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Ethnopharmacological Research of Plant Resources of Central and Eastern Yakutia

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Abstract. In this study, the authors analyzed the ethnopharmacological use of 55 medicinal plant species (herbalists, healers, and shamans) by the population of Central and Eastern Yakutia. The results indicate that the most commonly used plants belong to the *Asteraceae*, *Rosaceae*, and *Lamiaceae* families. In Eastern Yakutia, the population most widely uses *Dryopteris fragrans*, *Pinus pumila*, *Dracocephalum palmatum*, and *Juniperus sibirica*. The population of Central Yakutia uses the species of *Artemisia* and *Thymus* genera, as well as *Veronica incana* and *Phlojodicarpus sibiricus* species. The most commonly used medicine forms are decoctions, infusions, and tinctures (60%). They are generally made from grass or leaves. The survey indicates that 34.5% of the plants are used as anti-inflammatory or invigorating means. The qualitative analysis shows that 48% of the plants accumulate phenolic compounds.

Keywords: Ethnopharmacology · Plant resources · Medicinal plants · Yakutia · Permafrost · Questionnaire survey · Phytochemical screening · Dietary supplements · Medicinal dosage forms

1. Introduction

The main goal of the pharmaceutical industry is to find medicinal plant raw materials. According to botanists and pharmacologists, traditional medicine is the primary source of information on medicinal plants [3, 9, 11]. Therefore, introducing new conventional medicinal plants to the pharmacology and substituting the already used plants with more widespread ones is one of the top priorities of pharmaceuticals [1, 10]. Taiga covers 75% of Yakutia. Its flora includes more than 1984 species of vascular plants, 230 of which are medicinal [4]. Yakutia's population still uses folk healing methods and techniques, indicating a developed ancient system of traditional medicine.

This study aims to gather information on the medicinal plants used by Yakutia's population, for its subsequent application as pharmaceutical raw materials.

2. Materials and Methods

The authors examined the most widespread medicinal plants that grow in the central (Namsky, Megino-Kangalassky, Amginsky, and Hangalassky districts) and eastern (Oymyakonsky, Tomponsky, and Tattinsky districts) areas of Yakutia. The Republic of Sakha (Yakutia) occupies vast permafrost territories. The climate of the republic is subpolar, with long winters and short summers.

The authors collected data from the population of seven districts in 2018–2019 using surveys, questionnaires, and observation methods. These methods allow for systematizing disconnected data



elements and getting precise results. Ethnobotanical data was then summarized and analyzed using Microsoft Office and descriptive statistical methods. The authors sorted medicinal plants using the indexing method. The total value index for a species was calculated by summing the values assigned by each respondent. The plants were then ranked in descending order according to the index values. The demand index of a species was calculated by dividing the respondents that used actively used the species by the total number of respondents. The resulting data was used to determine the most popular folk medicine [7].

The authors identified the medicinal plants by providing the subjects with the photographs of plants and having them compare the pictures with dried plant materials. In most cases, the subjects provided dried plants themselves. The authors then tested the authenticity of the provided materials. Almost all plant species had the same local names, indicating a uniform folk nomenclature. A total of 30 herbalists, healers, and shamans (27 women and 3 men) aged 45 to 88 years were interviewed. The interview and discussion were based on a 24-point questionnaire in the Yakut language. The interviewees accompanied the authors in their field observations, which were conducted according to morphological features and range of each species.

Plant samples were sent to Makarov Herbarium at Ammosov North-Eastern Federal University for conservation and further research. The authors confirmed the botanical identity of the collected samples. The qualitative analysis of plant materials was conducted according to the State Pharmacopoeia recommendations [8].

3. Results

The authors analyzed respondent data and compiled a list of medicinal plants that included 55 species and 23 families. The most commonly used plant families are *Asteraceae*, *Rosaceae*, and *Lamiaceae* (see table 1).

Table 1. Most frequently used plants by family.

No.	Family	Relative amount, %
1	<i>Asteraceae</i> (Aster family)	16.3
2	<i>Rosaceae</i> (Rose family)	12.7
3	<i>Lamiaceae</i> (Mint family)	9.09
4	<i>Ranunculaceae</i> (Buttercup family)	9.09
5	<i>Ericaceae</i> (Heath family)	7.37
6	<i>Gentianaceae</i>	7.27
7	Miscellaneous	7.26

Source: Compiled by the authors.

Table 2 presents the most used medicinal plants. Earlier, the authors of this study published other works on the chemical composition and pharmacological activity of *Artemisia* sp, *Thymus* sp., *Dracocephalum palmatum*, *Phlojodicarpus sibiricus* [2, 5, 6].

