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A.S. Keleke[1], L.N. Ibragimova [1], G.T. Zhumashova[1], A.G. Sabitova[1], E.Sh. Sultanov[1], Z.B. Sakipova[1]
[1] Asfendiyarov Kazakh National Medical University, Almaty, Kazakhstan

KAZAKH PLANT SPECIES OF THE GENUS HEDYSARUM L.: DISTRIBUTION, BOTANICAL DESCRIPTION AND PROFILE OF PHARMACOLOGICAL ACTIVITY

Resume: *A review of Kazakhstani species of the genus Hedysarum L. (sweetvetch) has been conducted, that includes 28 plant species with scientific names recognized by international floristic bases, 10 of which are endemics. The ranges of distribution, botanical characteristics, phytochemical composition and profile of pharmacological activity of some represented species were studied. The life form of all the studied sweetvetches is represented by perennial herbs, the chemical composition of which is characterized by such phenolic compounds as three isoflavonoids – ononin, formonononetin, formonononetin-7-O-β-D-glucoside-6'-O-malonate and pterocarpan – medicarpin. It is established that the pharmacopoeial species of the genus is Hedysarum polybotrys Hand.-Mazz, the most phylogenetically close to it is Hedysarum semenowii Regel & Herder species, which commonly grows on the territory of the Central Tien Shan. This species is used in folk medicine and is not inferior in its valuable properties to pharmacopoeial species, but it has not been widely studied, which was the reason for its selection as an object for further research.*
Keywords: *medicinal plants, Hedysarum (sweetvetch), Hedysarum semenowii, flora of Kazakhstan, distribution, botanical description, pharmacological activity.*

А.С. Келеке[1], Л.Н. Ибрагимова[1], Г.Т. Жумашова [1], А.Г. Сабитова[1], Э.Ш. Султанова[1], З.Б. Сакипова[1]
[1]С.Ж. Асфендияров атындағы қазақ ұлттық медицина университеті, Алматы қ., Қазақстан

HEDYSARUM L. ТҰҚЫМДАС ӨСІМДІКТЕРДІҢ ҚАЗАҚСТАНДЫҚ ТҮРЛЕРІ: ТАРАЛУЫ, БОТАНИКАЛЫҚ СИПАТТАМАСЫ ЖӘНЕ ФАРМАКОЛОГИЯЛЫҚ БЕЛСЕНДІЛІГІНІҢ БЕЙІНІ

Түйін: Тиынтақ (Hedysarum L.) тұқымдасының қазақстандық түрлеріне шолу жүргізілді: ол халықаралық флористикалық базалармен танылған 28 өсімдіктер түрінің ғылыми атауларын қамтиды, және соның ішіде 10-ы эндемик болып табылады. Кейбір ұсынылған түрлердің таралу аймақтары, ботаникалық белгілері, фитохимиялық құрамы және фармакологиялық белсенділіктерінің бейіні зерттелді. Зерттелетін барлық тиынтақтардың тіршілік формасы – көпжылдық шөптер, олардың химиялық құрамына үш изофлавоноид – ононин, формонетин, формононетин-7-о-β-d-глюкозид-6"-О-малонат және птерокарпан – медикарпин сияқты фенолдық қосылыстар тән. Тұқымдастың фармакопеялық түрі Hedysarum polybotrys Hand- Mazz екені анықталды, оған филогенетикалық ең жақын түр Орталық Тянь-Шань аумағында

А.С. Келеке[1], Л.Н. Ибрагимова[1], Г.Т. Жумашова [1], А.Г. Сабитова[1], Э.Ш. Султанова[1], З.Б. Сакипова[1]
[1]Казахский национальный медицинский университет имени С.Д. Асфендиярова, г. Алматы, Казахстан

КАЗАХСТАНСКИЕ ВИДЫ РАСТЕНИЙ РОДА HEDYSARUM L.: РАСПРОСТРАНЕНИЕ, БОТАНИЧЕСКОЕ ОПИСАНИЕ И ПРОФИЛЬ ФАРМАКОЛОГИЧЕСКОЙ АКТИВНОСТИ

Резюме: Проведен обзор казахстанских видов рода копеечник (Hedysarum L.), включающих 28 видов растений с научными названиями, признанными международными флористическими базами, 10 из которых являются эндемиками. Изучены ареалы распространения, ботанические признаки, фитохимический состав и профиль фармакологической активности некоторых представленных видов. Жизненная форма всех изучаемых копеечников представлена многолетними травами, для химического состава которых характерны такие фенольные соединения, как три изофлавоноида – ононин, формононетин, формононетин-7-О-β-D-глюкозид-6''-О-малонат и птерокарпан – медикарпин. Установлено, что фармакопейным видом рода является Hedysarum polybotrys Hand.-Mazz, наиболее филогенетически близкий к которому вид Hedysarum semenowii Regel & Herder, широко при-

кең таралған Hedysarum semenowii Regel & Herder. Аталған түр халық медицинасында қолданылады және өзідік құнды қасиеттері бойынша фармакопеялық түрінен кем түспейді, алайда аз зерттелген, бұл оны әрі қарайғы зерттеу объектісі ретінде таңдауға негіз болды.

