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DETERMINATION OF PHARMACO-TECHNOLOGICAL PARAMETERS OF RAW MATERIALS OF CERATOCARPUS ARENARIUS L.

Resume: *The search for new plant sources of biologically active substances among the wild flora species of Kazakhstan, widely used in folk medicine, is one of the important tasks of modern pharmaceutical science and practice. Innovative technologies, new approaches to the creation of medicines, the combination of classical technological techniques with the latest trends makes pharmaceutical production a direction with positive dynamics of development. But along with the appearance of new synthetic drugs, as well as biotechnological products, the use of plant raw materials for the production of medicines remains relevant. One of the main stages is the study of the technological parameters of raw materials, which make it possible to optimize the technology, and the determination of the amount of extractive substances allows the selection of extraction parameters and is one of the criteria for the quality of raw materials, according to the requirements of pharmacopoeias. The article presents the results of a study to determine the technological parameters (specific gravity, bulk mass, volume mass, porosity, fenestration, free volume of the raw material layer and solvent absorption coefficient) of raw materials in the form of a sand horn of Ceratocarpus arenarius L. A comparative study of the dependence of the yield of extractive substances on the degree of grinding of raw materials showed the optimal size of 3 -5 mm. The obtained data allow us to predict the optimal extraction method and the choice of a suitable extractant, thereby increasing the efficiency of the extraction technology. The results of the study will be used in the development of technology for the production of medicinal plant raw materials and the preparation of regulatory documents.*
Keywords: *Ceratocarpus arenarius L., technological parameters, specific gravity, bulk mass, volume mass, porosity, fenestration, free volume of the raw material layer, solvent absorption coefficient.*

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ҚҰМ ЕБЕЛЕК (CERATOCARPUS ARENARIUS L.) ӨСІМДІК ШИКІЗАТЫНЫҢ ФАРМАКО-ТЕХНОЛОГИЯЛЫҚ ПАРАМЕТРЛЕРІН АНЫҚТАУ

Түйін: Халық медицинасында кеңінен қолданылатын Қазақстанның жабайы флора түрлері арасында биологиялық белсенді заттардың жаңа өсімдік көздерін іздеу қазіргі заманғы фармацевтикалық ғылым мен практиканың маңызды міндеттерінің бірі болып табылады. Инновациялық технологиялар, дәрілік препараттарды жасаудың жаңа тәсілдері, классикалық технологиялық тәсілдердің жаңа үрдістермен үйлесуі фармацевтикалық өндірісті дамудың оң серпіні бар бағытқа айналдырады. Бірақ жаңа синтетикалық препараттардың, сондай-ақ биотехнологиялық өнімдердің пайда болуымен қатар дәрілік заттарды алу үшін өсімдік шикізатын пайдалану өзекті болып қалуда. Негізгі кезеңдердің бірі - технологияны оңтайландыруға мүмкіндік беретін шикізаттың технологиялық параметрлерін зерттеу, ал экстрактивті заттардың мөлшерін анықтау экстракция параметрлерін таңдау-

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ОПРЕДЕЛЕНИЕ ФАРМАКО-ТЕХНОЛОГИЧЕСКИХ ПАРАМЕТРОВ СЫРЬЯ РОГАЧА ПЕСЧАНОГО (CERATOCARPUS ARENARIUS L.)

Резюме: Поиск новых растительных источников биологически активных веществ среди дикорастущих видов флоры Казахстана, широко используемых в народной медицине, является одной из важных задач современной фармацевтической науки и практики. Инновационные технологии, новые подходы к созданию лекарственных препаратов, сочетание классических технологических приемов с новейшими тенденциями делает фармацевтическое производство направлением с позитивной динамикой развития. Но наряду с появлением новых синтетических препаратов, а также биотехнологической продукции остается актуальным использование растительного сырья для получения лекарственных средств. Одним из основных этапов является изучение технологических параметров сырья, которые дают возможность оптимизировать технологию, а определение сум-

