Stocks of raw materials of wild medicinal plants in the Western Baikal Region

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Abstract. The paper presents the results of resource studies of wild medicinal plants of the Western Baikal. The area of thickets, productivity, operational stock and volumes of possible annual procurement of raw materials of the studied species are determined, 10 species are recommended for industrial blanks for the needs of the region and for Russia, 5 species are recommended for regional and district use. The collection of medicinal raw materials is possible subject to scientifically grounded recommendations on the procurement of medicinal plants, taking into account the frequency of collection and the possible annual removal of raw materials from a specific territory.

The study of the plant resources of Russia for the purpose of their rational use and protection remains one of the main tasks of modern biology and medicine. The development of resource industries in the pharmaceutical and food industries involves the expansion of the range of useful species, taking into account the experience of traditional and Tibetan medicine. The search for new medicinal and food plants requires a comprehensive study of the flora and vegetation, and the conduct of comprehensive ecological and biological research.

Wild medicinal plants play a major role in providing the pharmacy network and enterprises of the chemical and pharmaceutical industries with medicinal raw materials of plant origin. In 1964, more than half of the total volume of preparations of medicinal plant materials and about 75% of its entire nomenclature were provided by collecting wild plants in Russia [1]. The available natural resources of most plants are hundreds and thousands of times greater than the annual need for their raw materials [1-3]. Despite this, the pharmacy network and the chemical and pharmaceutical industry are experiencing...
a significant shortage in many wild medicinal plants due to poor knowledge of their resources and insufficient use.

Hundreds of valuable useful plants grow on the territory of the Baikal region (Russia), the main part of the study area (82.9%) is covered by forests [4], in which more than 600 species of medicinal and promising plants for medicine used in scientific, traditional and Tibetan medicine grow [5].

Resource work on the territory of Irkutsk region, previously conducted by members of the Department of Pharmacognosy and Botany of the Irkutsk State Medical Institute. From 1976 to 1982 stocks of medicinal plants in the southern regions of the Irkutsk region including Irkutsk, Slyudyansky, Bayandayevsky, Ekhirit-Bulagatsky, Bokhansky, Osinsky and Tulunsky districts were studied. From 1985 to 1993 Alarsky, Nukutsky, Nizhneudinsky, Kuytunsky, Ziminsky, Zalarinsky, Cheremkhovsky, Olkhonsky and Tulunsky districts were explored [6]. It should be noted that stocks of wild medicinal plants do not remain unchanged. Many factors influence their composition including climatic, soil, anthropogenic and others. In addition, the most valuable food and medicinal plants from year to year have been harvested by various procuring organizations and local people without taking into account possible annual collection and the requirements of auxiliary activities, and rare and protected plants, i.e. without special licenses for their harvesting.

Ecological and biological research, methodological and practical recommendations obtained on the basis of experimental data will allow preserving the biodiversity of the region’s plant resources and optimizing their use in industrial production.

The purpose of the research is to study of stocks of raw materials of wild medicinal plants in the Western Baikal region. Research objectives include determining the area of thickets, productivity, operational stock and the volume of possible annual procurement of raw materials of the studied species.

The authors carried out research to determine the resources of 20 species of medicinal plants used in scientific and traditional medicine in the territory of the Western Baikal region from 2000 to 2015. The research areas included Alarsky, Irkutsk, Bokhansky, Ziminsky, Nizhneudinsky and Olkhonsky districts. The search for thickets of medicinal plants was carried out based on the study of phytocenotic confinement using materials from forest and land management, geobotanical surveys and information available from foresters, pharmacy workers and the local population. Phytocenotic studies were carried out by route-reconnaissance method [7,8].

The nomenclature of medicinal plants is given in accordance with the abstract of the flora of Asian Russia of L.I. Malysheva, V.M. Dronkina, V.V. Zueva et al. [9], taking into account the abstract of the flora of the Irkutsk region compiled by V.V. Chepinoga, N.V. Stepantsova, A.V. Grebenyuk et al. [10].