Түйінді сөздер: дәрілік өсімдіктер, тиынтақ, Hedysarum semenowii, Қазақстан флорасы, таралу, ботаникалық сипаттама, фармакологиялық белсенділік.

зрастающий на территории Центрального Тянь-Шаня. Данный вид применяется в народной медицине и не уступает по своим ценным свойствам фармакопейному, однако малоизучен, что явилось основанием его выбора в качестве объекта для дальнейших исследований.

Ключевые слова: лекарственные растения, копеечник, Hedysarum semenowii, флора Казахстана, распространение, ботаническое описание, фармакологическая активность.

Introduction. The strategy of development of health care and pharmaceutical industry of the Republic of Kazakhstan for the coming years includes scientific research in the direction of expanding the range of medicines and dietary supplements, from medicinal plants that grow in the country. Expansion of the list of medicinal plants used in medicinal practice is a promising field for development and production of herbal pharmaceutical products. In working through this issue, it is important to select a suitable object of research based on the available relevant scientific knowledge.

The Republic of Kazakhstan is rich in natural resources, its flora includes more than 6 thousand species of plants, 25% of which are medicinal ones. Nevertheless, only a small part of them, not exceeding 17%, is used in official medicine [1-3]. Medicinal plants of interest in the field of pharmacy include the legume family (Fabaceae), which is the third largest family of flowering plants, numbering about 20 thousand species from approximately 880 genera [4, 5]. One of the most interesting genera to study in this family is the genus Hedysarum L., which consists of about 290 species of annual and perennial grasses, as well as shrubs and semi-shrubs [4-6]. Hedysarum plants are widely distributed in temperate climatic zones of the northern hemisphere, including Asia, Europe, North Africa and North America [4, 6], and are also found in various habitats such as alpine and arctic meadows, rocky meadows, deserts or seashores [7, 8].

The pharmacological activity profile of some Hedysarum species is well studied; many species have long been used in folk medicine [3]. Hedysarum polybotrys Hand.-Mazz. known as "Hongqi" (Huang-Qi), is widely used in traditional Chinese medicine as an immunomodulatory, anti-inflammatory, antioxidant and tonic agent [6, 9-13]. H. polybotrys is often included in medicines to improve cognitive disorders, in functional dietary nutrition and rejuvenating cosmetics [14-17]. In addition, H. polybotrys is the only representative of the genus included in the national pharmacopoeias of the People's Republic of China and Japan [6, 18-19]. Hedysarum neglectum Ledeb. is known as "bear root" or "red root", and also as a general tonic, immunomodulating and potency restoring remedy [20-23]. Hedysarum alpinum L., widespread throughout the northern hemisphere, has antiviral, cardioprotective, antioxidant properties [24-26].

The wide range of pharmacological activity of the plants of Hedysarum L. genus opens up great possibilities for their potential application in pharmacy and medicine. In that regard, in order to select the most promising species for research and successful implementation into practice, the primary task is to conduct a detailed review of the available information on the species of the genus Hedysarum in the literature.

Materials and methods

Analysis of following information sources on plant species of the genus Hedysarum L. growing in the territory of the Republic of Kazakhstan in the literature and international databases was performed: World Flora Online, Plantarium, Web of science Core Collection (Clarivate), ScienceDirect (Elsevier), PubMed (MEDLINE), GoogleScholar, eLibrary (Russian scientific electronic library integrated with the Russian Science Citation Index). The floristic data on Kazakh plant species of the genus Hedysarum L., which were given in the publication "Flora of Kazakhstan" [27], were compared with the accepted taxonomy and nomenclature according to the databases World Flora Online [2] and Plantarium [28].

Results and discussion

Analysis of the literature sources showed that the most detailed floristic data on plant species of the genus Hedysarum L. growing in Kazakhstan were given in the publication "Flora of Kazakhstan". According to the "Flora of Kazakhstan", in the country occur 38 species of Hedysarum L. [27]. However, due to the reclassification and updating the distribution range of some species in recent years [3, 29], a comparative analysis of the data given in the "Flora of Kazakhstan" with the international information databases World Flora Online [2] and Plantarium [28] were conducted. During the comparison the taxonomic ranks and scientific names of species used in the "Flora of Kazakhstan" were compared with the accepted taxonomy and nomenclature of floristic databases (Figure 1). The species Hedysarum scoparium Fisch. & C.A.Mey is excluded from the review, due to the transfer of the species to the genus Corethrodendron Fisch. & Basiner as Corethrodendron scoparium (Fisch. & C.A.Mey.) Fisch. & Basin-

