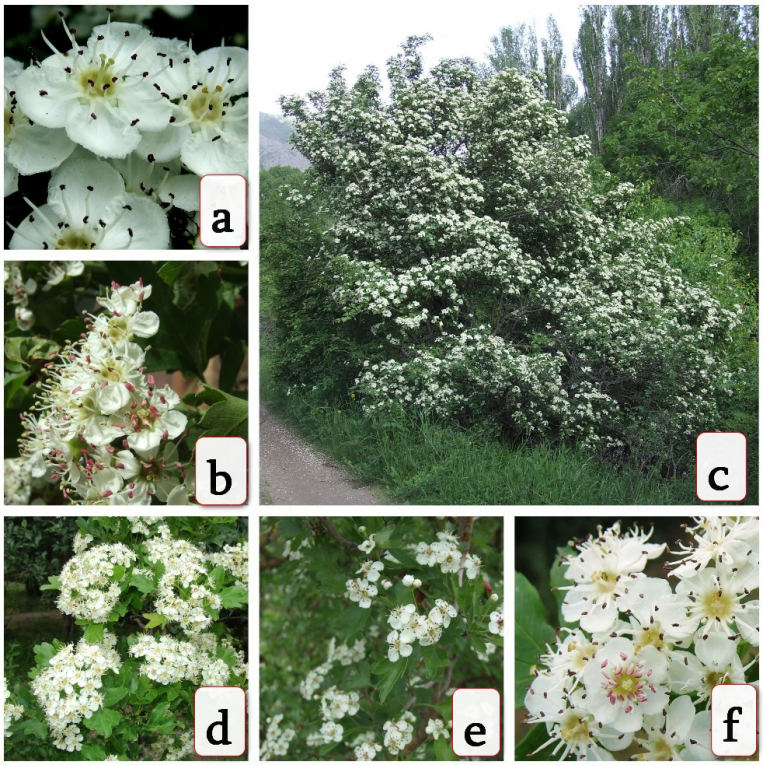


Figure 7. Species of hawthorns whose petals are used to make tea: a *Crataegus meyeri*; b *C. susanykleinae*; c *C.caucasica*; d *C. pentagyna*; e *C. rhipidophylla*; f *C.atrofusca*.

Use in Pharmacy and Folk Medicine

Hawthorn has long attracted the attention of healers and has been considered an important medicinal plant in Armenian folk medicine since ancient times. The population is well aware of the calming and soothing properties of tea prepared from hawthorn petals, which is commonly consumed during winter. Both the flowers and fruits have traditionally been used for medicinal purposes.

Today, hawthorn (*Crataegus*) is widely recognized as a medicinal plant and is commonly sold in pharmacies. It is known for its beneficial effects on cardiovascular health, including improving blood circulation and helping to maintain normal blood pressure. Hawthorn berries, leaves, and flowers are used to produce extracts, tablets, teas, and tinctures.

Such medicinal products are also produced in Armenia and are widely purchased by the population through pharmacies (Fig.8). In different regions of Armenia, flowers and fruits of 17 hawthorn species are collected and used for medicinal purposes.



Figure 8. Hawthorn products in Armenian pharmacies: a hawthorn fruits; b hawthorn fruit extract; c hawthorn flowers.

Cultural and Social Significance

Hawthorn species are also widely used in ornamental gardening. They are resistant to adverse urban conditions, undemanding to soil quality, tolerant of shading, and responsive to pruning and shaping. Most species are winter-hardy and drought-resistant and maintain decorative value throughout the growing season.

The following species are commonly cultivated for ornamental purposes: *Crataegus pseudoheterophylla*, *C. meyeri*, *C. rhipidophylla*, *C. atrosanguinea*, *C. pentagyna*, *C. orientalis*, and *C. susanykleinae*.

Some hawthorn species, including *C. rhipidophylla*, *C. armena*, *C. caucasica*, and *C. orientalis*, are used as rootstocks for cultivated fruit trees such as medlar, apple, quince, and pear. Hawthorn species are also occasionally planted as hedges. In addition, all representatives of the genus *Crataegus* are valuable honey plants, and their fruits serve as an important winter food source for birds.

