ABSTRACT

of the dissertation

for the degree of Doctor of Philosophy (PhD) in the specialty

«8D05108 - Geobotany»

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«Study of the current state and ecological and biological features of the *Capparis herbacea* Willd. plant in the conditions of the South-East of Kazakhstan»

General characteristics of the work. The dissertation work is aimed at studying the current state, ecological, anatomical structure and phytochemical features of plant populations of *Capparis herbacea* Willd., growing in the conditions of South-East of Kazakhstan.

The relevance of the work: Currently, there is a growing interest worldwide in the practical healthcare sector in the use of medicinal plants. This interest stems from the fact that plant-based medicinal products consist of complex biologically active substances with broad pharmacological effects. Phytopreparations exhibit a gentle therapeutic effect without additional side effects, making them a cost-effective choice. Medicinal plants possess higher therapeutic properties than synthetic alternatives, contributing to the prevention of many diseases.

Over 20,000 plant species are widely utilized in both scientific and public spheres, and the demand for botanical resources (medicinal plants) remains high or even increases each year. As advancements in medicine lead to an increasing variety of illnesses, society is paying more attention to herbal medications over synthetic drugs. However, the technology for manufacturing medications from medicinal plants, for commercial sale, is still under development.

The importance of the new direction of plant breeding - medicinal plant breeding has a great influence on modern requirements. In the market period, the main task facing medicinal plant breeding in Kazakhstan is the establishment of drug-producing enterprises in the country, that is, chemical-pharmaceutical and pharmaceutical plants, etc. to completely exclude the demand for medicinal raw materials from private households.

Demand for phytopreparations is increasing despite the many achievements in the production of chemical products in the last ten years. The main reason for this is that there is an addiction to the active substances found in the plant and there are no additional, negative effects compared to synthetic drugs. Currently, factories producing pharmaceuticals in our republic meet 6-10 percent of the country's need for medicines, and the rest is supplied by demand from abroad.

The growing use of plant resources in the perfumery-cosmetic industry in recent years has amplified the necessity to focus on medicinal and vitamin-rich plants. According to modern perspectives, herbal medications represent a holistic biogenetically formed complex containing secondary metabolites, proteins, macronutrients, micronutrients, and inorganic salts.

Presently, the medicinal plant repository plays a crucial role in modern medicine and cosmetology. Consequently, there is a need for the establishment of a new, effective

base of medicinal plants within the healthcare and pharmaceutical production sectors in Kazakhstan. Every region of the country boasts a rich diversity of flora, necessitating further research concerning distribution, ecological safety, and resources of many medicinal plants. For instance, it is imperative to collect and replenish the most commonly used, rare, and endangered species of medicinal plants for practical purposes. Currently, there is limited information available about the ecological status of medicinal plants.

The diversity of flora regarding medicinal plants throughout the Republic of Kazakhstan is extensive. Considering our country's vast territory, the species number and plant distribution vary significantly. Notably, plant distribution is limited to the country's natural climate zones and mountainous regions. The biodiversity of mountainous regions begins in the northeast and extends to the southwest, where 80% of the medicinal plants are found in locations such as Altai, Tarbagatai, Zailiysky Alatau, Ketpen, Kungey, and Terskey Alatau. For several medicinal plants, our country could become an exporter.

Official medicine recognizes specific pharmacopoeial types of primary medicinal plants, which are included in the State Pharmacopoeia edition of the Soviet government. In addition, 29 species are listed in the State Pharmacopoeial list of the Republic of Kazakhstan. The phytochemical composition of Kazakhstan's vegetation comprises a multitude of biologically active substances such as organic phenolic acids, flavonoids, alkaloids, vitamins, coumarins, saponins, and more. Furthermore, the medicinal properties of several plants in the country require thorough investigation. The phytochemical composition of the 800 endemic plants nationwide remains partially unexplored, with only a few species utilized as medicinal plants. Hence, expanding the assortment of plant-based medicinal products and ensuring the safe and effective utilization of phytopreparations are pivotal tasks for the domestic pharmaceutical industry. The consumer quality of medicinal plants is a significant focus for promoting a healthy lifestyle and requires theoretical and methodological experiments to preserve medicinal plant resources. Implementing modern approaches, such as geoinformation technologies, is crucial in the comprehensive study of medicinal plants.

