RESEARCH ARTICLE

SABRAO Journal of Breeding and Genetics
57 (1) 171-182, 2025
http://doi.org/10.54910/sabrao2025.57.1.17
http://sabraojournal.org/
pISSN 1029-7073; eISSN 2224-8978

BENEFICIAL FLORA OF NORTHWESTERN ZHETYSU ALATAU REGION, KAZAKHSTAN

D. AIDARBAYEVA, A. TALDYBAY*, and M. BASHENOVA

Abai Kazakh National Pedagogical University, Almaty, Kazakhstan
*Corresponding author's emails: aknurtaldybay@rambler.ru, aknur666@mail.ru
Email addresses of co-authors: d.kaisar@mail.ru, bashenova01@mail.ru

SUMMARY

The pertinent study presents the brief history, species composition, and ranking of the wild useful vegetation (medicinal, vitamins, and food) under natural conditions in the Zhetysu Alatau Region, Kazakhstan. Based on floristic analysis, recorded data established Northwestern part of Zhetysu Alatau has more than 161 species of useful plants, belonging to 89 genera and seven families. The leading families were *Asteraceae* (22 genera and 40 species), *Rosaceae* (15 genera and 30 species), *Lamiaceae* (15 genera and 24 species), *Fabaceae* (14 genera and 25 species), and *Apiaceae* (nine genera and 13 species). The study carried out taxonomic analysis of large families and list of useful plants in the Zhetysu Alatau flora. The plants' classification relied on different ecological groups. According to beneficial properties, ranking the species reached four groups based on their use as medicinal (used as official, traditional, and oriental medicines), food, vitamins, and for technical purposes. Moreover, resource data on reserves of the most crucial medicinal plants (*Inula helenium* L, *Origanum vulgare* L., *Achillea millefolium* L., *Hypericum perforatum* L. *Ajania fastigiata* Poljak., *Artemisia frigida* Willd, *Saussurea elegans* Ledeb., and *Ephedra equisetina* Bunge.) in Zhetysu Alatau region, were valuable outcomes.

Keywords: Zhetysu Alatau Region, useful plants, medicinal flora, species composition, taxonomic analysis, economic importance, prospects, pharmacological activities

Key findings: In Zhetysu Alatau flora, 161 species of useful plants have reached validation, with all of them used as folk medicines (41 species as official medicines, 27 species as oriental medicines, and 36 species as vitamins), 46 species served as food, and 14 species have technical uses.

Communicating Editor: Dr. Anita Restu Puji Raharjeng

Manuscript received: May 09, 2024; Accepted: September 29, 2024.

Citation: Aidarbayeva D, Taldybay A, Bashenova M (2025). Beneficial flora of Northwestern Zhetysu Alatau Region, Kazakhstan. *SABRAO J. Breed. Genet.* 57(1): 171-182. http://doi.org/10.54910/sabrao2025.57.1.17.

INTRODUCTION

The vegetation of the Kazakhstan mountainous areas contains unique reserves of the flora and richest gene pool of different crop plants. Therefore, the conservation and rational use of those plant genetic resources (PGR) of mountainous forest ecosystem is extremely critical for ecological, economic, and social values (Kokoreva, 2015). In 2020, D.K. Aidarbaeva studied the current state of the vegetation cover in the pastures of the Bulenka, Monaka, Tyksha, Zhylandy, Bastaushi, and Baldyrgan rivers and the mountain gorges of Uzynbulak, Tamysai, and Osek, located in the territory of the Zhetysu Alatau. These contained reserves of natural raw materials of some medicinal plants (*Aconitum monticola* Steib., *Delphinium dictyocarpum* DC., *Ephedra eguisetina* Bunge., *Hypericum perforatum* L., *Origanum vulgare* L., *Achillea millefolium* L., *Nepeta pannonica* L., and *Armeniaca vulgare* L.), assessing the number of procurements per year (Aidarbayeva, 2020). In the territory of the Zhetysu Alatau State National Natural Park, the destruction of vegetation cover is low. Moreover, the mountain meadows are not subject to a high level of load, although the registration of local areas under anthropogenic pressure have progressed in the buffer zone. Vegetation cover of the steppes and low mountains in the territory of the State National Natural Park "Altyn-Emel" have sustained a high grazing load of wild ungulates, which are increasing every year, and pastures are unable to meet their growing needs (Dimeeva and Gemedzhieva, 2023).

During 1957 to 1960 era, as requested by the Kazakh Office of Lekrastrust, the Department of Plant Resources, Institute of Botany, Academy of Sciences, Kazakhstan, conducted scientific expeditions to survey the reserves and distribution of Ephedra horsetail in the Zhetysu Alatau Region, led by N.V. Pavlova. The same Department also steered resource studies to identify the most important medicinal plants (Kukenov *et al.,* 1996, 2002; Kukenov*,* 1988, 1989, 1999; Aidarbayeva, 1991, 2019).

The promising medicinal plant *Saussurea elegans* Ledeb. underwent scrutiny, including its phytochemical studies of biologically active substances (flavonoids, alkaloids, saponins, extracts, free organic acids, vitamin B2 [riboflavin], and vitamin C) (Taldybay *et al.,* 2021a). The chemical composition of *Artemisia frigida* Willd, discovered in Zhetysu Alatau, also sustained assessment, carrying out quantitative and qualitative analyses of its aerial parts (Taldybay *et al.,* 2021b).

The localization and characterization of some medicinal plants in delta-I on the Southern macro-surface of the Zhetysu Alatau, Kazakhstan also bore a probe (Kaliyev *et al.,* 2023). Likewise, the study of plant diversity and distribution patterns of *Populus pruinosa* Schrenk (Salicaceae) in floodplain forests of Kazakhstan materialized (Dimeyeva *et al*., 2023).

A past study comprising distribution, morphological characteristics, phytochemical profiles, and optimization of the bioactive components of *Ajania fastigiata* in Zhetysu Alatau Region has also transpired (Ramazonov *et al*., 2024; Taldybay *et al.,* 2024). Moreover, *A. fastigiata* showed remarkable effectiveness against enzymes associated with diabetes and bacterial infections (α-glucosidase, PTP1B, BNA) and displayed promising antioxidant properties.

