

Assessment of raw material reserves of promising medicinal plants in the territory of Western Altai in Eastern Kazakhstan

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Abstract. The results of resource studies of economically valuable species of medicinal plants of the Western Altai (East Kazakhstan region) growing on the territory of 7 forestry municipal state institutions (FMSI) are presented: Zyryanovsk, Ridder, Pikhtovskoye, Cheremshanskoye, Malubinskoye, Verkh-Ubinskoye and Ust-Kamenogorsk. Western Altai occupies the right bank of the Irtysh, includes the interfluvium of the Uba, Bukhtarma and Naryn and is represented by a system of mountain ranges in the northern part of the Kazakhstan Altai. The operational reserves and volumes of possible procurement of raw materials of 8 species of medicinal plants were taken into account. For specific thickets of sites or model samples, raw material reserves were recorded. Traditional geobotanical methods were used to describe plant communities involving resource objects. For four species, the presence of commercial thickets with a supply of air-dried raw materials was established. from 300 to 2000 tons: *Veratrum lobelianum*, *Sanguisorba officinalis*, *Filipendula ulmaria*, *Epilobium angustifolium*. For other species, raw material reserves varied from 1 to 65 tons: *Aconitum leucostomum*, *Inula helenium*, *Achillea millefolium*, *Bupleurum multinerve*. The raw material base of the identified species of medicinal plants in the territory East Kazakhstan region is able to meet the needs of the domestic pharmaceutical industry.

1 Introduction

The problem of studying, using and preserving biological resources in modern conditions of a changing world is not only a regional, but also a geopolitical problem [1-3].

According to the literature, 1406 plant species in Kazakhstan have medicinal properties, however, only 230 species are used in official medicine[4-9]. The vast majority of medicinal plants grow in the southern (71%) and eastern (64%) regions of the republic. At the same time, the resources have been studied only in 141 species of medicinal plants in Kazakhstan. On the ridges of the Kazakhstan Altai, 7% of the resource species of medicinal

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plants form reserves of commercial value, including: *Aconitum leucostomum*, *Bergenia crassifolia*, *Epilobium angustifolium*, *Dasiphora fruticosa*, *Glycyrrhiza glycyrrhiza*, *Achillea millefolium*, *Veratrum lobellianum* and etc. [10-11].

The Kazakhstan Altai, which includes the system of ridges of the Western, Southern and Kalbinsky Altai, is distinguished by a unique diversity of flora, vegetation and plant resources. This study is a continuation of many years of population and resource studies of medicinal plants in the Kazakhstan Altai [12-13].

In order to regulate and resolve issues on the sustainable use of valuable medicinal plants, modern studies of natural populations of economically valuable, intensively exploited, as well as rare and endangered species of medicinal plants in the territory of the Kazakhstan Altai are necessary.

The main goal of this study was to assess the resource potential of economically valuable medicinal plants in the Kazakh part of Western Altai.

2 Materials and Methods

Eight economically valuable medicinal plants growing in the territory of the Kazakhstan Altai were selected as research objects: *Sanguisorba officinalis* L., *Epilobium angustifolium* L., *Filipendula ulmaria* (L.) Maxim., *Veratrum lobelianum* Bernh., *Achillea millefolium* L., *Inula helenium* L., *Aconitum leucostomum* Vorosch. and *Bupleurum multinerve* DC.

Research was carried out from 2021 to 2023 in 6 forestry municipal state institutions (FMSI): Ridder, Pikhtovskoye, Cheremshanskoe, Maloulbinskoe, Verkh-Ubinskoe and partly Ust-Kamenogorsk. The study area covered the Western Altai ranges: Ivanovsky, Ulbinsky, Ubinsky, Listvyaga, Lineysky, Koksinsky.

Western Altai occupies the right bank of the Irtysh, includes the interfluvium of the Uba, Bukhtarma and Naryn and is represented by a system of mountain ranges in the northern part of the Kazakhstan Altai. From north to south, in the east the border runs along the Tigiretsky and Koksinsky ridges, the height of which does not exceed 2300 m, and then along the watershed part of Kholzun (2500 m) and Listvyag (2000–2500 m). The border separates this region from the Altai Mountains, located to the east outside Kazakhstan. Parallel to the Koksinsky ridge, along the left bank of the upper reaches of the river. Chernaya Uba, the Lineisky ridge stretches (2200 m). The named ridges form interconnected links of a single mountain chain, stretching from north to south, where they merge with the Katun squirrels of the Altai Mountains, covered with eternal snow and glaciers. The Ubinsky (2067 m), Ivanovsky (2800 m), Ulbinsky (2000 m), Lineisky (2000 m) ridges fan out from the Koksinsky ridges and Kholzun in a southwestern direction, separated by picturesque river valleys.