Overall, the results show that in Armenia 14 hawthorn species are used as food, 20 species are used for tea preparation, 17 species are used as medicinal plants, 4 species are cultivated, and 7 species are used as ornamental plants (Fig. 9).

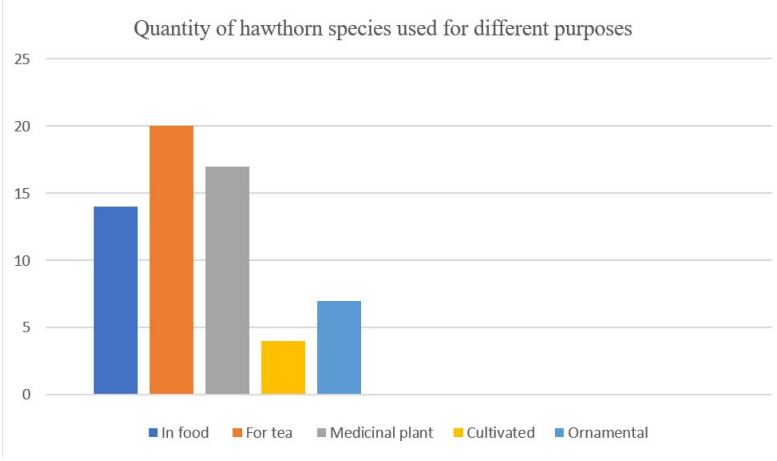


Figure 9. Applications of hawthorn species and the corresponding number of species.

Discussion

The present study demonstrates that the genus *Crataegus* has considerable ecological, geographical, and ethnobotanical significance in Armenia. The occurrence of numerous species across different altitudinal belts, together with their continued use as food, medicinal resources, and raw material for herbal preparations, indicates that hawthorns represent an important component of both the natural vegetation and traditional plant-use systems of the country. The results further suggest that the diversity and accessibility of *Crataegus* populations have contributed to the long-term integration of hawthorn species into local knowledge and household practices. The distribution pattern observed in Armenia is strongly associated with the country's pronounced topographic and climatic heterogeneity. The highest number of species was recorded in the middle-mountain belt (1200-1800 m), where 20 species occur, compared with 14 species in the lower-mountain belt, 9 species in the upper-mountain belt, and only three species in the subalpine belt. This concentration of species in the middle-mountain zone may reflect the interaction of several ecological factors, including moderate temperature conditions, greater habitat heterogeneity, seasonal moisture availability, and the presence of forest edges, open woodlands, shrub communities, and transitional habitats. Such ecotonal environments can provide a broad range of microsites and may therefore support the coexistence of species with different ecological requirements. The relatively high diversity of *Crataegus* in the lower and middle mountain zones also has an important ethnobotanical explanation. Most Armenian settlements are concentrated within these altitudinal belts, meaning that hawthorn populations occurring near villages are more accessible for collection. Consequently, the observed pattern of human use does not necessarily reflect only species abundance; it also reflects the spatial relationship between natural populations and human settlements. Species growing near settlements are more likely to be used for food and medicine. Knowledge of these uses is then passed down through generations. Thus, the distribution of *Crataegus* in Armenia represents an interaction between ecological suitability and cultural accessibility.

The occurrence of hawthorn mainly in forest margins, sparse woodlands, clearings, and open mountain habitats is particularly relevant to its utilization. These habitats combine relatively favorable conditions for flowering and fruit maturation with easier access for collectors than dense forest interiors. The concentration of edible and medicinal species in such accessible habitats may partly explain why hawthorn has remained an important component of local plant-use traditions. At the same time, increased commercial collection may gradually alter this relationship by shifting harvesting from predominantly household use toward market-oriented exploitation. The ethnobotanical results indicate that the traditional use of hawthorn in Armenia is characterized by considerable taxonomic diversity. Fourteen species were documented as food plants, approximately 20 species were reported as sources of flowers or fruits for tea preparation, and 17 species were reported as medicinal plants. This broad spectrum of utilization is noteworthy because it demonstrates that local communities do not treat *Crataegus* as a single undifferentiated resource. Rather, collectors recognize differences among species and, in some cases, preferentially select taxa or forms according to fruit size, taste, productivity, or other desirable characteristics. Such species-level recognition represents an important component of traditional ecological knowledge and may provide valuable information for future ethnobotanical and conservation studies.

