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Biodiversity of wild spice plants of the Central Kazakhstan region and their medicinal potential

YELENA POZDNYAKOVA♥, GULNARA OMAROVA, AIGUL MURZATAYEVA, NEILA TANKIBAEVA
[1]Department of Biomedicine, Karaganda Medical University. Karaganda, The Republic of Kazakhstan.
Tel./Fax.: +62-271-637457 Ext. 129, ♥email: nike_anteros@mail.ru

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Abstract. *Pozdnyakova Y, Omarova G, Murzatayeva A, Tankibaeva N. 2022. Biodiversity of wild spice plants of the Central Kazakhstan region and their medicinal potential. Biodiversitas 23: 4609-4625.* The Central Asian region stretches from the Caspian Sea in the west to the border of western China in the east. Central Kazakhstan occupies the space of steppe and semi-desert zones within the Turgay Plateau in the west and the Kazakh Uplands in the center and in the east. Due to the remoteness of the steppes of Central Kazakhstan from the oceans, the climate in the region is extremely continental and arid. Due to this, the diversity of plant species is quite small. In this work, we have studied the biodiversity of wild herbs growing in the climatic conditions of Central Asia. We also assessed the prospects of the found plant species as medicines. This study took place as part of the traditional summer practice of biology students in the period July-August 2019. The main method used in the field research was route reconnaissance. As a result of field research, 40 wild spice plant species belonging to 17 families were found. Among them, the most numerous are the families Lamiaceae - 9 species, Brassicaceae - 6 species, Apiaceae - 5 species, Asteraceae - 4 species, the families Rosaceae and Fabaceae - 2 species of herbs. All of these species are mentioned in a number of old recipes and can be revived and re-recommended for widespread use. A critical assessment of the literature on the medicinal properties of the studied spices irrefutably shows that they have enormous health potential. Based on the data obtained, it can be concluded that wild spice plants growing in the territory of Central Kazakhstan have a wide range of taste diversity and prospects for successful commercial exploitation.

Keywords: Biodiversity, Central Kazakhstan, medicinal plants, spice plants

INTRODUCTION

There are currently about 30,000 plant species in the world that are considered edible, and only 7,000 of them are planted or harvested for food. Twenty crop species provide 90% of the world's food needs. With the development of agriculture and technology, the use of edible wild plants by people has decreased. The gathering and consumption of edible wild plants would enrich modern nutrition culture and satisfy the need for greens and a rational diet (Trombino et al. 2020). A poor choice of products and the cultivation of a limited number of crops lead to the loss of traditional knowledge, which may disappear completely over time.

Currently, there is a constant increase in the world's population and global climate change, and in order to adapt to this, a variety of food plants is needed to ensure a safe and sustainable food supply (Cheng et al. 2022). Also in recent times, due to the increase in the standard of living, the requirements for diet and variety of food products have been gradually increasing. People have become more careful about what they eat. Therefore, there is a need for a variety of diets for the modern man. And only wild food plants create opportunities for the introduction of new species in agriculture, the development of the food industry and open up new opportunities for medicine. Many plants are both edible and medicinal.

Spices are dried seeds, buds, fruits, roots, or bark that are primarily used to flavor, color, or preserve food, or mask other flavors. Spices improve the taste of food, reduce the need for salt, sugar, fat and preservatives (Otunola et al. 2022). Long ago, in the Age of Discovery (a period that began in the 15th century and continued until the 17th century), spices were valued not only for their effect on the taste of food, but also for their practical use: the preservation of products on long journeys (Guarrera and Savo 2016). More spices made it possible to make longer journeys without calling ports. Currently, spices not only enrich the taste of cooked dishes, but, according to modern data, they can also affect human physiology and biochemistry (Chouhan and Purohit 2018; Su et al. 2020; Mukherjee et al. 2021; Laabbar et al. 2021; Zhang et al. 2021).

Besides culinary purposes, the ability of active substances contained in spices to reduce the risk of disease has attracted the attention of researchers and nutritionists. Numerous epidemiological, preclinical and clinical studies have been conducted to provide insight into these abilities. For example, the positive effect of spices as antioxidants in the prevention of aging and degenerative diseases has been studied. (Fifi et al. 2018). The anti-inflammatory and antitumor properties of curcumin have been studied (Kunnumakkara et al. 2017; Li et al. 2019). The antifungal activity of Mexican oregano and tarragon has been established. The recently discovered capsaicin, found in hot chili peppers, has a beneficial effect on lipid metabolism

and helps overweight people overcome the disease (Medina-Contreras et al. 2017). Spices and herbs are revered for their potential health attributes. They are reported to have a positive effect on the treatment of chronic diseases such as cancer (Zheng et al. 2016), diabetes (Mohd Sahardi and Makpol 2019; Sanlier and Gencer 2020), cardiovascular diseases (Rastogi et al. 2017) and the treatment of functional gastrointestinal disorders (Fildan et al. 2019). The demand for cheaper and safer medicines is growing every year (Thomas and Ledowski 2019; Acri née Lybecker 2020; Tadesse et al. 2021). This stimulates interest in the use of local phytomedicine for the treatment and prevention of diseases (Dolui and Segupta 2012). Recent events associated with the necessary isolation of countries and continents have led to the need not only to search for new sources of plant materials with a medicinal effect, but also to use local plants with a similar effect.

Central Asia, made up of five countries - Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan - is an important global hotspot for biodiversity (Myers et al. 2000). These Central Asian countries have joined the ratification of the main objectives of the UN Botanical Surveys on Biological Diversity, such as inventory of biodiversity and endemic, rare and endangered species. (Convention on Biodiversity 1999). Intensive botanical research is being carried out to better understand and use the plant resources of Central Asia. A large amount of data and many plant samples were collected. Today there are books on the flora of the region as a whole and each of the five countries of Central Asia. There are also control lists of vascular plants in Kazakhstan, Kyrgyzstan and Turkmenistan and all regions of Central Asia. But the plant checklist for the Central Asian region as a whole still needs updating and new research (Li et al. 2020). So far, no new studies have been carried out to study the biological diversity of plants in Central Kazakhstan and data on their practical application have not been updated, based on modern scientific works.

The purpose of this study is to assess the biological diversity of wild spices growing in the territory of Central Kazakhstan, as well as to assess their culinary characteristics and modern prospects for use as medicines.

MATERIALS AND METHODS

Study area

Our research was carried out in the territory of Central Asia, namely Central Kazakhstan. Central Kazakhstan occupies the space of steppe and semi-desert zones within the Turgay Plateau in the west and the Kazakh Uplands in the center and in the east. Due to the remoteness of the steppes of Central Kazakhstan from the oceans, the climate in the region is extremely continental and arid. In winter, cold masses of arctic and temperate air with a low moisture reserve prevaiL. The level of precipitation is low (only 50-75 mm from November to March). The snow cover has a small thickness, which leads to the freezing of the soil. In winter, south-westerly winds prevail in the steppe zone. Winter storms and snow drifts are typicaL. The transition from winter to summer is abrupt. The air temperature rises rapidly due to the warming of the ground and the penetration of warm air from the south. The destruction of the winter anticyclone takes place, and high summer temperatures are established (the average temperature in July is 20-24°C). Daytime temperatures in summer sometimes rise to 35°C. The strong winds of the warm half of the year cause soil dispersal. Dust storms also contribute to the general drying of the territory. Due to the continentality and dryness of the climate, the rivers are shallow. The main rivers of the region are the Tobol, Ishim, Nura, Shiderty, Selety. Most of them dry up in summer or break up into stretches, only the largest rivers retain water throughout the year. Lakes, like rivers, receive the main part of the water in spring from melting snow. In summer, they become shallow. Due to this, the species diversity of plants is quite small. According to the literature, there are about 850 species of flowering plants belonging to 78 families growing here (Karaganda 1986).

From the point of view of plant geography, the steppe zone of vegetation prevails in this area. This is a special type of vegetation dominated by communities of xerophilous cespitose species. Cespitose grasses from the genera *Stipa*, *Festuc*a, and others dominate here. Under different ecological conditions, communities are formed from some cespitose sedges, herbs, subshrubs (from the genera *Artemisia*, *Thymus*), and shrubs (from the genera *Amygdalus*, *Caragana*). Feather grass and grass-forb communities are developed here. In the steppe meadows and meadow steppes of Central Kazakhstan, the beginning of the vegetation season falls in the first half of April and the vegetation season ends in September. The flowering periods of most species fall in the spring-summer and late-summer months, which is determined by the precipitation regime (Lavrenko 1991).