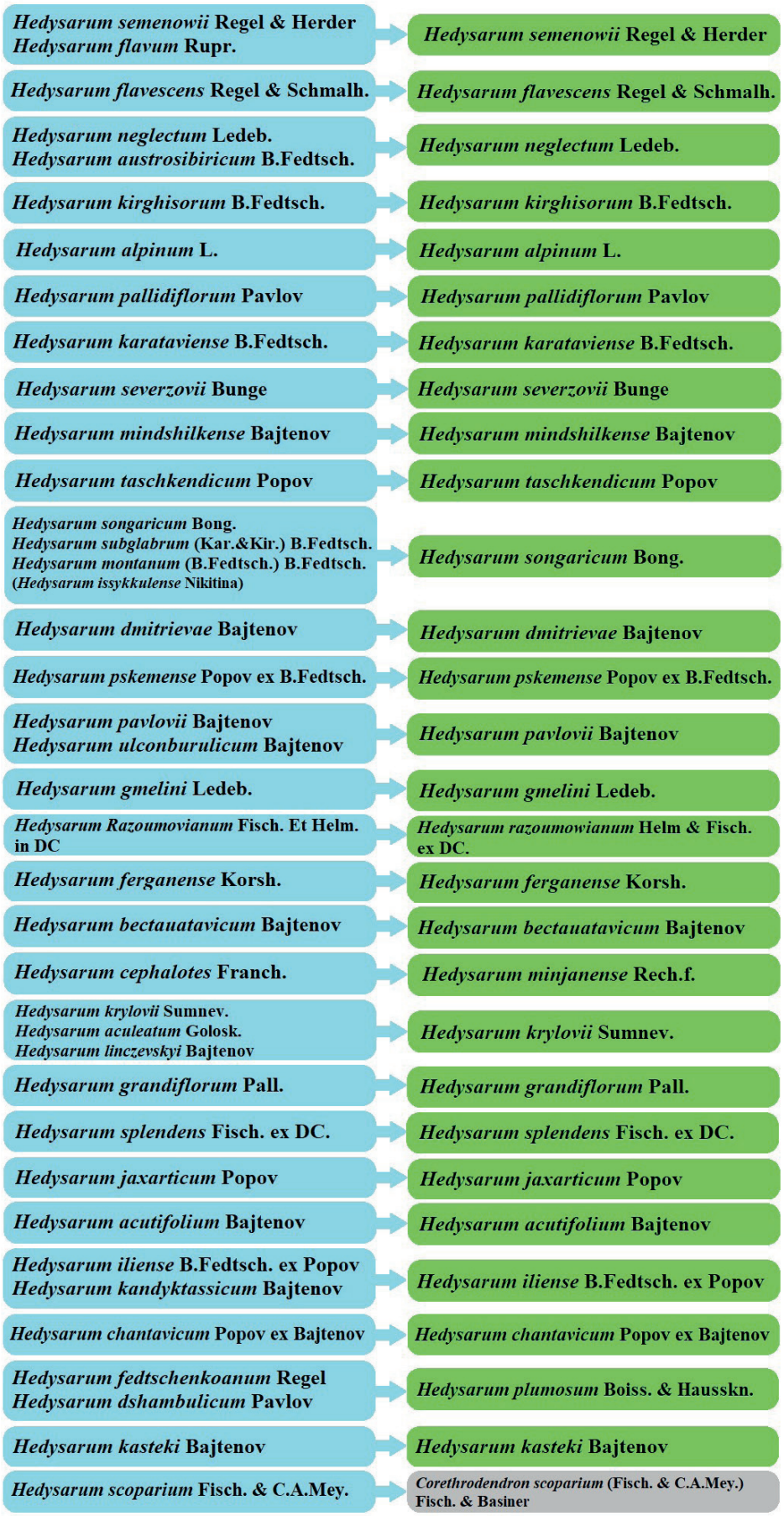

Figure 1 – Uniformed names of Kazakh Hedysarum species according to international floristic databases

er. In the same way, synonymic species were combined under the accepted scientific names: Hedysarum flavum Rupr. merged with Hedysarum semenowii Regel & Herder; Hedysarum austrosibiricum B.Fedtsch. with Hedysarum neglectum Ledeb. species; Hedysarum subglabrum (Kar. & Kir.) B.Fedtsch. and Hedysarum montanum (B.Fedtsch.) (Hedysarum issykkulense Nikitina) with Hedysarum songaricum Bong. species; Hedysarum ulconburulicum Bajtenov with Hedysarum pavlovii Bajtenov species; Hedysarum aculeatum Golosk. and Hedysarum linczevskyi Bajtenov with Hedysarum krylovii Sumnev.; Hedysarum kandyktassicum Bajtenov with the species Hedysarum iliense B.Fedtsch. ex Popov; Hedysarum fedtschenkoanum Regel and Hedysarum dshambulicum Pavlov with Hedysarum plumosum Boiss. & Hausskn.

