

## TECHNOLOGY FOR OBTAINING A DRY COMPLEX OF BIOLOGICALLY ACTIVE COMPOUNDS FROM A PLANT OF THE SPECIES *ROSA BEGGERIANA* SCHRENK

B.A. Assetova<sup>1\*</sup>, A. Aituarova<sup>1,2</sup>, G.E. Zhusupova<sup>1,2</sup>

<sup>1</sup>Al-Farabi Kazakh National University, Almaty, Kazakhstan

<sup>2</sup>Centre for Physico-Chemical Research and Analysis Methods (CPRAM), Almaty, Kazakhstan

\*E-mail: [balzhan\\_asetova@mail.ru](mailto:balzhan_asetova@mail.ru)

**Abstract.** *Introduction.* The study of medicinal plant raw materials as a source for the creation of unique and highly effective medicines based on it is of great importance for the development of pharmacy and medicine in Kazakhstan. Various types of rosehip contain a valuable complex of biologically active compounds (BAC), which causes their widespread use in folk medicine due to antioxidant, anti-inflammatory, choleric and body-strengthening effects, as well as pharmacopoeial objects of both the plants themselves and the medicines obtained on their basis. The object of this study – *Rosa beggeriana* Schrenk, which grows only in Asia, in particular Kazakhstan, Iran, and some parts of China, and has an almost unexplored valuable arsenal of compounds with biological activity, can increase the share of domestic medicines in the pharmaceutical market of the country. *Goals and objectives.* The purpose is to identify the suitability of raw material for further use in medicine. *Research methods.* The research object was collected during the fruiting season along the Ili River in the Almaty region and dried in accordance with recommendations for this type of raw material. In this study, chemical and physicochemical research methods were used. The article presents data on the establishment of the goodness of the studied *Rosa beggeriana* Schrenk plants and the dry complex of BAC obtained on a comparative context with the well-known pharmacopoeia species of this plant family of *Rosa canina* plants, the mineral composition of macro- and microelements and the development of an optimal technology for obtaining a complex of biologically active substances from *Rosa beggeriana* Schrenk in the form of a dry extract. *Conclusion.* It has been established that this type of rose hip can be used for medical purposes and is not inferior in quality to the widespread type of rose hip *Rosa canina*. Parameters were also established under which the highest yield of raw materials can be obtained.

**Key words:** *Rosa beggeriana* Schrenk, *Rosa canina*, biologically active compounds (BAC), quality indicators, BAC's obtaining technology, ultrasound-assisted extraction (US)-extraction.

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*Assetova Balzhan Akhmetkyzy*

*Master's degree student, e-mail: [balzhan\\_asetova@mail.ru](mailto:balzhan_asetova@mail.ru)*

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*Aituarova Aigerim Shakirovna*

*PhD candidate, e-mail: [aytuarova.a270293@gmail.com](mailto:aytuarova.a270293@gmail.com)*

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*Zhusupova Galiya Eventayevna*

*Doctor of Chemical Sciences, Professor,  
e-mail: [zhusupova@gmail.com](mailto:zhusupova@gmail.com)*

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## 1. Introduction

Thus far plants that have therapeutic effects attract the attention of many researchers, which is due to the reliability of their therapeutic value, which has been confirmed by scientific medicine. The continuing interest in herbal treatment is due to the so-called "medicinal disease". According to information received from the World Health Organization (WHO), about 7% of patients were hospitalized due to intolerance to chemicals, while this is a rare phenomenon when using herbal medicines. According to WHO experts, it is desirable to use herbal medicines in the treatment of 75% of patients. The introduction of phytopreparations into the healthcare system is under the positive view of WHO [1].

To date, various types of rosehip are widely distributed around the world and are used in pharmaceutical production due to the high content of BAC. The increased interest in these plants is caused by the high content of several BAC. Thus, due to the rich composition of plants of the Rosaceae family, the value of application in the pharmaceutical industry increases significantly. Of these, almost unstudied *Rosa beggeriana Schrenk* grows largely in Kazakhstan [2-6].