This study took place as part of the traditional summer practice of biology students in the period July-August 2019. The main method used in the field research was route reconnaissance. The main purpose of reconnaissance is a general acquaintance with the territory, acquaintance with the main components that form the landscape peculiarities of the area under study, as well as with the specifics of the morphological structure of the landscape under study. The method of work during reconnaissance is mainly visual. Therefore, acquaintance with the area under study should begin, first of all, with landscape components that are well expressed in nature. Reconnaissance routes are divided into several independent tours. The first tour is devoted to acquaintance with the lithogenic group of components i.e. with the geological structure and relief features of this territory. For this purpose, special routes that best demonstrate these components are selected. The second tour, devoted to the review of biogenic components, includes a general acquaintance with the soil and vegetation cover of the territory (Ryabinina 2004). The route ran in the Karkaralinsky National Park, the eastern part of the Kazakh Uplands. The route coordinates covered a radius of 49°18'10"N 75°30'27"E and 49°17'41"N 75°32'19"E (Figure 1).

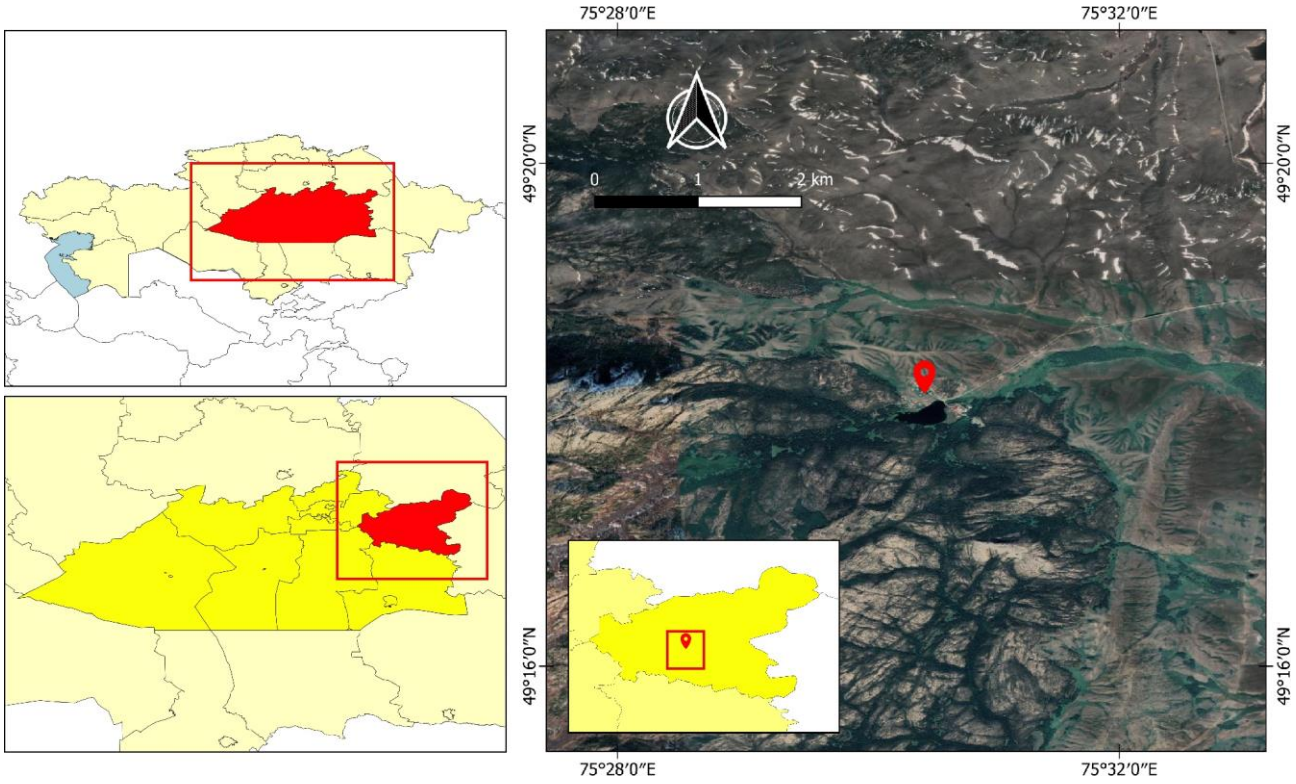

Figure 1. The territory of the field research route. The Karkaralinsky National Park

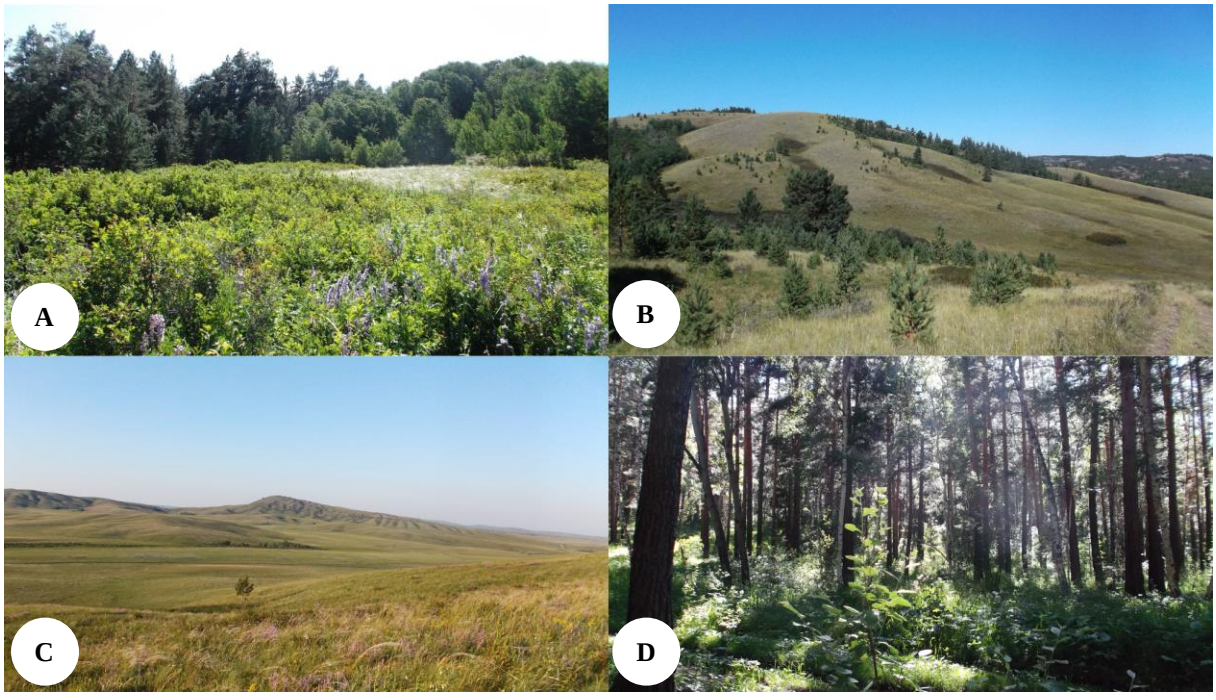

Figure 2. Natural areas of the territory of the field studies route: A. Flood-meadow, B. Hillside slope, C. Steppe zone, D. Forest zone

This territory has all the characteristics inherent in the landscape of entire Central Kazakhstan. There are steppe, forest-steppe and forest zones here (Figure 2). There are flood meadows between the hills, where moisture accumulates during the melting of snows, and at the same time, there are steppes open to the sun and winds.

Specimen identification

Laboratory processing of the source material was carried out in strict accordance with all requirements, and herbarium samples were stored in the herbarium collection of Karaganda Medical University (Herbarium business 1995; Shcherbakov and Mayorov 2006). To identify the

collected materials, the main floristic annotations covering the territory of Kazakhstan were used: "Flora of Kazakhstan" and "Flora of Kazakhstan. Generic Flora Complex" (Baitenov 1999; 2001).

Literature research

We conducted an extensive review of literatures that presented information on botanical and culinary to find spice plants and recipes suitable for them. We deliberately used the old literature, as modern sources contain no original recipes using herbs and spices traditional to our region (Koshcheev 1981; Dudchenko et al. 1989; Molchanov 1991; Tlemisov 1995).

We also searched for modern research on the medicinal potentials of the spice plants we found. The search was carried out using the Google Scholar, Medline and Scopus databases for various keywords, including the Latin names of the plant species found. The search included literature published over a five-year period (to the extent possible) up to December 2021.