The above reviews indicate relatively little research has progressed on wild useful plants of the Zhetysu Alatau Region, Kazakhstan. In addition, under the influence of anthropogenic factors, the current state of their populations is considerably varying. Concerning the above discussion, it is urgently necessary to conduct a systematic survey about the genetic resources of useful plants in the Zhetysu Alatau Region. Therefore, the presented study aimed to comprehensively assess the flora of useful plants and ensure the rational application of local useful plants in the Zhetysu Alatau Region, Kazakhstan.

MATERIALS AND METHODS

The relevant study comprised different research methods, such as, resource studies, geobotanical, cartographic, and phytochemical analysis for determining biologically active substances of wild useful flora in Zhetysu Alatau Region, Kazakhstan (Figure 1). The resource survey employed the route methods. The plants' raw material reserves accounting on different sites proceeded on specific thickets using the model specimens. The size of the operational reserves and the volume of possible annual harvests also incurred calculations, considering the period of restoration of thickets of each species (Rubsov, 1948).

For describing the plant communities with the participation of research objects utilized the geobotanical methods (Goloskokov, 1984; Nalawade *et al.,* 2003). The different species identification progressed according to the available data based on the Flora of Kazakhstan (Flora of Kazakhstan, 1958, 1960, 1961, 1963, 1964, 1965, and 1966). Similarly, the research applied the Illustrated Identifier of Plants of Kazakhstan (1969 and 1972) and the Identifier of Plants of Central Asia and Kazakhstan (Key to Plants of Central Asia, 1968 and 1996; Illustrated Guide to Plants of Kazakhstan, 1969 and 1972). The nomenclature of the different species is available according to the summary of Cherepanov (1995).

The use of the Plants Database version 1.1 (2013) helped unify the plant materials. The recording of family size of the flowering plants followed the method according to the APG IV system (Angiosperms Phylogeny Group, 2020). Identification of medicinal species occurred based on the Plant Resources of Russia. Based on Wild flowering plants and their component composition and biological activity, the plants' division into different types ensued for use in official and folk medicines, and identifying groups was according to the pharmacotherapeutic action (Plant Resources of Russia, 2008, 2009, 2020, 2011, and 2012).

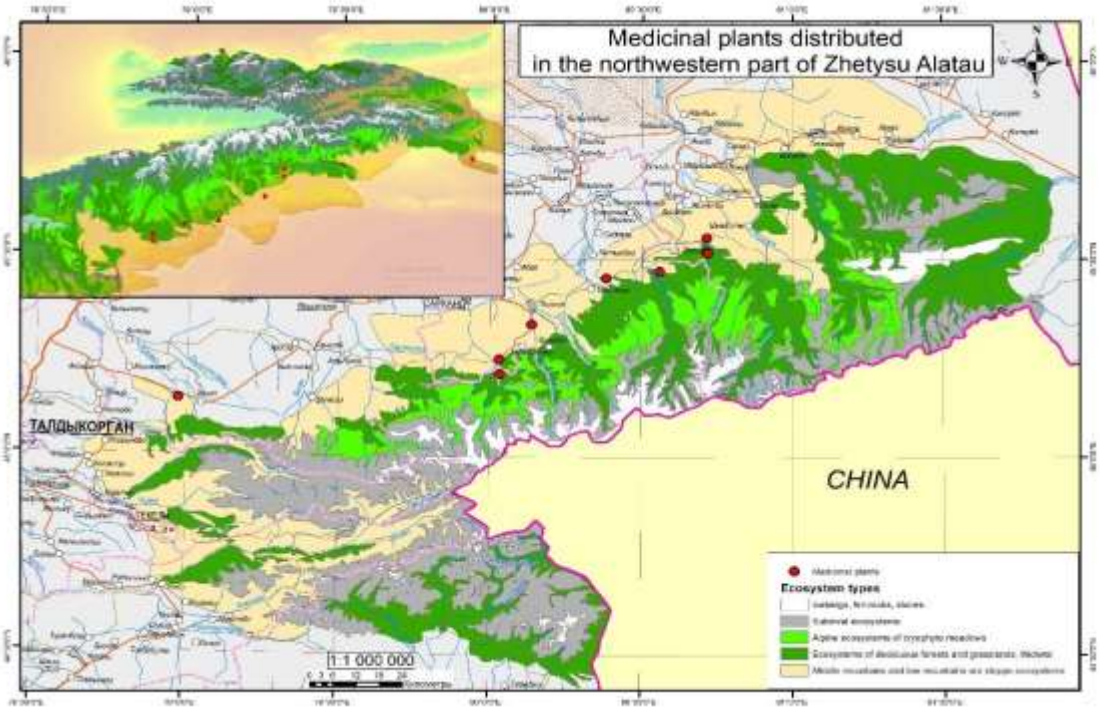

Figure 1. Medicinal plants identified in Zhetysu Alatau region.

The identified medicinal species' ranking comprised three categories as per the degree of prevalence, area of thickets, and possible reserves of plant raw materials, i.e., a) with a wide range, forming significant natural thickets and available for commercial collection of raw materials, b) forming small, natural thickets and suitable for supplying the local pharmacy network needs, and c) species with a wide range, but grow sporadically and do not form natural thickets suitable for collecting raw materials.

The species ranking by ecological groups relied on the relationship to moisture regime (Serebryakov, 1964) and forms of life—in accordance with the ecological and morphological classification of life forms of seed plants based on the growth and life expectancy of vegetative organs. Studying the habitats and resources of medicinal plants received guidance from the methodological instructions and provisions (Krylova*,* 1985, 1972, 1973, and 1981; Korchagin, 1964), as well as, the Methodology for Determining Reserves of Medicinal Plants (1986).