The study of plants of the family Rosaceae is associated with a high content of tannins and flavonoids in the above-the-ground part; fruits are rich in BAC, carbohydrates, organic acids, tannins, salts of iron, manganese, calcium and magnesium. [2, 3, 7, 8]. Of course, it is necessary to mention the content of ascorbic acid, which is the reason for their use in medicine. Vitamin C is a strong antioxidant, which helps to inhibit, that is, slow down, oxidation and at the same time normalizes the redox reactions of the body [3, 8, 9]. In order to conduct a comprehensive study and further introduction into the production of medicinal plant raw materials, it is necessary to determine quality indicators. The indicators of the quality of medicinal plant raw materials, first of all, include the determination of humidity, three types of ash content, the amount of extractive substances, which are determined according to regulatory documents. These indicators are directly affected by factors such as the correct assembly of raw materials, the conditions of its cleaning and drying, and a low content of mineral impurities [10, 11].

The development of technology for extracting complexes of biologically active compounds from plant raw materials can be divided into several stages, the purpose of which is to maximize the depletion of raw materials. These stages are characterized by the choice of the optimal extractant, the optimal ratio of raw materials and extractant, the duration and multiplicity of extraction. The ultrasonic extraction method was chosen as the extraction method, as it has a number of advantages. The most important thing is to reduce the extraction time. The use of ultrasonic extraction overcomes the problem of time costs in the direction of reduction, at the same time contributes to the maximum release of active substances from the intercellular space.

Thus, *the goal of the study* is to develop an optimized technology for obtaining the BAC complex by ultrasound-assisted extraction from plants of the

*Rosa beggeriana Schrenk* species, harvested and processed in accordance with the international standards and pharmacopeial requirements [10, 11].

## 2. The experimental part

The beginning of work is marked by collecting, cleaning, drying at a temperature of no more than 40°C and further grinding it. The optimal size of the crushed particles is considered to be 3 mm, the reason for this choice is that the raw material retains the cellular structure and this contributes to the rapid flow of diffusion processes. The methodology for determining ash content, humidity and mineral composition is given in the methodology of processing medicinal plant raw materials [12]. During the course of the extraction process, first of all, wetting occurs, as a result of which there is a swelling of the raw material due to the solvent. Next, extractive substance is transferred from the intercellular space to the extractant. With subsequent concentration of the extractant, a complex of BAC is obtained in the form of a dry extract. An ultrasonic bath was used for extraction, while a rotary evaporator was used to obtain a dry substance.

According to literature, ethyl alcohol and its aqueous solutions contribute to the greatest extraction of substances. 30%, 50% and 70% aqueous solutions of ethyl alcohol were selected for the studies. The choice of the ratio of raw materials to extractant was carried out in the range from 1:3 to 1:9. The duration of extraction varied from 30 minutes to 4 hours. The multiplicity of extraction was also determined. All studies are designed for 10 g of crushed vegetable raw materials.

Among the various physical methods of extraction intensification, this study was conducted using ultrasound-assisted extraction. This is due to the fact that when using it, it is possible to achieve a reduction in extraction time and an increase in the yield of biologically active compounds from plant raw materials. It is worth noting that previously the extract from *Rosa beggeriana Schrenk* was not obtained by this method.

## 3. Results and discussions

The plant - *Rosa beggeriana Schrenk* - was collected in September, 2021 at temperatures ranging from 23 to 25°C close to the Ili River and within Almaty oblast at coordinates N44°79.3959, E76°29.8245. Subsequently, the plant underwent a drying process in a cabinet at 35°C for 6 hours, followed by an additional 48 hours at room temperature.

A sample of the collected vegetable raw materials was then preserved in the herbarium collection at the Institute of Botany and Phytointroduction, affiliated with the Ministry of Science and Higher Education in Almaty, Kazakhstan, with the assigned reference number 0002540 (Figure 1).



**Figure 1** – *Rosa beggeriana* Schrenk

The results of the quality indicators analysis of the studied samples are shown in Table 1. For comparison, a more studied species of rosehip was selected, which has an affinity for the objects of research - *Rosa canina* – which is a pharmacopeial medicinal plant.

**Table 1** – Data on the quality indicators in the above-the-ground part and the fruits of the *Rosa beggeriana* Schrenk and substances obtained on their basis, %

Quality indicators	Above-the-ground part	Substance from the above-the-ground part	Fruits	Substance from fruits	<i>Rosa canina</i> (pharmacopeial medicinal plant)
Humidity	7.76	8.45	9.33	11.02	no more than 15.0
Total ash	6.68	7.01	8.34	8.12	no more than 17.0
Ash insoluble in 10% HCl	0.57	0.53	0.67	0.66	no more than 1.5
Sulfate ash	9.93	8.27	7.00	7.76	12.0
Extractive substances	33.07	-	78.77	-	at least 6.0