RESULTS AND DISCUSSION

Biodiversity of wild spice plants of Central Kazakhstan

As a result of field research, 40 wild spice plant species belonging to 17 families were found among the collected materials. Table 1 shows data on the morphology and habitat of the plant species found by us.

Table 1. List of wild spice plants of Central Kazakhstan

Wild spice plants	Local name (Kazakh)	Morphology	Habitat
Lamiaceae			
Glechoma hederacea L. (Syn.: *Glechoma hederacea var. hederacea*)	Shyrmaýyq býdra	Perennial	In brushwood, in forests, in meadows and as a weed near dwellings
Ziziphora capitata L. (Syn.: *Ziziphora capitata subsp. capitata*)	Bas tárizdi kıikoty	Annual	On steppe and rocky slopes, in abandoned fields
Dracocephalum moldavica L. (Syn.: *Dracocephalum moldavica f. albiflorum* L.Q.Zhao)	Moldova jylanbas	Perennial	There is no accurate account of its natural range, native to the temperate climate
Phlomoides tuberosa Moench.	Túınekti flomıs	Perennial	On steppe slopes, steppe meadows, in dry places in agrocenoses; in thickets of bushes, in meadows, wastelands, along limestone outcrops
Hyssopus officinalis L.	Dárilik saısaǵyz	Subshrub	Sunny locations and well-drained soil
Mentha asiatica Boriss. (Syn.: *Mentha longifolia var. asiatica* (Boriss.) Rech.f.)	Azıa jalbyzy	Annual	In river valleys, on slopes, pebble beds, irrigation ditches, in meadows
Teucrium polium L.	Aq kıiz emenshóp	Perennial subshrub	On dry clay and rocky slopes and talus deposits, on limestone and chalk outcrops
Thymus serpyllum L.	Tasshóp jebir	Perennial subshrub	Abundant mainly in the steppe zone. It is confined to rocks, stony and rubble slopes, edges of pine forests
Salvia verticillata L.	Sálben	Subshrub	In open garbage grounds, on clay cliffs and limestone slopes
Brassicaceae			
Sinapis alba L.	Aq qysha	Annual	Weed plant, grows in fields, along roads
Descurainia sophia (L.) Webb ex Prantl	Sofia sarmala	Annual	In pastures, in gardens, along roads, in garbage grounds, near dwellings, in fields, flood meadows and saline places, along cliffs
Raphanus raphanistrum subsp. sativus (L.) Domin (Syn.: *Raphanus sativus* L.)		Annual	Weed plant, grows in fields, along roads
Nasturtium officinale R.Br.	Kádimgi sarybassha	Perennial aquatic herb	In swamps and water bodies
Thlaspi arvense L.	-	Annual	In dry meadows, fallow lands, wastelands, on roads, on salt licks
Lepidium sativum L. (Syn.: *Lepidium sativum subsp. sativum* Thell.)	Egistik shytyrmaq	Annual	In garbage dumps and in other places near dwellings, on railway embankments
Apiaceae			
Pimpinella saxifraga L.	Tasjarǵan pımpınella	Perennial	In meadow steppes, among bushes, on forest edges, in sparse deciduous and pine forests, on hills, along roadsides and fields
Heracleum sibiricum L. (Syn.: *Heracleum sphondylium subsp. sibiricum* (L.) Simonk.)	Sibir baldyrǵan	Biennial or perennial	In wet places - in meadows, between bushes
Archangelica officinalis Hoffm. (Syn.: *Angelica archangelica* L.)	Dári baldyrǵan	Biennial	In damp places, in forest ravines, among bushes, in swamps, along the banks of rivers and streams

Coriandrum sativum L.	Korıandr	Annual	Invasive feral plant
Carum carvi L. (Syn.: *Carum carvi f. carvi*)	Kádimgi zıre	Annual and biennial	In meadow steppes, among bushes, on forest edges, in sparse deciduous and pine forests, on hills, along roadsides and fields
Asteraceae			
Artemisia absinthium L.	Ashshy jýsan	Perennial	On fallow lands and field edges, along roads, near houses, in weedy meadows, vegetable gardens, along forest edges
Artemisia dracunculus L. (Syn.: *Artemisia dracunculus* Pursh.)	Estragon	Perennial	On dry steppificated slopes, on pebble beds, sometimes in the fields
Cichorium intybus L.	Kádimgi shashyraqty	Perennial or biennial	In meadows, forest glades, grassy slopes, often as a weed in wastelands, fields, near roads, near settlements
Cnicus benedictus L. (Syn.: *Centaurea benedicta* (L.) L.)	Arqal	Annual	On dry slopes, wastelands, near dwellings, roads and in crops
Rosaceae			
Geum urbanum L.	Qala gravılat	Perennial	On forest edges, roadsides, in gardens and parks, on wastelands and other weedy places
Potentilla erecta L. (Syn.: *Potentilla erecta* Maiden)	Túzý qaztaban	Perennial	In damp meadows, felling sites, forest edges and pastures
Fabaceae			
Melilotus officinalis (L.) Pall.	Dári túıejońyshqa	Biennial	On wastelands, fallow lands, meadows, along roads, in quarries
Glycyrrhiza glabra L. (Syn.: *Glycyrrhiza glabra var. asperula* Regel & Herder)	Jalań mıa	Perennial	In steppes and semi-deserts, in meadows, in thickets of bushes, along roads and irrigation canals
Hypericaceae			
Hypericum perforatum L.	Shilter japyraqty shaıqýraı	Perennial	Can be found as a weed along forest roads and on headlands
Polygonaceae			
Persicaria hydropiper (L.) Delarbre (Syn.: *Persicaria hydropiper* Opiz.)	Burysh taran	Annual	On swampy meadows, along the banks of rivers, ponds, marshes, lakes, as well as along roads, in damp places
Gramineae			
Hierochloe odorata (L.) P.Beauv.	Hosh ıisti tilqıar	Perennial	In meadows, on grassy slopes, forest glades among bushes; in sparse pine forests, on forest edges, swamps, riverside sands
Cupressaceae			
Juniperus communis Thunb. (Syn.: *Juniperus rigida* Siebold & Zucc.)	Kádimgi arsha	Perennial shrub	On dry mountain slopes, river banks, in the undergrowth
Boraginaceae			
Asperugo procumbens L.	Jataǵan jabysqaq	Annual	As a weed, the species is distributed almost everywhere
Zygophyllaceae			
Zygophyllum fabago L. (Syn.: *Zygophyllum fabago subsp. fabago*)	Kádimgi túıetaban	Perennial	In sandy, saline and clayey places, on the seashore
Resedaceae			
Reseda lutea L.	Sary rezeda	Annual or biennial	In fields, along roads, on rocky areas, outcrops, rocks
Cyperaceae			
Cyperus longus L. (Syn.: *Cyperus longus* Boeckeler)	Uzyn sálemshóp	Perennial	In damp meadows and ditches
Acoraceae			
Acorus calamus L.	Kádimgi andyz	Perennial	In damp places or in shallow waters - along the banks of streams, rivers and lakes, on the edges of swamps
Saxifragaceae			
Bergenia crassifolia (L.) Fritsch. (Syn.: *Bergenia crassifolia var. sajanensis* Stepanov)	Etjapyraq badan	Perennial	On rocks, talus deposits, old moraines and rocky slopes
Berberidaceae			
Berberis vulgaris L. (Syn.: *Berberis vulgaris var. ilicifolia* Schult.f.)	Kádimgi bóriqaraqat	Shrub	On forest edges, slopes, lawns, on chalk outcrops and river pebble beds
Amaryllidaceae 0			
Allium schoenoprasum L.	Shalǵyndy piiaz	Perennial	Grows in meadows, in river valleys, usually on moist poor soils, less often on rocky mountain slopes

As a result of resource studies of the territory of Central Kazakhstan, it was found that most spice plants grow near roads, in meadows, and in the steppe zone and have the status of weeds. The greatest floral diversity is observed between the hills and in the floodplains of rivers, where the soils are sufficiently moistened. At the same time, many types of spice plants do not form thickets but grow in small groups or single plants. The numerical distribution of species by family is extremely uneven, but many of the listed families occupy leading positions in the regional flora (Lamiaceae, Apiaceae, Asteraceae, Rosaceae, Brassicaceae).

