

**Abstract of the doctoral dissertation entitled:**  
**"Ecomorphological, and molecular genetic characterization of an**  
**endangered population of *Rhodiola rosea* L."**  
**submitted for the degree of**  
**Doctor of Philosophy (PhD) on the specialty "6D060700 - Biology"**  
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**Relevance of the work.** Currently, climatic and anthropogenic changes in the environment have led to the extinction of many plant species or a serious reduction in their geographic range. Many plant species that were widespread at the beginning of the 20th century have greatly declined in numbers and have subsequently been designated as rare and endangered. From 9% to 34% of plant species will be threatened with extinction within the next decades. There are more than six thousand plant species in Kazakhstan, 515 of which are endemics, including various forms of useful plants. The family Crassulaceae includes 30 genera and about 1500 species of succulents, including two species *Rhodiola rosea* L. and *Pseudosedum karatavicum* Boriss are included in the Red Book of Kazakhstan. Ethnobotanical studies of medicinal plants of the Kazakh Altai used in folk medicine have shown that the most popular species among the local population of Eastern Kazakhstan is *Rhodiola rosea* L., popularly known as golden root, which is used for many diseases. The reasons for the rarity of medicinal plants in Kazakhstan are mainly related to the impact of anthropogenic factors on their habitat when using land for agriculture and uncontrolled harvesting of medicinal plants also lead to the degradation of their populations. In addition to anthropogenic factors, biotic factors such as ecological conservatism and natural rarity also influence the rarity of species.

At the present stage, research on geographical distribution, study of phytocenotic, ecological and biological features of rare species of medicinal plants is very relevant. To develop a strategy for the conservation of rare medicinal plants of the Kazakhstan Altai research of morphological and genetic variability, ecological and biological characteristics, phytocenotic structure of populations, interpopulation differentiation, limiting factors determining the rarity of species and development of methods of their conservation are necessary.

**The object of the study** is the *Rhodiola rosea* L. or golden root plant population

**Research methods** - geobotanical, anatomical, phytochemical, mass spectrometers, gas chromatographic and molecular genetic methods.

**Objective of the work:** The study of ecological and biological features and genetic variability of the endangered plant species *Rh. rosea* and the recommendation of effective ways to preserve the biodiversity of the Kazakh Altai.

To achieve the goal the following tasks were realized:

1. *Rh. rosea* geography, ecology and phytocenosis of the plant, the total areal, the map of the areal.
2. *Rh. rosea* determination of ecological, biological and population-quantitative features of plants.
3. *Rh. rosea* determination of biologically active substances contained in the plant and determination of antioxidant and cytotoxic properties.

4. *Rh. rosea* preclinical studies of the plant were conducted and the effect of the tincture on obesity was evaluated.

5. *Rh. rosea* population genetic polymorphism study. Theoretical and methodological basis:

The study of medicinal plants of the Kazakh Altai are devoted to the works of Y. A. Kotukhov, A. N. Danilova, Y. M. Samoilov, E. S. Zinchenko, A. A. Ivashchenko, t. r. Utyasheva, O. A. Anufrieva, S. A. Kubentayev and other researchers have studied.

#### **Scientific novelty and significance of the dissertation work.**

For the first time in the Kazakhstan Altai the results of study of prevalence and ecological and biological features of the medicinal plant *Rh. rosea*, stages of ontogenetic state of individuals, floristic and ecological and phytocenotic characteristics of habitats are presented. Population of rare medicinal plants in Kazakhstan is an important gene pool of the species, in connection with that *Rh. rosea* genetic variability *rosea* was studied in various ecological populations. Our study provides new insights into the ecology, biology and variability of the species, thereby contributing to the conservation of biodiversity in a wide area.

1. Distribution of *Rh. rosea* in Kazakhstan was studied, mapping of the location points of the species (48 points) was made.

2. The ecologo-biological and population-quantitative features of *Rh. rosea* of Kazakhstan Altai were studied. The age composition of populations was established, anatomomorphological indicators of *Rh. rosea* of the studied region were investigated. The limiting factors negatively affecting the current state of populations of *Rh. rosea* were revealed, and measures for the conservation of the natural population were proposed.

