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The study of the main phenological phases and the compilation of the calendar for the collection of medicinal plants of the Bukhar-Zhyrau district of the Karaganda region

The results of phenological investigation of 39 species of medicinal plants of Bukhar-Zhirau district of Karaganda region mountains are presented. According to botanical-geographical zoning classification, the vegetation of Bukhar-Zhirau district of Karaganda region mountains belongs to Kopalisky area of Central Kazakhstan sub province. Establishment phase collection of raw material medicines plants over several years allowed by experiment to establish the optimal time for the collection of raw materials of medicinal plants Bukhar-Zhirau district of Karaganda region mountains allowing for the local climate. It was revealed that for the preparation of 6 species of medicinal plants (patrinia medium, medicinal herb, iris leathery, Dzungarian ferula and others), underground organs are prepared on the territory of Bukhar-Zhyrau district of the Karaganda region. For 1 species, the dogrose is loose, fruit is collected. For 23 species, such as donut whiteness, donutic dipstick, serpuhus, venous pumpkin, saussurea salsa, ziziphora peach and other, the production of grass is produced. For other species harvest leaves, shoots and flower baskets are harvested. Phenological spectra for 33 species of medicinal plants of Bukhar-Zhyrau district were compiled on the basis of which a calendar was compiled and the frequency of collection of plant raw materials during the growing season was determined. The basic rules for organizing the preparation and drying of medicinal plant raw materials are determined. The data by phenological spectra let us to create the schedule and periods of the gathering of the raw material. The results of the work are the base for the organization of plan exploitation of the natural populations.

Keywords: population, vegetation, raw materials, phenology, stocks, flower, fruits, root, rhizome, grass.

The most important aspect in the study of wild medicinal plants and the evaluation of their raw materials is the optimization of the timing of harvesting.

Thus, in the pharmacopeia and in separate pharmacopoeial articles [1–11], the phases of collecting raw materials are determined on the basis of studying the dynamics of the accumulation of biologically active compounds. For different types of plants, raw materials, different terms have been determined, and even the time of harvesting [12]. For example, the collection of grass is carried out from the phase of growing to fruiting, the flowers to the phase of mass flowering, the fruits to the phase of ripening of fruits and seeds, the roots to the phase of growth or death of the above-ground organs, etc.

However, the specific dates for the collection of raw medicinal plants should be determined at the regional (and even district) level, as the climatic conditions vary greatly in the territory of Kazakhstan. The dates of the onset of individual phenological phases by regions and regions of the republic can vary from 1 to 2 months. The length of the growing season varies. So, in the South Kazakhstan the vegetation period lasts from the end of February to the middle of November, in South-Eastern and Western Kazakhstan — from April to the end of October, in Central Kazakhstan — from mid-April to early October, in North and East Kazakhstan — from early May to 1 half of September.

The correct definition of the timing of the collection of any plant species plays an important role in maximizing the accumulation and preservation of valuable components contained therein.

During the observation period 2014–2017 we conducted observations of the phases of development of medicinal plants in the Bukhar-Zhyrau district of the Karaganda region (included in the 3rd and 4th categories), on the basis of which phenological spectra of individual plant species were compiled (Table 1).

The data obtained show that the studied plants differ in the rhythms of growth and development. Through the flowering cycle, all species can be divided into spring, early summer, mid-summer and later-summer.

Spring plants begin to grow from the moment of the snow cover, they bloom in May, fruiting — in June – early July. To this group of plants we include the following: *Descurainia sophia*, *Íris scariósa*, *Spiraea hypericifolia* L., *Patrinia intermedia*.