Thus, according to the results of the comparison, in the process of unification obtained 28 accepted scientific species names of Kazakhstani sweetvetches (Figure 1), 10 of which are endemics: Hedysarum pallidiflorum Pavlov, Hedysarum karataviense B.Fedtsch, Hedysarum mindshilkense Bajtenov, Hedysarum dmitrievae Bajtenov, Hedysarum pavlovii Bajtenov, Hedysarum bectauatavicum Bajtenov, Hedysarum krylovii Sumnev., Hedysarum acutifolium Bajtenov, Hedysarum chantavicum Popov ex Bajtenov, Hedysarum kasteki Bajtenov.

The area of distribution of 28 Kazakh species of the genus Hedysarum L. is mostly represented by mountainous terrain of southern and southeastern Kazakhstan: Dzungarian Alatau, Trans-Ili Alatau and Kungey Alatau, Western Tien Shan, Karatau (Table 1). In particular, the greatest number of different species of sweetvetches, including endemics, is found in the Western Tien Shan, where such species as H. flavescens, H. taschkendicum, H. dmitrievae, H. pskemense, H. ferganense, H. minjanense, H. jaxarticum, H. acutifolium, H. plumosum, H.kasteki can be found [27, 30]. All species of the genus Hedysarum L. growing in the country are perennial herbaceous plants, most of which are fodder plants.

Plants of the genus Hedysarum L. have a number of different biologically active compounds belonging to such groups as flavones, flavonones, isoflavones, pterocarpans, chalcones, flavonols, triterpenoids, coumarins, lignanoids, alkaloids, sterols, carbohydrates, fatty acids and others [6, 31]. However, depending on the plant life form and the section to which the species belongs, different groups of compounds can be accumulated [32]. Characteristic compounds for herbaceous representatives of this genus are isoflavonoids (ononin, formonononetin, formonononetin-7-O-β-D-glucoside-6'-O-malonate) and pterocarpans (medicarpine) [6, 31]. Representatives of Obscura section, such as H. alpinum and H. flavescens, accumulate the maximum amount of xanthone glycosides, mainly mangiferin [32].

Mangiferin has antiviral activity; therefore, there are a number of studies aimed at increasing its content and improving the methods of its extraction from H. alpinum and H. flavescens [24, 33, 34]. Mangiferin preparations are effective in the treatment of viral skin and mucosa diseases, including herpes [33, 34].

Preparations of H. alpinum selectively completely inhibit human H3N2 and H5N1 avian influenza virus subtypes [25], and ethanol extracts of the above-ground part of the herb in various concentrations are used as cardioprotective and antioxidant drugs [26], and also as neuroleptic agents [35].

The correlation between flavonoid accumulation and antioxidant activity of Hedysarum plants was observed. H. neglectum, H. flavescens and H. kirghisorum, as well as H. dmitrievae flowers exhibited a pronounced antioxidant effect [36]. Besides, the root of H. neglectum possesses geroprotective potential comparable with ginseng (Panax ginseng C.A. Mey.) due to antimicrobial and antioxidant action [23].

H. neglectum showed significant immunostimulatory activity compared to Shilajit and Gingko biloba, with a fourfold increase in total immunoglobulin Y (IgY) [21]. Extracts based on H. neglectum are included in medicines for the prevention and treatment of diseases of the urogenital system [37]. Also, it is included in folk medicine for the treatment of postpartum edema and chest pain, as an antipyretic and detoxifier [38], and extracts of this root are used as an active ingredient in cosmetics for whitening, smoothing and bringing lustre to the skin [39].

H. gmelinii exhibits a moderate selective antiproliferative effect on cancer cells, and 95% ethanolic plant extracts have a pronounced anti-inflammatory effect [40]. A study of the antibacterial activity of aqueous extracts of H. grandiflorum showed that rhizome extracts inhibit the growth of E. coli and B. cereus, but in general the action is estimated as weak [41].

Most species of Hedysarum L. growing in Kazakhstan are poorly studied. No mention of pharmacognostic studies and research on pharmacological activity of endemics and following species has been found in scientific literature: H. semenowii, H. severzovii, H. taschkendicum, H. songaricum, H. pskemense, H. razoumowianum, H. ferganense, H. minjanense, H. splendens, H. jaxarticum, H. iliense, H. plumosum. The vast majority of the above species are included in the ranks of rare and protected plants [27], which imposes some limitations in full-scale pharmacognostic studies.

In this connection, the species H. semenowii, belonging to the Obscura section of the genus Hedysarum L., is a viable object for study. According to phylogenetic studies, H. semenowii is closest to the pharmacopoeial species H. polybotrys [42]. In addition, the plants of the species have sufficient biomass in their habitats and are of interest for introduction into culture [27]. Scientists of the Asfendiyarov Kazakh National Medical University included H. semenowii among the objects of study in the framework of the scientific project "Ethnopharmaceutical study of the flora of Kazakhstan" as a promising raw material for the domestic pharmaceutical industry.