RESULTS AND DISCUSSION

Zhetysu Alatau Region, an isolated mountainous area, lies at the junction of two floristic regions—Northern boreal (Siberian-Altai) and Southern ancient Mediterranean (Iranian-Tien Shan)—and its flora has a mixed and transitional characters. The Zhetysu mountain system begins in China with the table heights of Urkashir and Jair, rising to 2500 m above sea level. Near the territory of Kazakhstan, Urkashir turns into the Barlyk ridge (3300 m), and Jair gives way to the flat Maili ridge. Zhetysu Alatau occupies an intermediate position between the mountainous areas of the South of Central Asia and the South of Siberia. It consists of two main, almost latitudinally elongated ridges, with a length of 400 km, separated from each other by the longitudinal valley of the Koksu River, decreasing and expanding to the West. The arched Northern ridge, convexly facing the South, has the highest absolute height of 4622 m (Rubsov, 1948).

The gentle Northern slope of the ridge, although characterized by deep erosional dissection, gradually decreases to the north and west. The mountain uplift of the Zhetysu Alatau lies between 77.5° to 82.5° East and 44.0° to 46.5° North latitude. Zhetysu Alatau unites several mountain ranges (ridges), with mountain valleys (depressions) separating them, elongated mainly in the latitudinal direction, gradually decreasing to the west. The central uplift of the Zhetysu Alatau incurs dissecting in the latitudinal direction by a longitudinal depression (valley) of the river. Koksu (and the Borotala river in the Eastern part) and the mountain range breaks into the northern part, the Zhetysu ridge itself, about 420 km long, and the southern part, the Koksu ridge, about 100 km.

Two main folds of the synclinal trough of this ridge exist. The upper reaches of the Koksu ridges merge into a single mountain unit, its peaks rising above 4500 m. It serves as the main watershed of the Zhetysu Alatau rivers and forms powerful glaciation. In total, over 150 glaciers abound, with a total area of more than 1000 km^2. The mountain climate significantly differs from the plain climate in numerous features associated with variations in elevation, rugged terrain, illumination, heat transfer, humidity, precipitation, and various other factors. The varying climatic conditions resulted from the great diversity of the Zhetysu Alatau Region, Kazakhstan (Aidarbayeva, 2019).

Based on the flora study of the Zhetysu Alatau ridge, the research identified 178 species of higher plants belonging to 89 genera and seven families (Figure 2). Among them, 161 species emerged with medicinal properties, accounts for 30% of the species diversity of the Zhetysu Alatau. Dominant families were *Asteraceae* (22 species), *Lamiaceae* (15), *Rosaceae* (15), *Fabaceae* (14), *Apiaceae* (9), *Poaceae* (9), and *Polygonaceae* (5 species). The seven dominant families comprised 161 taxa (Table 1).

According to ecological and morphological classifications, dividing all the useful species follow the groups, i.e., trees (seven species, 5.1%), shrubs (12 species, 8.7%), subshrubs (14 species, 10.2%),

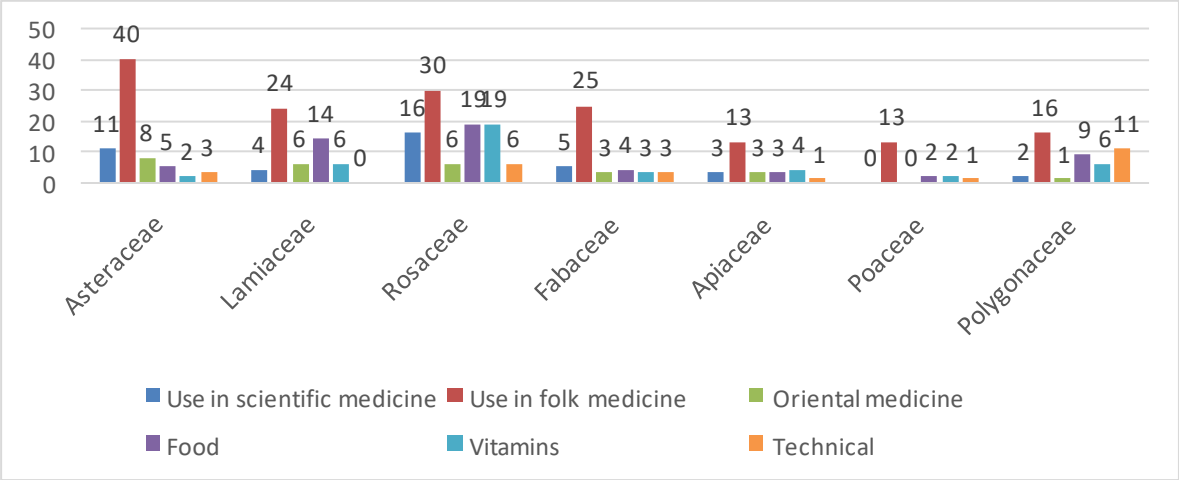

Figure 2. Range of purposes of the useful plants.

Table 1. Taxonomic analysis of the largest families of useful plants in the flora of Zhetysu Alatau Region.

Family	Diversity genus	Total percentage	Species diversity	Total percentage
Asteraceae	22	24.7%	40	25%
Rosaceae	15	16.8%	30	18.5%
Lamiaceae	15	16.8%	24	15%
Fabaceae	14	15.7%	25	15.5%
Apiaceae	9	10.2%	13	8%
Poaceae	9	10.2%	13	8%
Polygonaceae	5	5.6%	16	10%
Total: 7	89	100%	161	100%

herbaceous annuals and biennials (19 species, 14%), herbaceous perennials (83 species, 60.5%), and grasses (two species, 1.5%) (Figure 3). Ranking of plants by ecological groups in relation to moisture conditions revealed the predominance of mesophytes (59 species, 36.7%), followed by xerophytes (38 species, 23.7%), mesoxerophytes (30 species, 18.6%), xeromesophytes (25 species, 15.5%), and hygrophytes (nine species, 5.5%) (Figure 4).

The current ratio of life forms and ecological groups indicates the predominance of herbaceous mesophytic plants, indicating moderate moisture conditions in the habitat. However, other environmental groups revealed few ecotopes with surface water sources. In the Family Apiaceae Lindl, 13 species served as folk medicines, three species as official medicines, three species as oriental medicines, three species used as food, four as vitamins, and one species for technical type.