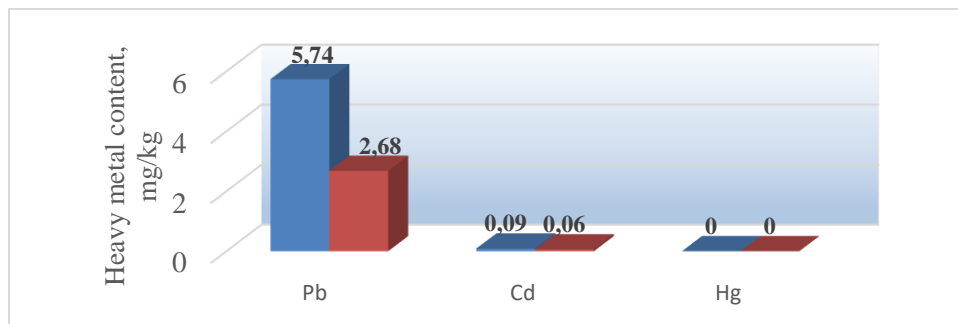
According to the above data from Table 1, the values of humidity indicators, three types of ash are within the limits of tolerance in accordance with the requirements of the State Pharmacopoeia of the Republic of Kazakhstan for *Rosa canina* [13]. And the content of extractive substances significantly exceeds the threshold, which indicates the profitability of *Rosa beggeriana* Schrenk.

**Table 2** – Macro- and microelement composition of the above-the-ground part and fruits of *Rosa beggeriana Schrenk*, mg/kg.

	Na	K	Ca	Mg	Zn	Ni	Mn	Fe	Cu
Above-the-ground part	542.02	6967.56	8938.82	2261.17	10.67	5.69	42.01	66.48	10.55
Fruits	122.81	5511.13	1213.17	728.42	3.01	1.54	26.34	7.03	5.03

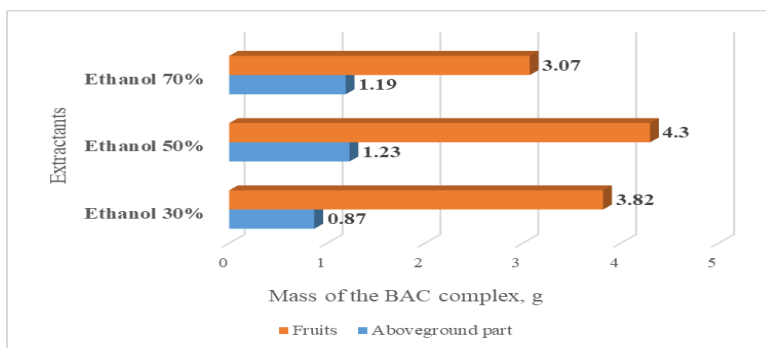
From Table 2, it can be seen that the mineral composition of the above-the-ground part of *Rosa beggeriana Schrenk* is richer than in fruits. This is due to the fact that the above-the-ground part is in contact with the ground and irrigated water, rather than the fruits. Accordingly, mineral substances accumulate to a large extent in the above-the-ground part. In addition, table 2 can also highlight the high content of metals such as potassium, calcium, iron and manganese.

Deviation from the norm of Cd, Hg, Pb content negatively affects the nervous, cardiovascular and immune systems of a living organism, the cause of which is caused by numerous metabolic disorders in the body. Cadmium can cause accumulation of lipids in vascular walls, oxidative stress, and inflammatory processes. At the same time, toxic damage to cardiomyocytes, dilation of the heart chambers can be noticed. Mercury, entering the body, binds to sulfhydryl groups of blood enzymes, blocking their activity, which leads to a violation of the processes of biosynthesis of proteins and cellular ribonucleic acids. The toxic effect of lead is due to the formation of bonds between lead ions and the centers responsible for the formation of certain enzymes. The production of hexokinase, glucose-6-phosphate dehydrogenase is blocked, and the tricarboxylic acid cycle is disrupted. Their quantity is shown in Diagram 1.