When carrying out the research, we used a set of generally accepted and currently relevant methods used in classical areas of botanical science: flora, geobotany, resource science, taxonomy of higher plants, phytocenology.

The resource survey of medicinal plants in Kazakhstan Altai was carried out using generally accepted methods (1986). For specific thickets of sites or model samples, raw material reserves were recorded. Traditional geobotanical methods were used to describe plant communities involving resource objects.

3 Results and Discussion

Our resource studies on the ridges of Western Altai (Ivanovsky, Ulbinsky, Ubinsky, Listvyaga, Lineysky, Koksinsky) made it possible to identify and take into account the reserves of raw materials of 8 species of economically valuable medicinal plants from 76

populations, which are distributed in the FMSI: Ust-Kamenogorsk – 7 species in 13 populations; Verkh-Ubinsky – 5 species in 10 populations; Malo-Ubinsk – 5 species in 9 populations; Pikhtovskoye – 6 species in 9 populations; Ridder - 5 species in 19 populations; Cheremshanskoe - 5 species in 16 populations.

The possible workpiece volume (PWV) and the volumes of possible annual production (VPAP) for each FMSI are shown in Table 1 and Figure 1.

Table 1. Total PWV and OVEZ of air-dried raw materials of economically valuable medicinal plants of Western Altai, t.

Name of the plants	Name of FMSI											
	Ust - Kamenogorsk		Verkh-Ubinsky		Malo-Ubinsk		Pikhtovskoye		Ridder		Cheremshanskoe	
	PW V	VPAP	PW V	VPAP	PW V	VP AP	PW V	VPAP	PW V	VP AP	PWV	VPAP
<i>Achillea millefolium</i>	4,1	0,8	–	–	–	–	7,8	1,5	–	–	–	–
<i>Aconitum leucostomum</i>	4,24	0,83	2,18	0,43	9,34	1,86	2,45	0,48	36,78	7,34	9,62	1,91
<i>Bupleurum multinerve</i>	–	–	–	–	–	–	1,9	0,63	–	–	–	–
<i>Epilobium angustifolium</i>	13,1	2,6	5,1	1	4,7	0,9	33,5	6,7	336,6	67,3	1,9	0,3
<i>Filipendula ulmaria</i>		5,6	62,7	12,5	52,9	10,5	22,2	4,4	217,3	43,4	155,1	31
<i>Inula helenium</i>	6,6	0,6	–	–	–	–	–	–	–	–	16,3	1,6
<i>Sanguisorba officinalis</i>	110,8	11	59,6	5,9	95,4	9,5	–	–	191,2	19,1		
<i>Veratrum lobelianum</i>	<u>126</u> <u>5</u> 220, 3	<u>25.2</u> 21,7	<u>24.7</u> 45,1	<u>4.9</u> 4,5	<u>65.4</u> 133, 3	<u>13.0</u> 13,2	<u>135</u> <u>0</u> <u>260</u> <u>8</u>	<u>27.0</u> <u>26.0</u>	<u>781</u> <u>5</u> <u>150</u> <u>3.2</u>	<u>156</u> <u>2</u> <u>150</u> <u>3</u>	<u>7.2</u> 17,1	<u>1.4</u> <u>1.7</u>

Note* – above ground part
 underground
 possible workpiece volume (PWV)
 volumes of possible annual production (VPAP)

It should be noted that the highest indicators of total operational reserves of raw materials were identified for *Veratrum lobelianum*, *Filipendula ulmaria* and *Sanguisorba officinalis*. The lowest level of raw material reserves was noted for *Bupleurum multinerve* (1.9 t), which grows in the subalpine meadows of Western Altai and does not form large thickets due to extreme habitat conditions.