Based on their use, the species have different groups, i.e., scientific medicines (*Ferula foetida, Oenanthe aquatica, Peucedanum morisonii*), folk medicines *(Archangelica decurrens, Anthriscus sylvestris, Aulacospermum anomalum, Cenolophium fischeri, and Ferula ovina, Ferula capsica* and *Ferula foetida*), eastern medicines (*Archangelica decurrens* and *Ferula foetida*), food (*Cenolophium fischeri, Ferula foetida,* and *Ferula karelinii*), vitamins (*Archangelica decurrens, Ferula capsica,* and *Ferula foetida*), and as technical (*Anthriscus sylvestris*).

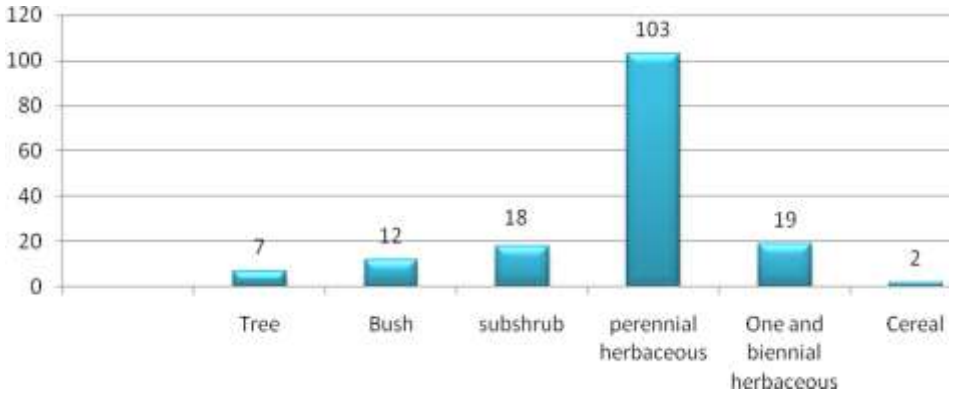

Figure 3. Correlation of life forms of medicinal plants of the flora of Zhetysu Alatau Region (Serebryakov, 1964).

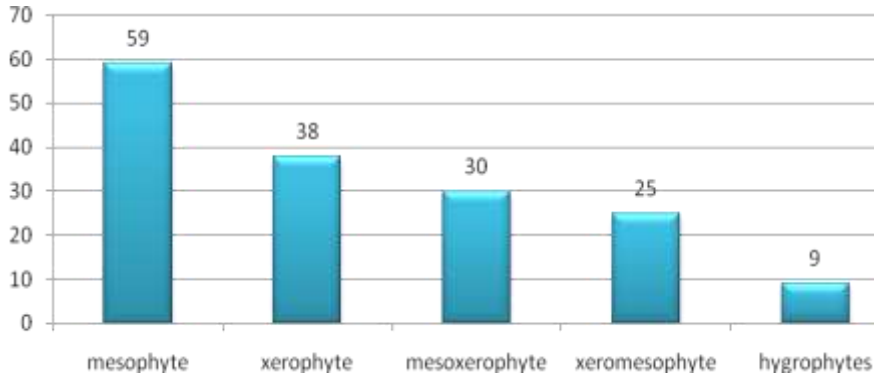

Figure 4. Ranking of plants by environmental groups.

In family *Asteraceae* Dumort, 40 types apply in folk medicines, 11 types for official medicines, eight types for oriental medicines, five types serve as food, two types as vitamins, and three types as technical. The species used in scientific medicines were *Achillea millefolium, Artemisia absinthium, Centaurea cyanus, Cnicus benedictus, Inula helenium, Serratula coronata, Solidago virgaurea, Tanacetum vulgare, Tussilago farfara, Rhaponticum carthamoides, Onopordum acanthium,* and *Helichrysum arenarium.*

The species used in folk medicines included *Achillea arabica, A. millefolium, A. nobilis,* and *A. setacea, Ajania fastigiata*, *Artemisia absinthium*, *A. annua, A. austriaca, A. dracunculus, A. frigida, A. gmelinii, A. rutifolia, A. rupestris, A. pauciflora, A. stechmanniana,* and *A. sublessingiana, Alfredia cernua, Anthemis tincroria, Centaurea* species *Centaurea cyanus, Rhaponticoides ruthenica, and Centaurea sibirica, Crupina vulgaris, Crepis sibirica, Echinops chantavicus*, *Inula britannica*, *I. helenium,* and *Saussurea elegans*, *Serratula coronata, Solidago virgaurea*, *Lactuca serriola*, *Ligularia altaica, Matricaria recutita*, *M. matricarioides, Tanacetum vulgare, Tussilago farfara, Stemmacantha carthamoides, Onopordum acanthium,* and *Helichrysum arenarium*.

The species used in Eastern medicines were *Achillea setacea, Artemisia* species *A. absinthium, A. annua, A. frigida, A, santolinifolia, Centaurea cyanus, Inula britannica*, and *Solidago virgaurea,* as food (*Artemisia absinthium, A. austriaca*, *A. dracunculus*, *Lactuca serriola*, and *Tussilago farfara*), as vitamins (*Achillea Biebersteinii* and *A. millefolium*), and as technical (*Artemisia gmelinii, Anthemis tincroria,* and *Centaurea ruthenica*).

In the family *Fabaceae* Lindl., 25 types emerged for folk medicine use, five types for official medicines, three types for oriental medicines, five types as food, four types as vitamins, and three types serving as technical. The species used in scientific medicines were *Medicago sativa, Melilotus officinalis, Ononis arvensis, Psoralea drupaceae*, and *Glvcyrrhiza uralensis.* For folk medicines, these are *Astragalus onobrychis* and *A. sieversianus*, *Caragana aurantiaca* and *C. frutex*, *Lathyrus* species—*L. humilis*, *L. pisiformis*, *L. pratensis*, and *L. tuberosus*, *Medicago lupulina* and *M. sativa*, *Melilotus officinalis*, *Ononis arvensis*, *Oxytropis glabra* and *O. lapponica*, *Psoralea drupaceae*, *Trifolium pratense, repens*, *and lupinaster*, *Vicia cracca* and *V. sylvatica*, *Glvcyrrhiza uralensis*, *Sphaerophysa salsula*, *Hedysarum flavescens and H. neglectum*, and *Cicer frutex*. Those used for Eastern medicines are *Oxytropis glabra, Glvcyrrhiza uralensis,* and *Hedysarum neglectum*), as food (*Medicago sativa, Trifolium pratense, T. repens, T. lupinaster,* and *Glvcyrrhiza uralensis*), as vitamins (*Trifolium repens, T. lupinaster,* and *Glvcyrrhiza uralensis)*, and used as technical type (*Caragana frutex, Ononis arvensis,* and *Cicer frutex*).