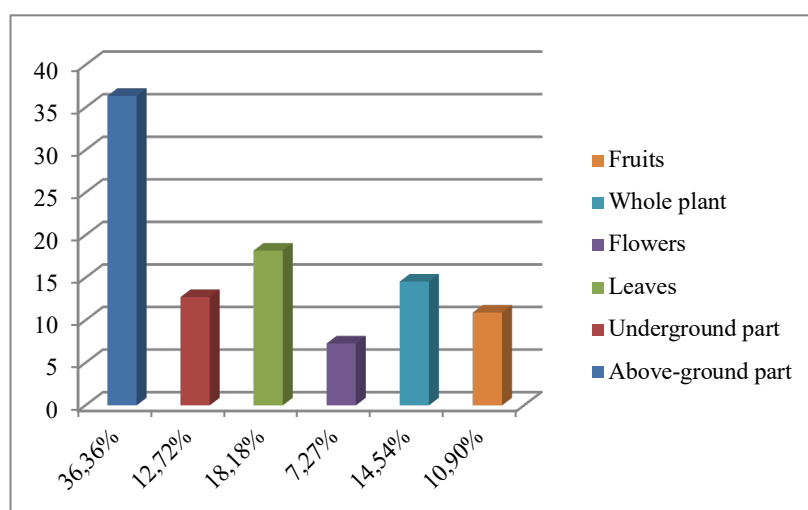
In the eastern regions, the population most commonly uses *Dryopteris fragrans*, *Pinus pumila*, *Dracocephalum palmatum*, and *Juniperus sibirica*. The respondents from the central regions mainly mentioned the species of *Artemisia* and *Thymus* genera, *Veronica incana*, and *Phlojodicarpus sibiricus*.

Most herbalists and healers use only specific parts of the plant (roots, stems, leaves, flowers) or the whole plant (see Figure 1). Tradition and the specifics of nutrient or medicinal substance storage in the plant explain the unequal use of their parts. The most used part is the above-ground section of the plant (36.36%). The leaves are in second place (18.18%). The least commonly used part is the flowers (7.27%).

Table 2. Most commonly used plant species.

No	Latin name	Yakut name	Family
1	<i>Artemisia sp.</i>	Үөрэ ото, кыа уга	<i>Asteraceae</i>
2	<i>Thymus sp.</i>	Боџуруоскай	<i>Lamiaceae</i>
3	<i>Dracocephalum palmatum</i>	Тангара ото	<i>Lamiaceae</i>
4	<i>Veronica incana</i>	Лохуор от	<i>Plantaginaceae</i>
5	<i>Polygonum aviculare</i>	Чыычаах ото	<i>Polygonaceae</i>
6	<i>Gentiana sp.</i>	Чороон от	<i>Gentianaceae</i>
7	<i>Dryopteris fragrans</i>	Хайа баттаџа	<i>Dryopteridaceae</i>
8	<i>Phlojodicarpus sibiricus</i>	Бөрө сиир ото	<i>Umbelliferae</i>
9	<i>Pinus pumila</i>	Болбукта	<i>Pinaceae</i>
10	<i>Juniperus sibirica</i>	Кытыан	<i>Cupressaceae</i>

Source: Compiled by the authors.

**Figure 1.** Plant section and organ use ratio Source: Compiled by the authors.

The survey results revealed nine disease categories, treated by the respondents using medicinal plants (table 3). Medicinal plants are most commonly used as anti-inflammatory or invigorating means. The extreme environment of the Far North may serve as an explanation for this fact.

The population of Eastern Yakutia, instead of *Thymus sp.*, uses the above-ground part of *Dracocephalum palmatum*, which has a stronger effect. According to the ethnopharmacological data, the plant's young shoots and flowers have anti-inflammatory, diuretic, gastrointestinal treatment, and alcoholism treatment uses.

The *Pinus pumila* needle baths are used to treat rheumatism, neuralgic and radicular pain, and wounds and bruises. Young shoot decoctions are used in inhalation therapy against chronic bronchitis and as mucoactive agents. Tinctures made from its buds are used to treat tuberculosis.

Herbalists recommend using decoctions of *Juniperus sibirica* branches and galbuli to lower blood pressure and against common colds. The baths from the branches of this plant help resolve skin diseases and eczema. Some herbalists reported using the galbuli infusions to treat kidney, bladder diseases and as an anti-inflammatory medicine.

Decoctions of *Phlojodicarpus sibiricus* are widely used to treat tuberculosis, thyroid issues, gastrointestinal disorders, cardiovascular diseases, and rheumatism. The pestled leaves of the plant are

applied to suppurating wounds. The roots of the plants are used to treat stomach and esophagus tumors and tooth pain.

The respondents use the grassy parts of *Artemisia* against respiratory, liver, and kidneys diseases. An ointment made from the leaves of this plant and cow fat is considered a universal cure. The above-ground part is added to the fermented dairy products (“сорат,” “быппах,” and “бутугас”) to improve gastrointestinal tract performance. Some herbalists use *Artemisia* for invigoration.