Table 1

**The dates of the onset of the main phenological phases of the development of medicinal plants
in the Bukhar-Zhyrau district of the Karaganda region**

Species	Phenological phases (decades and months)						
	Beginning of vegetation	Mass budding	Beginning of flowering	Mass flowering	Mass fruiting	Mass fruiting	Dying off
<i>Ferula soongarica</i> Pall.	3 IV	1–3 V	1 VI	2–3 VI	2 VII	2–3 VII	1–2 IX
<i>Seseli buchtormense</i>	3 IV	1–2 VI	3 VI	1–2 VII	1 VIII	2–3 VIII	2 IX
<i>Achillaea setacea</i>	2 IV	1–2 VI	3 VI	1–3 VII	1–2 VIII	3 VIII	3 IX
<i>Achillaea millefolium</i>	2 IV	1–2 VI	3 VI	1–3 VII	1–2 VIII	3 VIII	3 IX
<i>Achillaea nobilis</i>	2 IV	1–2 VI	3 VI	1–3 VII	1–2 VIII	3 VIII	3 IX
<i>Artemisia dracunculus</i>	2–3 IV	2–3 VII	2 VIII	3 VIII	1 IX	3 IX	1 X
<i>Artemisia nitrosa</i>	2 IV	2–3 VIII	3 VIII	1 IX	2 IX	1–2 X	3 X
<i>Artemisia scoparia</i>	2 IV	2–3 VIII	3 VIII	1 IX	2 IX	1–2 X	3 X
<i>Artemisia austriaca</i>	1–2 IV	2–3 VI	1 VII	2 VII	2 VIII	3 VIII	1 X
<i>Artemisia frigida</i> Wild.	1–2 IV	2–3 VI	1 VII	2 VII	2 VIII	3 VIII	1 X
<i>Helichrysum arenarium</i>	2 IV	1 VI	2 VI	3 VI-1 VII	2 VII	1–2 VIII	2–3 IX
<i>Jurinea multiflora</i>	1–3 IV	2 VI	1 VII	2–3 VII	1 VIII	3 VIII	2–3 IX
<i>Saussurea amara</i>	1–3 IV	2 VI	1 VII	2–3 VII	1 VIII	3 VIII	2–3 IX
<i>Tanacetum vulgare</i>	2 IX	2 VI	1 VII	2–3 VII	1 VIII	3 VIII	1 X
<i>Descurainia sophia</i>	1 IV	3 V	3 V	1 VI	2 VI	2 VI	1–2 VII
<i>Salsolacollina</i> Pall	3 IV-1 V	2–3 VIII	3 VIII	1 IX	2 IX	3 IX	3 IX
<i>Hypericum perforatum</i>	1–2 IV	2 VI	2–3 VI	1 VII	3 VII	2–3 VIII	3 IX
<i>Iris scariosa</i>	1 IV	3 IV-1 V	1 V	2–3 V	1 VI	2–3 VI	1 X
<i>Hyssopus ambiguus</i>	2 IV	2–3 VI	1 VII	2–3 VII	1 VII	3 VIII	1 X
<i>Salvia stepposa</i> Schost	2 IV	2–3 VI	1 VII	2–3 VII	1 VII	3 VIII	1 X
<i>Thymus marschallianus</i>	1–2 IV	3 V-1 VI	1–2 VI	3 VI	2 VII	1 VIII	2–3 IX
<i>Limonium gmelinii</i>	2 IV	2–3 VI	2 VII	1 VIII	3 VIII	2 IX	1 X
<i>Rosa laxa</i>	1–2 IV	1 V	2–3 V	1 VI	3 VI	2–3 VIII	1 X
<i>Sanguisorba officinalis</i>	2–3 IV	2 VI	2 VII	3 VII	1 VIII	2–3 VIII	3 IX
<i>Urtica dioica</i>	3 IV	2 VI	1 VII	3 VII	1 VIII	3 VIII	3 IX
<i>Chartolepis intermedia</i>	2 IV	1 VI	3 VI	2 VII	1 VIII	3 VIII	1 X
<i>Saussurea salsa</i>	2–3 IV	2 VI	1 VII	3 VII	2 VIII	3 VIII	1 X
<i>Serratula coronata</i>	2 IV	1 VI	3 VI	2 VII	2 VIII	3 VIII	3 IX
<i>Melilotus albus</i>	3 IV	1 VI	2–3 VI	2 VII	1 VIII	1 IX	3 IX
<i>Melilotus officinalis</i>	3 IV	1 VI	2–3 VI	2 VII	1 VIII	1 IX	3 IX
<i>Ziziphora clinopodioides</i>	2–3 IV	3 V	2 VI	3 VI-2 VII	3 VII	3 VIII	1 X
<i>Spiraea hypericifolia</i> L.	2 IV	2 V	2 V	3 V	1 VI	3 VI	3 IX
<i>Patrinia intermedia</i>	2–3 IV	1–2 V	3 V	1 VI	2 VI	1 VIII	2 IX