When conducting research to determine the resources of raw materials, we used methodological guidelines for the study of stocks of wild medicinal plants recommended by A.I. Schroeter, I.L. Krylova, N.A. Borisova et al. [1,11,12] as well as the methodological guidelines of A.D. Agafonov [13], A.V. Polozhiy, N.A. Nekratova, E.E. Timashek [14], Budantseva A.L. [15-17].

Determination of stocks of raw materials was carried out on specific thickets by the method of model specimens, accounting sites or projective cover, depending on the object of study. To determine the reserves of raw materials, two indicators were taken into account - the area of thickets and yield.

The results of resource studies are presented in table 1. All thickets of medicinal plants, depending on the value of the operational stock, were divided into 5 groups: 1 - over 100 tons, 2 - over 10 tons, 3 - over 1 tons, 4 - less than 1 tons, 5 - rare and protected species of useful plants [18-21].

| Type | Raw materials | Periodicity, years | Thickets area, ha | Productivity, (air-dry), M ± m, kg/ha | Operating stock of raw materials, kg | Possible volume of annual harvesting, kg |
|------|---------------|--------------------|-------------------|--------------------------------------|-------------------------------------|----------------------------------------|
| Group 1 (operational stock over 100 tons) | | | | | | |
| Vaccinium vitis-idaea | leaves | 4-7 | 421.7 | 483.9±31.6 | 177409 | 35481 |
| Group 2 (operational stock over 10 tons) | | | | | | |
Periodicity of harvesting for leaves of Ribes nigrum L., Ribes spicatum E. Robson, Fragaria vesca L., for inflorescences of Filipendula ulmaria (L.) Maxim., for fruits of Padus avium Mill., Rosa acicularis Lindl., Rosa majalis Herrm., Rubus matsumuranus Lev. et Vaniot, Sorbus sibirica Hedl. was 2-3 years, for grass of Origanum vulgare L. - 3-4 years, for leaves and shoots of Arctostaphylos uva-ursi (L.) Sprengel - 3-6 years, Vaccinium vitis-idaea L.. – 4-7 years, Vaccinium myrtillus L. - 4-8 years, for last year's leaves of Bergenia crassifolia (L.) - 1-2 years. Whereas the inefficient harvest of Thymus growing on sandy soil leads to the rapid desertification of lands and the disappearance of the species for Thymus baicalensis Serg. and Thymus mongolicus (Ronn.) Ronn. The periodicity of procurement is set at 4-6 years. For roots and rhizomes of Rhodiola rosea L., Sanguisorba officinalis L., Valeriana alternifolia Ledeb. - from 15 to 20 years.

Industrial importance, both for the needs of the region, and for Russia as a whole, have plants assigned to groups 1 and 2 with an operating reserve of more than 10–100 tons.

The stocks of raw materials of Vaccinium vitis-idaea leaves are assigned to group 1 (the operational stock of raw materials is 177,409 kg). Group 2 with an operational reserve of more than 10 tons unites 9 species: Arctostaphylos uva-ursi, Bergenia crassifolia, Fragaria vesca, Ribes nigrum, Ribes spicatum, Sanguisorba officinalis, Thymus baicalensis, Thymus mongolicus, Vaccinium myrtillus.

The results of the analysis of the areas of thickets of useful plants showed that significant identified areas (more than 100 ha) are occupied by 6 species: Bergenia crassifolia, Fragaria vesca, Sanguisorba officinalis, Thymus baicalensis, Thymus mongolicus, Vaccinium vitis-idaea. Areas less than 100 ha occupy 4 species: Arctostaphylos uva-ursi, Ribes nigrum, Ribes spicatum, Vaccinium myrtillus.

The productivity of raw materials of medicinal plants varies considerably. Four species with a productivity of more than 500 kg/ha were identified: Bergenia crassifolia, Ribes nigrum, Ribes spicatum, Vaccinium uliginosum. Species with a raw material productivity of 250-500 kg/ha - 3: Arctostaphylos uva-ursi, Sanguisorba officinalis, Vaccinium vitis-idaea. Species with the productivity of raw materials up to 250 kg/ha - 4: Fragaria vesca, Thymus baicalensis, Thymus mongolicus, Vaccinium myrtillus.