The predominance of certain species in food systems, particularly *Crataegus orientalis* and *C. meyeri*, as well as *C. pontica, C. rhipidophylla, C. atrosanguinea, C. armena, C. pentagyna,* and *C. susanykleinae*, suggests that culinary use is influenced by both availability and organoleptic characteristics. Species with larger, fleshy, and palatable fruits are more likely to be selected for direct consumption and processing. The regional differences observed in species use support this interpretation. In northern and southern Armenia, where forest habitats are more extensive, species associated with forest edges and undergrowth are more frequently utilized, whereas in central Armenia, drought-tolerant species characteristic of more arid landscapes are more prominent. This regional differentiation demonstrates that traditional plant use is closely linked to local species pools and environmental conditions. The historical information on the consumption and storage of hawthorn fruits further illustrates the continuity and flexibility of traditional knowledge. Fresh consumption was apparently the most common form of use, while drying and winter storage provided an opportunity to extend the period of availability beyond the autumn fruiting season. The reported practice of incorporating processed hawthorn fruit pulp into wheat flour during periods of food shortage is particularly significant from an ethnobotanical perspective. Although this practice is no longer widespread, it demonstrates the role of wild plants as supplementary food resources during periods of economic or agricultural stress. Similar practices may have contributed historically to the resilience of rural households by diversifying available food resources.

The increasing commercialization of hawthorn since the post-Soviet period represents an important change in the relationship between local communities and wild *Crataegus* populations. Traditional collection was primarily oriented toward household consumption and medicinal use, whereas contemporary collection increasingly includes the sale of fresh and dried fruits and flowers. The movement of collectors into more remote and higher-altitude areas indicates that market

demand may expand the spatial extent and intensity of harvesting. This transition creates both opportunities and risks. On the one hand, commercialization can increase the economic value of local biodiversity and strengthen interest in maintaining valuable wild plant resources. On the other hand, intensive and repeated collection may place additional pressure on natural populations, particularly where harvesting is concentrated on species with desirable fruit characteristics or where collection occurs before natural regeneration is completed. The use of flowers for herbal tea represents another important dimension of resource utilization. The collection of flowers during the relatively short flowering period requires collectors to identify suitable populations and harvest material at an appropriate developmental stage. Because flowering occurs for only a limited period, repeated or intensive collection could potentially affect reproductive output if flowers are removed in large quantities. This issue is particularly relevant for populations located close to settlements, where accessibility and market demand may result in repeated harvesting. Sustainable collection practices should therefore distinguish between fruit harvesting and flower harvesting and should consider the reproductive biology and population structure of individual species.

The medicinal importance of *Crataegus* in Armenia also reflects a long continuity between traditional knowledge and contemporary pharmaceutical use. The historical association of hawthorn with cardiovascular and calming remedies has persisted into modern practice, where hawthorn-derived products are available through pharmacies in the form of teas, extracts, tablets, and tinctures. This continuity suggests that traditional knowledge has not simply been replaced by modern pharmacological approaches but has, in some cases, been incorporated into contemporary patterns of plant use. However, the increasing medicinal and commercial value of hawthorn also emphasizes the need for accurate species identification, particularly in a genus containing numerous morphologically similar taxa. The historical vernacular names recorded for hawthorn provide additional evidence of the long-standing cultural importance of the genus in Armenia. The existence of multiple local names for particular species indicates that knowledge of hawthorn was embedded within regional linguistic and cultural traditions. The distinction made historically between the palatable fruits of *Crataegus orientalis* and the fruits of *C. meyeri*, which were traditionally consumed after frost, further demonstrates that local communities recognized differences in the characteristics of individual taxa. Such observations may represent empirical knowledge accumulated through generations and deserve consideration in future ethnobotanical research. From a conservation perspective, the combination of high species diversity and increasing human use requires particular attention. The concentration of *Crataegus* diversity in the middle-mountain belt means that this zone should be considered a priority region for monitoring wild hawthorn populations. Conservation measures should integrate both habitat protection and sustainable harvesting practices. Particular attention should be given to species that are geographically restricted, locally rare, or subject to intensive collection. Maintaining populations in natural forest margins, open woodlands, and other semi-natural habitats is essential because these habitats simultaneously support biodiversity and provide important resources for local communities.