3. Identified biologically active substances, antioxidant and cytotoxic properties contained in the *Rh. rosea* plant.

4. Preclinical studies were conducted and the effect of *Rh. rosea* plant tincture on alimentary obesity was evaluated.

5. Analysis of genetic biodiversity of Kazakhstan populations of *Rh. rosea* with i-PBS marker method was carried out for the first time.

**Scientific and practical significance of the research work.** The obtained scientific results and formulations are endangered R. allows to estimate the current state of the price populations of plants *rosea*, herbarium specimens of species in the association *Rhodiola* (Nur) transferred to the branch of the Republican State Enterprise by right of economic management" Institute of Botany and Phytointroduction "Committee of Forestry and Wildlife Ministry of Ecology, Geology and Natural Resources of Kazakhstan" Astana Botanical Garden "(Appendix A). R. obtained new information on the content of essential oils in the plant *rosea* (Appendix B).

**Author's personal contribution to the scientific result.** On materials of research work are published about 11 articles of the author.

#### **Approbation and approval of the results of the work.**

According to the results of the research work:

1. The status of the Red Book category 3 species, the number of which is decreasing, is associated with a narrow ecological and cenotic combination, displacement from the territory of the dominant species in the populations reduces the competitiveness of the species;

The floristic composition of plant communities where *Rhodiola* plant participates is described, 140 species belonging to 39 families and belonging to 104 genera were identified.

3. The studied price populations *Rh. rosea* are characterized by a full age spectrum, the generative period is maximal in all price populations, only subsenile individuals were rarely found.

4. The results of a comprehensive study of morpho-anatomical features of organs obtained in the ontogeny of *Rh. rosea* plants add to the information on morphological and anatomical features characteristic of representatives of the genus *Rhodiola*.

5. At isolation of biologically active substances from roots and rhizomes of *Rh. rosea* cinnamyl alcohols, squalene have been revealed and complex estimation of properties against obesity as pharmacotherapeutic effect in preclinical researches of their action has been studied

6. The findings suggest that rosea extract can be used in the fight against obesity due to its anti-adipogenic properties.

7. Based on the results of PBS marker amplification, a dendrogram of genetic distances of rosea populations was developed using the UPGMA method. The dendrogram, based on the results of cluster analysis, showed close genetic similarity between the populations of Ivanovo ridgeback and garlic ridgeback. The greatest differentiation was observed in the West Listvyaga population.

8. Genetic variability of the species is relatively average, with genetic diversity of 46% among populations and 54% among populations.

9. The genetic diversity of individual DNA samples from *Rh. rosea* populations was first analyzed using PBS primers, the results showed that *Rh. rosea* allows the preparation of a genetic passport of the genotype.

10. Proposals for protection of rare plant species based on an integrated ecological-cenotic and population-ontogenetic approach were developed.

**The results of the dissertation research were reported at international, national scientific and practical conferences, methodological seminars:**

1. Study of antioxidant activity of the medicinal plant *Rhodiola rosea* L. Materials of the international scientific conference of students and young scientists "Farabi əlemi" Almaty, Kazakhstan, April 9-10, 2019, 2. *Rhodiola rosea* L. health care medicine. International Kazakh-Turkish University named after Yasawi medical faculty student scientific society collection of materials of the international scientific conference of students and young scientists "Modern medicine: traditions and innovations" Turkestan, March 13 -14, 2019., 3. Prospects for studying *Rhodiola rosea* L. as a potential means for correction of metabolic disorders. MATERIALS of the international scientific conference of students and young scientists "Farabi əlem" Almaty, Kazakhstan, April 6-9, 2020, 4. Zhumagul M.Zh. Anatomical Aspects of the Root, Stem and Leaves Structure of *Rhodiola rosea* L. in East Kazakhstan