**Diagram 1.** The content of heavy metals of *Rosa beggeriana Schrenk*.

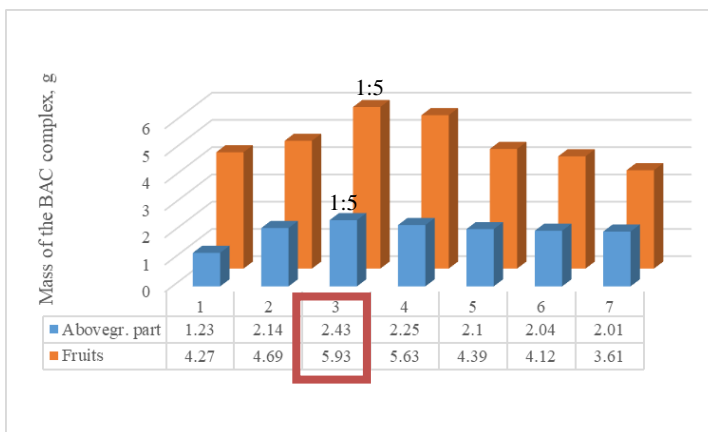
According to the analysis, the content of heavy metals, namely, lead, cadmium, comply with the requirements of the State Pharmacopoeia of the Republic of Kazakhstan for *Rosa canina* and does not exceed 6.0 mg/kg and 1.0 mg/kg, respectively, and the mercury content was not detected in the above-the-ground part and in the fruits [13].

After establishing the quality, the parameters of the technology for extracting the maximum amount of extractive substances from the plant sample were determined. The first step was to determine the most optimal extractant (Diagram 2).



**Diagram 2.** Dependence of the output of the BAC complex on the optimal extractant for the aboveground part and fruits of plants of the *Rosa beggeriana Schrenk* species.

According to the extracted amount of substances, it is possible to determine the optimal extractant. The most optimal extractant for both the above-the-ground part and the fruit, according to the results obtained, is a 50% aqueous solution of ethanol. Next, the most optimal ratio of the plant to the extractant was studied (diagram 3).

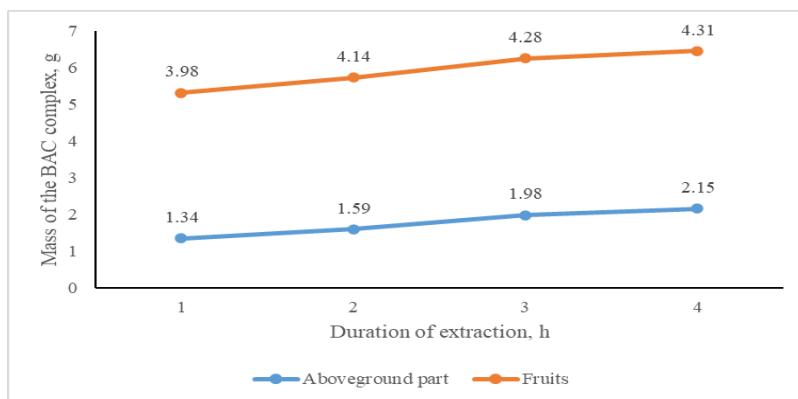


**Diagram 3.** Dependence of the output of the BAC complex on the optimal ratio of raw materials and extractant for the aboveground part and fruits of *Rosa beggeriana Schrenk* plants.

As can be seen from Diagram 3, both for the above-the-ground part and for fruits the most optimal ratio is 1:5, which was determined by the yield of substances.

It is logical to assume that the more extractant will take part in the extraction, the more biologically active substances will be dissolved and extracted from the cells of plant raw materials. Nevertheless, an immeasurable increase in the volume of the solvent leads to a decrease in the concentration of biologically active substances in the extract.

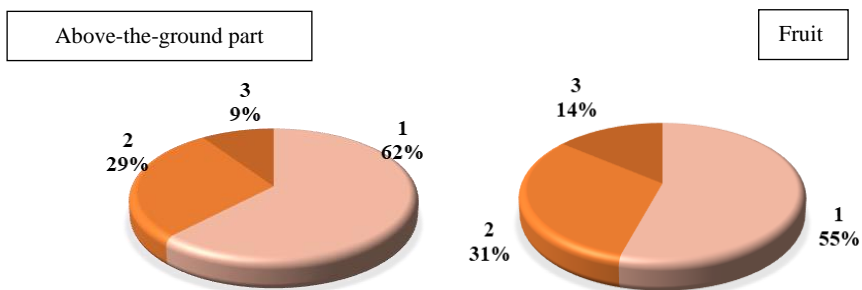
The data on determining the optimal extraction time is shown in chart 1.



**Chart 1.** Dependence of the output of the BAC complex on the optimal extraction time of the aboveground part and fruits of *Rosa beggeriana* Schrenk plants.