ға мүмкіндік береді және фармакопея талаптарына сәйкес шикізат сапасының критерийлерінің бірі болып табылады. Мақалада Ceratocarpus arenarius L. түріндегі шикізаттың технологиялық параметрлерін (нақты массасы, сусымалы массасы, көлемдік массасы, кеуектілігі, кеуектілігі, шикізат қабатының бос көлемі және еріткіштердің сіңу коэффициенті) анықтау бойынша зерттеу нәтижелері келтірілген. Экстрактивті заттардың шығымының шикізатты ұнтақтау дәрежесіне тәуелділігін салыстырмалы зерттеу 3 -5 мм оңтайлы өлшемді көрсетті. Алынған мәліметтер экстракцияның оңтайлы әдісін болжауға және қолайлы экстрагентті таңдауға мүмкіндік береді, осылайша экстракция технологиясының тиімділігін арттырады.
Зерттеу нәтижелері дәрілік өсімдік шикізатын өндіру технологиясын әзірлеуде және нормативтік құжаттарды құрастыруда пайдаланылатын болады.
Түйінді сөздер: Ceratocarpus arenarius L., технологиялық параметрлер, нақты масса, сусымалы масса, көлемдік масса, кеуектілік, кебектілік, шикізат қабатының бос көлемі, еріткіштердің сіңу коэффициенті.

мы экстрактивных веществ позволяет осуществить подбор параметров экстрагирования и является одним из критериев качества сырья, согласно требованиям фармакопей. В статье представлены результаты исследования по определению технологических параметров (удельная масса, насыпная масса, объемная масса, пористость, порозность, свободный объем слоя сырья и коэффициент поглощения растворителей) сырья в виде рогача песчаного Ceratocarpus arenarius L. Сравнительное изучение зависимости выхода экстрактивных веществ от степени измельчения сырья показало оптимальность размера 3 -5 мм. Полученные данные позволяют прогнозировать оптимальный способ экстрагирования и выбор подходящего экстрагента, тем самым повышая эффективность технологии экстрагирования.
Результаты исследования будут использованы в разработке технологии производтсва лекарственного растительного сырья и составлении нормативных документов.
Ключевые слова: Ceratocarpus arenarius L., технологические параметры, удельная масса, насыпная масса, объемная масса, пористость, порозность, свободный объем слоя сырья, коэффициент поглощения растворителей.

Introduction. The flora and vegetation of Kazakhstan are unique, consisting of wild, weed and cultivated plants, the differences between which are not always clear enough. Wild plants in their distribution are associated with territories that are not disturbed or slightly disturbed by human economic activity. They are stable and long-term components of natural phytocenoses, the composition and structure of which depend on the external environment and on the history of flora formation. Weed and cultivated plant species originated from wild plants. The latter differ from wild and weed plants in that they are the product of artificial selection, conscious and directed human activity. Weeds populate territories where wild plants have been completely or partially destroyed as a result of human economic activity [1]. Habitats and ecological features that differ from the original ones are formed. The sand horn is a poorly studied plant that belongs to the haze family and is associated with malicious garden weeds and ruderal plants, which are very difficult to fight.

The introduction of new types of medicinal plant raw materials into the practice of domestic healthcare, which have a wide range of pharmacological effects, is always promising and relevant.

To determine the rational technology for obtaining medicinal products of plant origin, an important element of the study of medicinal products is the establishment of technological parameters: specific gravity, bulk mass, porosity, the number of cavities between particles, the free volume of the raw material layer and the solvent absorption coefficient [2].

The purpose of the study. Establishment of the main technological parameters of the sand horn grass for further development of the technology for obtaining extracts from them.

Objectives of the study. Study of technological and pharmacopoeial parameters, comparative analysis of the yield of extractive substances, definition of pharmacopoeial quality criteria for raw materials.

Materials and methods of research The material of the study is the aboveground part of the sand horn (Ceratocarpus arenarius L.), which was collected in July 2020 in the Almaty region during its flowering phase. The degree of grinding was 3-5 mm (Figure 1). The determination was carried out with 5 samples. The study was conducted in the scientific and practical control and analytical laboratory of chemistry and pharmacognosy in the Kazakh National Medical University named after S. D. Asfendiyarov [2,3].

Specific gravity (ds, g / cm3) is the quotient of the mass of absolutely crushed dry raw materials to the volume occupied by vegetable raw materials. To determine the specific gravity, about 5.0 g (exact weight) is placed in a pycnometer with a volume of 100 ml, then the raw material is filled with purified water for 2/3 of the volume and kept for 1.5-2 hours in a boiling water bath. During the procedure, it is necessary to mix everything to remove air from the raw material. After the procedure, the pycnometer is cooled to 20 ° C, its volume is brought to the mark with purified water. Determine the mass of the pycnometer with water and raw materials. Before conducting the experiment, the mass of the pycnometer with water is determined. The calculation of the specific mass is carried out according to the following formula:

$$d_s = P \cdot d_j \ /P+G-F,$$

where:

P is the mass of absolutely dry raw materials (g); G is the mass of a pycnometer filled with water (g); F is the mass of a pycnometer filled with water and raw materials(g); dj is the specific mass of water (g/ cm^3) (dj=0.9982,g/ cm^3) [3].