The country's current research policy regarding medicinal plants strives to provide the population with effective, safe, and accessible medicinal products. To date, over 7,000 plant-based preparations have been officially registered in the National Register of Kazakhstan, with local products constituting 30% of the market share. Foreign products often dominate the pharmaceutical market. Therefore, to reduce dependency on foreign products, developing the domestic pharmaceutical industry is imperative. Scientists have made significant strides in advancing the pharmaceutical production sector in Kazakhstan.

The wealth of plants in our country requires care and extreme economy. Due to the impact of anthropogenic factors (human activity), a number of plants decrease in number, their population composition is reduced, and their self-recovery is disturbed. This situation is especially true for medicinal, ornamental, technical and food plants.

According to the World Health Organization, herbal medicines form the basis of the pharmaceutical industry worldwide. To do this, it is necessary to consider the physicochemical composition of plants containing biologically active substances, determine the quantitative, qualitative composition and study it. When developing new drugs, it is necessary to take into account the technology of the pharmaceutical substance of herbal medicines. The rich flora of Kazakhstan is the basis of scientific research in determining new, modern, safe plant raw materials. Given the vast expanses of the country, there are still many plant species that require study.

Research Objective: To identify the populations of «*Capparis herbacea* Willd» growing in the conditions of Southeastern Kazakhstan, provide them with geobotanical descriptions, and investigate the plant's current state as well as its ecological and biological characteristics.

The aim of the study: The study of the current state and ecological and biological features of the plant *Capparis herbacea* Willd., growing in the South-East of Kazakhstan.

Research Objectives:

1. To identify populations of the medicinal plant *Capparis herbacea* Willd. growing in the southeastern regions of Kazakhstan and provide a description of the associated phytocenoses.
2. To evaluate the growth conditions of *Capparis herbacea* Willd. populations (including an analysis of age composition and morphometric parameters).
3. Analysis of the anatomical features of the *Capparis herbacea* Willd. plant.
4. Identification of sources of biologically active substances concentrated in the aerial and underground parts of the *Capparis herbacea* Willd. plant.
5. Study of soil structure and growing environment of plant populations *Capparis herbacea* Willd
6. Determine the composition of the total content of biologically active substances and the level of biological activity in the extractive preparation obtained from the medicinal plant *Capparis herbacea* Willd. using various methods."

Scientific novelty of the research work: For the first time, a population of *Capparis herbacea* Willd. was discovered, providing a geobotanical description and analyzing the floral composition in the plant's habitat. The phytochemical composition, biological activity of surface and underground plant organs, as well as extracts from stems, leaves, roots, and seeds of *Capparis herbacea* Willd. were identified. The morphological and anatomical characteristics of vegetative plant organs were studied, providing detailed descriptions. Cuttings were planted in the soil in three plant populations of *Capparis herbacea* Willd., morphological characteristics were examined across different horizons, samples were collected from each horizon, and chemical analyses were conducted. As a result of such comprehensive studies, conducted for the first time in the country, new valuable data related to the biological and ecological characteristics of *Capparis herbacea* Willd. were obtained. The data obtained from this comprehensive research allowed for an assessment of the current state and eco-biological features of the plant.

Theoretical and Practical Significance of the Study: *Capparis herbacea* Willd. found in the conditions of Southeast Kazakhstan, has been scientifically evaluated based on the comprehensive study of plant populations. The seeds collected from the plants were transferred to the laboratory "Seed Bank of Natural Flora of Kazakhstan" of the Republican State Enterprise under the economic management "Institute of Botany and Phytointroduction" of the Forestry and Wildlife Committee at the Ministry of Ecology, Geology, and Natural Resources of the Republic of Kazakhstan for the preservation of the species' genetic diversity. The phytochemical composition analysis of the above-ground and underground parts of the Kazakhstani *Capparis herbacea* Willd. revealed the presence of beneficial and biologically active substances. Particularly, the leaves were found to contain 38 important organic compounds. The roots were discovered to contain a high amount of essential oils and sugars. Studies on the biological activity of *Capparis herbacea* Willd. were conducted using extracts obtained from the leaves, stems, roots, and seeds of the plant. The extraction preparations obtained through various methods showed the presence of a complete set of biologically active substances, antioxidant activity, antitoxin activity, and antiradical activity. The research, conducted using different methods, will be more comprehensive for use as a raw material in domestic pharmaceutical production based on the actual data results.