According to the obtained chart 1, when using ultrasound-assisted extraction, the optimal time is considered to be 3 hours for both samples. It only stands to reason that the longest extraction time will lead to the greatest yield. Since the technological scheme for obtaining the extract is being developed, it is necessary to take into account various parameters of a production nature. Therefore, it is necessary to choose such an extraction duration in which the process is considered not time-consuming, but so that the amount of BAC is allocated as much as possible.

Data on the determination of the extraction multiplicity is shown in diagram 4.



**Diagram 4.** Yields of substances extracted from the above-the-ground part and fruits, depending on the number of extractions.

Due to the high absorption capacity, plant raw materials are able to retain part of the extractant in their cellular structure. As a result, at the first extraction, it will not be possible to fully extract BAC. And, accordingly, it is considered necessary to carry out extraction several times to maximize the depletion of raw materials. According to diagram 4, the extraction multiplicity is equal to three. Since the following extractions after the third did not lead to significant yields of the BAC complex, it was decided to consider three-fold extraction sufficient.

#### 4. Conclusion

Quality indicators, heavy metal content and macro- and microelement composition for *Rosa beggeriana Schrenk* plants in the above-the-ground part and fruits were determined. As shown above, the obtained research data have shown that this type of medicinal plant raw materials can be suitable to use for medicinal purposes but it also needs further investigation for large-scale production of substances based on it.

After checking the quality, parameters such as the optimal extractant, the optimal ratio of raw materials to extractant, the duration of extraction and the multiplicity of extraction were selected. And, thus, the technology of obtaining a complex of biologically active compounds from plants of the species *Rosa beggeriana Schrenk* in the form of dry extract is determined.

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**Conflicts of Interest:** The authors declare no conflict of interest.

#### **ROSA BEGGERIANA SCHRENK ӨСІМДІГІНЕН БИОЛОГИЯЛЫҚ БЕЛСЕНДІ ЗАТТАРДЫҢ ҚҰРҒАҚ КЕШЕНІН АЛУ ТЕХНОЛОГИЯСЫ**

**Б.А. Әсетова<sup>1\*</sup>, А. Айтұарова<sup>1</sup>, Г.Е. Жусупова<sup>1</sup>**

<sup>1</sup>Әл-Фараби атындағы Қазақ ұлттық университеті, Алматы, Қазақстан

<sup>2</sup>Физика химиялық зерттеу және талдау орталығы (ФХЗТО), Алматы, Қазақстан

\*E-mail: [balzhan\\_asetova@mail.ru](mailto:balzhan_asetova@mail.ru)

**Түйіндемe.** *Kіріспе.* Дәрілік өсімдік шикізатын оның негізінде бірегей және жоғары тиімді дәрілік заттарды жасау көзі ретінде зерттеу Қазақстан фармацевтика мен медицинаны дамыту үшін зор маңызға ие. Итмұрынның әртүрлі түрлерінде биологиялық белсенді заттардың (ББЗ) құнды кешені көп мөлшерде қамтиды, бұл олардың антиоксидантты, қабынуға қарсы, холеретикалық және адам ағзасын жалпы күшейтетін әсерлерге байланысты халықтық медицинада кеңінен қолданылуына, және бұдан басқа өсімдіктердің фармакопоялық объектілері ретінде және олардың негізінде алынған дәрілік заттар дайындалуына себепкер болады. Бұл зерттеудің нысаны Азияда, атап айтқанда Қазақстанда, Иранда және Қытайдың кейбір бөліктерінде өсетін және биологиялық белсенділігі бар қосылыстардың іс жүзінде зерттелмеген құнды арсеналына ие. Беггер итмұрыны өсімдігінің әрбәр бөлігі елдің фармацевтикалық нарығындағы отандық дәрілік заттардың үлесін арттыра алады. *Мақсаттар мен міндеттер.* Бұл зерттеудің мақсаты мен міндеті осы шикізаттың медицинада одан әрі пайдалану үшін жарамдылығын анықтау болып табылады. *Зерттеу әдістері.* Зерттеу нысаны Алматы облысындағы Іле өзені бойынан жеміс беру кезеңінде (қыркүйек айында) жиналып, шикізаттың осы түріне қажетті ұсыныстарға сәйкес келтірілді. Бұл зерттеуде химиялық және физика-химиялық зерттеу әдістері қолданылды. Мақалада зерттелетін *Rosa beggeriana*