Tea from *Veronica incana* leaves is drunk for its anti-inflammatory and cardiovascular uses. The tinctures of grassy parts of *Veronica incana* are used for common cold prevention, as well as an analgesic and wound healing agent.

The Yakut population has kept the centuries-old recipes of traditional plant medicine. The current species diversity and chemical composition of local plants confirm the effectiveness of herbal medicine dosage forms. Decoctions, infusions, and tinctures are the most common dosage forms – 60.0%. Ointments accounted for only 9.1% of usage, and fresh plants for 20%. Miscellaneous dosage forms (herbal cautery, powders, etc.) amounted to 10.9%.

Table 3. Medicinal plants use by application.

No.	Application	Use ratio, %
1.	Anti-inflammatory use	20.00
2.	Invigorating effect	14.54
3.	Skin diseases, wounds	12.72
4.	Cardiovascular diseases	12.72
5.	Respiratory diseases	10.90
6.	Liver diseases	10.90
7.	Gastrointestinal diseases	7.27
8.	Urinary tract, kidney diseases	5.45
9.	Central nervous system diseases	5.45

Source: Compiled by the authors.

Table 4 Dosage form use ratio.

No.	Dosage form	Species used	Ratio of used species, %
1	Infusions	14	25.5
2	Tinctures	9	16.4
3	Ointments	5	9.1
4	Miscellaneous	6	10.9
5	Decoctions	10	18.1
6	Fresh plants	11	20

Source: Compiled by the authors.

Different abiotic factors affected not only the nature of Yakutia vegetation but the chemical composition of plants. Permafrost plants have a high concentration of bioactive substances, compared to the plants of the milder climates. The authors conducted a qualitative analysis of the plants and found that they mainly accumulate phenolic compounds (48%). The plants from *Rosaceae* and *Lamiaceae* families are the richest in phenolic compounds (see figure 2).

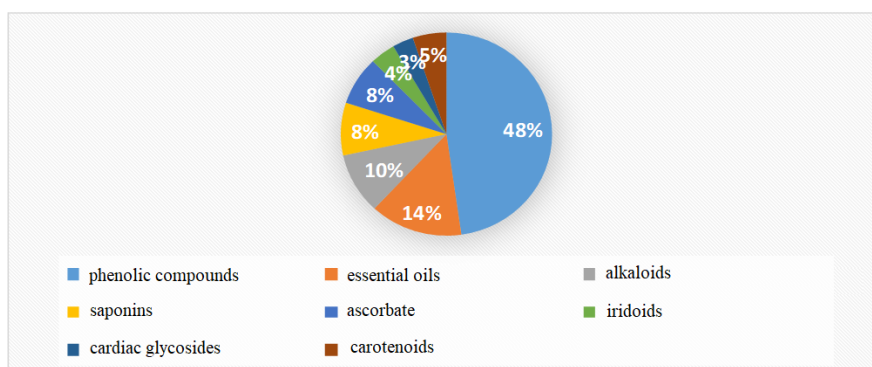


Figure 2. The occurrence of bioactive substances in the examined plants. *Source:* Compiled by the authors.

A high relative concentration of phenolic compounds indicates that they are used in the environment adaptation mechanisms. The qualitative analysis has shown that permafrost plants also contain such bioactive substances as terpenoids, alkaloids, cardiac glycosides, carotenoids, and ascorbate.

4. Discussion

Researching plant resources of such a vast and unexplored region as Yakutia is highly relevant. Yakut traditional medicine is unique and well-preserved, as evidenced by the distinctive methods and recipes of local plant preparation for medical use. The collected information on medicinal plant use in Yakutia, the species examination, the analysis of dosage form usage frequency, and the selection of lucrative plants are essential for pharmaceuticals development. Researching chemical composition of the plants and projecting their pharmacological activity may allow them to enter the official register of pharmaceutical raw plant resources.

5. Conclusion

The authors confirmed the widespread medicinal plant usage by the population of seven districts of Yakutia. The preservation of phytotherapy in the region indicates a developed history of traditional medicine. The republic's remoteness, low population density on the vast territory (3,107 thousand sq. km), the extreme environment, and respect for tradition may account for this preservation. As a result of the survey of herbalists, shamans, phytotherapy healers, and long-term residents, the authors obtained unique herbal medicine methods and techniques. The conducted research has shown that Yakut plants tend to accumulate phenolic compounds. The authors compiled a list of pharmaceutically viable plants: *Үөрө ото, кыа уга* – *Artemisia* sp., *Танара ото* – *Dracocephalum palmatum*, *Боџуруоскай* – *Thymus sibiricus*, *Лохуор от, огонньор ото* – *Veronica incana*, *Чороон от* – *Gentiana* sp., *Хайа баттаџа* – *Dryopteris fragrans*, *Бөрө сиир ото* – *Phlojodicarpus sibiricus*, *Болбукта* – *Pinus pumila*, *Кытыан* – *Juniperus sibirica*.

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