A B

Figure 1 - a) appearance of the sand horn, b) crushed medicinal plant raw materials

Bulk mass (db, g / cm³) – the ratio of the mass of crushed raw materials at natural humidity to the total volume occupied by the raw material. To measure the bulk mass, crushed raw materials are placed in a measuring cylinder, slightly shaken to level the layer on the surface and determine the full volume that the raw material occupies, and then it is weighed.Formula for calculating the bulk weight (g / cm3):

$$d_b = P_c / V_c,$$

where:
Pc is the mass of crushed raw materials measured at a certain humidity (g);
Vc is the volume occupied by the raw material (cm³).

Volume mass (dv, g / cm³) – the ratio of crushed raw materials, which are pre-weighed at a certain humidity, to the total volume of raw materials, including pores, cracks and capillaries filled with air. To calculate the volume mass of about 10.0 g (exact weight), the raw materials are quickly placed in a measuring cylinder with purified water and the volume is determined. The volume occupied by the raw material is measured by the difference in the measuring cylinder. Formula for calculating the volume mass (g / cm³):

$$d_v = P_v / V_v,$$

where:
Pv is the mass of crushed raw materials when measured under conditions with a certain humidity (g);
Vv is the volume occupied by the raw material (cm³).

Porosity (P_s) is the amount of voids inside the plant tissue. The porosity is calculated based on the partial difference between the specific and volumetric mass and the specific mass. Formula for calculating porosity:

$$P_s = d_s - d_v / d_s,$$

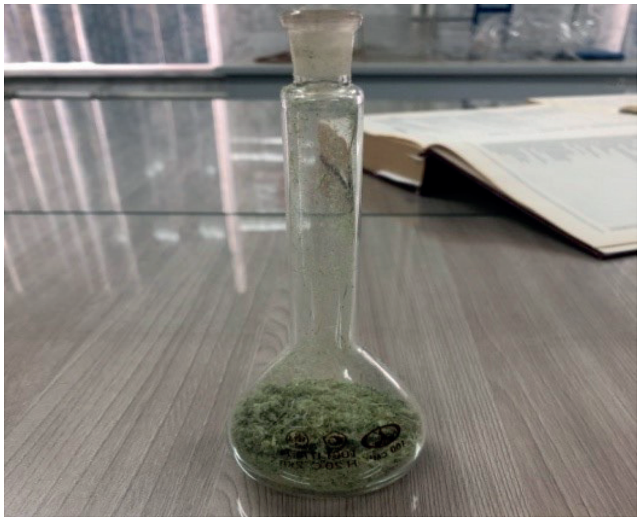

Figure 2 – raw material 5.0 g (exact weight) placed in a pycnometer with a volume of 100 ml

Figure 3 – raw material 10.0 g (exact weight) placed in the cylinder

where:
dy is the specific mass of raw materials (g/cm^3);
do is the volume mass of raw materials (g/ cm^3).

Fenestration (Pf) – the amount of voids between the pieces of crushed material. The porosity value is calculated by the ratio of the difference between the bulk mass and the bulk mass to the bulk mass.

$$P_f = d_v - d_b / d_v,$$

where:
do is the bulk mass of raw materials (g/cm^3);
db is the bulk mass of raw materials (g/ cm^3).

The free volume of the raw material layer (V) is the relative volume of voids in a unit of the raw material layer. The quotient of the difference between the specific and bulk mass and the specific mass.Formula for calculating the free volume of the raw material layer:

$$V = d_s - d_b / d_v,$$

where:
dy is the specific mass of raw materials (g /cm^3);
dh is the bulk mass of raw materials (g/ cm^3) [4].

The extractant absorption coefficient (X, ml/g) is the amount of solvent that fills the air cavities in the raw material, vacuoles, intercellular pores and is not extracted from the meal. To determine the absorption coefficients of extractants, about 5.0 g (exact weight) of crushed raw materials, weighed with an accuracy of ±0.01 g, is placed in a measuring cylinder and filled with a known volume of extractant [water, alcohol-water solutions 40, 70, 90% (by volume)] so that the raw material is completely covered with the solvent, and left for several hours. After that, the raw material is filtered through a paper filter. The resulting filtrate is placed in the next measuring cylinder and its volume is measured. Formula for calculating the extractant absorption coefficients (X, ml/g):