Plants of the early summer flowering cycle begin budding in May, the main flowering is in June, in July seeds begin to be tied. They include *Helichrysum arenarium*, species *Achillaea*, *Chartolepis intermedia* and others.

Middle-summer plants differ in that the period of mass flowering is in July — early August, fruiting — in July — August. Among them are the *Melilotus officinalis*, *Melilotus albus*, *Serratula coronata* L., *Urtica dioica*, *Ziziphora clinopodioides*, *Sanguisorba officinalis* and others.

To the plants of the autumn flowering cycle, the species are bloomed, which bloom at the end of August–September; these are *Salsolacollina* Pall., *Artemisia dracunculus*, *Artemisia nitrosa*, *Artemisia scoparia*.

According to the results of the analysis of phenological indices and analysis, which plant organs and in what phase are harvested, the frequency of collection in each time interval of the growing season was determined and it was determined which parts of the plants should be collected (Table 2).

Periodicity of collection of medicinal plants of Bukhar-Zhyrau district of Karaganda region during the vegetation period

Species	Procured organ	Vegetation phase	Timing of collection
<i>Ferula soongarica</i>	Roots and rhizomes	Beginning of vegetation, death of aerial organs	3 decades of April, 1–2 decades of September
	Grass	The beginning of flowering	1 decade of June
<i>Seseli buchtormense</i>	Grass	The beginning of flowering	3 decades of June
	Roots and rhizomes	End of vegetation	1 decade of September
<i>Achillaea setacea</i>	Grass	Bloom	3 decades of June — beginning of July
<i>Achillaea millefolium</i>	Grass	Bloom	3 decades of June — beginning of July
<i>Achillaea nobilis</i>	Grass	Bloom	3 decades of June — beginning of July
<i>Artemisia dracunculus</i>	Young shoots with leaves	Beginning of budding	3 decades of June
<i>Artemisia nitrosa</i>	Grass	The beginning of flowering	2–3 decades of August
<i>Artemisia scoparia</i>	Grass	The beginning of flowering	2–3 decades of August
<i>Artemisia austriaca</i>	Grass	The beginning of flowering	2–3 decades of July
<i>Artemisia frigida</i> Wild.	Grass	The beginning of flowering	2–3 decades of July
<i>Helichrysum arenarium</i>	Flowering baskets	Butonization — The beginning of flowering	Mid-July
<i>Jurinea multiflora</i>	Grass	Butonization — The beginning of flowering	2nd decade of June
<i>Saussurea amara</i>	Grass	The beginning of flowering	1 decade of August
<i>Tanacetum vulgare</i>	Flowering shoots with baskets	The beginning of flowering	1 decade of July
<i>Descurainia sophia</i>	Grass	Butonization — flowering	1 decade of June
<i>Salsolacollina</i> Pall	Grass	Fruiting	1–2 decades of September
<i>Hypericum perforatum</i>	Grass	Bloom	2nd decade of June
<i>Iris scariosa</i>	Roots and rhizomes	End of vegetation	2 decades of September
<i>Hyssopus ambiguus</i>	Grass	Bloom	2–3 decades of July
<i>Salvia stepposa</i> Schost	Grass	Bloom	2–3 decades of July
<i>Thymus marschallianus</i>	Grass	Bloom	1–2 decade of June
<i>Limonium gmelinii</i>	Roots and rhizomes	End of vegetation	2 decades of September
<i>Rosa laxa</i>	Fruits	Mass maturation	3 decades of August
<i>Sanguisorba officinalis</i>	Roots and rhizomes	End of vegetation	1–2 decades of September
<i>Urtica dioica</i>	Leaves	The beginning of Butonization	2nd decade of June
<i>Chartolepis intermedia</i>	Grass	Butonization — flowering	Mid-July
<i>Saussurea salsa</i>	Grass	Butonization — flowering	1 decade of August
<i>Serratula coronata</i>	Grass	Butonization — flowering	Mid-July
<i>Melilotus albus</i>	Grass	Butonization — flowering	Mid-July
<i>Melilotus officinalis</i>	Grass	Butonization — flowering	Mid-July
<i>Ziziphora clinopodioides</i>	Grass	Butonization — flowering	2–3 decades of June — 1decades of July
<i>Spiraea hypericifolia</i> L	Sprigs	Bloom	3 decades of May
<i>Patrinia intermedia</i>	Roots and rhizomes	End of vegetation	1–2 decades of September