A possible annual harvest of over 10 tons is possible for 4 species: Bergenia crassifolia, Ribes nigrum, Ribes spicatum, Vaccinium vitis-idaea. The possible volume of annual harvesting is from 5 to 10 tons - for 2 species: Arctostaphylos uva-ursi, Fragaria vesca, up to 5 tons - for 4 species: Sanguisorba officinalis,
Thymus baicalensis, Thymus mongolicus, Vaccinium myrtillus. These types, according to the volumes of possible annual blanks, belong to a large-tonnage group of raw materials, which will allow organizing their industrial harvesting in the Baikal region.

For regional and district use, 5 species are recommended, assigned to group 3 with an operating reserve of more than 1 ton (from 1 to 10 tons): Filipendula ulmaria, Origanum vulgare, Padus avium, Rosa acicularis, Rosa majalis.

The results of the analysis of the areas of thickets of useful plants of the third group showed that Rosa majalis occupies a significant area identified (more than 100 hectares). Areas of less than 100 hectares are occupied by Filipendula ulmaria, Origanum vulgare, Padus avium, Rosa acicularis. The productivity of raw materials of species of the 3rd group ranges from 30.1 to 229.8 kg/ha. A possible volume of annual harvesting of more than 1 ton (from 1 to 5 tons) has been identified for Padus avium, Rosa acicularis, Rosa majalis; less than 1 ton for Filipendula ulmaria, Origanum vulgare. Raw materials of these types can be used to provide pharmacies and medical institutions of the Irkutsk region and for the needs of the study areas.

The useful plants with limited reserves include species of the 4th group with an operating reserve of less than 1 ton: Rubus matsumuranus, Sorbus sibirica, Valeriana alternifolia. These species occupy minor identified areas: Sorbus sibirica (11.3 ha), Rubus matsumuranus (9.5 ha), Valeriana alternifolia (8.7 ha). The productivity of raw materials ranges from 40.6 to 137.9 kg/ha. The possible annual volume of procurement of species of the 4th group ranges from 46 to 340 kg. The raw materials of the species of this group are insufficient for procurement, due to their low abundance in the surveyed territory or the small areas occupied by them.

In order to preserve and increase the stocks of raw materials of rare and protected species, it is recommended to exclude Adonis sibirica (category of threatened state 3, identified area 83.7 ha, raw material productivity 237.8±23.6 kg/ha) and Rhodiola rosea (category of threatened state 2, identified area 0.2 ha, raw material productivity (133.6 ± 13.7 kg/ha), included in the Red Book of the Irkutsk Region [22-23]. Monitoring of rare and protected species was carried out in the framework of the research of the Irkutsk State Agrarian University to preserve their gene pool in the Baikal region.

For the studied period of time, there was a decrease in the operational supply of raw materials in species exposed to strong anthropogenic effects as a result of irrational harvesting, pasture digression, and recreational load (Adonis sibirica, Arctostaphylos uva-ursi, Bergenia crassifolia, Thymus baicalensis, Rhodiola rosea, Rosa acorisis syrosis syrosis, irai syrsia syrosis iphysylosis, Thymus baicalensis others). The stock of raw materials of Vaccinium myrtillus and Vaccinium vitis-idaea is reduced as a result of gathering fruits for food purposes, gathering leaves and shoots for medicinal needs, an increased number of strong fires in recent years.

Despite the decline in stocks of raw materials, a rational collection of useful species is possible on the territory of the Baikal region, and the territory itself can serve as a raw material base for medicinal plants, many of which have industrial significance: Arctostaphylos uva-ursi, Bergenia crassifolia, Fragaria vesca, Ribes nigrum, Ribes spicatum, Sanguisorba officinalis, Thymus baicalensis, Thymus mongolicus, Vaccinium myrtillus, Vaccinium vitis-idaea. Сырье Filipendula ulmaria, Origanum vulgare, Padus avium, Rosa acicularis and Rosa majalis are recommended for regional and district use.

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