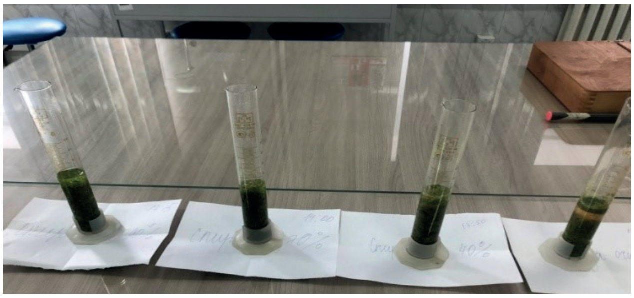

Figure 4 – raw materials filled with extractants in the form of water, alcohol-water solutions 40, 70, 90%

$$X = V - V_1 / P,$$

where:
V is the volume of the extractant filling the raw material (ml);
V1 is the volume of the extractant remaining after absorption of the extractant by the raw material (ml);
P is the mass of the crushed raw material (g) [5].

Results and discussions.
The results of studying the technological parameters of the raw materials of the sand horn are shown in Table 1 and Table 2.

As can be seen from Table 2, the maximum yield of the sum of extractive substances (78.32%) is observed with ethyl alcohol at a concentration of 70% with a degree of

Table 1 - Technological parameters of raw materials Ceratocarpus arenarius L.

№	Specific gravity, g / cm^3	Bulk mass, g / cm^3	Volume mass, g / cm^3	Porosity	Fenestration	Free volume of raw materials
1	0,5956	0,0796	0,2703	0,5418	0,7055	0,8651
2	0,6025	0,0795	0,2704	0,5493	0,706	0,8675
3	0,5978	0,0797	0,2705	0,5415	0,7054	0,8649
4	0,5863	0,0796	0,2704	0,5337	0,7056	0,8628
5	0,6045	0,0795	0,2705	0,5492	0,7061	0,8675
Xcp	0,5923	0,0796	0,2704	0,5432	0,7056	0,8655

Table 2 - Comparative analysis of the yield of the sum of extractive substances from raw materials

Extractant absorption coefficients, m3/kg		yield (%)
Purified water	6,5	35,78
40% ethanol	6,4	59,01
70% ethanol	7,6	78,32
90% ethanol	4	62,23

grinding of raw materials of 0.001- 0.003 m. An increase in the particle size to 0.005-0.007 m shows a decrease in the yield of extractive substances (59.01%).

Conclusion

1. As a result of research numerical values of technological parameters of raw materials: bulk weight, specific weight, volume weight, porosity, free volume of a layer of raw materials are established. Absorption coefficients of the extractant have been determined: ethyl alcohol in concentrations of 40%, 70%, 90%.

2. A comparative analysis of the yield of extractive substances from raw materials by various solvents (ethyl alcohol in concentrations 40%, 70%, 90%) and it was found that the largest amount of extractive substances (78.32%) is extracted with ethyl alcohol at a concentration of 70%.

3. Pharmacopoeial criteria for the quality of raw materials are determined: the numerical values of the raw material quality indicators meet the requirements of the Pharmacopoeia Kazakhstan and were included in the development of the raw material quality specification.

REFERENCES

1 Zhumashova G. T., Sayakova G. M., Gemedzhieva N. G., Bekezhanova T. S. (2016) Study of technological and some pharmacopoeial characteristics of medicinal plant raw materials - rhizomes of Tatar rhubarb.(Vestn. KazNMU) Izuchenie technologicheskih b nekotorych farmacopeinych haracteristik lecarstvennogo rastitel'nogo syr'ya - cornevish' revenya tatarskogo [Vestn. KazNMU]. 1: 531-4 (in Russ).

2 E. I. Demidova (2016) Pharmacognostic study of non-pharmacopoeial medicinal plants: common pomegranate and pharmacy ginger. (Smolensk Medical Almanac) Pharmacognosticheskoe izuchenie nepharmacopeinych lecarstvennych rastenii: granata obyknovennogo I imbirya aptechnogo [Smolensk Medical Almanac]. No. 1. pp. 78-81(in Russ).

3 Plantarium plant determinant. URL: http://www. plantarium.ru/page/view/item/3710.html (accessed 15.09.2021).

4 State Pharmacopoeia of the Republic of Kazakhstan Vol.1 (2009) Almaty: Publishing House "Zhibek Zholy". 585 p. (in Russ).

5 State Pharmacopoeia of the Republic of Kazakhstan. Vol. 2 (2009) - Almaty : Publishing House "Zhibek Zholy". 804 p. (in Russ).

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