Regional Academy of Management. Materials of the VI International Scientific-Practical Conference "Quality Management: Search and Solutions" November 25-27, 2020 Los Angeles (USA). Volume II. Los Angeles, 2020., 5. Zhumagul M.Zh. Introduction of medicinal plants and assessment of their resistance in astana botanical garden. International Marmara scientific research and innovation congress. 21- 22/08/2021, 6. Zhumagul M.Zh. Study of the chemical properties of lingins of the medicinal plant *Rhodiola rosea* L.2021. VI Inter.Scientific and Practical Conference "Membership in the WTO: prospects for scientific research and international technology market". (Montreal, Canada) October 20-22, 2021, 7. M. Zh. Zhumagul, S. A. Kubentaev, M. S. Kurmanbaeva. Comprehensive study of the population of medicinal plant *Rhodiola rosea* L.. Materials of the International Scientific-Practical Conference "Independence of Kazakhstan: aspects of biodiversity conservation" to the 80th anniversary of the honorary member of the National Academy of Sciences of the Republic of Kazakhstan, academician of KazNAI Nashtay Mukhitdinovitch. 2021. The journals recommended by CCSON MES RK:

1. Kubentaev SA, Kotukhov Yu, Zhumagul MJ, Izbastina KS, Mukhtubaeva SK Ecological and biological features and phytocoenotic structure of populations of *Rhodiola quadrifida* in East Kazakhstan / "Bulletin of Kazakh National University. Biological Series". 2021, 2. Zhumagul M.Zh. GC-MS analysis of the lipophilic compounds of medicinal plant *Rhodiolarosea* L. "International Journal on Chemistry and Biology" "Web of sciens" 2019, V.12, №1., 3. Zhumagul M. *Rhodiola rosea* L., found in eastern Kazakhstan. features of the anatomical structure of the medicinal plant. "Bulletin of KazNU. Series of biology" №3 (84) for 2020

**In journals included in the database Scopus and Web of Science:**

1. Kubentayev SA, Zhumagul M.Zh., Kurmanbayeva MS, Alibekov D.T., Kotuhov JA, Sitpayeva G.T., Mukhtubayeva S.K. and Izbastina K.S. Current state of populations of *Rhodiola rosea* L. (Crassulaceae) in East Kazakhstan / Botanical Studies. 2021

**Scientific novelty and significance of the dissertation work.** Scientific novelty and significance of the dissertation work. For the first time the results of study of prevalence and ecological and biological features of the endangered medicinal plant *rosea*, stages of ontogenetic state of individuals, floristic and ecological and phytocenotic characteristics of habitats of Kazakhstan Altai are presented. Genetic variability of *Rh. rosea* in various ecological populations was studied. The population of rare medicinal plants in Kazakhstan is an important gene pool of the species. Our study provides new insights into the ecology, biology and variability of the species, thereby contributing to the conservation of biodiversity in a wide area.

**Conclusion.**

1. The distribution of the medicinal plant *Rh. rosea* on the territory of Kazakhstan was studied, mapping of locations of the species (48 points) was made., 2. As a result of field studies and processing of herbarium collections, the cenoflora of communities with Rh includes 140 species belonging to 39 families and 104 genera, which is 14% of the flora of the Altai Mountains. The results of the studies

established 8 age states in *Rh. rosea* ontogeny: seedlings; juvenile; immature, virginile, young generative, mature generative; old generative; subsenile (old vegetative). *Rh. rosea* ontogeny lasts 50-55 years, sometimes more. Studying the anatomical structure of *Rh. rosea* plants, diagnostic features were revealed and the place of biologically active substances in the cell was determined.

3. Cinnamon alcohol and squalene were detected for the first time. The compounds tested for biological activity had high antioxidant potential. Biochemical analysis showed that the biologically active substance, high production of salidroside was  $25.87 \pm 1.27$  mg/g, tyrosol  $10.93 \pm 0.52$  mg/g, rosavin  $1.59 \pm 0.07$  mg/g.

4. Studies have shown that the treatment of rosacea is the most suitable and effective medicinal plant that fights obesity and the mechanism of occurrence.

5. According to the results of PBS analysis, this type of markers was used for the first time to study the genetic polymorphism of rhesus populations.

**The structure and volume of the dissertation are conditioned by the purpose and logic of the research.** The thesis consists of the introduction, four sections, conclusions and the conclusion, the list of references containing 202 names and 3 appendices. The volume of the work is 129 pages. There are 28 tables, 38 figures in the text of the dissertation.