In the family *Lamiaceae* Lindl., 24 types were applicable as folk medicines, four types as official medicines, six types as oriental medicines, 14 types as food, and six types for vitamins. The species used in the scientific medicines include *Origanum vulgare, Melissa officinalis, Salvia sclarea,* and *Marrubium vulgare*), in folk medicines (*Amethyst coerulea*, *Dracocephalum oblongifolium, Hyssopus ambiguus*, *H. cuspidatus, Nepeta pannonica*, *Origanum vulgare*, *Lamium amplexicaule, Leonurus glaucescens, Mentha asiatica*, *M. arvensis, M. longifolia, Melilotus officinales, Melissa officinalis, Salvia species S. nemorosa, S. deserta, S. macrosiphon, S. sclarea, and S. stepposa, Stachys sylvatica*, *Thymus marschallianus, T. sibirucus, Teucrium scordioides, Scutellaria galericulata,* and *Marrubium vulgare*), used in eastern medicines (*Amethyst coerulea*, *Origanum vulgare, Mentha arvensis, M. longifolia, Teucrium scordioides, Scutellaria galericulata),* as food (*Hyssopus ambiguous*, *Origanum vulgare, Mentha* species *M. asiatica*, *M. arvensis, M. longifolia, Melilotus officinales, Melissa officinalis, Salvia* species *S. nemorosa, S. deserta, S. macrosiphon, S. sclarea, S. stepposa,* and as vitamins (*Hyssopus cuspidatus, Origanum vulgare, Mentha asiatica*, *M. arvensis, M. longifolia,* and *Salvia sclarea*).

In the family *Poaceae* Barnhart., 13 types provide usage as folk medicines, two types for food, two types as vitamins, and one type is technical. The species used in the folk medicine are *Agrostis gigantea, Achnatherum splendens, Clematis orientalis, Leymus angustus, Melica altissima, M. transsilvanica, Milium effusum*, *Poa angustifolia, P. bulbosa, P. pratensis, Stipa capillata, S. caucasica,* and *Festuca rubra*, as food (*Melica altissima* and *M. transsilvanica*), as vitamins (*Melica altissima* and *M. transsilvanica*) and as technical (*Achnatherum splendens*).

For the *Polygonaceae* Juss. family, 16 species serve as folk medicines, two species as official medicines, one species in oriental medicines, nine species as food, six species as vitamins, and 11 species as technical. The species used in scientific medicines were *Rheum tataricum,* and *Rumex confertus,* used in folk medicines (*Atraphaxis frutescens, A. pyrifolia, Fallopia convolvulus*, *Polygonum* species *P. olpinum*, *P. cariarium*, *P. hydropiper*, *P. persicaria*, *P. songaricum, P. viviparum, P. patulum*, *Rheum* species *R. cordatum*, *R. wittrockii*, *R. tataricum*, and *Rumex confertus*, *R. crispus*, and *R. thyrsiflorus*, used in eastern medicines (*Fallopia convolvulus)*, used as food (*Polygonum cariarium, P. songaricum, P. viviparum, Rheum cordatum, R. wittrockii*, *R. tataricum*, *Rumex confertus, R. crispus,* and *R. thyrsiflorus*), as Vitamins (*Polygonum cariarium, Rheum wittrockii*, *R. tataricum*, *Rumex confertus, R. crispus,* and *R. thyrsiflorus*), and as technical (*Polygonum* species *P. cariarium, P. hydropiper, P. persicaria, P. songaricum, P. viviparum,* and *P. patulum, Rheum cordatum, R. wittrockii*, *R. tataricum*, *Rumex confertus, R. crispus,* and *R. thyrsiflorus*).

In the family *Rosaceae* Juss., folk medicines had 30 types, while 16 types are for official medicines, six types as oriental medicines, 19 types as food, 19 types as

vitamins, and six types as technical. The species used in scientific medicines were *Armeniaca vulgaris, Crataegus korolkowii, C. sanguinea, Fragaria vesca*, *F. viridis*, *Filipendula ulmaria*, *Geum urbanum*, and *Padus avium,* used as folk medicines (*Agrimonia pilosa, Armeniaca vulgaris*, *Crataegus* species *C. songarica, C. korolkowii*, *C. altaica*, *C. sanguinea*, *Fragaria vesca, F. viridis, Filipendula ulmaria*, *Geum urbanum*, *Padus avium*, *Potentilla orientalis, P. impolita*, *P. chrysantha, Prunus Sogdiana, Rosa* species *R. acicularis, R. alberti, R. beggerana, R. canina, R. platyacantha*, *R. spinosissima, R. laxa*, *Rubus caesius*, *Rubus idaeus*, *Sanguisorba officinalis, Sorbus tianschanica*, *Spiraea hypericifolia, Spiraea chamaedryfolia,* and *Malus sieversii*), used in eastern medicines (*Fragaria vesca, Fragaria viridis, Rosa acicularis, Rubus idaeus, Sanguisorba officinalis,* and *Spiraea hypericifolia*), used as food (*Armeniaca vulgaris, Crataegus* species *C. songarica, C. korolkowii*, *C. altaica*, *C. sanguinea*, *Fragaria vesca, Fragaria viridis, Padus avium, Rosa* species *R. acicularis, R. alberti, R. beggerana, R. canina, R. platyacantha*, *R. spinosissima, R. laxa, Rubus caesius*, *Rubus idaeus, Sorbus tianschanica,* and *Malus sieversii*), used as vitamins (*Armeniaca vulgaris, Crataegus songarica, C. korolkowii*, *C. altaica*, *C. sanguinea*, *Fragaria vesca, Fragaria viridis, Prunus sogdiana, Rosa acicularis, R. alberti, R. beggerana, R. canina, R. platyacantha*, *R. spinosissima, R. laxa, Rubus caesius*, *Rubus idaeus, Sorbus tianschanica,* and *Malus sieversii*), and used as technical (*Agrimonia pilosa, Potentilla chrysantha, Sanguisorba officinalis, Sorbus tianschanica, Spiraea chamaedryfolia,* and *Malus sieversii*).