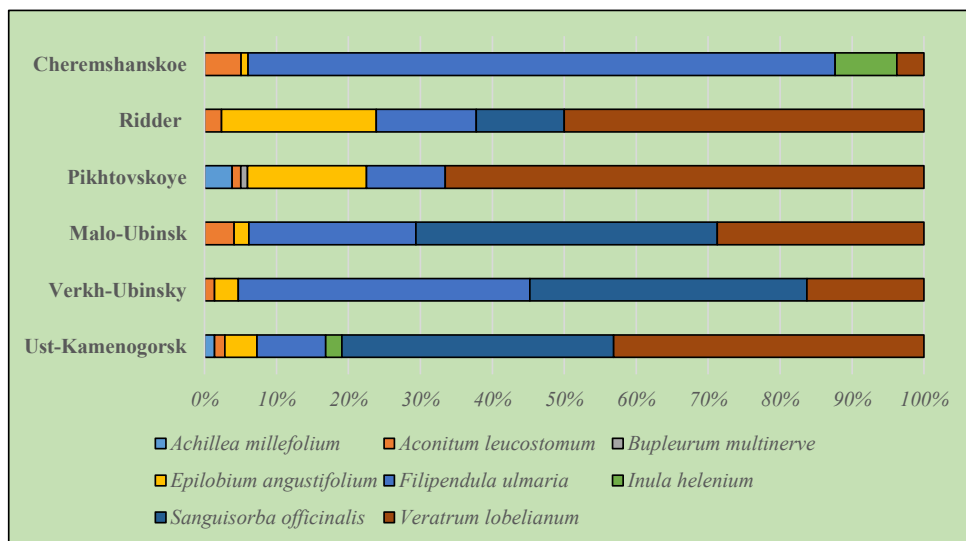


Fig. 1. Distribution of total PWV of medicinal plants in forest protection areas of Western Altai.

Depending on the value of the operational reserve, the obtained data were ranked into 4 categories: VPAP less than 1 ton (I); from 1 to 10 t (II); from 10 to 100 t (III); over 100 tons of raw materials (IV). The results of ranking the studied types of medicinal products by categories of reserves in the context of forest protection areas are given in Table 2. In the surveyed territory, medicinal products with an operational reserve of raw materials of more than 1 ton (categories II–IV) were identified.

Category II with a supply of raw materials from 1 to 10 tons includes the following species: *Achillea millefolium* in FMSI: Ust-Kamenogorsk, Verkh-Ubinsk and Malo-Ubinsk; *Aconitum leucostomum* in FMSI: Ust-Kamenogorsk, Verkh-Ubinsk, Malo-Ubinsk, Pikhtovskoye and Cheremshansk; *Bupleurum multinerve* at FMSI: Pikhtovskoye; *Epilobium angustifolium* in FMSI: Verkh-Ubinsky, Malo-Ubinsk and Cheremshanskoe; *Inula helenium* at Ust-Kakmenogorsk FMSI; *Veratrum lobelianum* at Cheremshanskoe FMSI.

The following species are included in category III with a reserve of 10 to 100 tons: *Achillea millefolium* in Ridder FMSI; *Epilobium angustifolium* at Ust-Kamenogorsk FMSI, Pikhtovskoye FMSI; *Filipendula ulmaria* in FMSI: Ust-Kamenogorsk, Verkh-Ubinsk, Malo-Ubinsk and Pikhtovskoye; *Inula helenium* at Cheremshanskoe FMSI; *Sanguisorba officinalis* in FMSI: Malo-Ubinsk and Verkh-Ubinsky; *Veratrum lobelianum* in FMSI: Verkh-Ubinsky, Malo-Ubinsk and Cheremshanskoe.

Category IV with a reserve of raw materials of over 100 tons includes the following species: *Epilobium angustifolium* at Ridder FMSI; *Filipendula ulmaria* in Ridder and Cheremshanskoe FMSI; *Sanguisorba officinalis* in Ust-Kamenogorsk and Ridder FMSI; *Veratrum lobelianum* in FMSI: Ust-Kamenogorsk, Malo-Ubinsk, Pikhtovskoye and Ridder.

Table 2. Ranking of medicinal plants by categories of electronic health raw materials.