Table 1 - Species of the genus Hedysarum L. growing in the territory of the Republic of Kazakhstan

No.	Species name	Area of distribution	Botanical description	Compounds	Pharmacological activity/application	Source
	Hedysarum semenowii Regel & Herder	Central Tien Shan, Chinese Tien Shan. In Kazakhstan: on herbaceous slopes, in the sloe forest belt in Dzungarian Alatau, Trans-Ili and Kungey Alatau, Ketmen-Terskey Alatau	Perennial plants up to 100 cm tall, with thickened roots; erect stems; up to 10 leaves on stem with rounded leaflets; oblong multi-flowered tassels with yellow corollas; and beans with 3-5 rounded-square brown segments	Ononin, Formononetin, Calycosin, Afromosin-7-O-β-D-glucopyranoside, Calycosin-7-O-β-D-glucopyranoside, Afrormosin, (-)-medicarpin, hedysarimpterocarpene B, Betulinic acid, Guanosine, Stigmasterol	Forage plant	[27]
	Hedysarum flavescens Regel & Schmalh.	Central Asia (Western Tien Shan, Pamir-Altai), Hindu Kush. In Kazakhstan: on herbaceous slopes, in juniper beds, on river gravels, on rubbly and fine-grained places, mainly in the subalpine belt, at altitudes of 2500-3100 m in the Western Tien Shan	Perennial plants up to 120 cm tall with long thickened roots; simple erect stems; up to 10 leaves on stem with 4-8 paired elliptical leaflets; multi-flowered tassels with yellow corolla; with leg beans on stalks of 1-3 rounded elliptical segments	Mangiferin, Isomangiferin, Glucomangiferin, Glucoisomangiferin	Antiviral, antioxidant activity. Forage plant	[27, 33,34,36]
	Hedysarum neglectum Ledeb.	Central Asia (Pamir-Alai), Western and eastern Siberia, Northern Mongolia. In Kazakhstan: mainly in the subalpine belt in the Altai, Tarbagatai, Dzungarian Alatau, Trans-Ili and Kungey Alatau, Ketmen-Terskey Alatau, Kyrgyz Alatau	Perennial plants, up to 50 cm tall, with thickened roots and erect stems; with 4-6 leaves with 4-8 paired elliptic leaflets; oblong tassels with drooping flowers whose corolla is pink-purple; with hanging pods on stalks of 3-5 rounded segments	Quercetin, Quercetin 3-α-L-rhamnofuranoside, Polystachoside (quercetin3-β-L-arabinofuranoside), Hyperoside, Ononin, Formononetin, Sparaginic acid, Mangiferin, Daucosterol, 7β-hydroxysitosterol, Sucrose	Antioxidant, antimicrobial, immunostimulating activity. Prevention and treatment of urogenital diseases, cosmetics. Forage plant.	[21, 23, 27, 36-39]
	Hedysarum kirghisorum B.Fedtsch.	Kazakhstan, Mongolia, Xinjiang. In Kazakhstan: on stony places in the alpine belt in Trans-Ili and Kungey Alatau, Ketmen-Terskey Alatau	Perennial plants up to 30 cm tall; long, thin roots; ascending, furrowed stems with 2-4 leaves per stem; 3 to 5 paired ovate leaflets; brushes with drooping flowers with pink corolla; beans with 2-4 rounded, jagged-edged, brownish segments	Ononin, Calycosin, Sissotrin, Afrormosin, (-)-epicatechin, (-)-epigallocatechin, Plumbocatechin	Antioxidant activity. Forage plant	[27, 28]
	Hedysarum alpinum L.	Canada, Russia, China, India, Kazakhstan, Korea, Mongolia, USA, Pakistan, Western Himalayas. In Kazakhstan: in meadows, in light birch and pine forests, on mountain slopes and river gravels in northern Akmola province and Altai	Perennial plants up to 120 cm tall with long thickened roots; erect, solitary stems with 4-7 shortly petiolate leaves, with 5-9 paired narrowly elliptical leaflets; elongated racemes with drooping flowers whose corolla is blue-purple; beans with 2-4 round-elliptical segments	Quercetin 3-α-L-arabinofuranoside, Polystachoside (quercetin3-β-L-arabinofuranoside), Quercetin, Hyperoside, Quercitrin, Mangiferin, Isomangiferin, Glucomangiferin	Antiviral, cardioprotective, antioxidant, neuroleptic activity	[24-26, 27, 28, 33-35]
	Hedysarum pallidiflorum Pavlov E	In Kazakhstan: on rocky slopes and plumes in the lower belt of the Karatau mountains	Perennial plants up to 25 cm in height, with short, numerous stems; with leaves with 3-7 paired, elliptical leaflets; with loose tassels with drooping flowers, corolla pale pink; beans of 1-3 rounded-semiannular segments	–	–	[27]
	Hedysarum karataviense B.Fedtsch.E, RS	In Kazakhstan: on rocky and rubbly slopes in the middle belt of the Karatau mountains	Perennial plants up to 25 cm tall with short, thickened roots; numerous, short stems; leaves with 4-6 paired, linear-lanceolate leaflets; small-flowered tassels, corolla purplish-purple; beans with 2-4 rounded segments	–	–	[27]