Overall for useful plants, 161 species function as folk medicines, 41 species as official medicines, 27 species as oriental medicines, 36 species as vitamins, 46 as food, and 14 species as technical (Figure 2). During the field season 2020–2021, resource studies proceeded on the Southeastern Macro slopes of the Zhetysu Alatau ridge. The wide distribution of thickets of industrial value had characteristics of elecampane species, i.e., St. John's wort, oregano, and common yarrow. In this regard, the resources of the listed species underwent examination (Table 2).

Tall elecampane, *Inula helenium* L., grows on the ridge in large numbers, most often along the rivers and streams, intermountain depressions, on top of hills, and along the highways. The most significant thickets were notably in the interfluve of the rivers. In the river basin Tentek, investigators have identified several associations with the participation of elecampane. Elecampane-forb-cereal is predominant here and includes more than 30 species (*Polygonum coriarium, Ferula songarica, Verbascum songoricum, Salvia stepposa, Achillea millefolium, Hypericum perforatum,* and *Leonurus* sp.). The number of elecampane has 10–15 samples on an area of 5 m^2 × 5 m^2. Shrub-forb-elecampane had a significant participation of shrubs (*Lonicera tatarica, Rosa beggerana,* and *Spiraea hypericifolia*). Its floristic composition was poorer (20–25 species), and the number of elecampane was 15–16 specimens.

Forb-cereal-elecampane includes a small amount of apple. The forbs were richer in species (35 species), the number of elecampane specimens was 12–13. The average weight of elecampane root was 165 g, the total area of the thickets was 115 ha, and the total supply of dry root was 4.5 t. In the Krutoe Gorge, researchers identified the following associations with the participation of tall elecampane: elecampane-forb-shrub association, including forbs and shrubs, represented by 40 plant species. Numerous elecampane existed there (9–11 specimens). It also has other official species, i.e., St. John's wort, common oregano, and common yarrow. Therefore, a joint calculation of the resources of these species progressed on 10 m^2 × 10 m^2 sites. The elecampane-ram association distinctly had less widespread distribution; the number of elecampane specimens was six to eight. Along the rivers and stream banks, the elecampane-angelica association occupies small areas with a very high percentage of elecampane participation (18–21 specimens). The average weight of the raw elecampane root was 295 g (average of 10 determinations) (Table 2). The area of thickets in the gorge was 125 ha, with a supply of dry roots of 9.0 t.

The total area of the thickets was 240 ha; the total stock of dry roots was 13.5 t. Considering the need to renew elecampane after harvesting, the possible annual harvest volume in these habitats should not exceed 3.0 t.

At the same locations, significant reserves of *Achillea millefolium* L. have occurred, which grow in meadows, steppes and meadow slopes, fallow lands, and along the edges of fields. Reserves were visible in the Krutoe Gorge, on the road to the apple tree reserve, and in mixed-grass meadows along the river floodplain near the Village Lepsinsk (Table 2). The total operational reserve was around 179.4 t of dry mass above the ground. *Origanum vulgare* L. occurs in forb meadows on mountain slopes. Reserves manifested at the same place (Krutoye Gorge), and on the road to the apple reserve, forb meadows of Karasyryk Gorge, and along the floodplain of the Lepsy River. The total operational reserve exceeds 97.7 t of dry mass above the ground.

Table 2. Reserves (with dry mass) of the most important medicinal plants in Zhetysu Alatau Region.

No.	Plant type	Locations of groves	Area (ha)	Operational fund (vol)
1	*Inula helenium* L.	Tentek River Ranges	115	4.5±0.6
		Krutoe Gorge	125	9.0±1.1
2	*Origanum vulgare* L.	Krutoe Gorge, on the way to the Apple Tree Reserve	538.5	56.0±2.6
		Mixed grassy meadows near the Lepsi River	252	12.0±1.3
		Mixed grassy meadows with Kharasyrik Gorge	158	26.2±5.0
		Flooding of the Lepsi River	180	3.5±0.4
3	*Achillea millefolium* L.	Krutoe Gorge, on the way to the Apple Tree Reserve	800	105.0±13.3
		Valley of the Lepsi River	152	21.5±0.1
		Mixed grassy meadows near the Lepsi River	110	52.9±11.8
4	*Hypericum perforatum* L.	Krutoe Gorge, on the way to the Apple Tree Reserve	508	92.0±15.7
		Tentek River Ranges	43.7	6.5±1.1
		Flooding of the Lepsi River	120	3.0±0.3
5	*Ajania fastigiata* Poljak.	The right side of the valley of the Poplar River	516.5	54.0±2.4
		Water basin between Kishi Badan and Sarkan	250	11.0±1.3
		Karasyryk Gorge	350.6	26.0±2.4
6	*Artemisia frigida* Willd.	Near the Big Shymbulak River	109	42.9±11.8
		Karasyryk Gorge	480	90.0±17.7
7	*Saussurea elegans* Ledeb.	Krutoe Gorge	700	105.0±13.3
		Karasyryk Gorge	157	21.5±0.1
		Near the Terekti River	67.7	52.9±11.8
8	*Ephedra equisetina* Bunge.	Near the Sarkand River	78.0	64.0±12.4
		Near the Bakhan River	17.8	58.0±8.4
		Near the Tentek River	64. 5	44.0±2.5

Ajania fastigiata Poljak grows among the bushes on rocky and clayey crushed slopes, foothills, and steppes. The study of its deposits transpired in the gorges, on the right side of the valley of the Terekti River, and between Kishi Bakan and Sarkan and Karasyryk. As a result of field research in the Zhetysu Alatau Region, Kazakhstan, *Saussurea elegans* was prevalent in three gorges, i.e., Krutoye tract, right bank of Terekti (Topolevka)

river valley, and Karasyryk. It also grows in meadows, steppes, rocky, loess, and gravel slopes of mountains, among the bushes and stones, and on river banks. Krutoe tract sits in the Northern part of the Zhetysu Alatau ridge, on the right side of the Lepsi river valley. During the field study, observing the plant *Artemisia frigida* Willd materialized in the Bolshoi Shymbulak River and Karasyryk Gorge. *Artemisia frigida* Willd grows in plains and mountain meadows, on stony slopes, on cliffs, and sometimes on sandy soils at the edge of pine forests. However, more of its population appeared in the ridges. For conservation purposes, the 25%–30% should remain for the plant community to not disappear.