Possibilities of culinary use of wild spicy herbs of Central Kazakhstan, their active components and medicinal value

The ethnic people who have been living in this territory for a long time are the Kazakhs. For hundreds of years, Kazakhs were herders. The cooking methods and the main ingredients were heavily influenced by the nation's nomadic lifestyle. For example, most cooking methods focus on the long-term preservation of food. There is a great practice of salting and dry-curing meat, and sour milk is preferred, as such foods are easier to store in a nomadic way of life (Kazakhstan food 2020). At present, the national cuisine of Kazakhstan reflects the interweaving of cultures that exist in the country, where people have long been accustomed to living side by side with many other nationalities. Today, the cuisine of Kazakhstan includes not only traditional Kazakh dishes, but also a variety of dishes inspired by Russian, European, Eastern and Caucasian neighbors. However, as in most countries, fast food has gained immense popularity in Kazakhstan. Many recipes and traditions become forgotten. Therefore, we took old recipe books to learn and revive the knowledge about the use of local herbs.

Lamiaceae family

Glechoma hederacea L. (Syn.: *Glechoma hederacea var. hederacea*) - the leaves are used for flavoring in the preparation of tonic drinks. According to ancient Chinese recipes, it was used to treat urine output and stimulate blood circulation. The aerial part of the plant contains tannins, bitter principles, choline, carotene, ascorbic acid, resins, free amino acids, gums, saponins, essential oil, and trace elements (Döring et al. 2014). The results showed that the extract of *G. hederacea* has antioxidant and anti-inflammatory and antimelanogenic properties (Chou et al. 2018; 2019). *G. hederacea* is registered as the main source of ursolic acid, which has important biological effects, including anti-inflammatory, antitumor, antidiabetic, antioxidant and antibacterial effects (Mlala et al. 2019). *G. hederacea* extracts have shown a protective effect against cholestatic liver damage, showing hepatoprotective, antioxidant, anti-inflammatory and antifibrotic effects (Wang YY. et al. 2017).

Ziziphora capitata L. (Syn.: *Ziziphora capitata subsp. capitata*) - the fruits and essential oil are used in the preparation of sauces for lamb meat, added to various spice mixtures, vegetable soups and cheese dishes. *Z. capitata* - contains essential oil, which is a colorless liquid with a minty odor, but without a cooling taste. The main part of the oil is pulegone. In addition, the presence of α-pinene, menthol has been established (Tunçtürk et al. 2017). Its methanol extracts show strong broad-spectrum activity against *B. cereus* and *L. monocytogenes* strains (Egamberdieva et al. 2017). The infusion is taken to enhance cardiac activity, and in the case of neurasthenia and heart disease, children are given in the case of diarrhea and colitis (Ogudin 2021).

Dracocephalum moldavica L. (Syn.: *Dracocephalum moldavica f. albiflorum* L.Q. Zhao) - the flowers and leaves have a pleasant lemon scent. It is used to flavor salads, vegetables, meat, fish soups and main dishes. All parts of the plant contain essential oil. The essential oil obtained from fresh plants is a clear, light yellow liquid with a lemon scent, which can serve as a source of citral. In addition, the oil contains geraniol, thymol, nerol (Song et al. 2021). *Dr. moldavica* - traditionally used in East Asia to treat mental retardation, migraines, and cardiovascular diseases. Recent scientific studies have confirmed the usefulness of this plant in the treatment of neurodegenerative diseases, including Alzheimer's disease (Deepa et al. 2020). Also, this Chinese herbal medicine noticeably improves neurobehavioral performance and reduces cerebral edema (Jia et al. 2017). The extract of *Dr. moldavica* has been found to be protective against cerebral ischemia-reperfusion injury (CIRI) and may be useful in the treatment of cerebrovascular diseases (Wu et al. 2019**Error! Reference source not found.**). Tilianin, the main ingredient in all flavonoids isolated from *Dr. moldavica*, has several biological functions, including cardiovascular protective effects, antitumor and anti-inflammatory effects. Tilianin may have immunotherapeutic significance in inhibiting human pharyngeal squamous cell carcinoma (Jiang et al. 2020).

Phlomoides tuberosa Moench. - the root tubers are used to make flour, in the manufacture of confectionery and sauces, milk porridge. Kalmyks add this flour to tea. In root tubers, saponins and trace elements were found - iron, magnesium, zinc, copper, manganese (Khobrakova et al. 2017). *Ph. tuberosa* - has an immunoprotective effect, stabilizes the membrane of immunocompetent cells and increases the activity of catalase (Kirillov et al. 2018; Khazdair et al. 2019).

Hyssopus officinalis L. - young shoots with leaves and flowers, fresh and dried, have ginger and sage aroma and a pleasant bitter-spicy taste. They are used to flavor soups, main dishes and cold snacks. The flowering aerial part contains essential oil, flavonoids (diosmin, issopin, hesperidin), tannins and bitter substances, resins, gum, triterpenic acids (ursolic and oleanolic) and other substances. The essential oil of *H. officinalis* is a greenish-yellow liquid with a strong turpentine-camphor odor; it contains pinene, pinecampheol, camphene, aldehydes, hydrocarbons, and alcohols (Aćimović et al. 2021). *H. officinalis* - its essential oil shows antibacterial activity against gram-negative and gram-positive bacteria

(Kovalenko et al. 2019). The essential oil also shows mild antioxidant activity (Pirbalouti et al. 2019).

Mentha asiatica Boriss. (Syn.: *Mentha longifolia var. asiatica* (Boriss.) Rech.f.) - the leaves are used as a seasoning in gravies and soups. The main active component of *M. asiatica* is menthol contained in the essential oil of the plant. In addition to the essential oil, mint contains terpenoids (limonene, cineol, dipentene), carotene, rutin, ascorbic, ursolic, oleanolic acids, flavonoids, tannins, and trace elements (Bashir et al. 2021). *M. asiatica* - has antibacterial activity against drug-resistant P. aeruginosa (Almawlah et al. 2017).

Salvia verticillata L. - the leaves give the food a strong aroma with a specific "cool" smell. It can be used as a seasoning for fatty meat dishes; dry leaves are used to flavor beer, and as a spicy aromatic seasoning for cheese, fish soup and meat. The aerial part of the plant contains greenish essential oil with a very pungent odor (Myha et al. 2021). *S. verticillata* - is the species of the genus Salvia with the highest total phenol content and antioxidant activity (Tzanova et al. 2019).

Thymus serpyllum L. - it has a pleasantly strong aroma and a pungent, very spicy, bitter taste. It is added to smoked meats, pork and lamb, pates, mushrooms, curd and cheeses. *T. serpyllum* herb contains over 1% essential oil, the main components of which are phenols - crystalline thymol (up to 30%) and liquid carvacrol (up to 20%). The oil contains cymene, borneol, terpinene, terpineol, etc. in small amounts. Tannins, ursolic and oleanolic acids, flavonoids, bitter principles and mineral salts were found in the herb (Malankina et al. 2019). *T. serpyllum* - possesses antihyperlipidemic and hepatoprotective action (Alamgeer and Mushtaq 2017). The results showed that the administration of *Thymus serpyllum* led to a decrease in inflammation, accelerated regeneration of the ileal mucosa and a positive effect on the damaged intestine. *Thymus serpyllum* increases the body's resistance to potentially pathogenic microorganisms and toxic compounds, restoring the microflora of the colon (Tarmakova et al. 2019).

Teucrium polium L. - the leaves are used as a spice in fish processing. The essential oil contains about 45 compounds, the important components of which are β-cadinene, β-citronellol, carvacrol and eugenol (Khadhri et al. 2022). *T. polium* aqueous extract (TPAE) has an antiatherothrombotic effect (Mohd Nor et al. 2019). It can also be used as a natural product for the treatment of cardiovascular diseases (Amraei et al. 2018). *T. polium* extracts have shown good antioxidant properties in an experiment with the male reproductive system of rats, which indicates its protective effect against chemically induced reprotoxicity (Rahmouni et al. 2019).

Brassicaceae family

Sinapis alba L. - the seeds have a delicate, piquant taste, they are used in complex spice mixtures, for cooking vegetables and mushrooms. The seeds contain fatty oil, essential (mustard) oil, proteins, minerals, and the enzyme myrosin. The composition of the oil includes sinalbin glycoside, mucilage, acids (erucic, oleic, linoleic, palmitic, arachidic, linolenic). The oil is a dark yellow liquid with a pleasant odor and a distinctive, peculiar bitterish taste (Martinović et al. 2020). *S. alba* - contains in its composition allyl isothiocyanate, which has an inhibitory effect on a wide variety of bacteria. The results of the studies made it possible to determine that *S. alba* had an inhibitory effect on *S. aureus* (Camacho et al. 2019).