The main principles recommended for defense: *Capparis herbacea* Willd in Southeast Kazakhstan. The distribution area of the medicinal plant has been determined, and a scientific assessment of its populations' current state has been given. For this purpose, the following rules are proposed for defense:

1. *Capparis herbacea* Willd., found in the southeastern region of Kazakhstan. Results of geobotanical studies of medicinal plant populations;
2. *Capparis herbacea* Willd., found in the southeastern region of Kazakhstan. Analysis results of the flora of medicinal plant associations;
3. The object of study - *Capparis herbacea* Willd. Results of morphological-anatomical study of vegetative organs of the plant (leaves, stems, roots);
4. *Capparis herbacea* Willd. Results of soil studies on plant populations;
5. *Capparis herbacea* Willd. Results of phytochemical studies of major concentrated bioactive substances in the vegetative organs of the medicinal plant;
6. *Capparis herbacea* Willd. Results of research on the composition, biological activity of the total set of bioactive substances in the extractive preparation, obtained by different methods of the medicinal plant.

The personal contribution of the dissertation author to the implementation of the results of the research work presented for defense: The author of the work approached the definition of the set goal and the specification of tasks with great responsibility. In the Southeast Kazakhstan region, *Capparis herbacea* Willd. found a population of the plant and provided geobotanical characteristics. During the analysis of the floristic composition of each population in the region where the plant grows, responsible analyses were carried out. Additionally, in determining the phytochemical composition of the plant's surface and underground organs, a comprehensive analysis of the results meeting laboratory requirements was conducted. By determining the biological activity of the plant from extracts of

stems, leaves, roots, and seeds, he contributed to the publication of articles with other authors based on the results of this research work.

The personal contribution of the dissertation author who supervised the implementation of the scientific research aimed at conservation: The author clearly defines the purpose of the work and demonstrates a high level of responsibility in fulfilling the tasks. In the South-East of Kazakhstan, the population of *Capparis herbacea* Willd. was studied by providing a geobotanical description. The author conducted systematic observations based on the study of the floral composition of each population of *Capparis herbacea* Willd. In addition, a comprehensive study was carried out to meet the specific scientific requirements for the identification of the phytochemical composition of the above-ground and underground parts of *Capparis herbacea* Willd. The author's involvement was also significant in publishing articles with other authors based on the results of this research.

The validation of the study: The results of the dissertation research were presented and discussed at 5 international scientific conferences:

1. International Scientific Conference of students and young scientists "World of Farabi" (Almaty, Kazakhstan, 2021);
2. International Scientific Conference of students and young scientists "World of Farabi" (Almaty, Kazakhstan, 2022);
3. International Scientific Conference of students and young scientists "World of Farabi" (Almaty, Kazakhstan, 2023);
4. International scientific-practical conference "Conservation Aspects of Biodiversity" dedicated to the 80th anniversary of Mukhitdinov Nashtay Mukhitdinuly, Doctor of Biological Sciences, Professor, Honored Member of the National Academy of Sciences of the Republic of Kazakhstan, Academician of the National Academy of Sciences of the Republic of Kazakhstan (Almaty, Kazakhstan, 2021);
5. International scientific-practical conference "Issues of Territorial Development of the Republic of Kazakhstan and Ways to Solve Them" dedicated to the 80th anniversary of Ametov Abibulla Ametuly, Candidate of Biological Sciences, Associate Professor (Almaty, Kazakhstan, 2022).

Publications of articles: The results of the research work have been published in scientific papers. Of these: 1 article published in international journals included in the Scopus database, 3 articles in republican scientific journals from the list of the Committee for Control in the field of education and science of the Republic of Kazakhstan, 2 articles in the collection of materials of international scientific conferences, 3 abstracts in the collection of materials of international scientific conferences. In addition, Patent N 8704 was obtained for the utility model «Use of aboveground parts of *Capparis herbacea* Willd. as a cytotoxic substance».

The structure of the doctoral dissertation:

The dissertation consists of an introduction, three chapters, a conclusion, and a list of references. The work is presented on 157 typewritten pages, contains 33 figures, and 32 tables. The list of references includes 203 titles.