Ephedra equisetina Bunge trees were evident in the Baskan river basins and were easy to collect. The slopes of the gorge were rocky, and the *Ephedra equisetina* grows on both sides. Fruit trees also grow in the Shatkal tube. On the surface, brush grows together with the following shrubs, i.e., *Spiraea hypericifolia, Berberis sphaerocarpa, Rosa albertii,* and *R. beggerana.* The production stock was 10.0 t, and the amount for preparation in one year was 7.0 g dry weight. The length of the gorge in the Tentek river basin was 10 km, and the width was 25–40 m. *Ephedra equisetina* can prevail on both sides of the gorge, among the species that grow together were *Juniperus pseudosabina, Spiraea hypericifolia, Rosa spinosissima,* and *Atraphaxis virgata*. *Ephedra equisetina's* production stock was 25–30 t, and the one year of production was 19.0 t of dry weight. The area of *Ephedra equisetina* found in Sarkand district is 489.9 ha, common production resources are 240.5 t, and production per year was 109.0 g of dry weight.

Useful plants have a wide range of uses, as medicinal, vitamins, food, and technical (Figure 1). Thus, modern research based on pharmacopoeial use of different species of Zhetysu Alatau and the development of a scientific basis for their rational usage were relevant and necessary. The main ways of rational applications and preservation of natural vegetation of medicinal plants, per this study's opinion, these populations shortened to the following: a) Mandatory implementation of the developed instructions for collection and drying of medicinal raw materials, which provide for the regime of preparation, and ensures the protection of the populations of the prepared plants, b) Categorical ban on the collection of medicinal species by private individuals, which may cause a shortage of medicines and preparations, and c) Identification of sources of medicinal raw materials, similar in pharmacological action to rare medicinal species search for substitutes. Likewise, pursue the study and involvement in economic turnover of promising plants containing biologically active substances of secondary origin. In 2014, the identified medicinal plant resources included *Origanum vulgare* L. *Achillea millefolium* L., *Inula helenium* L*., Hypericum perforatum* L. from the gorges of Monaka, Baldyrgan, and Bastauchi. Comparing this with the latest research in 2024, it revealed the resources of these medicinal plants in the northern part of the Zhetysu Alatau are richer in the gorges of Karasyryk, Krutoye, near the Lepsi River than in Monaka, Baldyrgan and Bastushki gorges.

CONCLUSIONS

The 161 species of useful plants belonging to 82 genera and seven families obtained identification in the flora of Zhetysu Alatau Region, Kazakhstan. Overall, all the 161 species were beneficial in folk medicines, and among them, 41 species also serve as official medicines, 27 species as oriental medicines, 36 species as vitamins, 46 species as food, and 14 species as technical. In relation to moisture, vascular plants were divisible into ecological groups, with the leading position occupied by 59 species of mesophytes and nine species of hygrophytes. The predominant number of species belonging to perennial herbaceous plants were 93 species, with at least two cereal species. The results suggested planning an effective and rational use of beneficial plants for the future in Zhetysu Alatau Region, Kazakhstan.

ACKNOWLEDGMENTS

Thanks to financing Rector's grant №05-04/329 dated 05/14/2024Abai Kazakh National Pedagogical University, Almaty, Kazakhstan.

REFERENCES

Aidarbayeva DK (2020). Useful plants of Kazakhstan. *Karaganda*, pp. 270-288.

Aidarbayeva DK (1991) Plant resources (medicinal and food plants) of the Dzhungar Alatau and their development. Abstract. *Alma-Ata,* pp. 18-21.

Cherepanov SK (1995). Vascular plants of Russia and neighboring countries. St. Petersburg: *Peace and Family*. pp. 80-95.

Dimeyeva L, Islamgulova A, Permitina V, Ussen K, Kerdyashkin A, Kurmantayeva A (2023). Plant diversity and distribution patterns of *Populus pruinosa* Schrenk (Salicaceae) floodplain forests in Kazakhstan. *Diversity* 15(7): 797. https://doi.org/10.3390/d15070797.

Dimeeva LA, Gemedzhieva NG (2023). Methodological Tool for Comprehensive Cadastral Assessment of Flora of Kazakhstan. Almaty. pp. 72.

Flora of Kazakhstan (1965). T.1. Alma-Ata: Publishing house of the Kazakh SSR AS: pp. 330-354.

Flora of Kazakhstan (1958). T.2. Alma-Ata: Publishing house AS of the Kazakh SSR: pp. 260-290.

Flora of Kazakhstan (1960). T.3. Alma-Ata: Publishing house of the Academy of Sciences of the Kazakh SSR: pp. 440-458.

Flora of Kazakhstan (1961). T.4. Alma-Ata: Publishing house of the Academy of Sciences of the Kazakh SSR: pp. 450-545.

Flora of Kazakhstan (1961). T.5. Alma-Ata: Publishing house of the Kazakh SSR AS: pp. 400-515.

Flora of Kazakhstan (1963). T.6. Alma-Ata: Publishing house of the Kazakh SSR AS: pp. 457-465.

Flora of Kazakhstan (1964). T.7. Alma-Ata: Publishing house of the Kazakh SSR AS: pp. 467-498.

Flora of Kazakhstan (1964). T.8. Alma-Ata: Publishing house of the Kazakh SSR AS: pp. 270-279.

Flora of Kazakhstan (1966). T.9. Alma-Ata: Science: pp. 420-425.

Goloskokov VP (1984). Flora of Dzungarskogo Alatau: Synopsis and analysis. Alma-Ata: Nauka, pp. 220-224.