Thus, for 6 species of medicinal plants (*Patrinia intermedia*, *Sanguisorba officinalis*, *Iris scariosa*, *Ferula soongarica* and others) harvesting of underground organs. Fruit is collected for *Rosa laxa*. For 23 species, such as *Melilotus albus*, *Melilotus officinalis*, *Serratula coronata*, *Saussurea salsa*, *Ziziphora clinopodioides* and others harvesting of grass. Leaves, shoots and flower baskets are prepared for other species. As a set of data, we compiled a calendar of harvesting medicinal plants during the vegetation period (Table 3).

Calendar of collection of various species of raw materials of medicinal plants in the Osakarovskiy district of the Karaganda region

Timing of procurement	Months	Decades	Number of harvested species, pcs.
Early Spring	April	III	1
Later Spring	May	III	1
Early Summer	June	I	3
		II	5
		III	7
Mid-summer	July	I	4
		II	9
		III	5
Later Summer	August	I	1
		II	2
		III	3
Autumn	September	I	5
		II	5

From the data obtained it is clear that in April it is possible to collect 1 name of medicinal raw materials, in May — 1 name, in June — 12 names, in July — 15 names, in August — 5 names, in September — 5 names.

Thus, phenological spectra for 33 species of medicinal plants of the Bukhar-Zhyrau region were compiled, on the basis of which a calendar was compiled and was determined the frequency of collection of plant raw materials during the vegetation period. The main rules for the organization of harvesting and drying medicinal plant raw materials.

The above-ground parts of plants — leaves, grass, flowers and inflorescences — must be collected in dry weather, after drying of the morning dew, it is easy to lay them in piles and, after 1–2 hours of collection, [13]. Dustily polluted or polluted plants should not be collected. Grass is usually harvested during flowering.

It is cut at the base, at the level of the lower leaves, in order to avoid getting thick coarse leaves. Should not to pull out plants with a root. Some plants (*Hyssopus*, *Artemisia*, *Hypericum*) cut the upper flowering parts of plants 10–20 cm long or side shoots.

The leaves are harvested in the period of their full development, more often during the flowering period. For biennial plants — before the flowering period, for example, in the phase of rosettes of leaves. Tear off the leaves with or without the petiole. The collection is subject only to well-developed lower or middle green leaves. Eaten by insects, afflicted with fungal diseases, yellowed and faded leaves are not suitable for collecting raw materials. Flowers and inflorescences are recommended to be collected during the flowering period, after which they can withstand drying well without losing their commercial qualities. Tear off the flowers by hand with minimal remains of pedicels.

Fruits are removed only in dry weather, as rules, during their full maturation. Peduncles are removed, damaged fruit is not collected.