	Hedysarum severzovii Bunge	Central Asia (Tajikistan, Kazakhstan, Kyrgyzstan). In Kazakhstan: on peaks, stony and rubbly slopes of low mountains in Karatau, Talas Alatau	Perennial plants, up to 15 cm tall, with thickened roots, numerous, short stems; leaves with 5-8 paired, lanceolate leaflets; 10-20 flowering racemes, corolla pink-purple in color; beans with 1-3 rounded segments	–	–	[27]
	Hedysarum mindshilkense Bajtenov E, RS	In Kazakhstan: on rocky slopes in Karatau	Perennial plants up to 20 cm tall, blue with dense silky-pressed pubescence; with thickened roots, woody stems; with leaves of 3-5 paired, elliptical leaflets; with 10-20 flowering racemes, corolla pink-purple in color; with beans of 2-3 segments	–	–	[27]
	Hedysarum taschkendicum Popov	Central Asia (Kazakhstan, Kyrgyzstan, Uzbekistan). In Kazakhstan: on stony and rubbly slopes in the foothills, on clay and loess hillsides in the Western Tien Shan	Perennial plants up to 50 cm tall with numerous stems; leaves with 4-7 paired, lanceolate leaflets; multifloral tassels, corolla pink-purple in color; beans with 2-4 rounded, bristle-shaped segments	–	–	[27, 28]
	Hedysarum songaricum Bong.	Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan, Xinjiang. In Kazakhstan: in steppes, on rubbly and fine-grained slopes in the middle and lower belts of mountains in the area of Zaisan, Altai, Tarbagatai, Dzungarian Alatau	Perennial plants up to 60 cm tall with numerous stems; leaves with 5-8 paired, lanceolate leaflets; multifloral racemes, corolla pink-purple in color; beans with 2-5 rounded ovate, spike-lined segments	–	Forage plant	[27]
	Hedysarum dmitrievae Bajtenov E	Kazakhstan, Kyrgyzstan, Uzbekistan. In Kazakhstan: on stony clones in the upper belt of the mountains in the Western Tien Shan	Perennial plants up to 25 cm high with numerous stems; with leaves of 4-6 paired, oblong-elliptical leaflets; with oblong tassels, corolla pink-purple; with beans of 2-3 rounded-elliptical segments	–	Antioxidant activity	[27, 36]
	Hedysarum pskemense Popov ex B.Fedtsch.	Kazakhstan, Kyrgyzstan, Uzbekistan. In Kazakhstan: on stony slopes and stream banks in the middle-mountain belt in the Western Tien Shan	Perennial plants up to 40 cm tall with numerous stems; with leaves of 4-7 paired, ovate leaflets; with multi-branched, pink-purple corollas; with beans of 2-5 rounded, bristly segments	–	–	[27]
	Hedysarum pavlovii BajtenovE	In Kazakhstan: on rocky slopes in the lower belt of the Karatau mountains	Perennial plant up to 30 cm tall with numerous stems; leaves with 3-5 paired, oblong-elliptic leaflets; with multi-branched, pink corolla; beans with 2-1 cross-ribbed, bristle-shaped segments	–	–	[27]
	Hedysarum gmelini Ledeb.	Russia, China, Kazakhstan, Mongolia. In Kazakhstan: on stony outcrops, rubbly and steppe slopes in the spurs of the general syrt, near Tobyl-Ishim, Irtysh, boron near Semei, Aktobe region, near the rivers Yrgyz and Torgai, Akmola region, Ulutau, near Balkhash and Alakol, Altai, Tarbagatai	Perennial plants, up to 50 cm tall, with thickened roots, numerous stems; leaves with 4-11 paired, elliptical leaflets, with multi-branched, pink-purple corollas; beans with 2-6 transverse-rubbed segments with small spinules	Quercetin 3-α-L-rhamnofuranoside, Quercetin 3-α-L-arabinofuranoside, Hedysarumine A, Hedysarumine B, Paratocarpin E, 3-hydroxy-9-methoxy pterocarpan, Lupeol, Soyasapogenol, Squasapogenol, 3,9-dihydroxy coumestan, β-sitosterol, Palmitic acid, Hexadecanoic acid, 2,3-dihydroxypropyl ester	Antiproliferative, anti-inflammatory activity. Forage plant	[27, 40]