Descurainia sophia (L.) Webb ex Prantl. - the seeds have a pungent taste and are sometimes used as a substitute for mustard. All parts of the plant contain saponins, coumarins, alkaloids, alcohols, steroids, organic acids, cardenolides, thioglycosides, and mineral salts; the leaves contain vitamins (C, E and P), pigments; the seeds contain fatty oil containing arachidonic, linoleic, erucic and other fatty acids, up to 1.5% of sinigrin glycoside, which determines the taste and smell of mustard (Mahomoodally et al. 2018). In Chinese medicine, it is used to treat cough by removing the phlegm in asthma and inflammatory airway diseases. The results show that *D. sophia* is a potent immunomodulator for attenuating allergic responses by suppressing Th2 cytokine expression in asthmatic mice (Ting et al. 2019). Aqueous extract of *D. sophia* has an effect on the prevention and treatment of kidney stones (Saremi et al. 2018), and its decoction has significant diuretic activity (Zeng et al. 2018).

Raphanus raphanistrum subsp. sativus (L.) Domin (Syn.: *Raphanus sativus* L.) - both root vegetables (mainly in salads and okroshkas) and young leaves (in salads, okroshkas, soups) are eaten. Root vegetables are usually consumed raw. They are crispy and have a spicy taste. Root tubers contain a significant amount of sugars, proteins, a large amount of coarse fiber, essential oil, choline, glycosides, ascorbic acid, carotene, B vitamins, enzymes, lysozyme, phytoncides, purine bases, various mineral salts (Keyata et al. 2021). *R. sativus* - has a strong antioxidant effect - root tubers, as well as leaves and peel, which are often discarded, contain significant amounts of antioxidants and phenol (Chorol 2019). In the treatment of non-alcoholic fatty liver disease, R. sativus improves biochemical parameters and reduces liver fibrosis (Ahn et al. 2019).

Nasturtium officinale R.Br. - it has a bitter, tart taste, can be used as a seasoning for soups and salads. The leaves are traditionally used as stomachic, diuretic, expectorant, hypoglycemic and stimulant agents (Chaudhary et al. 2018). *N. officinale* herb contains a significant amount of iodine, ascorbic acid, carotene, mustard essential oil, glyconasturtin glycoside, organic acids, sugars and trace elements (potassium, iron, arsenic). The mustard essential oil contains phenylethyl oil (Rawal et al. 2021). Diet mix with *N. officinale* and coconut oil improves growth performance, intestinal microbiota, antioxidant status and immunity in growing rabbits (Alagawany et al. 2018).

Thlaspi arvense L. - the vegetative organs and seeds contain sinigrin glycoside, which has a strong garlic odor and can be used as a substitute for garlic in dishes. The aerial part of the plant contains flavonoids (glycosides of quercetin and kaempferol), mustard oil, thioglycosides (sinigrin, glucocapparin), vitamin C, saponins, alkaloids. Seeds contain 20-33% fatty oil (it contains acids: erucic, linoleic, tetracosenoic, linolenic, eicosene, oleic, arachidic,

eicosadiene, palmitic, palmitoleic, stearic), mustard oil, triglycosides (sinigrin, glucocapparin), isothiocyanates (allyl isothiocyanate) (Hojilla-Evangelista et al. 2015). *T. arvense* - is a popular medicinal plant. The extract from a fresh plant has a uterine hemostatic, astringent, disinfectant, antiscorbutic, expectorant, diaphoretic, antifebrile and wound-healing effect. In folk medicine, a decoction of the herb is used for ovarian diseases, stomach ulcers, headaches, uterine cancer, diabetes mellitus, atherosclerosis, hypertension, and constipation (Semenova et al. 2019).

Lepidium sativum L. (Syn.: *Lepidium sativum subsp. sativum* Thell.) - the fresh leaves have a pleasant tart, bitter and pungent taste, reminiscent of horseradish (*Armorácia rusticána*) or radish (*Ráphanus*). It is used only fresh as a seasoning for salads, meat, fish, omelets, gravies and soups. *L. sativum* - various parts of the plant are traditionally used for many respiratory, rheumatological, cardiovascular, metabolic and gastrointestinal disorders. There have been several studies demonstrating its anti-inflammatory, anticarcinogenic, antiproliferative and tissue protective effects. In all of these studies, its beneficial effect was in its antioxidant properties due to polyphenols and organosulfur compounds (Türkoğlu et al. 2018). *L. sativum* methanol extract successfully controls diabetes, increases antioxidants and improves lipid profile (Attia et al. 2019).

Apiaceae family

Pimpinella saxifraga L. - the taste of young leaves is tart, astringent, it is used to make piquant vinegar. The leaves are used for brewing tea, the so-called “Chigir tea”. *P. saxifraga* - underground organs contain essential oil, terpenoids (α-bisabolol, saxazulene), polyacetylene compounds, aromatic compounds (propylbenzene), phenols and their derivatives (isoeugenol, pseudoeugenol), coumarins (pimpinellin, isopimpinellin, isobergapten, sphondin, umbelliferone, bergapten, peucedanin, xanthotoxin, imperatorin) (Masoudi et al. 2009). *P. saxifrage* - its essential oil has strong antibacterial activity against gram-positive and gram-negative bacteria (Ksouda et al. 2019).

Heracleum sibiricum L. (Syn.: *Heracleum sphondylium subsp. sibiricum* (L.) Simonk.) - the pickled young shoots are used in salads to add a spicy flavor. The root oil contains β-pinene, methyleugenol and elemicin. Leaf and flower oils are dominated by various sesquiterpenes (germacrene D, β-sesquifellandrene, (E)-β-farnesene and/or (E)-caryophyllene) and/or phenylpropanoids (apiol, methyleugenol, elemicin and/or (Z) isoelemycin) (Ušjak et al. 2017). The main constituent of the roots is pimpinellin, while bergapten and imperorin are the main compounds in its fruits. It has antioxidant activity (Ozek et al. 2019). The essential oil of *H. sibiricum* has weak antimicrobial activity (Miladinović et al. 2013).

Archangelica officinalis Hoffm. (Syn.: *Angelica archangelica* L.) - the rhizomes and roots are used as a spice for drink flavoring. *A. officinalis* - all parts of the plant contain up to 1% essential oil. An integral part of the essential oil are monoterpenes: phellandrene, pinene, borneol, cymol; terpenoids, coumarins (osthol, ostenol, umbelliprenin, xanthotoxin, imperatorin, angelicin, archangellicin, umbelliferon); phthalic acid derivatives: legustilide, sedanolide. Polyacetylene compounds were found in the oil: falcarinol, falcarindiol; coumarins: pinene, osthol and furocoumarin, angelicin and furocoumarins (angelicin, xanthotoxin, psolaren, bergapten, oxypeucedanin); phytosterols, resins, wax, bitter substances and tannins, organic acids (malic, acetic, angelic, valeric, etc.); sugars, pectins, carotene, starch (Dudchenko et al. 1989). *Archangelica officinalis* - decoction of its rhizomes is used for flatulence, gastrointestinal diseases, hypoacid gastritis, biliary dyskinesia, colds, bronchitis, laryngitis, pneumonia, as a diuretic, bactericidal and expectorant agent. The tincture is used to increase appetite and improve digestion, enhance the motor and secretory functions of the intestines. The extract is used as an antispasmodic and sedative for spasms of organs with smooth muscles (Maznev 2004).

Coriandrum sativum L. - the fruits are widely used as a spice for aromatization and vitaminization of sausages, cheese, canned meat and fish, marinades, pickles and liqueurs. They are added when baking pumpernickel bread, confectionery and culinary products. *Coriandrum sativum L.* - fruits contain carbohydrates (glucose, fructose, sucrose), essential oil (contains linalool, geraniol, linalyl acetate, geranyl acetate, borneol, thymol, α-pinene, camphene, etc.), triterpenoids (coriandrinol, coriandrinonediol), sterols (β- and γ-sitosterol, stigmasterol), phthalides (neocnidilide), phenolcarboxylic acids and their derivatives, coumarins, flavonoids, fatty oil (Foudah et al. 2021). *C. sativum* - the essential oil has antibacterial activity and antioxidant activity (Handayani et al. 2019). It has an antithrombotic effect (Azmi et al. 2019). *C. sativum* reduces the level of oxidants and inhibits the activity of acetylcholinesterase in the nervous system. It improves the condition in neurodegenerative diseases, and has therapeutic potential in disorders associated with neuroinflammation and neurotransmitter deficiencies such as Alzheimer's disease and depression (Khazdair et al. 2019).