Name of the plants	Category for raw material reserves (t) and name of FMSI		
	II (from 1 to 10 t)	III (from 10 to 100 t)	IV (over 100 t)
<i>Achillea millefolium</i>	Ust-Kamenogorsk (3,0), Pikhtovskoye (7,8)	–	–
<i>Aconitum leucostomum</i>	Ust-Kamenogorsk (4,24), Verkh-Ubinsky (2,18), Malo-Ubinsk (9,34), Cheremshanskoe (9,62), Pikhtovskoye (2,45)	Ridder (33,9)	
<i>Bupleurum multinerve</i>	Pikhtovskoye (1,9)	–	–
<i>Epilobium angustifolium</i>	Verkh-Ubinsky (5,1), Malo-Ubinsk (4,7), Cheremshanskoe (1,9)	Ust-Kamenogorsk (13,1), Pikhtovskoye (33,5)	Ridder (336,6)
<i>Filipendula ulmaria</i>	–	Ust-Kamenogorsk (28,0), Verkh-Ubinsky (62,7), Malo-Ubinsk (52,9), Pikhtovskoye (22,2)	Ridder (217,3) Cheremshanskoe (155,1)
<i>Inula helenium</i>	Ust-Kamenogorsk (6,6)	Cheremshanskoe (16,3)	–
<i>Sanguisorba officinalis</i>	–	Malo-Ubinsk (95,4), Verkh-Ubinsky (59,6)	Ust-Kamenogorsk (110,8), Ridder (191,2)
<i>Veratrum lobelianum</i>	Cheremshanskoe (7,2/-)	Verkh-Ubinsky (24,7/45,1), Malo-Ubinsk (65,4), Cheremshanskoe (/17,1)	Ust-Kamenogorsk (126,5/220,3), Malo-Ubinsk (-/133,3), Pikhtovskoye (135,0/260,8 т), Ridder (781,5/1503,2)
Note* – above ground part underground			

Species of categories II–IV in the specified forest protection institutions are recommended for industrial procurement of medicinal raw materials, taking into account the recommended annual volume of procurement.

Among the surveyed medicinal plants in terms of reserves of air-dried raw materials and volumes of possible annual procurement, the leaders are:

Veratrum lobelianum: PWV – 1140,59 t aboveground and 2180,80 t underground phytomass, VPAP – 228,05 t air-dry above ground and 217,59 t underground phytomass; *Sanguisorba officinalis*: PWV – 568,64 t, VPAP – 56,8 t; *Filipendula ulmaria*: PWV – 38,53 t, VPAP – 107,64 t; *Epilobium angustifolium*: PWV – 395,22 t, VPAP – 79,01 t; *Aconitum leucostomum*: PWV – 64,61 t, VPAP – 12,92 t air-dried raw materials.

The remaining types are characterized by relatively smaller reserves of air-dried raw materials: *Inula helenium*: PWV – 22,96 t, VPAP – 2,29 t; *Achillea millefolium*: PWV – 12,08 t, VPAP – 2,4 t; *Bupleurum multinerve*: PWV – 1,9 t, VPAP – 0,38 t.

4 Conclusion

As a result of field research on the Western Altai ridges of the East Kazakhstan region, the raw material reserves of 8 species of economically valuable medicinal plants in 76 populations were taken into account. The research was carried out on the territory of

forestry municipal state institutions (FMSI): Zyryanovskoye, Ridderskoye, Pikhtovskoye, Cheremshanskoye, Malubinskoye, Verkh-Ubinskoye and Ust-Kamenogorskoye. Based on the results of resource surveys for four species of medicinal plants (*Veratrum lobelianum*, *Sanguisorba officinalis*, *Filipendula ulmaria*, *Epilobium angustifolium*), reserves of air-dried raw materials were estimated from 300 to 2000 tons. For the remaining species (*Aconitum leucostomum*, *Inula helenium*, *Achillea millefolium*, *Bupleurum multinerve*), the operational supply of raw materials varies in the range from 1 to 65 tons. Among the examined medicinal plants, the largest reserves of air-dried raw materials are formed by thickets of *Veratrum lobelianum* (EZ - 1140.59 tons of above-ground parts and 2180.80 tons of underground phytomass). In the surveyed forest protection institutions, thickets of medicinal plants of categories III–IV (with an EZ of 10 tons and above) are suitable for industrial procurement of medicinal raw materials, taking into account the recommended annual volume of procurement. Thickets of medicinal plants of category II (from 1 to 10 t) are suitable for harvesting for the needs of the local pharmacy chain. Thus, it has been established that the raw material base of the identified types of medicinal plants in the East Kazakhstan region is capable of meeting the needs of the domestic pharmaceutical industry.

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