	Hedysarum razoumowianum Helm & Fisch. ex DC.RS	European part of Russia, Western Siberia, Kazakhstan. In Kazakhstan: on stony and rubbly slopes, chalk outcrops near Tobyl and Ishim, the Caspian Sea, Aktobe region.	Perennial plants up to 45 cm tall with numerous stems; leaves with 4-7 paired, oblong-lanceolate leaflets; 8-20 flowering racemes, corolla pink-purple in color; beans with 2-5 round-elliptical segments with small spinules	–	–	[27]
	Hedysarum ferganense Korsh.	Altai, Kazakhstan, Kyrgyzstan, Mongolia, Tuva, Xinjiang. In Kazakhstan: on stony and rugged slopes in the lower belt of mountains in Altai, Tarbagatai, Dzungarian Alatau, Trans-Ili Alatau, Kyrgyz Alatau, Western Tian Shan.	Perennial stemless plants up to 30 cm tall, with twisted leaves of 3-7 paired, elliptical leaflets; with multi-flowered tassels, corolla purplish-purple; with beans of 1-3 rounded, hairy segments	Ononin, Formononetin, Formononetin-7-O-β-D-glucoside-6'-O-malonate, (-)-medicarpine, 4-hydroxy-lonchocarpine, Canzonol C, Paratocarpine C, Paratocarpine A	Forage plant	[27]
	Hedysarum bectauatavicum Bajtenov E, RS	In Kazakhstan: on granite outcrops in the eastern shallow depression (Bektau-ata mountains)	Perennial stemless plants, up to 20 cm tall, with leaves on long petioles of 4-5 paired, rounded leaflets; with oblong tassels, corolla violet in color; with beans of 2-3 naked segments with transverse veins	–	–	[27]
	Hedysarum minjanense Rech.f.	Afghanistan, Kazakhstan, Kyrgyzstan, Pakistan, Tajikistan, Western Himalayas, Xinjiang. In Kazakhstan: on stony slopes in the middle and upper belts of mountains in the Western Tien Shan	Perennial plants, up to 30 cm tall, with nearly undeveloped stems; with leaves of 4-7 paired, elliptical leaflets; with multi-flowered tassels, corolla purple; with beans of rounded quadrangular and slightly transversely ribbed segments	–	–	[27]
	Hedysarum krylovii Sumnev.E	Kazakhstan, Mongolia, Xinjiang. In Kazakhstan: on rubbly slopes in the lower belts of mountains in Dzungarian Alatau, Trans-Ili and Kungei Alatau	Perennial stemless plants, up to 30 cm tall, with leaves of 3-7 paired, lanceolate leaflets; with multifloral tassels, purple corolla; with beans of 2-3 rounded segments with small tubercles	–	–	[27]
	Hedysarum grandiflorum Pall.	Bulgaria, Russia, Greece, Kazakhstan, Romania, Ukraine. In Kazakhstan: in steppes in spurs of Common Syrt, Tobyl-Ishim area, Pre-Caspian region, Aktobe region	Perennial stemless plants, up to 40 cm tall, with leaves on long petioles of 1-4 paired, ovate, large leaves; with multi-flowered tassels, yellow corolla; with beans of 2-5 rounded, densely hairy segments with spikes along the edges	Mangiferin	Antibacterial activity	[27, 41]
	Hedysarum splendens Fisch. ex DC.	Kazakhstan, Mongolia, Xinjiang. In Kazakhstan: on stony slopes, precipices and steppe meadows near Zaisan and Altai	Perennial plants, up to 20 cm tall, with strongly shortened stems; leaves with long petioles of 2-4 paired, roundish-ovate, silky-pressed, hairy leaves; with oblong tassels, pale yellow corolla; with beans of 2-4 roundish, thickly hairy segments with tubercles at margins	–	–	[27]
	Hedysarum jaxarticum Popov	Kazakhstan, Uzbekistan. In Kazakhstan: on rubbly and clay slopes of low mountains and steppe hills in the Western Tien Shan	Perennial stemless plants, up to 15 (30) cm tall, leaves on long petioles with 3-5 paired, rounded, silvery hairy leaves; with oblong tassels, corolla pale pink with an admixture of yellow; with beans of 1-3 transversely ribbed segments margined with longer spines	–	–	[27]