Carum carvi L. (Syn.: *Carum carvi f. carvi*) - the fruits and oil give the products a spicy, pungent taste. The fruits are used as a spice for flavoring bakery products. *C. carvi.* - fruits contain essential and fatty oils, flavonoids quercetin and kaempferol, tannins, proteins, resins, wax, mineral salts, d-carvone, d-limonene, carvacrol, dihydrocarvone, dihydrocarveoL. In addition, the fatty oils contain fatty acids (butyric, linoleic, palmitic, stearic, linolenic), phytosterols (sitosterol), triterpenoids, flavonoids (quercetin, kaempferol), tannins and proteins, phenolcarboxylic acids, coumarins, waxes, resins and mineral salts (Chauhan et al. 2021). *C. carvi* - has antioxidant and hypoglycemic properties (Trifan et al. 2016). Its hydroalcoholic extract has analgesic and anti-inflammatory properties (Seddighfar et al. 2020).

Asteraceae family

Artemisia absinthium L. - the leaves are used in cooking as a seasoning for fatty meat dishes. The aerial

part and leaves contain sesquiterpene lactones, bitter glycosides (absinthine, anabsinthine, artabsin and others), which give the plant a peculiar bitter taste, saponins, flavonoids, phytoncides, ascorbic acid, resinous substances and tannins, potassium salts, artemisetin, essential oil, carotene, organic acids (malic, succinic) (Szopa et al. 2020). *A. absinthium* - shikimic acid obtained from the leaves lowers glucose and glycated hemoglobin levels, and reduces the formation of advanced glycation end products derived from glucose. Shikimic acid has an effect on the release of inflammatory mediators in the retina and has antioxidant potential (Hassan et al. 2018). It has antitrypanosomal activity, and root extract can be used in the production of nematicides and fungicidal agents (Liu TT. et al. 2019). The use of *A. absinthium* extract can improve the healing process (Hoseinian et al. 2018).

Artemisia dracunculus L. (Syn.: *Artemisia dracunculus* Pursh.) - has a slightly spicy aroma and a pungent, spicy and piquant taste. It is used for pickling cucumbers, tomatoes, mushrooms, and making marinades. Finely chopped fresh leaves are added as a spice to poultry, eggs, light sauces, meat dishes, and all types of salads. *A. dracunculus* - the aerial part of tarragon contains carotene, essential oil; ascorbic acid, alkaloids, flavonoids, coumarins, tannins, resins, bitter principles, vitamins A, B1, B2 and C, as well as a significant amount of micro and macro elements. Sabinene, myrcene, sesquiterpene fraction, p-methoxycinnamic aldehyde, resin, methylchavicol, ocimene, phellandrene were found in the essential oil (Sahakyan et al. 2021). *A. dracunculus* - possesses antioxidant properties and antidepressant-like activity (Jahani et al. 2019). Consuming *A. dracunculus* extract with food improves fatty acid oxidation and metabolic flexibility in skeletal muscle, lowers insulin levels, and improves insulin signaling in skeletal muscle and liver (Yu et al. 2018). *A. dracunculus* extracts can reduce inflammatory cytokines and alleviate certain signs of multiple sclerosis (Safari et al. 2019). *A. dracunculus* aqueous extract can improve the thyroid hormone profile in hypothyroidism (Mohammadi et al. 2020).

Cichorium intybus L. - the root is known as an excellent coffee substitute or as a necessary addition to real Arabica coffee, giving it a pleasant, pungent bitterness. *C. intybus* - the roots and leaves of the plant contain a large amount of inulin polysaccharide, there are protein substances, intibin glycoside, which gives a specific bitter taste, tannins, organic acids, vitamins - thiamine, riboflavin, ascorbic acid, carotene (Saybel et al. 2020). *C. intybus* - has an antioxidant and antimicrobial effect due to the content of components such as chicoric acid, galuteolin, chlorogenic acid, caffeic acid, caftaric acid (Jasim 2018). It can be used as a promising therapeutic agent for gout (Wang et al. 2019), provides hepatoprotection in diabetes mellitus (Ramya 2018), and has a protective effect against liver tissue damage (Asadi et al. 2018). *C. intybus* extract protects human red blood cells from hemolysis (Migliorini et al. 2019).

Cnicus benedictus L. (Syn.: *Centaurea benedicta* (L.) L.) - the dried top leaves and anthodia are used as a spice for flavoring drinks (Paun et al. 2019). *Cnicus benedictus* L., the herb contains bitterness - knitsin, salonitenolide, as well as lignins, tannins, flavones, resins, as well as essential oils and mucus. *Cnicus benedictus* is used for fever, anorexia (lack of appetite), indigestion, constipation, and bloating. This remedy is used for indigestion, heartburn, and decreased appetite (Kelber et al. 2017; Ahmadimoghaddam et al. 2020).

Rosaceae family

Geum urbanum L. - the rhizomes have a pleasant odor and a bitter, astringent taste. They are used as a substitute for cloves and cinnamon. The rhizomes contain carbohydrates (starch, sucrose, raffinose), essential oil (contains eugenol, hein), resins, alkaloids, vitamin C, tannins, phenolcarboxylic acids and their derivatives, catechins (Schmitt et al. 2020). *G. urbanum* - has antimicrobial and antioxidant potential (Dimitrova et al. 2017). Decoctions of its roots are used externally to reduce bleeding and inflammation of the gums (gingivitis) and mucous membranes. The results showed that *G. urbanum* extracts were effective in regulating several important cardiogenic markers, supporting the therapeutic role of this plant as a traditional heart medicine (Neshati et al. 2018).

Potentilla erecta L. (Syn.: *Potentilla erecta* Maiden) - the rhizomes are used as a spice for canned fish and in the alcoholic beverage industry for the preparation of aromatic tinctures. The rhizomes contain organic acids, essential oil, tannins, triterpenoids (quinovic acid, tormentoside), phenols (pyrocatechin, pyrogallol, florglucin), phenolcarboxylic acids, catechins, flavonoids (kaempferol), anthocyanins (cyanidin glucoside), lipids (Augustynowicz et al. 2021). *P. erecta* - it is traditionally used to treat inflammatory diseases of the skin and mucous membranes, as well as chronic diarrhea. It has anti-inflammatory and vasoconstrictive effects and therefore may be useful for the topical treatment of inflammatory skin diseases (Wölfle et al. 2017). It has the ability to reverse chromosomal aberrations caused by ROS, shows high protective activity against cell damage caused by oxidative stress, and has a strong antihemolytic activity (Madić et al. 2019).

Fabaceae family

Glycyrrhiza glabra L. (Syn.: *Glycyrrhiza glabra var. asperula* Regel & Herder) - it is used as a flavoring agent in fish processing, in making sauerkraut, and as an additive to green tea. The roots and underground shoots of licorice contain glycyrrhizin, more than 20 flavone glycosides (liquiritin, liquiritozide, liquiritigenin-7, 4-dioxiflavone, etc.), glabric acid, steroids (β-sitosterol, estriol), asparagine, essential oil (0.03%), ascorbic acid and other substances (Han et al. 2020). The main biologically active compounds of licorice are liquiritin, liquiritigenin, glycyrrhizin, isoliquiritigenin and glabridin. It has an antioxidant effect (Quintana et al. 2019). *Gl. glabra* extract relieves liver disease through targeted therapeutic mechanisms including anti-steatosis, antioxidant stress, anti-inflammatory effects and is used to treat liver diseases and drug-induced liver injury (DILI) (Li et al. 2019). *Gl. glabra* root extract relieves pancreatitis (Srikantam and Arumuga 2019), has an antibacterial effect, and can be

recommended for the prevention of tooth decay (Malvania et al. 2019).

Melilotus officinalis (L.) Pall. - the aerial part is used in the preparation of beer and bitter vodkas. The herb contains coumarins and their derivatives (coumarin, dicoumarol, dihydrocoumarin, melitoside glycoside), flavonoids (robinin, flovin, kaempferol and its derivatives), melilotin, essential oil, polysaccharides (mucilage), protein, saponins, purine derivatives (allantoin), phenolcarboxylic acids (hydroxycinnamic, coumaric, melilotic), phenolic triterpene compounds. The pleasant smell of the plant is given by coumarin and melilotin (Ma et al. 2019). *M. officinalis* - has antioxidant and anti-inflammatory effects (Khosroyar and Arastehnodeh 2018), and has antitumor activity (Liu YT. et al. 2018). It is commonly used to treat bronchitis, dysmenorrhea, hemorrhoids, kidney stones, eye ulcers, ear pain, and induration and swelling of the uterus. The European Medicines Agency has announced the use of *M. officinalis* orally for stomach pain, stomach ulcers and liver and uterine diseases in traditional medicine (Ilhan et al. 2020). It improves apoptosis of brain tissue in rats with cerebral ischemia by decreasing cerebral thrombosis, oxidative stress and inflammatory mediators (Zhao et al. 2017).