Illustrated guide to plants of Kazakhstan (1969). T.1. Alma-Ata, pp. 155-160.

Illustrated guide to plants of Kazakhstan (1972). T.2. Alma-Ata,pp. 124-130.

Kaliyev B, Sitpayeva G, Musrat A, Yerekeyeva S, Saikenov B, Nurimzhan A (2023). Sciences - Localization of some medicinal plants in the Ile Delta on the Southern Macrosurface of the Zhetysu Alatau (Kazakhstan) *OnLine J. Biol. Sci.* 23(4): 418-423. https://thescipub.com/abstract/ojbsci.2023.418.423.

Korchagin AA (1964). Species (floristic) composition of plant communities and methods of its study. *Field Geobot*. M.L., T.3: pp. 39-60.

Kokoreva II (2015) Plants of Dzungar and Zailiy Alatau that need protection (identifier of plants). *International Journal of Experimental Education* No. 12: pp 30-38.

Krylova IL (1981). Methods for determining the timing of restoration of stocks of raw materials of medicinal plants. *Rastit. resources. T.17*, issue 3: pp. 440-446.

Krylova IL (1972). On some methodological issues in determining the reserves of medicinal plants. Resources of wild medicinal plants of the USSR. M.L. pp. 56-58.

Krylova IL (1973). On the number of recording sites and model specimens when determining the yield of medicinal plants. *Plant resources. L. T 9.* Issue 3. pp. 457-466.

Krylova IL (1981). Methods for determining the timing of restoration of stocks of raw materials of medicinal plants. *Plant resources. T 17.* Issue 3. L. 446-450.

Krylova I.L. (1985). Resource characteristics of medicinal plants as a scientific basis for their rational exploitation: Author's abstract. Doctoral Diss. M., pp. 45-50.

Kukenov MK, Rakhimov KD, Averina VYu, Gemedzhieva NG, Atalykova FM, Kuzmin EV, Moiseev RK, Sinitsyna VG, Suyunshalieva UKh, Ryakhovskaya TV (1996). Medicinal plants of Kazakhstan and their use. *Almaty*, pp. 339-343.

Kukenov MK, Grudzinskaya LM, Beklemishev ND (2002). Herbal medicines. *Almaty,* pp. 200-208.

Kukenov MK (1988). Rational use of wild useful plants in Kazakhstan. News of the Academy of Sciences of the KazSSR. Biology series No 2. pp. 3-10.

Kukenov MK (1989). Resources of medicinal plants of the Kazakhstan Tien Shan. Alma-Ata. 200-216.

Kukenov MK (1999). Botanical resource science of Kazakhstan. *Almaty*, pp. 155-160.

Key to plants of Central Asia (1968-1996). Tashkent: FAN. – T.T. 1-10.

Nalawade SM, Sagare AP, Lee SI, Cao SL, Tsai HS (2003). Chinese tissue culture research: Resource of medicinal plants in Taiwan and their sustainable use. *Bot. Byk. Academic Syn*. 44: pp. 79-98.

Methodology for determining reserves of medicinal plants (1986). Moscow pp. 50-56.

Plant Resources of Russia (2008). Wild flowering plants, their component composition and biological activity. Vol. 1. St. Petersburg-Moscow. BIN named after V.L. Komarov RAS: KMK Scientific LLC Press, pp. 411-421.

Plant Resources of Russia (2009). Wild flowering plants, their component composition and biological activity. Vol. 2. St. Petersburg-Moscow. BIN named after V.L. Komarov RAS: KMK Scientific LLC Press, pp. 506-513.

Plant Resources of Russia (2010). Wild flowering plants, their component composition and biological activity. Vol. 3. St. Petersburg-Moscow. BIN named after V.L. Komarov RAS: KMK Scientific LLC Press, pp. 594-601.

Plant Resources of Russia (2011). Wild flowering plants, their component composition and biological activity. Vol. 4. St. Petersburg-Moscow. BIN named after V.L. Komarov RAS: KMK Scientific LLC Press, pp. 620-630.

Plant Resources of Russia (2012). Wild flowering plants, their component composition and biological activity (2012). Vol. 5. Part 1. St. Petersburg - Moscow. BIN named after V.L. Komarov RAS: KMK Scientific Press LLC Press, pp. 310-316.

Ramazonov B, Mutalov K, Egamberdiyeva L, Atabayeva D, Abdurashitova YE, Allanazarova I (2024). Growing salt-resistant flora under natural conditions of the Kyzyl-Kum desert and arid bed of Aral Sea, Uzbekistan. *SABRAO J. Breed. Genet.* 56(5): 1895-1905. http://doi.org/10.54910/sabrao2024.56.5.13.

Rubsov NI (1948). Plant protection of Dzungar Alatau.-*Alma-ataIzdatelstvo* Academy of Sciences of the Kazakh SSR: pp. 178-183.

Serebryakov IG (1964). Life forms Life forms of plants and their study. Field Geobotany. *Field Geobot*, Vol. 3. Moscow-Leningrad, Nauka, pp. 36-48.

Taldybay A, Aidarbayeva D, Aksoy A, Sitpayeva G, Baiseitova A, Jenis J (2024). *Ajania fastigiata* in Zhetysu Alatau: Distribution, morphological characterization, phytochemical profiles, and optimization of extraction of bioactive constituents. *J. Appl. Res. Med. Arom. Plants* 40: 100540. http://creativecommons.org/licenses/by-nc-nd/4.0/.

Taldybay A, Aidarbayeva D, Aksoy A (2021a). Study of the chemical composition of *Artemisia frigida* Willd found in Zhetysu Alatau Al-Farabi Kazakh National Universit. *Exp. Biol*. 4(89). https://doi.org/10.26577/eb.2021.v89.i4.0.

Taldybay A, Aidarbayeva D, Aksoy A (2021b). Prospects of studying and using *Saussurea elegans* Ledeb. in the foothills of the Zhetysu Alatau Al-Farabi Kazakh National University. *Int. J. Biol. Chem*. 14(2): https://doi.org/10.26577/ijbch.2021.v14.i2.017.