	Hedysarum acutifolium Bajtenov E	Kazakhstan, Kyrgyzstan. In Kazakhstan: on stony mid-mountain slopes in the Western Tien Shan	Perennial plants, up to 15 cm tall, with shortened stems; long, petiolate leaves with 3-5 paired, ovate-lanceolate, appressed, hairy leaflets; multifloral tassels, corolla pink-purple; with beans of 2-3 short, pointed segments	–	–	[27]
	Hedysarum iliense B.Fedtsch. ex Popov	Kazakhstan, Mongolia, Xinjiang. In Kazakhstan: on rubbly-melkozem slopes in the foothills and on clay and chalk hills near Balkhash and Alakol, Dzungarian Alatau (Altyn-Emel, Malay-Sary), Chu-Ili mountains.	Perennial plants, up to 15 cm tall, with short, densely hairy stems; leaves with long petioles of 1-4 paired, ovate-lanceolate, silvery-silky leaflets; multifloral tassels, corolla purplish-purple; with beans of 2-4 rounded-elliptical segments with small tubercles	–	–	[27]
	Hedysarum chantavicum Popov ex Bajtenov E	In Kazakhstan: on granite outcrops, stony and rubbly plumes in the Chu-Ili mountains	Perennial stemless plants up to 15 cm tall, leaves with 2-4 paired, ovate, silvery hairy leaves; with multifloral tassels, corolla pink-purple in color; with beans of 1-3 short lowered segments	–	–	[27]
	Hedysarum plumosum Boiss. & Hausskn.	Iran, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan. In Kazakhstan: on rubbly slopes in low mountains in Karatau and Western Tien Shan	Perennial plants up to 12 cm tall, with thickened, long roots; numerous, shortened stems; with bunched leaves of one or 1-2 pairs of lateral silvery hairy leaves; with multi-flowered tassels, corollas bright purplish-purple; with beans of 2-3 rounded, hairy segments	–	–	[27]
	Hedysarum kasteki BajtenovE	In Kazakhstan: on the rubbly slopes of the foothills in the Trans-Ili Alatau	Perennial stemless plants, up to 20 cm tall, with long petiolate leaves of 1-2 paired, rounded ovate leaflets; with ovate tassels, corolla pink-purple in color; with beans of 1-3 short rounded elliptical segments	–	–	[27]
E - endemic; RS - rare species						

Conclusions

Thus, as a result of the analysis of literature data the distribution area, botanical characteristics, phytochemical composition and application of Kazakh plant species of the genus Hedysarum L. were established. Unification of their nomenclature with international floristic bases was carried out: by abolition of reclassified species, synonyms and obsolete names, the list of sweetvetches growing in Kazakhstan was optimized from 38 to 28 scientific names. Taxonomic marker compounds for these species – isoflavonoids (ononin, formonononetin, formononononetin-7-O-β-D-glucoside-6'-O-malonate) and pterocarpane (medicarpine). Well-studied species are – H. alpinum, H. flavescens, H. neglectum and H. gmelinii, whose biologically active substances possess antiviral, immunomodulatory, cardioprotective, antioxidant, geroprotective, antiproliferative and antimicrobial action. However, most of the Kazakh species of the genus remain poorly studied. In this regard, the species Hedysarum semenowii Regel & Herder, as the closest and not inferior in its valuable properties to the pharmacopoeial species Hedysarum polybotrys Hand.-Mazz is of greater scientific and practical interest.

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Сведения об авторах:
Keleke Anel Satzhankyzy, Master of Technical Sciences, PhD doctoral student, Asfendiyarov Kazakh National Medical University, Almaty, Kazakhstan, e-mail: kelekeanel@gmail.com, https://orcid.org/0000-0001-5502-6142.
Ibragimova Liliya Nikolaevna, Candidate of Pharmaceutical Sciences, Professor, Department of Engineering Disciplines and Proper Practices, Asfendiyarov Kazakh National Medical University, Almaty, Kazakhstan, e-mail: pln_19@mail.ru, https://orcid.org/0000-0002-8381-5330.
Zhumashova Gulsim Tokanovna, PhD, Head of the Department of Pharmaceutical and Toxicological Chemistry, Pharmacognosy and Botany, Asfendiyarov Kazakh National Medical University, Almaty, Kazakhstan, e-mail: zhumashova.g@kaznmu.kz, https://orcid.org/0000-0002-5997-0584.
Sabitova Aisulu Gabitkyzy, master's student, Asfendiyarov Kazakh National Medical University, Almaty, Kazakhstan, e-mail: aisulusabitova69@gmail.com, https://orcid.org/0000-0001-8652-9631.
Sultanova Eldana Shakirkyzy, undergraduate student, Asfendiyarov Kazakh National Medical University, Almaty, Kazakhstan, e-mail: eldanka.s@icloud.com, https://orcid.org/0000-0002-2534-2539.
Sakipova Zuriyadda Bektemirovna, Doctor of Pharmacy, Professor, Dean of the School of Pharmacy, Asfendiyarov Kazakh National Medical University, Almaty, Kazakhstan, e-mail: sakipova.z@kaznmu.kz, https://orcid.org/0000-0003-1400-1971.
Keleke Anel Satzhankyzy, Asfendiyarov Kazakh National Medical University, Almaty, Kazakhstan, e-mail: kelekeanel@gmail.com, tel. +7 707 840 74 90.