Hypericaceae family, *Hypericum perforatum* L. - its blooming aerial part is used as a flavoring agent for drinks, and its leaves as a surrogate for tea. The hypericum herb contains tannins, essential oil, β-sitosterol, triterpene saponins, vitamins C, E, flavonoids (hyperoside, rutin), anthraquinones, macro and microelements (Vuko et al. 2021). *H. perforatum* - has antibacterial, antiviral, and anti-inflammatory properties. The antinociceptive and analgesic properties of *H. perforatum* have been described (Galeotti 2017). Crude *H. perforatum* extracts contain chloroglucinols and are used to scavenge free radicals and prevent DNA damage (Mir et al. 2019). *H. perforatum* supplements protect against apoptotic, inflammatory and oxidative damage to muscles, blood and brain caused by sciatic nerve injury (Uslusoy et al. 2019).

Polygonaceae family, *Persicaria hydropiper* (L.) Delarbre (Syn.: *Persicaria hydropiper* Opiz.) - the crushed seeds are used as a hot seasoning for sauces, salads and soups. The aerial part contains essential oil, polygopiperine glycoside, rutin, carotene, ascorbic acid, ergosterol, tocopherol, naphthoquinone, phytosterol, tannins, organic acids (formic, acetic, valeric, malic), acetylcholine, iron, sugars, flavone derivatives - rhamnosine, rutin, isorhamnetin, quercitrin, quercetin, hyperoside, kaempferol (Ayaz et al. 2020). *P. hydropiper* - is a natural source of polyphenols with antioxidant properties (Kostici 2019). It has anti-inflammatory effects (Zhang et al. 2018). It is used to treat a variety of neurological disorders, including Alzheimer's disease (AD) (Ayaz et al. 2016). It can be useful as a natural source of collagenase inhibitor that can be used to treat skin aging (Kawaguchi and Nagata 2019).

Gramineae family, *Hierochloe odorata* (L.) P. Beauv. - it is included in spice mixtures as a flavoring agent that enhances the overall bouquet. *H. odorata* - contains coumarin, which gives the plant an odor that intensifies when the plant is dried (characteristic smell of fresh hay). The plant also contains various acids, alkaloids and vitamin C (Cantrell et al. 2016). *H. odorata* - has a membrane-protective effect associated with the effect of ethanol (Dobrzyńska et al. 2013).

Cupressaceae family, *Juniperus communis* Thunb. (Syn.: *Juniperus riqida* Siebold & Zucc.) - crushed berries are used in the preparation of meat and poultry dishes to give them a specific taste. They can be added to sauces, minced meat, marinades for meat and liqueurs. The fruits contain terpenoids (α-pinene, cadinene, camphene, α-terpinene, dipentene, sabinene, borneol, isoborneol, α-phellandrene, juniper camphor, etc.), and also contain sugars, resins, organic acids (formic, acetic and malic acid), flavonoids, pectins (pentosans), vitamin C, dyes (juniperine), fatty oil, wax and trace elements (manganese, iron, copper and aluminum) (Orav et al. 2010). *J. communis* - has a high content of antioxidants (Ved et al. 2017), and is used in several traditional medicinal systems for the treatment of various diseases, including rheumatism, arthritis and gout. A recent study found the high bioactivity of *J. communis* berry extracts and their inhibitory effects on the growth of bacteria and carcinoma cells, indicating their potential in the treatment and prevention of certain autoimmune inflammatory diseases and certain types of cancer (Fernandez and Cock 2016). The hydroalcoholic extract obtained from *J. communis* has genoprotective, antioxidant, antifungal and anti-inflammatory properties (Fierascu et al. 2018). The research results showed that *J. communis* extract successfully penetrates the blood-brain barrier and effectively inhibits the growth of glioma cells (Tsai et al. 2018).

Boragináceae family, *Asperugo procumbens* L. - the young leaves in spring are used as a spicy seasoning for dishes, for pickling and in marinades. *A. procumbens* - is used in Iranian folk medicine for refreshing, soothing and uplifting actions. It has a sedative-hypnotic effect (Mirshafa et al. 2013).

Zygophyllaceae family, *Zygophyllum fabago* L. (Syn.: *Zygophyllum fabago subsp. fabago*) - all parts of the plant have a bitter spicy taste and are used as a seasoning. The stems and leaves contain 27-nortriterpenoid glycosides, sulfated triterpenoid saponins (fabagoin and zygophylosides E, G, OR) and disulfated triterpenoid derivatives, as well as zygofiloside A, a disulfated saponin (Ali and Mohammed 2019). *Z. fabago* - the aerial parts have been reported as anti-rheumatic, anthelmintic, cathartic, antiasthmatic, antitussive, expectorant and anti-inflammatory agents, as well as external remedies for skin diseases, wounds, septic diseases and injuries (Yaripour et al. 2017).

Resedaceae family, *Reseda lutea* L. - the fresh stems, roots and leaves have a pleasant mustard scent and are used as a spice and flavoring agent. The roots, leaves, stems and fruits contain mustard essential oil; the seeds contain fatty oil, which includes tocopherol; the leaves contain a flavone derivative, the pigment luteolin (Pagnotta et al. 2020). *R. lutea* - contains the flavone luteolin. Luteolin shows antioxidant, anti-inflammatory and anti-allergic activity

(Seelinger et al. 2008). Aqueous extracts have antioxidant activity and neuroprotective effect (Kim et al. 2015).

Cyperaceae family, *Cyperus longus* L. (Syn.: *Cyperus longus* Boeckeler) - the rhizome contains essential oil with a violet scent and is used as a spice. *C. longus* - shows an antibacterial effect (Ait-Ouazzou et al. 2012), contains components that have hepatoprotective properties (Xu et al. 2004). It exhibits antiproliferative and antiapoptotic effects and is considered a promising chemotherapeutic agent in cancer treatment (Memariani et al. 2016).

Acoraceae family, *Acorus calamus* L. - the dried rhizome is used instead of ginger, cinnamon and bay leave. It has a bitter-burning, tart, spicy smell and taste. In *A. calamus* rhizomes, the plant-specific bitter glycoside acorin, the bitter principle acoretin, tannins, ascorbic and palmitic acids, starch, choline, vitamins, iodine were found. The smell of rhizomes is caused by azarylaldehyde (Süzgeç-Selçuk et al. 2017). *A. calamus* - has an insecticidal, antifungal, antibacterial, tranquilizing, antidiarrheal, antidyslipidemic, neuroprotective, antioxidant, anticholinesterase, antispasmodic, vascular modulator effect (Mohammed and Hameed 2020). It is currently being investigated as a new antiviral drug candidate for Dengue fever (Rosmalena et al. 2019). In experiments with lipopolysaccharide-induced neuroinflammation, the aqueous fraction of *A. calamus* caused the prevention of memory deficit and anxiety reduction by controlling oxidative stress and inflammatory processes (Esfandiari et al. 2018). *A. calamus* has antioxidant activity that can affect neurotransmitter systems and is potentially neuroprotective (Kardani et al. 2019).

Saxifragaceae family, *Bergenia crassifolia* (L.) Fritsch. (Syn.: *Bergenia crassifolia var. sajanensis* Stepanov) - the overwintered, blackened leaves are used for making aromatic tea called “Mongolian tea”. The leaves contain tannins, phenolic compounds, phenolcarboxylic acids, a coumarin derivative - bergenin, as well as isocoumarins, catechins, starch, sugars, and mineral salts (Akzhigitova et al. 2020). *B. crassifolia* - is a potential source of tannins, benzanoids, flavonoids, polysaccharides and other active compounds. It shows adaptogenic, anti-inflammatory, antihypertensive, antimicrobial, antioxidant, anti-obesity, antitussive, cerebro-protective, hepatoprotective, immunomodulatory and diuretic properties (Tumova et al. 2018).