The results also have implications for the conservation of traditional ecological knowledge. The use of 14 species as food, approximately 20 species for tea, and 17 species for medicinal purposes demonstrates a substantial body of species-specific knowledge. However, changes in rural livelihoods, migration, commercialization, and the increasing reliance on information from external sources may contribute to the erosion or transformation of traditional knowledge. Documentation of local names, harvesting methods, preparation techniques, and species preferences should therefore accompany biological surveys. Such integrated documentation can provide a more complete basis for developing conservation strategies that are socially appropriate and culturally relevant. The observed diversity of edible and medicinal *Crataegus* species also indicates considerable potential for further research into their nutritional, phytochemical, and functional-food properties. The preference of local collectors for species with larger and more palatable fruits suggests that Armenian populations may contain valuable genetic resources for future selection and cultivation. However, the transition from wild collection to cultivation should be approached cautiously, particularly for taxa with restricted distributions or conservation concerns. Ex situ cultivation, propagation studies, and the establishment of reference collections could reduce pressure on natural populations while preserving locally important genetic material. Overall, the findings demonstrate that *Crataegus* in Armenia should be viewed not only as a taxonomically diverse plant group but also as a multifunctional natural resource linking biodiversity, traditional knowledge, food systems, medicine, and local economies. The strong representation of species in the middle-mountain zone, their occurrence in accessible semi-natural habitats, and their extensive use by local communities indicate that ecological and cultural factors jointly determine the current significance of hawthorn in Armenia. Future conservation and management programs should therefore adopt an integrated approach that combines floristic and population studies with ethnobotanical documentation, sustainable harvesting guidelines, and conservation of habitats supporting wild *Crataegus* populations.

Conclusions

Historically, the gathering and consumption of wild edible plants have also supported food security, particularly in rural and mountainous communities where access to cultivated crops was limited. Furthermore, the preservation and transmission of knowledge related to wild plant use represent an important element of cultural heritage, reflecting long-standing ecological knowledge and culinary traditions within Armenian society.

Hawthorn (*Crataegus* L.) represents an important wild food resource in both traditional and contemporary Armenian cuisine. It has long been known to the people of Armenia through traditional culinary practices and folk medicine.

Hawthorn fruits are rich in sugars, organic acids, pectins, vitamins, and biologically active compounds. In addition to their nutritional value, hawthorn-based foods have cultural significance, especially in rural areas where traditional knowledge is actively preserved and transmitted from generation to generation.

For culinary purposes, species with larger and more fleshy fruits are mainly harvested. The species *Crataegus orientalis*, *C. meyeri*, *C. pontica*, *C. susanykleinae*, *C. atrosanguinea*, and *C. pentagyna* are among the most frequently used in Armenian food traditions.

Hawthorn tea and tinctures are widely consumed, often with honey or fruit preserves. Due to the abundant fruiting of hawthorn species, these plants represent promising resources for further development and potential industrial use.

Ethnographic materials, as well as historical sources on Armenian folk medicine and medieval medical literature, indicate the frequent use of hawthorn-based beverages for preventive health purposes.

Hawthorn fruits also play an ecological role, serving as an important food source for birds during winter. Several species, including *Crataegus orientalis, C. meyeri*, *C. armena*, and *C. rhipidophylla*, are recommended for landscaping and the creation of drought-resistant gardens.

The documentation of ethnobotanical knowledge related to *Crataegus* contributes to the preservation of cultural heritage and supports the sustainable use of wild plant resources. Growing global demand for natural and organic foods highlights the importance of such resources. Further interdisciplinary research is needed to integrate traditional knowledge with modern food and nutrition science.

Declarations

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