Roots and rhizomes are excavated mainly during the resting period of plants, that is, either in the early spring before the onset of regrowth, or in the fall — after the death of the aerial organs. The roots and rhizomes collected in autumn are usually larger and richer with active substances. Excavated underground organs shake off the ground, thick parts are cut into 2–4 parts, washed in cold running water.

Freshly picked vegetable raw materials contain a significant amount of moisture: roots — up to 45 %, overground organs — up to 85 %. Therefore, after collecting the raw materials must be quickly and correctly dried. Otherwise, under the influence of enzymes present in plants, and the temperature resulting from self-heating, raw materials quickly deteriorate, losing marketable appearance and valuable biological components. Drying in most cases is carried out at temperatures up to 30 °C, although sometimes a higher temperature (fruits of *Rósa* and *Crataégus*).

To preserve the natural color of the aerial organs, drying is carried out in dry, sheltered from the sun, as the sun's rays destroy chlorophyll, leading to yellowing or discoloration. In addition, some biological substances (terpenoids) can be destroyed by direct sunlight. Roots, bark, seeds and berries can be dried in the light.

For drying it is recommended to arrange well-ventilated rooms with an iron roof, equipped with special racks with stretched cloths and (or) metal grids.

Raw materials should be laid out in a thin layer, not more than 1–2 cm, and, as they dry up, turn over. For raw materials to be harvested in the autumn period, drying rooms must be equipped with a heating system, an extractor, and also special dryers.

In addition to these general rules, for each type of medicinal plant and its individual organs, special rules for collection and drying are established in accordance with the biologically active compounds accumulated in them. So, the collection of poisonous plants is carried out in the early morning hours until 11.00 am. After their collection, the hands are thoroughly washed. It is better to assemble etheric oil plants in the morning.

Drying and storage is carried out in the form of a single raw material in order to preserve as many essential oils as possible, grinding is carried out immediately before processing.

Roots and rhizomes containing phenolic compounds, alkaloids are first collected in piles, wilted, and then dried at elevated temperature. The oil-oil raw material is also first recommended to wither for 1–2 hours to seal the oil-oil containers and avoid the loss of oils, and then lay out a thin layer for final drying.

Flowers and inflorescences are dried, scattering them with a very thin layer, so as not to mix and avoid scattering flowers. Herbs are often dried as hay, laying a layer on a strong draft or hanging under a roof in bundles. Small leaves (*Arctostáphylos*, *Vaccínium vítis-idaéa*, *Vaccínium myrtillus*, *Fragária*) are laid out in a thin layer, and large (*Tussilágo*, *Ribes*, *Plantágo*) — one by one.

Drying is considered complete, if the leaves and flowers are easily triturated in their hands, the stems break with a characteristic crackle; roots break, but do not bend, berries crumble without lumps and do not make your hands dirty.

Before packing, the raw material is ground and sorted; its pharmacopeial indices are determined. Medicinal plants should have certain sizes, color, smell, taste, contain a certain amount of moisture, ashes of general, inorganic impurities and impurities of other plants, browned and yellowed parts.

The obtained data can be used for organization of systematic harvesting of plant raw materials and development of environmental measures.

Based on the results of the work carried out, we made the following conclusions:

1. On the territory of Bukhar-Zhyrau district of the Karaganda region it was revealed that for 6 species of medicinal plants (*Patrinia intermedia*, *Sanguisórba officinális*, *Iris scariósa*, *Ferula soongarica* and others), the harvesting of underground organs. Fruit is collected for *Rósa laxa*. For 23 species, such as *Melilótus álbus*, *Melilótus officinális*, *Serratula coronata*, *Saussurea salsa*, *Ziziphora clinopodioides* and others harvesting of grass. Leaves, shoots and flower baskets are prepared for other species.

2. Phenological spectra for 33 species of medicinal plants of the Bukhar-Zhyrau region were compiled, on the basis of which a calendar was compiled and was determined the frequency of collection of plant raw materials during the vegetation period.