Berberidacea family, *Berberis vulgaris* L. (Syn.: *Berberis vulgaris var. ilicifolia* Schult.f.) - the crushed dry fruits are used as a sour and hot seasoning. Young leaves and shoots can be used to make tea. *B. vulgaris* - barberry fruits contain sugars, carotene, vitamins K, C (up to 172 mg/%), citric, malic, tartaric acids, berberine, tannins, pectin, dyes, mineral salts (Fatehi et al. 2005). *B. vulgaris* - contains isoquinoline alkaloids such as berberine and berbamine. Berberine has a positive effect on risk factors for obesity and metabolic syndrome. Berberine inhibits adipocyte differentiation and reduces obesity. It also regulates glucose metabolism by decreasing insulin resistance and increasing insulin secretion. Other effects of berberine include antihyperlipidemic and hypotensive activity and endothelial protection (Firouzi et al. 2018; Dimitrijević et al. 2020). It suppresses the accumulation of liver lipids and lipid parameters and reduces the risk of non-alcoholic fatty liver disease. *B. vulgaris* may be helpful in hypercholesterolemia (Neag et al. 2019). It has shown beneficial effects in lowering blood pressure, increasing cardiac contractility and protecting against reperfusion injury (Abushouk 2017).

Amaryllidaceae family, *Allium schoenoprasum* L. - is used to improve the taste of potato, bean, pea and meat soups, cucumber salads, potatoes, French meat salad and mixed salad, egg dishes, fish, roasts, pates, cottage cheese, soft cheeses, sauces, marinades, sandwiches, cold appetizers, sausages. *A. schoenoprasum* - it contains sugars, phenolic compounds, catechins, flavonols, polyphenols, calcium, phosphorus, iron, carotene, vitamins B1, B2, PP and C (Fomina et al. 2019). In Indonesia, *A. schoenoprasum* is used to treat hypertension, in China, it is used to relieve flu and lung congestion (Singh et al. 2018). In recent studies, essential oils derived from *A. schoenoprasum* have been evaluated for antimicrobial, antioxidant, antifungal, anthelmintic and anticancer activity (Sanei-Dehkordi et al. 2019). It demonstrates a neuroprotective effect by enhancing antioxidant protection against ischemia-reperfusion.

As a result of the analysis of old recipe books, we found out that most of the spice plants we found are used as part of dry spice mixtures for cooking meat and fish dishes, for preserving and flavoring baked goods. They are also used fresh in salads. Many types of spices can be added to tea or coffee to add flavor or used as a substitute for these drinks.

Having studied the literature, we found that all the types of herbs found by us in Central Kazakhstan contain essential oils, sesquiterpene lactones, phenols, flavonoids and phytoncides, coumarins, tannins, organic acids, vitamins and mineral components. This variety and combination of biologically active substances give spice herbs a medicinal effect.

As a result of searching through various databases, we found that all types of herbs that we found in Central Kazakhstan have antimicrobial and antioxidant effects. They are medicines for diabetes mellitus, atherosclerosis, hypertension, constipation, flatulence, gastrointestinal diseases, biliary dyskinesia, colds and they can act as diuretics. Some types of herbs show immunoprotective effects and have antiviral and anti-inflammatory properties.

Discussion

Plant biodiversity provides people with all kinds of sustainable goods such as food, timber, pet food, and medicines. All of them are important factors for survival. In most parts of the developing world, people are heavily dependent on local environmental resources, especially wild plants, for day-to-day existence and health care. Traditional knowledge about the use of these resources is seen as a means of adaptation during difficult times (Khakurel et al. 2021). Therefore, research into human interaction with plants is relevant to many global issues, including food security, climate change, conservation biology, and human health. All over the world, populations living in a variety of habitats rely on a variety of edible

plants to support their livelihoods. Even though agricultural communities rely primarily on improved cultivated plant varieties for their nutritional value, health benefits, and higher productivity, the habit of eating wild foods has not completely disappeared. Moreover, by 2050, the world population is expected to exceed 9 billion people, which will increase the global demand for food by 50% compared to 2021 (FAO, 2017). In recent years, the world has experienced numerous changes in the conditions of the economy, culture and social life of people, various demographic indicators, productivity changes, changes in domestic consumers' food preferences, changes in consumption, social factors and globalization. This has led to a change in people's eating habits, which eventually affected the consumption of spices.

Currently, the world is facing many problems - the COVID-19 pandemic and geopolitical events are affecting the whole world. The problem of lack of medicines due to disruption of logistical supplies came to the fore. For example, already in April 2022, the Minister of Health of the Republic of Kazakhstan announced that Kazakhstan was forced to terminate contracts for the supply of medicines with Ukrainian factories due to their closure. Another problem in Kazakhstan is the import dependence of drug production on certain components and logistics. (The Ministry of Health of Kazakhstan, 2022) This situation forces many countries to turn to the local flora in search of plants that can help solve problems. Thus, WHO in Africa (WHO 2020) has already recognized and proposed the use of traditional, complementary and alternative medicine in the treatment of COVID-19. The Chinese government actively promotes and recommends traditional medicines as treatments for COVID-19 that have proven effective in treating H1N1 diseases (National Health Commission of the PRC, 2020).

There is a complex relationship between food, health and people. Food provides normal human growth and development. Recent studies have shown that foods rich in phytonutrients can also provide health benefits and can be used as medicines (Temviriyanukul et al. 2021; Suttisansanee et al. 2021). Edible herbs, in addition to their primary nutritional functions, have potential benefits for promoting health, longevity, and reducing the risk of disease. A rapidly growing area of research is functional foods and nutraceuticals, also referred to as foods with physiological or health benefits (Myrie and Jones 2011). Spices are used in small quantities due to their strong taste. However, some spices are significantly higher in mineral, vitamin, and phytonutrient content, making them excellent sources of bioactive compounds. These bioactive compounds contribute to the overall biological activity of all food, thus providing a means to treat degenerative disorders and metabolic diseases (Bhathal et al. 2020). We analyzed scientific articles on the study of the composition of the spice plants we found. Forty species of spice plants discovered by us contain a large number of active substances, which allow them to show medicinal activity.

Spices and herbs have been used for centuries for both culinary and medicinal purposes. Spices not only improve the taste, aroma, and color of foods and drinks, but they can also protect against acute and chronic diseases. More and more people are considering the use of spices and herbs for medicinal and therapeutic purposes, especially for various chronic conditions. There is now ample evidence that spices have antioxidant, anti-inflammatory, anticancer, anti-carcinogenic, glucose and cholesterol-lowering activities, as well as properties that affect cognition and mood. Research over the past decade has shown a wide range of beneficial properties that they have due to their biologically active components, including sulfur-containing compounds, tannins, alkaloids, phenolic diterpenes and vitamins (Jiang 2019). Traditional knowledge helps to understand how local communities use local plant species, which is an additional input to the assessment of plant species. Documenting local people's knowledge of wild spices is important as this information can help in effectively assessing these resources locally when considering the different crops in the study (Houehanou 2011). Surveys conducted earlier showed that the local population is practically unfamiliar with local species of medicinal plants. This is especially true of the younger generation aged 18-25, whose representatives know only those plant species that are part of the known syrups and lozenges for colds and prefer pharmacological preparations, the use of which does not require time to prepare (Pozdnyakova et al. 2022).

Studies of the biodiversity of herbs in the territory of Central Kazakhstan were conducted for the 40 wild species of spice plants belonging to 17 families that can potentially be used in the modern daily diet as herbs. Among them, the most numerous are the families Lamiaceae - 9 species, Brassicaceae - 6 species, Apiaceae - 5 species, Asteraceae - 4 species, and the families Rosaceae and Fabaceae - 2 species of herbs. We have not included in the list the spice plants that are cultivated, such as dill (*Anethum graveolens*, the Apiaceae family), parsley (*Petroselinum*, the Apiaceae family), basil (*Ocīmum basilīicum,* the Lamiaceae family), marjoram (*Orīganum majorāna*, the Lamiaceae family), horseradish (*Armorácia rusticána*, the Brassicaceae family), etc. We studied only wild herbs that are little used for food. All of these species are mentioned in a number of old recipes and can be revived and re-recommended for widespread use.

A critical assessment of the literature on the medicinal properties of the studied spices irrefutably shows that they have enormous health potential. The work on the chemotherapeutic potential of plants is also noteworthy, especially considering the increased resistance of cancer cells and pathogenic microbes to conventional drugs. These spices may play a role in the development of next-generation antidiabetic agents to reduce the damaging effects of metabolic syndrome. Many of the herbs we found have antibacterial and antiviral effects.

Wild spicy plants growing on the territory of Central Kazakhstan have a wide range of taste diversity and have great prospects for studying their medicinal properties and using them as medicines. Given the low cost and availability, we believe that they should be popularized among the local population and recommended for commercial use.

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