Schrenk өсімдіктерінің қатерсіздігін және олардың негізінде бөлінетін затты *Rosa canina* өсімдіктерінің осы түрінің кеңінен танымал фармакопоялық түрімен, макро және микроэлементтердің минералды құрамымен салыстырмалы контексте анықтау және Беггер итмұрынынан құрғақ сығынды түріндегі биологиялық белсенді заттар кешенін алудың оңтайлы технологиясын әзірлеу туралы мәліметтер келтірілген. Қорытынды. Итмұрынның бұл түрін (*Rosa beggeriana* Schrenk) емдік мақсатта қолдануға болатыны және сапасы жағынан кең таралған *Rosa canina* итмұрынның түрінен кем түспейтіндігі анықталды. Шикізаттың ең жоғары шығымдылығын алуға болатын параметрлер де белгіленіп, оптималды технологиясы анықталды. Сонымен қатар, бұл параметрлер жемістер үшін де, жалпы зауыттың ауа бөлігі үшін де белгіленді.

**Түйін сөздер:** *Rosa beggeriana* Schrenk, *Rosa canina*, биологиялық белсенді заттар (ББЗ), сапа көрсеткіштері, ББЗ алу технологиясы, УД-экстракция

<i>Әсетова Балжан Ахметқызы</i>	<i>магистрант</i>
<i>Айтұарова Айгерім Шакировна</i>	<i>докторант</i>
<i>Жусупова Галия Евентаевна</i>	<i>химия ғылымдарының докторы, профессор</i>

## ТЕХНОЛОГИЯ ПОЛУЧЕНИЯ СУХОГО КОМПЛЕКСА БИОЛОГИЧЕСКИ АКТИВНЫХ ВЕЩЕСТВ ИЗ РАСТЕНИЙ ВИДА *ROSA BEGGERIANA SCHRENK*

*Б.А. Әсетова*<sup>1\*</sup>, *А. Айтұарова*<sup>1,2</sup>, *Г.Е. Жусупова*<sup>1,2</sup>

<sup>1</sup>Казахский национальный университет имени аль-Фараби, Алматы, Казахстан

<sup>2</sup>Центр физико-химических методов исследования и анализа (ЦФХМА), Алматы, Казахстан

\*E-mail: [balzhan\\_asetova@mail.ru](mailto:balzhan_asetova@mail.ru)

**Резюме. Введение.** Исследование лекарственного растительного сырья как источника для создания на его основе уникальных и высокоэффективных лекарственных средств имеет огромное значение для развития фармации и медицины в Казахстане. Различные виды шиповника содержат ценный комплекс биологически активных веществ (БАВ), что и обуславливает их широкое применение в народной медицине за счет антиоксидантному, противовоспалительному, желчегонному и общеукрепляющему организм влияниям, а также в качестве фармакопейных объектов как самих растений, так и получаемых на их основе лекарственных препаратов. Объект данного исследования – шиповник Беггера, произрастающий только на территории Азии, в частности Казахстана, Ирана и некоторых частях Китая, и обладающий практически не изученным ценным арсеналом соединений с биологической активностью, может поднять долю отечественных лекарственных средств на фармацевтическом рынке страны. *Цели и задачи.* Целью и задачей данного исследования является выявить пригодность данного сырья для дальнейшего использования в медицине. *Методы исследования.* Объект исследования был собран в сезон плодоношения вдоль реки Или в Алматинской области и высушен согласно необходимым рекомендациям для данного вида сырья. В данном исследовании были использованы химические и физико-химические методы исследования. В статье приведены данные по установлению доброкачественности исследуемых растений *Rosa beggeriana* Schrenk и выделяемой на их основе субстанции в сопоставительном контексте с широко известным фармакопейным видом данного рода растений *Rosa canina*, минерального состава макро- и микроэлементов и разработке оптимальной технологии получения из шиповника Беггера комплекса биологически активных веществ в виде сухого экстракта. *Вывод.* Установлено, что данный вид шиповника может быть использован для применения в медицинских целях и не уступает в качестве сырья широко распространённому виду шиповника *Rosa canina*. Также были установлены параметры, при которых можно получить наибольший выход сырья. Причем данные параметры были установлены как для плодов, так и для в целом надземной части растения.

**Ключевые слова:** *Rosa beggeriana* Schrenk, *Rosa canina*, биологически активные вещества (БАВ), показатели качества, технология получения БАВ, УЗ-экстракция.

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*Әсетова Балжан Ахметқызы* магистрант

---

*Айтуарова Айгерим Шакировна* докторант

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*Жусупова Галия Евентаевна* доктор химических наук, профессор

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