3. The main rules for the organization of harvesting and drying medicinal plant raw materials.

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Қарағанды облысы Бұқаржырау ауданының дәрілік өсімдіктерінің негізгі фенологиялық фазаларын зерттеу және олардың жинау күнтізбесін құру

Мақалада Қарағанды облысы Бұқаржырау ауданының 39 дәрілік өсімдіктеріне жүргізілген фенологиялық бақылауларының нәтижелері берілген. Қарағанды облысы Бұқаржырау ауданының өсімдіктері ботаника-географиялық аудандастыру бойынша Орталық Қазақстан аймағының тарамдарының Қопал округіне жатады. Бірнеше жыл бойы дәрілік өсімдіктердің шикізатын жинаудың фазаларын белгілеу жергілікті климаттың ерекшеліктерін ескере отырып, Қарағанды облысы Бұқаржырау ауданының дәрілік өсімдіктері үшін шикізат жинаудың оңтайлы мерзімін эксперименталды жолмен анықтауға мүмкіндік береді. Қарағанды облысы Бұқаржырау ауданының аумағында дәрілік өсімдіктердің 6 түрі (орта тасшөп, дәрілік шелна, ирис былғары, жоңғар феруласы және басқалары) жерасты мүшелерін дайындау үшін жиналды. 1 түрі үшін борпылдақ жеміс жиналды. 23 түрі үшін тәтті ақ түйежоңышқа, дәрілік түйежоңышқа, тәжі, сор сораң, иісті көк марал және басқа да шөптер жиналды. Басқа түрлер үшін жапырақтары, өркендері және гүл себеттері дайындалды. Бұқаржырау ауданындағы 33 дәрілік өсімдіктің фенологиялық спектрлері құрылды, олардың негізінде күнтізбе жасалды және өсімдік шикізатын өсіру кезеңінде жинау жиілігі белгіленді. Дәрілік өсімдік шикізатын дайындау және кептіруді ұйымдастырудың негізгі ережелері анықталды. Фенологиялық спектр бойынша берілгендер өсімдік қорын жинау күнтізбесін және дайындау мерзімін құруға мүмкіндік берді. Жұмыс нәтижелері табиғи популяцияның жоспарлы эксплуатациясын ұйымдастыру үшін негіз болып табылады.

Кілт сөздер: популяция, өсімдіктер, шикізат, фенология, қорлар, гүл, жеміс, тамыр, тамырсабақ, шөп.

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Изучение основных фенологических фаз и составление календаря сбора лекарственных растений Бухар-Жырауского района Карагандинской области

В статье приведены результаты фенологических наблюдений за 39 лекарственными растениями Бухар-Жырауского района Карагандинской области. Растительность Бухар-Жырауского района Карагандинской области по ботанико-географическому районированию отнесена к Копальскому округу Центрально-Казахстанской подпровинции. Установление фаз сбора сырья лекарственных растений в течение нескольких лет позволило экспериментальным путем определить оптимальные сроки сбора сырья для лекарственных и эфирно-масличных растений Бухар-Жырауского района Карагандинской области с учетом особенностей местного климата. На территории Бухар-Жырауского района выявлено, что для 6 видов лекарственных растений (патриния средняя, кровохлебка лекарственная, ирис кожистый, ферула джунгарская и др.) производится заготовка подземных органов. Для 1 вида, шиповник рыхлый, собираются плоды. Для 23 видов, таких как донник белый, донник лекарственный, серпуха венцосная, сосюрея солончаковая, зизифора пахучковидная и др., производится заготовка травы. Для остальных видов заготавливаются листья, побеги и цветочные корзинки. Составлены фенологические спектры для 33 видов лекарственных растений Бухар-Жырауского района, на основании которых подготовлен календарь сбора и определена периодичность сбора растительного сырья в течение вегетационного периода. Определены основные правила при организации заготовки и сушки лекарственного растительного сырья. Результаты работы являются основой для организации планомерной эксплуатации природных популяций.

Ключевые слова: популяция, растительность, сырье, фенология, запасы, цветок, плоды, корень, корневище, трава.

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